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END

Includes:	Powered Point Operating Equipment
Excludes:	Rail Clamp Point Lock (RCPL), In-Bearer Clamp Lock (IBCL), HPSS, T72 and Mechanical points

GENERAL

Before the Facing Point Lock (FPL) test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over, or control the points being tested (See NR/SMS/PartA/A04 (Method Statement Summary).

Record Keeping, FPL records shall be kept on the Points System Record Card.

1. Test

NOTE: *This test requires the 3.5mm/5mm point checking gauge and a 1.5mm gauge.*

1.1 For each closed switch position, place the 3.5mm end of the FPL gauge between the switch and stock rail at a point in line with the bolt securing the stock rail to the first slide chair.

1.2 Manually operate the points and check that the lock does not enter the notch in the lock slide.

a) If the lock fails to enter the lock notch, then this is a pass and you shall proceed to step 1.3. This result shall be recorded.

b) If the lock enters the lock notch, then this is a failure and shall be recorded, reported to ICC and investigated.

c) The 3.5mm test shall then be repeated using the 5mm gauge.

d) If the lock fails to enter the lock notch, then this shall be recorded. The gauge of the points shall now be adjusted to bring them back to a position where they fail the 3.5mm test.

e) If the lock enters the lock notch, the test (5mm) is a failure and shall be recorded, reported to ICC and investigated.

f) Additional gauges shall be added until the lock fails to enter the lock notch, this shall be recorded, reported to ICC and the level three on-call engineer advised.

NOTE: *If the lock blades or lock dogs are worn the level three on-call engineer can defer the renewal for a maximum of 48 hours, only if the points can be adjusted to fail when the 5mm gauge when it is inserted as described in 1.1.*

NOTE: *The recording of the extent of the gauge failure is required to allow hazard rating to be calculated.*

g) After 48 hours the facing point route shall be signed out of use (unless it is mechanically secured) until the renewal has been completed.

1.3 Place the 1.5mm FPL gauge between the switch and stock rail at a point in line with the bolt securing the stock rail to the first slide chair.

1.4 Manually operate the points and check that the lock enters the notch in the lock slide.

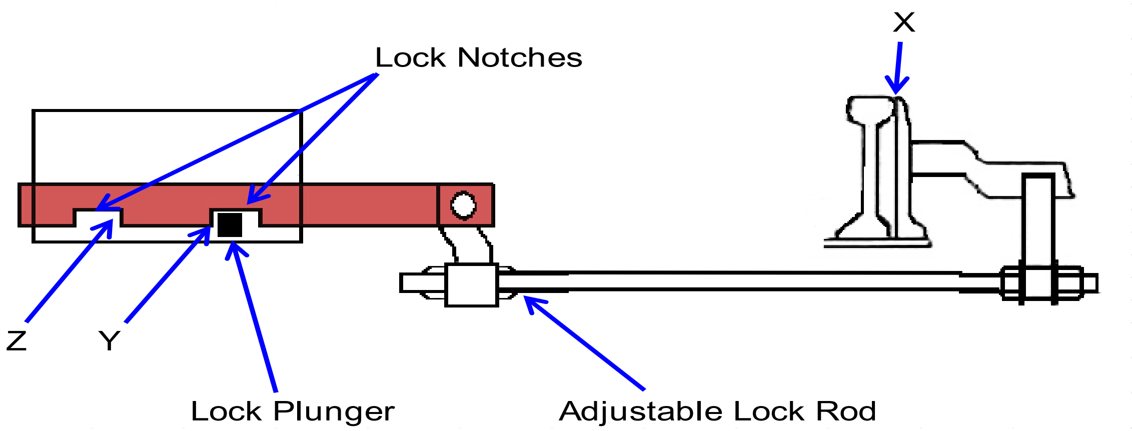


Figure 1 – FPL Blade Connections

1.5 With point switch fully closed (X), confirm there is a 1.5mm clearance on each lock face (Y & Z) see Figure 1.

1.6 Adjust and retest as necessary.

1.7 Record the results and details of any adjustments made on the record card.

1.8 Restore the points.

1.9 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Includes:	All Mechanical Point
Excludes:	All other points

GENERAL

Before the Facing Point Lock (FPL) test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over or control the points being tested, see NR/SMS/PartA/A04 (Method Statement summary).

1. Test

NOTE: *This test requires the 3.5mm/5mm point checking gauge and a 1.5mm gauge.*

1.1 Check that the travel of the lock plunger is approximately 215mm (8.5 inches).

1.2 Check that, in the unlocked position, the clearance between the lock stretcher and the end of the lock plunger is 19mm ±6.5mm (0.75 inches ±0.25 inches) adjust as necessary.

1.3 For each closed switch position, place the 3.5mm end of the FPL gauge between the switch and stock rail, at a point in line with the bolt securing the stock rail to the first slide chair.

1.4 Manually operate the points and check that the lock does not enter the notch in the lock slide.

a) If the lock plunger fails to enter the lock notch, then this is a pass and you shall proceed to step 1.5. This result shall be recorded.

b) If the lock plunger enters the lock notch, then this is a failure and shall be recorded, reported to ICC and investigated.

c) The 3.5mm test shall then be repeated using the 5mm gauge.

d) If the lock plunger fails to enter the lock notch, then this shall be recorded. The gauge of the points shall now be adjusted the points to bring them back to a position where the they fail the 3.5mm test.

e) If the lock plunger enters the lock notch, the test (5mm) is a failure and shall be recorded, reported to ICC and investigated.

f) Additional gauges shall be added until the lock plunger fails to enter the lock notch, this shall be recorded, reported to ICC and the level three on-call engineer advised.

NOTE: *If the lock plunger or lock notch is worn, the level three on-call engineer can defer the renewal for a maximum of 48 hours, only if the points can be adjusted to fail when the 5mm gauge when it is inserted as described in 1.3.*

NOTE: *The recording of the extent of the gauge failure is required to allow hazard rating to be calculated.*

g) After 48 hours the facing point route shall be signed out of use (unless it is mechanically secured) until the renewal has been completed.

1.5 Place the 1.5mm FPL gauge between the switch and stock rail at a point in line with the bolt securing the stock rail to the first slide chair.

1.6 Manually operate the points and check that the lock plunger enters the notch in the lock slide.

1.7 Adjust and retest as necessary.

1.8 Record the results and any adjustments made on the record card.

1.9 Request the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Includes:	Rail Clamp Point Lock (RCPL), In-Bearer Clamp Lock (IBCL)
Excludes:	All Powered Point Machines and Mechanical points

GENERAL

Before the FPL test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over or control the points being tested. See NR/SMS/PartA/A04 (Method Statement Summary).

Do not put any part of your hand between the stock and switch rail.

Record Keeping, FPL records shall be kept on the Points System Record Card.

All adjustments shall be classed as corrective maintenance.

Check detection by either connecting a meter to the outgoing KR circuit or in liaison with the Signaller.

1. FPL Safety Test

These steps shall be undertaken for both normal and reverse positions of the points.

This test requires the 3.5mm/5mm point checking gauge and a 1.5mm gauge.

1.1 Place the points on manual.

1.2 Check the correct voltage is present on the outgoing KR circuit for the mechanism being tested.

For each Lock Body mechanism:

<u>RCPL Only</u>

1.3 Place the 3.5mm end of the FPL gauge between the switch and stock rail at a point in line with the bolt securing the stock to the first slide chair.

1.4 Manually operate the points and check that the lock slide does not complete its travel, and the lock arm does not rise up and engage behind the locking piece.

a) Check that detection is broken.

b) If the lock slide fails to complete its travel, then this is a pass, proceed to step 1.5. This result shall be recorded.

c) If the lock slide completes its travel, then this is a failure and shall be recorded, reported to ICC and investigated.

d) The 3.5mm test shall then be repeated using the 5mm gauge.

e) If the lock slide fails complete its travel, this shall be recorded.

The packing of the points shall now be adjusted to bring them back to a position where they fail the 3.5mm test (See Appendix A).

When the points are returned to gauge you can proceed to step 1.5.

f) If the lock slide completes it travel, the test (5mm) is a failure and shall be recorded, reported to ICC and investigated.

g) Additional gauges or packing shall be added until the lock slide fails to complete its travel, this shall be recorded, reported to ICC and the level three on-call engineer advised.

If the fixed or adjustable cams are worn the level three on-call engineer can defer the renewal for a maximum of 48 hours, only if the points can be adjusted to fail when the 5mm gauge when it is inserted as described in 1.3.

The recording of the extent of the gauge failure is required to allow hazard rating to be calculated.

h) After 48 hours the facing point route shall be signed out of use (unless it is mechanically secured) until the renewal has been completed.

1.5 Place the 1.5mm gauge between the switch and stock rail in line with the lock arm.

a) Manually operate the points and check that the lock arm fully engages, and the drive lock slide fully completes its stroke.

b) Check that detection is made.

<u>IBCL Only</u>

1.6 Place the 3.5mm end of the FPL gauge between the switch and stock rail at a point in line with the lock arm.

1.7 Manually operate the points and check that the lock slide does not complete its travel, and the lock arm does not rise up and engage behind the locking piece (See Table 1 for dimensions).

Condition	Mk 2	Mk 3
Locked	> 25mm protrusion beyond lock body	> 71mm protrusion beyond lock body

Table 1 – Drive Lock Slide Protrusions when locked

1.8 Check that detection is broken.

a) Check that detection is broken.

b) If the lock slide fails to complete its travel, then this is a pass, proceed to step 1.9. This result shall be recorded.

c) If the lock slide completes its travel, then this is a failure and shall be recorded and investigated.

d) The 3.5mm test shall then be repeated using the 5mm gauge.

e) If the lock slide fails complete its travel, then this shall be recorded, reported to ICC and investigated.

The packing of the points shall now be adjusted to bring them back to a position where they fail the 3.5mm test (See Appendix A).

When the points are returned to gauge you can proceed to step 1.9.

f) If the lock arm completes it travel, the test (5mm) is a failure and shall be recorded, reported to ICC and investigated.

g) Additional gauges or packing shall be added until the lock slide fails to complete its travel, this shall be recorded, reported to ICC and the level three on-call engineer advised.

If the fixed or adjustable cams are worn the level three on-call engineer can defer the renewal for a maximum of 48 hours, only if the points can be adjusted to fail when the 5mm gauge when it is inserted as described in 1.6.

The recording of the extent of the gauge failure is required to allow hazard rating to be calculated.

h) After 48 hours the facing point route shall be signed out of use (unless it is mechanically secured) until the renewal has been completed.

1.9 Place the 1.5mm gauge between the switch and stock rail in line with the lock arm.

a) Manually operate the points and check that the lock arm fully engages, and the drive lock slide fully completes its stroke. Refer to Table 1 for dimensions.

b) Check that detection is made.

1.10 Restore the points to power.

1.11 Record the results of the FPL test on the record card.

1.12 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse (twice if possible). Observe correct operation.

APPENDIX A - Adjustment (Packing)

If either lock fails the FPL test, the lock shall be adjusted as follows:

If more than a 0.6mm shim is required, check for signs of a run-through by examining the switch rail and stretcher bars for damage.

Check for wear / damage on the locking piece, locating studs (**Mk1 only**), lock arm and inner edges of the switch and stock rails.

2. Fine Adjustment

2.1 Inset shim plates (0.3mm, 0.6mm & 1.6mm) behind the locking piece of the lock body mechanism in the smallest possible incremental steps as listed within the table, up to a maximum total of 4mm to a point at which the lock fails during the 3.5mm gauge test. For details see Table 2.

2.2 Renew tab washers.

2.3 Repeat NR/SMS/PartB/003 (Facing Point Lock Tests (Clamp Lock)).

Incremental Thickness	Packing Arrangement
0.3mm	**(1 x 0.3)**
0.6mm	(1 x 0.6)
0.9mm	**(1 x 0.6 & 1 x 0.3)**
1.2mm	(2 x 0.6)
1.5mm	**(2 x 0.6 & 1 x 0.3)**
1.6mm	(1 x 1.6)
1.8mm	**(3 x 0.6)**
1.9mm	(1 x 1.6 & 1 x 0.3)
2.1mm	**(3 x 0.6 & 1 x 0.3)**
2.2mm	(1 x 1.6 & 1 x 0.6)
2.4mm	**(4 x 0.6)**
2.5mm	(1 x 1.6 & 1 x 0.6 & 1 x 0.3)
2.7mm	**(4 x 0.6 &1 x 0.3)**

Incremental Thickness	Packing Arrangement
2.8mm	(1 x 1.6 & 1 x 0.6 & 2 x 0.3)
3.0mm	**(5 x 0.6)**
3.1mm	1 x 1.6 & 2 x 0.6 & 1 x 0.3)
3.2mm	**(2 x 1.6)**
3.3mm	(5 x 0.6 & 1 x 0.3)
3.4mm	**(1 x 1.6 & 3 x 0.6)**
3.5mm	(2 x 1.6 & 1 x 0.3)
3.6mm	**(6 x 0.6)**
3.7mm	(1 x 1.6 & 3 x 0.6 & 1 x 0.3)
3.8mm	**(2 x 1.6 & 1 x 0.6)**
3.9mm	(6 x 0.6 & 1 x 0.3)
4.0mm	**(1 x 1.6 & 4 x 0.6)**

Table 2 – Fine Adjustment

3. Coarse Adjustment

3.1 If greater than 4mm of fine packing is required, insert packing plates (3mm &1.6mm) between the switch rail bracket and the switch rail web.

3.2 Adjust / renew stretcher bar and tie bar.

3.3 Reset actuator packing to maintain the 3mm clearance between the lock arm and the drive lock slide.

3.4 Repeat NR/SMS/PartB/003 (Facing Point Lock Tests (Clamp Lock)).

3.5 Carry out NR/SMS/PartB/014 (Lock and Detector Full Test (Clamp Lock)).

END

Includes:	HPSS
Excludes:	All other Powered Point Machines and Mechanical points

GENERAL

Ask the Signaller to operate the points to identify the correct points are being tested.

Before the Facing Point Lock (FPL) test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over or control the points being tested, See NR/SMS/PartA/A04 (Method Statement Summary).

This FPL test is carried out with the machine under power, controlled by the Signaller.

To avoid injury whilst placing and removing gauges, it is recommended that you use the Hands-Free gauges (ask your SM(S) or hold the gauges with a pair of pliers or mole-grips.

Detection is confirmed by referring to the meter connected to the KR circuit at the location/disconnection box.

The HPSA Handset shall not be used to confirm detection as it is powered from a port on the ECU separate to the outgoing detection circuitry.

It is essential to confirm that detection is made and broken by referring to the meter only.

The secondary (supplementary) detection tests confirm the Rail Position Sensors shall not give detection when an obstruction is placed between the stock and switch rail, even though the rail bends around the obstruction.

This test requires:

a) Voltmeter, HPSA Handset (and passwords for old variants of Psion Handset).

b) Two 3.5mm point checking gauges. (Hands-free FPL Gauge recommended).

c) Two 8 mm (CEN 54) or two 10mm (NR60 / RT60).

Before carrying out the test, connect the HPSA Handset and check that each closed switch position is showing 0mm.

If the value is outside the limits -0.1mm to +0.5mm (primary / toe sensors) and/or –1mm to +2mm (secondary / supplementary sensors), this could indicate that the system is not securely fixed and it could impact performance.

Before and after values shall be recorded onto the record card so that any movement between maintenance visits is recorded.

If any excess movement is recorded, it shall be investigated and be reported.

1. Test

1.1 Connect the meter to the outgoing KR circuit at the location/disconnection box.

1.2 Perform a Datum Reset as detailed in NR/SMS/PartC/PC51 (High Performance Switch System (HPSS)) - Appendix A.

1.3 Check that the correct voltage is present on the outgoing KR circuit for the points being tested.

1.4 Place the 3.5mm gauge between the open switch and stock rails at a point in line with the centreline of the switch rail drive bracket. Hands-Free FPL Gauge recommended.

The gauge shall be inserted to prevent the switch rail from bending under the gauge and making detection.

1.5 Ask the Signaller to operate the points and ask what detection, if any, is given.

1.6 Check that no voltage is present on the outgoing KR circuit, by referring to the meter.

1.7 Place another 3.5mm gauge between the open switch and stock rails at a point in line with the centreline of the switch rail drive bracket. Hands-Free FPL Gauge recommended.

1.8 Ask the Signaller to operate the points and ask what detection, if any, is given.

1.9 Check that no voltage is present on the outgoing KR circuit, by referring to the meter.

1.10 Remove both gauges (operation of points is required).

1.11 Operate points under power and using the HPSA Handset, check that each supplementary position shows 0+/- 0.5mm at the closed position.

Check that any residual switch opening at the closed side is less than 2mm at the supplementary detection positions.

1.12 At the rear most pair of supplementary detection sensors place an 8 mm (CEN 54) or 10mm (NR60 / RT60) gauge between the open switch and stock rail at a point in line with the centre line of the switch rail drive bracket, power operate the points to close the open switch rail.

NOTE: *The purpose of this test is to confirm that the correct number of supplementary sensors have been selected during the datum reset procedure. Therefore, the testing of the supplementary detection sensor is only required to be completed with the points in either the normal or reverse position.*

1.13 Check that no voltage is present on the outgoing KR circuit, by referring to the meter. If voltage is present on the outgoing KR circuit:

a) Check that any residual switch opening at the closed side is less than 2mm at the supplementary detection positions.

b) Check on the HPSA Handset that the correct number of supplementary sensors have been commissioned during the datum reset procedure.

1.14 Remove all gauges (requires operation of Points).

1.15 Observe correct operation of the points to the normal and reverse position. The time taken is normally 4 seconds. If the time taken is greater than 5 seconds, make arrangements to carry out further investigation.

1.16 Record all sensor readings (open and closed positions) from the HPSA Handset, and any adjustments that have been carried out, on the record card.

END

Includes:	T72 Point machine
Excludes:	All other Powered Point Machines and Mechanical points

GENERAL

Before the Facing Point Lock (FPL) test is carried out, a safe system of work shall be established to prevent a Signaller setting a route over or operating the points being tested, see NR/SMS/PartA/A04 (Method Statement Summary).

Isolate the T72 point machine by moving the selector lever to the 'Hand' position.

When performing this test, check that when the clutch slips, the switch rail is tight against the inserted gauge.

1. Facing Point Lock Test

1.1 Disconnect the detection at the junction box by removing links T1 number 1 and T1 number 3.

1.2 Remove the VCC cover and the internal detector cover.

1.3 Connect a meter, set to the ohms range, to the terminals on the left hand VCC unit according to lie of points.

a) If the left-hand switch is closed and locked, use terminals 1 and 5.

b) If the right-hand switch is closed and locked, use terminals 4 and 8.

1.4 Measure the resistance (approximately 33k ohms).

1.5 Gently break each contact in turn and confirm that the reading is lost.

<u>If left hand switch is closed and locked:</u>

The contacts are the lock proving contacts on the left hand VCC and the open switch proving contacts on the right hand VCC.

<u>If right hand switch is closed and locked:</u>

The contacts are the open switch proving contacts on the left hand VCC and the lock proving contacts on the right hand VCC.

1.6 Place a 3.5 mm thick gauge between the switch blade and stock rail at a point in line with the hollow bolt securing the VCC body to the stock rail.

1.7 Manually operate the points, check that the cranked ‘C’ head does not engage the locking piece and observe that the detection is broken.

1.8 Replace the 3.5 mm gauge with the 1.5 mm gauge.

1.9 Manually operate the points. Check that the cranked ‘C’ head fully engages the locking piece and observe that detection is made.

1.10 Remove the gauge. If the lock has failed the test, perform steps 1.11 and 1.12. If the lock passes the test, continue from 1.13.

1.11 Adjust the shims under the ‘C’ heel and repeat clauses 1.6 to 1.10.

1.12 Carry out NR/SMS/PartB/Test/007 (Detection Test (VCC Detector)).

1.13 Remove the meter and replace the internal detector cover and replace and secure the VCC cover.

1.14 Repeat 1.2 to 1.13 for the other lock.

1.15 Replace links T1 number 1 and T1 number 3.

1.16 Record the results and details of any adjustments on the record card.

1.17 Restore the points to service operation.

1.18 Ask the Signaller to operate the points to Normal and Reverse positions (twice if possible). Observe correct operation.

END

Before the detection test is carried out, a safe system of work shall be established so that a signaller cannot set a route over, or control the wheelstop being tested (See NR/SMS/ Part/A04).

The detection test shall only be carried out using Manual operation only.

Standard gauges are required, but are used in non-standard ways.

DETECTION TEST

1. Detection Test – Normal Position

This test requires a meter and a 1.5mm or 2mm point checking gauge.

1.5mm or 2mm gauges are 15mm wide, as shown in diagram 1 below

Diagram 1 – 15mm gauge

1.1 With the 15mm point checking gauge place between the top of the rail head and wheel stop whilst slowly operating the wheel stop to the normal position.

1.2 Electrically prove that, with the gauge in place, normal detection is not achieved.

1.3 If normal detection is achieved the wheel stop circuit controller shall be adjusted/reset and the test restarted from clause 1.1

2. Detection Test – Reverse Position

This test requires a meter and a 3.5mm/5mm point checking gauge.

3.5mm - 5mm gauges are 80mm tall, as shown in diagram 2.

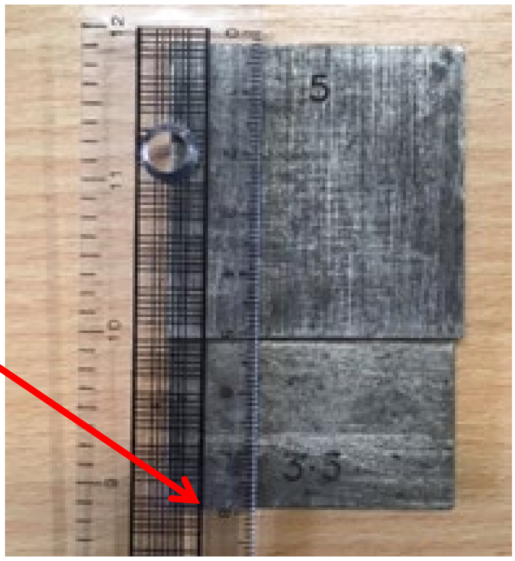
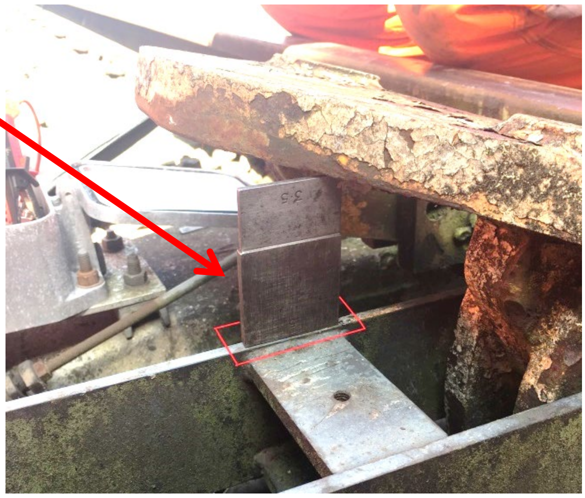


Diagram 2 – 80mm Gauge

2.1 With the 80mm length of the 3.5mm/5mm gauge placed between the top edge of the wheel stop casting and the wheel stop in line with the first horizontal plate. Slowly operate the wheel stop to the reverse position



2.2 Electrically prove that, with the gauge in place, reverse detection is not achieved.

2.3 If reverse detection is achieved the wheel stop circuit controller shall be adjusted/reset and the test restarted from clause 2.1

3. Final Check

3.1 Ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

GENERAL

Isolate the supply to the point machine and operate the points manually. Disconnect the point control links in the junction box or apply an alternative safe system of work, See NR/SMS/PartA/A04 (Method Statement Summary).

More information on performing this test can be found in NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).

1. Detection Test

This test requires the 6 mm ‘U’ shaped gauge, 13/26 mm gauge, rule, small inside callipers (for measuring tappet screw / locknut assembly), and a meter.

1.1 Check that the closed switch rail is fully up against the stock rail and is locked and also that there are no obstructions between the open switch rail and stock rail.

1.2 Disconnect the detection at the junction box by removing links T1 number 1 and T1 number 3.

1.3 Remove the VCC cover and the internal detector cover.

1.4 Connect a meter, set to the ohms range, to the terminals on the left hand VCC unit according to lie of points.

If the left-hand switch rail is closed and locked: use terminals 1 and 5.

If the right-hand switch rail is closed and locked: use terminals 4 and 8.

1.5 Measure the resistance (approximately 33 k ohms).

1.6 Manually operate the switch blade to the opposite lie of points.

1.7 While manually closing the switch rail, gauge the amount the crank head engages the locking piece, when the lock contacts are just made.

Check that the side of the gauge is fully against the face of the crank head, as detailed in NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).

Switch Closed and Locked

1.8 Manually operate the points and check that the switch rail is closed and locked on the side to be tested.

1.9 Check that the crank head fully engages the locking piece, see NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).

1.10 Gauge the stroke of the detector cam shaft.

Insert the 6 mm ‘U’ shaped gauge between the hexagonal nut and the rear of the detector frame at approximately 45° to straddle one of the hexagonal fixing screws.

The gauge shall be a sliding fit (6 mm + 1 mm). If the gap is incorrect adjust the stroke, see NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).

1.11 Check that the open switch detection contacts are broken and that the closed switch and lock proving contacts are made (i.e. not in contact with the cam plastic cover).

1.12 Remove the gauge and open the switch blade.

1.13 Measure the overall length of the tappet screw and lock nut assembly (maximum 17mm).

Details and action to take if over 17mm are in NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).

If any adjustment has been made, the test shall be repeated

1.14 Remove the meter, replace the internal detector cover, and replace and secure the VCC cover.

1.15 Repeat tests 1.4. to 1.14 on the right hand VCC.

1.16 Replace links T1 number 1 and T1 number 3.

1.17 Ask the Signaller to operate the points to Normal and Reverse positions (twice if possible). Observe correct operation.

END

GENERAL

Ask the Signaller to operate the points to identify that the correct points are being tested.

Before the test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over, or control, the points being tested (See NR/SMS/Part/A04).

These tests shall be carried out under powered operation in liaison with the Signaller.

To avoid injury whilst placing and removing gauges, it is recommended that you use the Hands-Free gauges (ask your SM(S)) or hold the gauges with a pair of pliers or mole-grips.

Due to the possibility of a small gap between the closed switch and stock rails, the Handset reading is unlikely to show the exact value (thickness) of the test gauge. If a residual gap was present without the gauge inserted, then the Handset values can be expected to under- read by an amount equivalent to the residual gap.

1. Brake Torque Test

1.1 Disconnect the brake power cable, ECU connector J3.

1.2 Ask the Signaller to operate the points to the opposite position and carry out the following during the movement:

a) Manually release both brakes by compressing both brake handles to allow the points to drive.

b) Once the points have started to move, apply one of the brakes by releasing one of the brake handles and confirm the points cease to move.

c) Manually release by compressing both brake handles together and confirm the points complete their movement to the opposite position under powered operation within 6 seconds.

d) Repeat 1.2 for the other brake handle.

1.3 Reconnect the brake power cable (J3) and ask the Signaller to operate the points to confirm satisfactory operation.

2. Toe Sensor Integrity Test

2.1 Using the HPSA Handset, carry out the ECU Datum Reset procedure as detailed in NR/SMS/PartC/PC51 (High Performance Switch System (HPSS)) Appendix A.

2.2 Place a 3.5mm gauge between the open switch and stock rails at a point in line with the centre line of the switch rail drive bracket. Power-operate the points to the normal position. Hands-Free FPL Gauge recommended.

2.3 Using the HPSA Handset, check that the measured position at the closed switch rail is 3.5mm +/- 0.5mm. Check that the open rail position has also decreased by 3.5mm +/- 0.5mm.

2.4 Place a 3.5mm gauge between the open switch and stock rails at a point in line with the centre line of the switch rail drive bracket. Power-operate the points to the reverse position. Hands-Free FPL Gauge recommended.

2.5 Using the HPSA Handset, check that the measured position at the closed switch rail is 3.5mm +/- 0.5mm. Check that the open rail position has also decreased by 3.5mm +/- 0.5mm.

2.6 Remove both gauges (operation of points is required).

NOTE: *This test confirms the integrity of the Toe Sensor LVDTs and is not an alternative to the FPL test.*

3. Supplementary Sensor Integrity and Detection Test

3.1 Connect the meter to the outgoing KR lines at the location/disconnection box.

3.2 Operate points under power and using the HPSA Handset, check that each supplementary position shows 0+/- 0.5mm at the closed position, and that any residual switch opening at the closed side is less than 2mm at the supplementary detection positions.

3.3 Carry out the same tests as described in Section 2 at each supplementary detection position, using 8mm (CEN54) or 10mm (NR60/RT60) gauges.

It is strongly recommended that the Hands-Free Detection Gauge (PADS No. 086/035401) is used (placed on the stock rail), to avoid injury.

3.4 Using the HPSA handset, check that the relevant sensor shows the measured position at the closed switch rail is equal to the thickness of the gauge, minus the residual switch opening (thickness of the gauge +/- 0.5mm).

Check that the open rail position has also decreased by the same amount (thickness of the gauge +/- 0.5mm).

3.5 Check that no voltage is present on the outgoing KR circuit.

3.6 Repeat 3.1 to 3.4 for all other Supplementary Sensors.

3.7 Remove all gauges (requires operation of points).

END

GENERAL

Isolate the mechanism by turning to the "Manual" position on the hydraulic pack. Disconnect the point detection from the KR lines or apply an alternative safe system of work, see NR/SMS/PartA/A04 (Method Statement Summary).

Gauges: 2mm and 4mm detection gauge.

1. Switch Closed and Locked

1.1 Check the correct voltage is present on the outgoing KR circuit in the associated disconnection box for the SO Supplementary Drive Unit being tested.

1.2 Insert the 4mm gauge between the switch and stock rail at a point in line with the drive rod.

1.3 Manually operate the points and test that detection is broken.

1.4 Where adjustment is required, remove the horizontal drive pin, loosen the gauge adjusting lug locking screws, and wind the gauge adjusting lug out (away from the SO unit) to adjust.

Replace the horizontal drive pin. Repeat from 1.2 as necessary.

Check that the drive shuttle does not drop out of the gauge adjusting lug during adjustment.

Check that the gauge adjusting lug locking screws are re-secured once adjustments are complete.

1.5 Repeat using the 2mm gauge and test that detection is made, and the correct voltage is present on the KR circuit.

1.6 Where adjustment is required, remove the horizontal drive pin, loosen the gauge adjusting lug locking screws, and wind the gauge adjusting lug in (towards the SO unit) to adjust.

Replace the horizontal drive pin. Repeat from 1.2 as necessary.

Check that the drive shuttle does not drop out of the gauge adjusting lug during adjustment.

Check that the gauge adjusting lug locking screws are re-secured once adjustments are complete.

1.7 Repeat tests 1.1 to 1.6 for each drive.

1.8 Restore the points to power.

1.9 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Excludes:	Detectors are excluded from this test if one of the following conditions is met: • The detector is part of a detection circuit wired directly to a SSI points module without any intermediate relays • The detector forms part of a circuit which feeds polar or phase sensitive detection relays (e.g., BR 961, VL1) over a two-wire circuit indicating both normal and reverse detection • There is another detector, clamp lock or point machine in the circuit between the BR998 detector and the detection relay(s) • The detector is part of a detection circuit wired directly to a Westrace Mk2 SOM24 without any intermediate relays

GENERAL

If applicable, isolate the supply to the point machine and operate points manually.

Disconnect the point detection from the KR lines or apply an alternative safe system of work, see NR/SMS/PartA/A04 (Method Statement Summary).

When taking measurements with respect to the chassis, check a good electrical connection to the chassis is obtained, otherwise false readings might be obtained.

1. Electrical Test

1.1 Using the maintenance diagrams identify the terminals which carry the outgoing feed to the detection relay(s) for each lie of the points.

For points with electrical detection made for one position only (e.g., train operated) arrange for the points to be in the detection made position.

Tasks 1.2 to 1.10 Apply to DC Detection Circuits Only

1.2 With the detection made, measure using a DVM with a 150kΩ shunt the outgoing detection voltage for the current position of the points.

Check that this voltage is correct to diagram and note this.

1.3 Transfer the DVM to the terminals for the outgoing detection for the opposite detection and measure the voltage. If a voltage greater than 5% of the voltage measured in 1.2 is obtained, your SM(S) shall be informed immediately.

1.4 Leave the DVM connected and have the points moved to the opposite position.

1.5 Measure the voltage. Check this voltage is the same as obtained in 1.2.

NOTE: *This might not apply where electrical detection is proved for one position of the points only.*

1.6 Transfer the DVM to the terminals used in 1.2 and measure the voltage. If a voltage greater than 5% of the voltage measured in 1.5 is obtained, your SM(S) shall be informed immediately.

1.7 Have the points moved to their original position and move the DVM to terminals 2 and 5 of the detector. Measure the voltage and check it is the same as measured in 1.2 (ignore the polarity).

1.8 Connect the DVM between terminal 2 and the metal detection chassis. Measure the voltage and note it as V1.

1.9 Connect the DVM between terminal 5 and the metal detection chassis. Measure the voltage and note it as V2.

1.10 Report immediately to your SM(S) if:

a) V1 or V2 is more than 60% of that measured in 1.2.

b) V1 + V2 is more than 80% of that measured in 1.2.

<u>Tasks 1.11 to 1.19 Apply to AC Detection Circuits Only</u>

1.11 Using a DVM (with a input impedance of least 1Mohm) set the range to DC volts and connect the red and one of the black terminals of an AC busbar earth test adaptor.

Connect the green and other black terminal of the adaptor together and check that the obtained reading is at least +8V.

Note this voltage as Vb.

If the voltage is <+8V, change the battery in the adaptor and carry out step 1.11 again.

1.12 Disconnect the green and black terminals of the adaptor from each other and connect them to the outgoing terminals of the detector corresponding to the current position of the points. Measure the voltage and note this voltage.

1.13 Transfer the green and black terminals of the adaptor to the outgoing terminals for the Normal BX and Reverse BX detection lines. Measure any voltage present. If a voltage greater than 5% of that recorded in 1.12 is found, inform your SM(S) immediately.

1.14 Transfer the green and black terminals of the adaptor to the outgoing terminals for the Normal NX and Reverse NX detection lines. Measure any voltage present. If a voltage greater than 5% of that recorded in 1.12 is found, inform your SM(S) immediately.

1.15 Arrange to have the points moved to the opposite position and repeat steps 1.12 to 1.14.

1.16 Arrange to have the points moved to their original position and transfer the green and black terminals of the adaptor to terminals 2 and 5 of the detector. Measure the voltage and check it is the same as measured in 1.12 (ignore the polarity).

1.17 Connect the black terminal of the adaptor to terminal 2 of the detector and the green terminal of the adaptor to the metal chassis of the detector. Measure the voltage and note it as V1.

1.18 Connect the black terminal of the adaptor to terminal 5 of the detector and the green terminal of the adaptor to the metal chassis of the detector. Measure the voltage and note it as V2.

1.19 Report immediately to your SM(S) if:

a) V1 + V2 is more than 90% of Vb.

b) V1 - V2 is more than 11% of Vb.

2. Microswitch Tests

2.1 With point switch fully closed, insert a 2mm gauge between limit switch tappet screw and plunger button. Observe that detection is lost.

2.2 Repeat using a 1.5mm gauge. Observe that detection remains made.

2.3 Repeat 2.1 and 2.2 for the opposite lie of the points.

3. Train Operated and Yard Points fitted with August 2000 Wiring Modifications Tests

The modified circuit is designed to make sure that the detection fuse will blow through the reverse limit switch contact if a normal contact welds up. This test makes sure that the reverse contact on each limit switch is not high resistance.

3.1 Manually operate the points to the reverse position.

3.2 Disconnect ONE end of ONE short-circuit strap.

3.3 Measure the loop resistance of the micro-switch circuit. Use a multi-meter set to ohms. Place the prods across the end of the disconnected short circuit strap and its associated terminal. The resistance shall be less than 2Ω. If the resistance is more than 2Ω, investigate the cause and take corrective action.

3.4 Remove the meter and reconnect the short-circuit strap.

3.5 Manually operate the points to the normal position.

3.6 Reconnect the detection links.

3.7 Observe that the point indicator only lights up when the points are detected fully in the normal position.

3.8 Observe that the point indicator does not light up after the points have been moved from the normal position until the restoration process is fully complete.

END

Includes:	Point machine internal detectors and external detectors used for main point detection
Excludes:	Supplementary detectors (see NR/SMS/PartB/Test/016) Clamp lock point detectors (see NR/SMS/PartB/Test/013)

GENERAL

Isolate the supply to the point machine and operate points manually.

Disconnect the point detection from the KR lines or apply an alternative safe system of work, see NR/SMS/PartA/A04 (Method Statement Summary).

On WRSL Style 63 Point machines, only section 3 shall be undertaken for the detection test.

Gauges : This test requires the 3.5mm/5mm point checking gauge (slotted gauges).

1. Adjusting Nuts Adjacent to Detection Mechanism

1.1 Check that the points are fully over, locked and in correspondence.

1.2 Check the short detector rod is connected to the closed switch (Figure 1).

1.3 Check the correct voltage is present on the outgoing KR circuit.

1.4 Slacken the red nut to allow a 5mm gauge to be placed between the detector blade and blue nut. DO NOT move the blue nut.

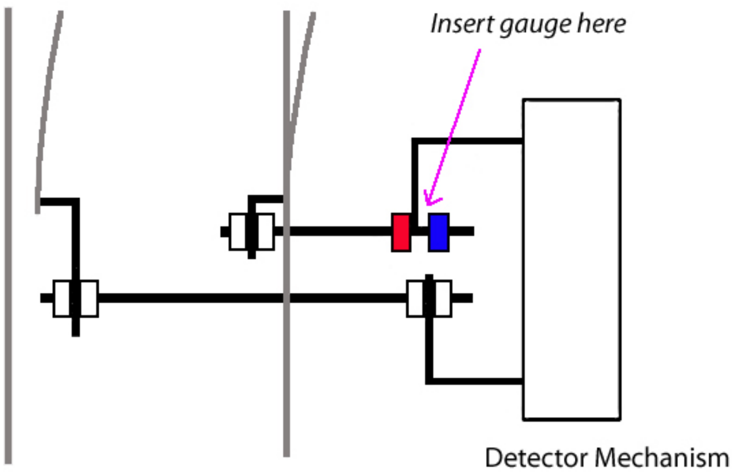


Figure 1 – Detector Mechanism (1)

1.5 Insert the 5mm gauge between the detector blade and the blue nut, re-tighten the red nut.

1.6 Check the detection voltage is lost.

1.7 Replace the 5mm gauge with a 3.5mm gauge and check the detection voltage is present.

1.8 Remove the gauge and re-tighten the red nut, check that the blue has not moved.

1.9 Check the correct voltage is present on the KR circuit.

1.10 Operate the points to the opposite position, lock and check they are in correspondence.

1.11 Check the long detector rod is attached to the closed switch (Figure 2).

1.12 Check the correct voltage is present on the outgoing KR circuit.

1.13 Slacken the pink nut enough to allow a 5mm gauge to be placed between the detector blade and green nut. DO NOT move the green nut.

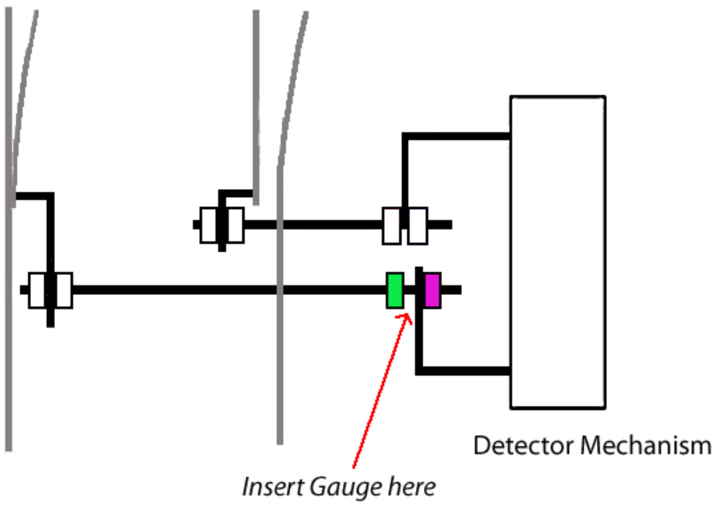


Figure 2 – Detector Mechanism (2)

1.14 Insert the 5mm gauge between the detector blade and the green nut and re-tighten the pink nut.

1.15 Check the detection voltage is lost.

1.16 Replace the 5mm gauge with a 3.5mm gauge and check the detection voltage is present.

1.17 Remove the gauge and re-tighten the pink nut, check that the green nut has not moved.

Any adjustments shall be verified by repeating the test.

1.18 Check the correct voltage is present on the KR circuit.

1.19 Carry out NR/SMS/PartB/Test/001 (Facing Point Lock Tests (Machine)).

The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

2. Adjusting Nuts Fitted on the Switch Rail Extension Ends in the Four Foot

2.1 Check that the points are fully over, locked and in correspondence.

2.2 Check the short detector rod is connected to the closed switch (Figure 3).

2.3 Check the correct voltage is present on the outgoing KR circuit.

2.4 Slacken the red nut to allow a 5mm gauge to be placed between the detector blade and blue nut. Do not move the blue nut.

2.5 Insert the 5mm gauge between the extension piece and the blue nut and re-tighten the red nut.

2.6 Check the detection voltage is lost.

2.7 Replace the 5mm gauge with a 3.5mm gauge and check the detection voltage is present.

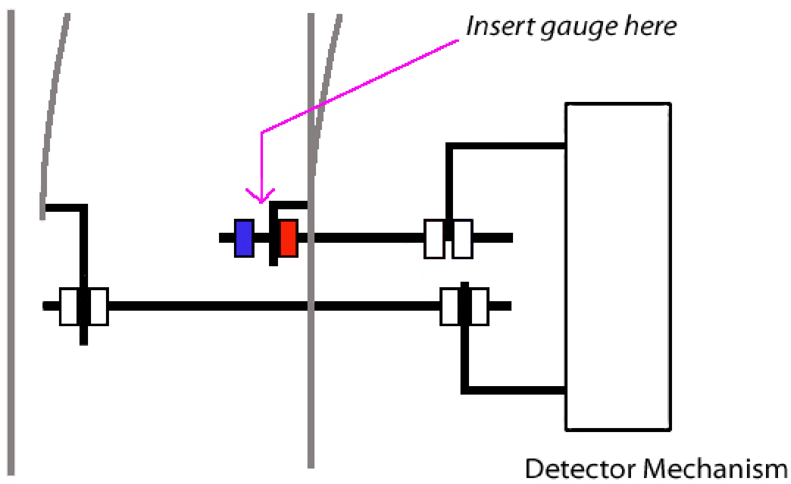


Figure 3 – Detector Mechanism (3)

2.8 Remove the gauge and re-tighten the red nut, check that the blue nut has not moved.

2.9 Check the correct voltage is present on the KR circuit.

2.10 Operate the points to the opposite position, lock and check they are in correspondence.

2.11 Check the long detector rod is attached to the closed switch (Fig 4).

2.12 Check the correct voltage is present on the outgoing KR circuit.

2.13 Slacken the pink nut enough to allow a 5mm gauge to be placed between the extension piece and green nut. Check the green nut does not move.

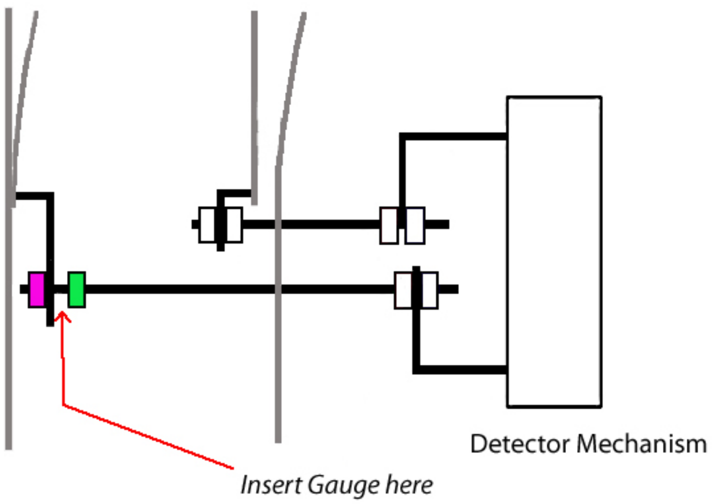


Figure 4 – Detector Mechanism (4)

2.14 Insert the 5mm gauge between the extension piece and the green nut and re-tighten the pink nut.

2.15 Check the detection voltage is lost.

2.16 Replace the 5mm gauge with a 3.5mm gauge and check the detection voltage is present.

2.17 Remove the gauge and re-tighten the pink nut, check that the green nut has not moved.

Any adjustments shall be verified by repeating the test.

2.18 Check the correct voltage is present on the KR circuit.

2.19 Carry out NR/SMS/PartB/Test/001 (Facing Point Lock Tests (Machine)).

2.20 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

3. WRSL Style 63 Point Machine

Unless this detection test is being done in conjunction with NR/SMS/PartC/PC41 (Point Machine WRSL Style 63) the machine shall be isolated by removal of the motor and detection fuses, or apply an alternative safe system of work (See NR/SMS/Part/A04).

Contact Setting

3.1 Close and lock the points reverse.

3.2 Unlock the points without opening the switch rails.

3.3 Gauge the 2mm gap of both reverse detection contacts (insert and remove 2mm insulated gauge). If the gap is less than 2mm, the points shall be booked out of use.

3.4 Repeat 3.2 and 3.3 for the point's normal position.

Normal Detection

3.5 Lock the points normal.

3.6 Examine the normal detection roller.

NOTE: *It should be free from wear, rotate freely, and drop correctly into the detector blade notch.*

3.7 Check detection is made by connecting a meter across the normal detection terminals on the ohms range.

3.8 Using the 2mm gauge (Position 1 – in Figure 5), check that detection is broken by reference to the meter.

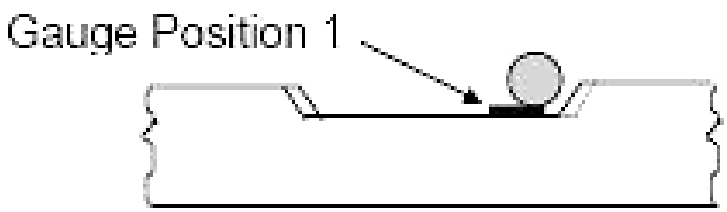


Figure 5 – Gauge Position 1

Any adjustment shall be followed by a repeat of steps 3.7 and 3.8.

3.9 Using the 2mm gauge (Position 2 – Figure 6), check that detection remains made by reference to the meter.

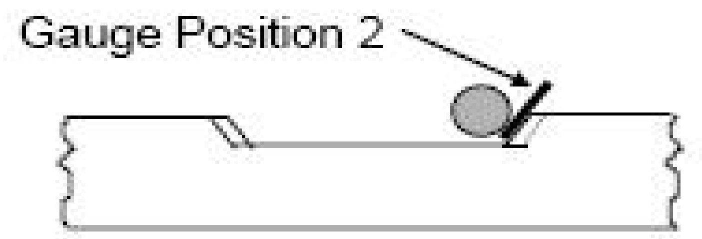


Figure 6 - Gauge Position 2

3.10 Using the 3.5mm gauge (Position 2), check detection is broken.

3.11 Using the 5mm gauge (Position 2), check the normal detection contact gap using the 2mm insulated gauge.

If the gap is less than 2mm, the points shall be booked out of use.

<u>Reverse Detection</u>

3.12 Repeat steps 3.5 - 3.11 for the points in the reverse position (Figure 7).

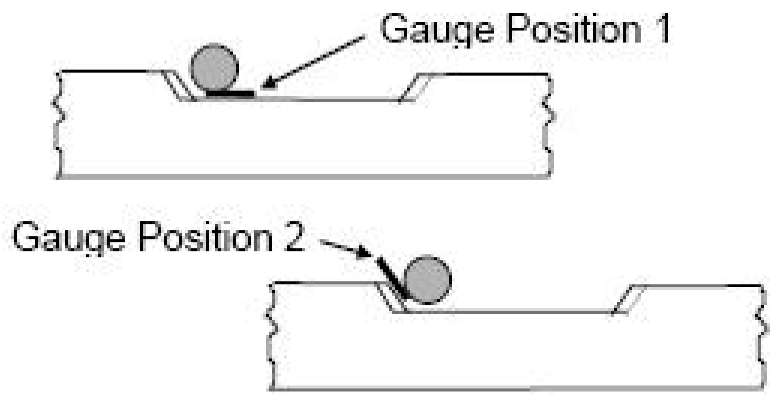


Figure 7 - Gauge Position – Reverse Position

3.13 When work is complete, reset the isolating contacts and restore the motor and detection fuses.

3.14 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

GENERAL

Before this test is carried out, a safe system of work shall be established so that a Signaller cannot clear a protecting signal, or move the points being tested (NR/SMS/Part/A04).

Gauges : This test requires the 3.5mm/5mm point checking gauge and a 2mm gauge.

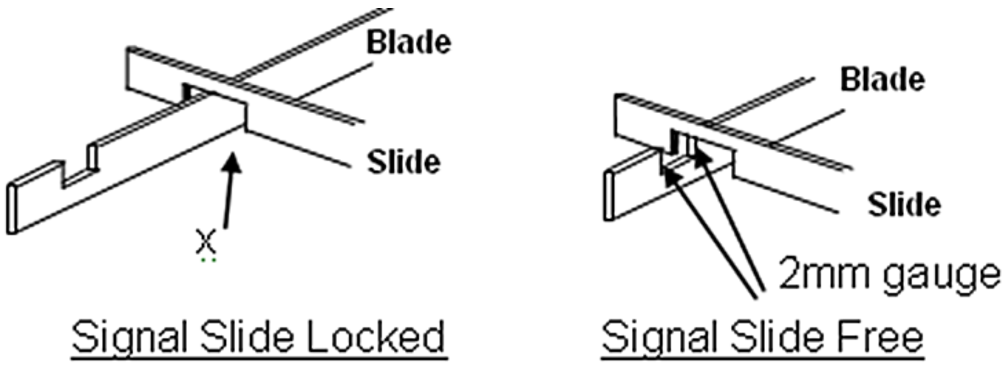


Figure 1 – Signal Slides

1. Detection Test

FOR NORMAL AND REVERSE POSITIONS:

1.1 Each detector blade should have a 2mm clearance to each notch face on each side of the signal slides. Fouling blades can cause a signal to stick off.

1.2 Check clearance ‘x’ between each signal slide notch face and the nearest blade.

Maximum 0.5 inch (13mm) for signals within 25yds (23m) of the signal, this dimension may be increased for distances over 25yds (23m) to cater for the effect of temperature changes.

Where two or more detectors control the same signal, the detector nearest the signal should have the normal clearance. Other detectors should have a progressively increased clearance up to a maximum of 2 inches (51mm) at the last detector if it is more than 200yds (183m) from the signal.

The increase of signal slide clearance should not exceed 1 inch per 100 yds (or 10mm per 36m) of wire run.

1.3 Insert a 5mm gauge between the point switch and stock rail at a position in line with the bolt securing the stock rail to the first slide chair.

1.4 Observe that the signal slides are held by the detector blade. Adjust as necessary and then retest.

1.5 Ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Includes:	Rail Clamp Point lock (RCPL) & In-Bearer Clamp Lock (IBCL)
Excludes:	All other types of POE

GENERAL

Isolate the mechanism by turning to the 'Manual' position on the hydraulic pack. Disconnect the point detection from the KR lines or apply an alternative safe system of work, see NR/SMS/PartA/A04 (Method Statement Summary).

If any of the following tests fail, carry out NR/SMS/PartB/014 (Lock and Detector full Test (Clamp Lock).

Gauges

a) 2.5mm & 4mm detection gauge (RCPL).

b) 3.5mm & 5mm detection gauge (IBCL).

c) 1.5mm & 2mm micro-switch gauges.

1. Switch Open

1.1 Check the correct voltage is present on the outgoing KR circuit for the mechanism being tested.

1.2 Check the right-hand micro-switch plunger is clear of its cam follower tappet screw.

1.3 Operate the right-hand micro-switch and observe that detection is broken.

2. Switch Closed and Locked

2.1 Check the correct voltage is present on the outgoing KR circuit for the mechanism being tested.

2.2 RCPL Only

Insert the 4mm gauge between the point detector blade lug and the shoulder of the connecting eye; tighten nut and observe that the detection is broken.

IBCL Only

Insert the 5mm gauge between the point detector blade lug and the shoulder of the connecting eye; tighten nut and observe that the detection is broken.

2.3 RCPL Only

Repeat using the 2.5mm gauge and observe the detection is made and the correct voltage is present on the KR circuit.

IBCL Only

Repeat using the 3.5mm gauge and observe the detection is made and the correct voltage is present on the KR circuit.

2.4 Remove the gauge, tighten the nut and check that detection is made.

2.5 Insert the 1.5mm gauge between the left-hand micro-switch plunger and the cam follower tappet screw. Observe the detection is made and the correct voltage is present on the KR circuit.

2.6 Repeat 2.5 using the 2mm gauge and observe that detection is broken.

2.7 Repeat tests 1.1 to 1.3 for the other mechanism.

2.8 Repeat tests 2.1 to 2.6 for the other mechanism.

2.9 The final check before completion of the work is to ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Clamp Includes:	Rail Clamp Point lock (RCPL) & In-Bearer Clamp Lock (IBCL)
Excludes:	

Isolate the mechanism by turning to the 'Manual' position on the hydraulic pack. Disconnect the point detection from the KR lines or apply an alternative safe system of work (See NR/SMS/Part/A04).

Detection shall always be checked by reference to a meter connected to the outgoing KR circuit.

Gauges: 2.5mm & 4mm detection gauge (RCPL) 3.5mm & 5mm detection gauge (IBCL) 1.5mm & 2mm micro-switch gauges.

1. Lock & Detection Setting

1.1 Close & lock the switch rail.

1.2 **Mk 2 Only:** Slacken the detector locking nut by 1/16th turn and turn the adjusting screw clockwise until the adjustable cam has reached the head of the adjusting screw.

1.3 **Mk 3 Only:** Slacken the detector locking nut by 1/16th turn. There is an additional inner lock nut on the adjusting screw (plain half nut). The inner nut (plain half-nut) shall be slackened sufficiently to allow the adjuster screw to move. Turn the adjusting screw clockwise until the adjuster screw head meets the detector blade lug.

Figure 1 - RCPL and IBCL (with Mk 2 clamp lock) Adjusting Screw field side

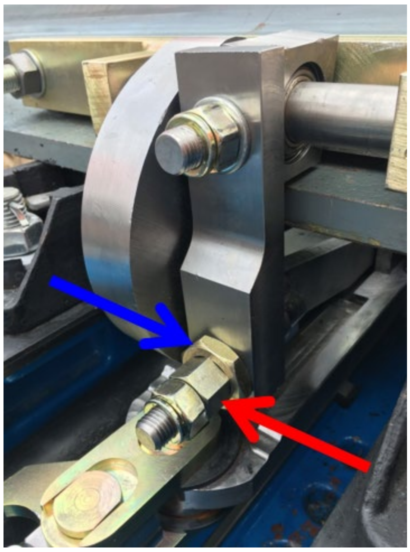


Figure 2 - IBCL Mk 3 Adjusting Screw (red). Inner lock-nut (blue). Adjustment made from 4' side

NOTE: *RCPL and IBCL (with Mk2 Clamp Lock) adjusting screws are found on the field side of the lock body. IBCL Mk3 adjusting screws are found on the 4ft side of the lock body. See Figure 1 and Figure 2 for details.*

1.4 Check the correct voltage is present on the outgoing KR circuit for the mechanism being tested.

1.5 Insert the 2mm gauge between the micro-switch plunger and the cam follower tappet screw.

1.6 Adjust the left-hand tappet screw until detection is broken; tighten the lock nut.

1.7 Retest the detection using the 1.5mm gauge. If necessary, adjust the left-hand tappet screw until detection is made. Tighten the lock nut.

Where adjustments are made to the left-hand tappet screw, repeat 1.1 to 1.7.

RCPL Only

1.8 Insert the 4mm gauge between the point detector blade lug and the shoulder of the connecting eye. Whilst observing the meter, turn the adjusting screw anticlockwise until the detection is just broken.

1.9 Tighten the nut and observe that the detection is broken. If detection is made, return to step 1.1.

Repeat using the 2.5mm gauge and observe the detection is made and the correct voltage is present on the KR circuit. If the detection is broken, remove the gauge and return to step 1.1.

IBCL Only

1.10 Insert the 5mm gauge between the point detector blade lug and the shoulder of the connecting eye.

NOTE: *On IBCL Mk 3, pull the bottom of the detector blade lug toward the 4' to open a gap for the 5mm gauge. When loosening or tightening the connecting eye nut retain the connecting eye with a spanner to prevent rotation of the spherical bearing.*

1.11 Whilst observing the meter, turn the adjusting screw anticlockwise until the detection is just broken.

1.12 Tighten nut and observe that the detection is broken. If detection is made, return to step 1.1.

1.13 Repeat using the 3.5mm gauge and observe the detection is made and the correct voltage is present on the KR circuit. If the detection is broken, remove the gauge and return to step 1.1.

1.14 Remove the gauge, tighten the nut and check that detection is made.

All Types

1.15 Insert the 1.5mm gauge between the left hand micro-switch plunger and the cam follower tappet screw. Observe the detection is made and the correct voltage is present on the KR circuit.

1.16 Repeat using the 2mm gauge and observe that detection is broken.

1.17 Remove gauge and open the closed switch rail to approximately 25mm (1”).

1.18 Observe that the right-hand tappet screw is level with the left-hand tappet screw. Adjust the right-hand tappet screw as necessary and tighten the lock nut.

1.19 Check, with the switch rail fully open, that there is a gap between the right-hand micro-switch plunger and its tappet screw.

1.20 Once adjustments have been correctly set, tighten lock nuts to specification.

> ***NOTE:*** *On IBCL Mk 3 are two lock nuts to tighten, one on the end of the adjuster screw and another against the detector blade lug.*

1.21 Repeat steps 1.1 to 1.20 for the opposite switch position.

1.22 Carry out Facing Point Lock Test (Clamp Lock) – NR/SMS/PARTB/003

1.23 Request the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

Includes:	Rail Clamp Point lock (RCPL) & In-Bearer Clamp Lock (IBCL)
Excludes:	All other “Tests for Air” in Hydraulic Systems

1. Check a System for Air

1.1 Check the following:

a) The hydraulic fluid level in the reservoir.

b) The power pack is reasonably level.

c) The hose run does not have any major humps that can trap air.

NOTE: *Ideally, the hoses should rise slightly towards the power pack.*

1.2 Switch the Power Pack to ‘Manual’.

1.3 Observe the lie of the points and move the direction control lever to the opposite lie.

1.4 Using the hand pump, gently pump until the drive mechanism just starts to move.

(In POCV fitted packs, a sudden release of pressure may be noticed).

1.5 Allow the direction control lever to return to the central position.

1.6 Using a crow bar:

RCPL & IBCL Mk 2:	Against the tie bar lugs, attempt to bar the points open.
IBCL Mk 3:	Against the open rail barring lug, attempt to bar the drive lock slide closed. It should not be possible to move the mechanism any measurable distance. Do not bar the switch rail itself.

1.7 The actuator piston should not move. If movement does occur, note how much and whether it springs back once released and refer to Table 1 regarding the action to be taken.

Movement	Likely Cause	Action
No measurable movement	Points free from trapped air.	No action required.
Some movement, spongy, mechanism springs back when released:	Some trapped air. (Expansion of long non-conductive hoses may result in some movement.)	Bleed the system and retest.
Movement with little resistance, mechanism does not spring back:	Internal leakage likely, possibly an over length POCV piston or piston head seal failure	Arrange to replace the power pack or ram as necessary. (This is not mandatory at a supplementary drive driven by a four-port power pack).

Table 1 – Results

1.8 Hand pump the points to the opposite position and repeat 1.6.

1.9 For installations fitted with traditional hydraulic supplementary drives (back drives) fed by four port packs, the tests shall be repeated at each drive point. Barring should be carried out at the closed switch rail.

1.10 When testing is completed, restore power operation.

2. Bleeding the System

2.1 Starting at the actuator, for each joint in turn, loosen the joint and hand pump fluid into the joint. When fluid flows without frothing, tighten that joint. Fit the locking wires.

2.2 Hand pump the points over and back again.

2.3 Operate the points, on power, normal and reverse for at least 6 complete cycles.

2.4 Test the system for air.

3. Installing a New Actuator

3.1 Refer to the relevant sections in the Clamp Lock Installation Manual suite for instructions, See table 2.

Clamp Lock Variant	S&C Design	Switch Opening	Supplementary Drive	Document Number
RCPL	CEN56 Full-Depth / UIC54 Shallow Depth	110	Mechanical	SRB0201ra
IBCL Mk 2	NR60 Mk 1	110	Mechanical / Hy-Drive	SRA0101ra
	NR56v	110	Mechanical / Hy-Drive	SRC0301ra
IBCL Mk 3	NR60 Mk 2	130	Mechanical	E05-01RA-1
		110	Hy-Drive	F06-01RA-1
	NR56v	110	Hy-Drive	G06-01RA-1
		110	Mechanical	H06-1RA-1

Table 2 – Document References

END

Isolate the supply to the point machine and operate points manually. Disconnect the point detection from the KR lines or apply an alternative safe system of work See NR/SMS/PartA/A04 (Method Statement Summary).

The positions and number of supplementary detectors can vary on switches of the same type from different manufacturers; in addition, the length of the turn out and the rail profile will affect the pass/fail criteria of the detector.

This means that with the position of the detector(s) and rail profile on certain combinations of switch layout, they will not always gauge to that stated in the test. An obstruction fail gauge lower than that stated is on the safe side.

In all circumstances, the obstruction pass/fail gauge shall NOT exceed the limits stated. If in doubt, ask your SM(S).

Tools and Gauges

- Detection Gauges (various depending on layout).
- Digital Volt Meter (DVM).
- Tape measure or rule.

1. Gauge Test (All detectors except those fitted to T72 style point machines)

1.1 Check that the points are locked REVERSE.

1.2 Disconnect the point detection from the KR lines or apply an alternative safe system of work. On Invensys Rail Westrace modular plug coupled points, the point detection shall be disconnected by uncoupling the 4c detection cable in the OC(P).

1.3 Check using the DVM that the correct voltage is present on the outgoing detection circuit (reverse detection).

On Invensys Rail Westrace modular plug coupled points, the correct voltage is a pulsing pseudo random voltage. This shall be checked for its presence at the first set of incoming terminals on which the detection supply cable is connected. Refer to site installation drawings.

1.4 Insert an 8mm gauge between the switch rail and stock rail at a point in line with the stretcher at the supplementary detector.

1.5 Manually operate and lock the points NORMAL.

1.6 Check normal detection is broken.

1.7 Repeat 1.3 to 1.6 using an 6mm gauge and Check that detection remains made.

1.8 Repeat 1.3 to 1.7 for the opposite lie of the points (reverse detection).

If any adjustments are made, the test shall be repeated.

1.9 Hand operate and lock the points REVERSE. Check reverse detection is made.

1.10 Repeat 1.1 to 1.9 for any other supplementary detectors in the layout.

1.11 Reconnect the points and Observe correct operation from the controlling point.

2. Gauge Test (Detectors fitted to T72 style point machines only)

2.1 Disconnect the detection at the junction box by removing links T1 number 1 and T1 number 3.

2.2 Remove the lineside detection disconnection box cover.

2.3 Connect a suitable meter, set to the ohms range, to the appropriate detection circuit terminals.

- If the left-hand switch blade is closed and locked: use T3 Link number 1 ‘B’ side (LHS) and test point on T2 Link 4.
- If the right-hand switch blade is closed and locked: use T1 Link number 1 ‘B’ side (LHS) and test point on T2 Link 4.

2.4 Measure the resistance (approximately 33kΩ).

2.5 Manually operate the switch blade to enable a 6mm gauge to be inserted between the switch rail and stock rail at a point in line with the stretcher at the supplementary detector.

2.6 Manually operate the switch blade onto the gauge.

2.7 Measure the resistance (approximately 33kΩ).

2.8 Manually operate the switch blade to enable an 8mm gauge to be inserted between the switch rail and stock rail at a point in line with the stretcher at the supplementary detector.

2.9 Manually operate the switch blade onto the gauge and Measure the resistance. This should be infinity.

2.10 Move the points to the opposite lie and repeat steps 2.3 to 2.10.

2.11 When the test has been completed for the lie of the point’s normal and reverse, replace the lineside detection disconnection box cover.

2.12 Replace links T1 number 1 and T1 number 3 and Observe correct operation from the controlling point.

END

Includes:	Mk.1 Rail Clamp Point Locks
Excludes:	All other types of Clamplock

Where gas type point heaters are fitted, the gas supply shall be turned off.

Allow heated points to cool before the test is carried out.

1. Dye Penetrate Test

1.1 Clean the lock body and allow to dry.

1.2 Spray the “dye penetrate” in an even film over the area to be tested from a distance of 300mm.

1.3 Wait for 10 minutes to enable complete penetration of any cracks.

1.4 Wipe all excess dye from the surface using paper tissue moistened with cleaner until all red coloration has been removed from the surface.

1.5 Spray the developer in an even film over the area to be tested.

1.6 Wait 10 minutes for the developer to react with any remaining dye.

1.7 Report any signs of cracking (red lines) to your SM(S) immediately.

2. Eddy Current Test

2.1 Use the eddy current detector meter in accordance with the instruction manual.

2.2 Report any signs of cracking to your SM(S) immediately.

End

Gauges: 3.5mm/5mm point checking gauge
1.5mm gauge.

1. Detection Test

For each position of the points:

1.1 Place a 3.5mm point checking gauge between the switch and stock rails at a point in line with first slide chair bolt. Observe that the detection is broken.

1.2 Repeat the test using a 1.5mm gauge. Observe that detection is made.

1.3 Record the results on the test record card.

End

Voltage Test (Excluding Reed, SSI and Invensys Rail Westrace SOM24 fed points)

With 4 ends of points and supplementary detection, you should expect a volt drop under 2.0V. If you find a volt drop greater than expected, you should isolate the cause with the resistance test.

1.1 Check all point ends are in correspondence.

1.2 Compare the voltage at the detection circuit fuse with the voltage at the incoming detection circuit links or at the relay coil.

1.3 Repeat the test for the opposite lie.

1.4 Record the results on the record card.

2. Resistance Test

50/0.25mm cable has a typical al resistance of approximately 8 Ω/km, therefore a typical 200m tail cable circuit (out & back) should give a resistance of approximately 1.6Ω. This should be added to the resistance of circuit components and judgment applied.

Investigate the cause of any high resistance and action as a corrective maintenance item (e.g. high resistance contacts, poor termination, and cable core resistance).

Any value above 10Ω indicates a potential failure.

2.1 Check all point ends are in correspondence.

2.2 Disconnect the detection circuit at the links adjacent to the detection relay.

On Invensys Rail Westrace modular plug coupled points, the point detection shall be disconnected by uncoupling the 4c detection cable in the OC(P)

2.3 Connect a multi-meter and Measure the resistance through each leg of the point detection circuit from the fuse/ terminal to the relay link. Tap the micro-switches and look for any light contacts.

2.4 Repeat the test for the opposite lie of points.

2.5 Reconnect the detection circuit and Observe correct operation of the points.

End

Includes:	Hydraulic Derailers (Type BRB 817) powered by SPX Hydraulic Pumps and Actuators.
Excludes:	All other types of Derailer.

The equipment shall not be operated on power until the unit has been proven to work correctly by hand pump operation.

Hydraulic Derailers use a standard Clamplock pump unit and a pair of Clamplock rams to drive a Derailer mechanism. Detection is accomplished using a standard circuit Controller or a 998 unit

Tests

1. Mechanical Set-up and Test

1.1 With the Derailer in its normal position (on rail) Check that the sleeper to sleeper dimension (Inside edge to inside edge) is 575mm

1.2 Check that the Derailer Rail Unit flange cut out aligns with the running edge of the rail.

1.3 Check that the Derailer Rail Unit is in contact with the rail when in the 'Normal' position.

1.4 Check that the Derailer Rail Unit is in contact with the Derailer stop when in the 'Reverse' position. In accordance with Drawing SE-SK-0415

1.5 Check the torque settings of the nuts for the bolts holding the Derailer mechanism to the rail at 80Nm.

1.6 Check the Derailer Drive Rod Alignment to the Driving Crank is parallel and in line to adjacent sleepers leading to the de-railer connection pin.

1.7 Check that when operated that the driving crank between the Hydraulic Pump Unit connecting rod, operates smoothly and that the driving angle does not become chocked or interferes with the Detector Box, and that the crank is greased and is fitted with respective grease nipples in the crank stud and joint pins.

2. Test Normal Detection

2.1 With the points on manual and with a meter connected to the detection lines check, that normal detection is made when the Derailer is in the 'Normal' position (in contact with the rail).

2.2 Move Derailer to off-rail position and check that 'Normal' detection is broken when the Derailer Rail Unit has moved by no greater than 2mm from the 'Normal' position i.e. no greater than 2mm between the rail surface and bottom of Derailer Rail Unit.

2.3 Move Derailer towards on-rail position and Check detection does not make until the Derailer is 2mm from the 'Normal' position i.e. no greater than 2mm between the rail surface and bottom of Derailer Rail Unit.

3. Motor Cut Out Test

3.1 Disconnect detection lines; Select 'Power' and ask the signaller to operate the Derailer. Check the overload cut-out operates (6-9 seconds) Reconnect detection after successful test.

4. Local Correspondence Test

4.1 Check that the KR Lines are disconnected before carrying out this test and that the signaller has been informed that indications for the De-railer will be lost.

4.2 Remove the pump unit cover and turn to "Power" before carrying out the following tests.

4.3 TEST the correspondence of all detection positions by the breaking of the Normal / Reverse detection contacts and observing the correct indication relays are operated. 50V shall be present on the NKR and 0V on the RKR for 'Normal' position. 50V shall be present on the RKR and 0V on the NKR for 'Reverse' position.

4.4 TEST the correspondence of all detection positions by the breaking of the Normal / Reverse detection contacts and observing that the correct detection at the signal box is lost.

5. Signal Box Correspondence Test

5.1 TEST that the signal box point switch, and any indication corresponds with the Derailer position for both 'Normal' and 'Reverse' positions.

5.2 TEST that a correct out of correspondence indication is present at the controlling signal box; with the Derailer in the 'Normal' position, key the points reverse and observe no movement of the Derailer. Confirm the out of correspondence indication with the signal box.

5.3 Using pump handle pump the Derailer into the 'Reverse' position and confirm correct indication in signal box.

5.4 TEST with the Derailer in the 'Reverse' position key the points 'Normal' and observe no movement of the Derailer. Confirm the out of correspondence indication with the signal box.

5.5 Using pump handle pump the Derailer into the 'Normal' position and confirm correct indication in signal box.

5.6 The final check before completion of the work is to ask the signaller to operate the Derailer to 'Normal' and 'Reverse' positions (3 times each way), while observing the movement of the Derailer is correct.

Specific Definitions

Term	Definition
Derailer Stop	Metal plate that protects rodding when Derailer Rail Unit is in reverse position.
Derailer Rail Unit	Derailing block that sits on top of rail.
BR817 Power Pack	Electro Hydraulic Power Pack that provided power to actuator.

End

General

Lamp voltage and current ranges are listed in NR/SMS/Part/Z01

A voltage below the specified range can result in insufficient light output conversely too high a voltage may affect the life of the lamp.

The notes following the types of lamp give more details. Where practicable every aspect should be tested once per year.

Lamps fed directly from 110V bus bars in most cases will not be able to be adjusted. Inform your SM(S) if a lamp fed directly in this way is out of the stated limits.

Quartz Halogen Lamps

Signals using these have separate lamps for the main and auxiliary.

Check these lamps are set to run as close as possible to their rated voltage. If this is not possible, report it to your SM(S) immediately.

Running a Quartz Halogen lamp at a voltage lower than its rated voltage will cause the glass envelope to blacken and consequently the light output will be reduced.

These lamps become very hot “do not” touch the glass with your bare hands.

If this occurs the glass should be cleaned with methylated spirits.

Automatic Signals

Aspects are tested using one of the following methods:

- Disconnection of the circuits to the controlling relay
- Following passage of a train.

Ansaldo SD321 Signals

The lamp / lamp holder metal components can be very hot.

Before refitting the lamp / lamp holder assembly, the red notches on the lamp holder and optical unit shall be aligned to confirm polarisation.

Because of the configuration of these signals, the lamp voltage and lamp proving tests are combined in this test. This does not apply to Position Light Junction Indicator (PLJI) and Ground Position Light (GPL) lamp proving which are contained in NR/SMS/Test/022.

The signal lamp voltage and proving tests requires the use of the Ansaldo Maintenance Terminal and shall only be performed with the agreement of the signaller.

These tests shall not be performed if a train is approaching as this may cause the signal to display a red aspect.

Every aspect shall be tested once per year as a minimum. Each lamp shall be illuminated and tested in turn.

Signal lamp voltages are recorded at the maintenance desk and on the signal head record card kept in the signal head.

If the voltage cannot be maintained within the voltage range detailed in NR/SMS/Part/Z01, report the problem to your SM(S) immediately.

If the voltage on an unlit lamp is found to be ≥0.8V, the actions detailed in NR/SMS/Appendix/02 shall be followed and your SM(S) informed immediately.

1. Voltage Test (Not Quartz Halogen Lamps)

1.1 Measure the main filament voltage for each signal aspect and Check (where provided) for 0V on the auxiliary filament. Voltages are listed in NR/SMS/Part/Z01

A standing voltage on the auxiliary filament terminals indicates a problem with the filament proving circuitry.

On SIMIS-W schemes, measure the main filament voltage for each signal aspect across the appropriate Wago terminals.

1.2 Disconnect the main filament and Measure the auxiliary filament voltage (where provided) for each aspect.

On SIMIS-W schemes, disconnection of the main filament is achieved at the Wago terminals for the appropriate aspect under test.

After the test, check that the Wago terminal is fully inserted in to its original position.

1.3 Record the results on the signal lamp record card. Where illumination of a lamp is refused by the signaller, endorse the record card ‘REFUSED’.

2. Voltage Test (Quartz Halogen Lamps Only)

Some banner repeater signals have two main lamps illuminated simultaneously; therefore the tests applicable to auxiliary lamps do not apply. If you are in doubt, ask your SM(S).

2.1 Measure the main lamp voltage and Check for 0V on the auxiliary lamp.

A standing voltage on the auxiliary lamp terminals indicates a problem with the filament proving circuitry.

2.2 Disconnect the main lamp and Measure the voltage on the auxiliary lamp.

2.3 Record the results on the signal lamp record card. Where illumination of a lamp is refused by the signaller, endorse the record card 'REFUSED'

3. Current Test (SIMIS-W Interlocking Areas Only)

3.1 Measure, using a suitable current clamp meter, the current on the primary side of the transformer. Currents are listed in NR/SMS/Part/Z01

4. Voltage Test & Proving Test (Ansaldo SD321 Signal)

For the lower optical unit:

4.1 Arrange for a red aspect to be displayed.

This should be displayed in the lower aperture.

4.2 Measure the voltage of the illuminated lamp.

4.3 Measure the voltage of the unlit lamps. See the notes in the general section

4.4 Remove the illuminated lamp/lamp holder assembly and Check that the filament failure alarm has operated. Use the Ansaldo Maintenance Terminal.

4.5 Check that the corresponding auxiliary aspect lamp illuminates in the upper optical unit.

4.6 Measure the voltage of the unlit lamps in the upper optical unit.

See the notes in the general section

4.7 Replace the lamp/lamp holder assembly.

4.8 Re-instate the lamp as the operative lamp. This is a Signaller action.

4.9 Check that the operative lamp is illuminated and that the corresponding auxiliary aspect lamp is extinguished.

4.10 Repeat 4.2 to 4.9 for the yellow aspect.

For the upper optical unit:

4.11 Arrange for a green aspect to be displayed.

This should be displayed in the upper aperture.

4.12 Measure the voltage of the illuminated lamp.

4.13 Measure the voltage of the unlit lamps. See the notes in the general section.

4.14 Remove the illuminated lamp/lamp holder assembly and Check the filament failure alarm has operated. Use the Ansaldo Maintenance Terminal.

4.15 Check that the corresponding auxiliary aspect lamp illuminates in the lower optical unit.

4.16 Measure the voltage of the unlit lamps in the lower optical unit.

4.17 Replace the lamp/lamp holder assembly.

4.18 Re-instate the lamp as the operative lamp (this is a Signaller action).

4.19 Check that the lamp is illuminated and that the auxiliary lamp is extinguished.

4.20 Repeat 4.12 to 4.19 for the yellow aspect.

End

GENERAL

There are no record cards for these tests, however where a route cannot be set to prove an aspect, junction indication or route indication, report this on your work order.

Computer Based Interlocking (CBI) Areas

In CBI areas the lamp proving function can be checked by use of the data link interrogator, the Technician's terminal or by asking the Signaller to observe their panel indications.

SIMIS-W Areas

In SIMIS-W areas, the S&D terminal is used to check the operation of the failure alarm. The S&D terminal and the Vicos terminals are used to check that the operation of the lamp proving function.

1. Multi Aspect Signals on CBI Areas (Filament Lamps)

1.1 Remove the lamp from lamp holder.

1.2 Check the lamp proving function has operated.

1.3 Replace the lamp.

1.4 Disable the main filament.

1.5 Check that the main filament is extinguished and the auxiliary filament illuminates.

1.6 Check the filament failure alarm has operated.

1.7 Reconnect the main filament.

1.8 Check that the auxiliary filament extinguishes and the main filament illuminates.

2. FOCL Signals on CBI Areas

2.1 Remove the flying leads of the main and auxiliary QH lamps.

2.2 Check that an alarm has been raised.

2.3 Connect the flying leads of the main and auxiliary QH lamps and check the main QH lamp is illuminated only.

2.4 Remove the flying lead to the main QH lamp and check the auxiliary QH lamp illuminates.

2.5 Check that an alarm has been raised.

2.6 Connect the flying lead to the main QH lamp and check that the main QH lamp illuminates and the auxiliary lamp extinguishes.

3. Multi Aspect Signals on Non-CBI Areas (Filament Lamps)

3.1 Remove the lamp from lamp holder.

3.2 Check the lamp-proving relay de-energises.

3.3 Replace the lamp.

3.4 Check the lamp-proving relay re-energises.

3.5 Disable the main filament.

3.6 Check that the main filament is extinguished and the auxiliary filament illuminates.

3.7 Check the filament failure alarm has operated.

3.8 Reconnect the main filament.

3.9 Check that the auxiliary filament extinguishes and the main filament illuminates.

4. Multi Aspect Signals on SIMS-W Areas (Filament Lamps)

4.1 Using the disconnection links in the signal head disable the main filament.

4.2 Check that the main filament is extinguished and the auxiliary filament illuminates.

4.3 Check the filament failure alarm has operated.

4.4 Using the disconnection links in the signal head disable the auxiliary filament.

4.5 Check the lamp proving function has operated.

4.6 Reconnect the auxiliary filament.

4.7 Check that the main filament is extinguished and the auxiliary filament illuminates.

4.8 Check the lamp proving function has operated.

4.9 Reconnect the main filament.

4.10 Check that the auxiliary filament extinguishes and the main filament illuminates.

4.11 Check the filament failure alarm shows rectified.

5. FOCL Signals on SIMIS-W Areas

5.1 Carry out these steps for each lamp in turn:

a) Using the disconnection links in the signal head disconnect the QH lamp.

b) Check that an alarm has been raised.

c) Reconnect the QH lamp.

d) Check the lamp failure alarm shows rectified.

6. LED Multi Aspect, Position Light, and Route Indicators (Dorman Light Modules Only)

NOTE: *Excluding areas fed by the Invensys Rail Westrace SOM24. See Section 15.*

6.1 Check drawings as some LED PLS are not lamp proved.

6.2 Disconnect the link to the light module under test. Liaise with the Signaller to obtain the required aspect/indication.

6.3 Check that the lamp-proving relay de-energises. On CBI areas check that an alarm is raised.

6.4 Reconnect the link to the module and check that the lamp-proving relay re-energises.

6.5 Check that the correct aspect/indication is displayed.

7. Fibre Optic Position Light Signals

7.1 Disconnect the link feeding the main QH lamp.

7.2 Check that the auxiliary QH lamp illuminates.

7.3 If lamp-proving indication is provided in the controlling signal box, check that the correct indications are given.

7.4 Reconnect the link feeding the main QH lamp. Check it illuminates and the auxiliary QH lamp extinguishes.

8. Mechanical Signals using a Paraffin Lamp and Pyrometer

8.1 Open the outer lamp case and allow the pyrometer to cool.

8.2 Check the Signaller receives a “lamp out” warning/indication. Check when the audible is cancelled the indication remains.

8.3 Close the cover and check that once the pyrometer has heated up, the audible sounds. Check when cancelled, the audible ceases and the indication restores.

9. Mechanical Signals using Electric Lamps

9.1 Disconnect the link feeding the lamp.

9.2 Check the lamp-proving relay de-energises and the correct indication is given in the controlling signal box.

9.3 Reconnect the link feed the lamp. Check it illuminates and the lamp-proving relay re-energises.

10. Junction Indicators with Five Lamps (Filament Lamps, not SIMIS-W Interlockings)

10.1 Arrange with the Signaller to display an agreed route indication. Check the indication is displayed and the main signal shows a proceed aspect.

10.2 Remove lamps until only two are illuminated.

10.3 Check the lamp-proving relay de-energises and the main signal shows a red aspect. On CBI areas check that an alarm has been raised.

If these checks fail, with only two lamps remaining fitted, have the Junction Indicator extinguished and re-illuminated. Repeat the checks.

10.4 Replace one lamp.

10.5 Check the lamp-proving relay re-energises and the main signal shows a proceed aspect.

10.6 It might be necessary to extinguish and re-illuminate the indicator.

10.7 Replace the remaining lamps.

10.8 Check that all lamps are illuminated.

10.9 Repeat steps 10.1 to 10.7 for each available route indication at the signal.

11. Junction Indicators with Five Lamps (Filament Lamps, SIMIS-W Interlockings Only)

11.1 Arrange with the Signaller to display an agreed route indication. Check the indication is displayed and the main signal shows a proceed aspect.

11.2 Remove each lamp in turn.

11.3 Check the relevant alarm message has been received on the diagnostic terminal.

11.4 Replace the lamp.

11.5 Repeat 11.2 to 11.4 for all remaining lamps.

11.6 Check all lamps are illuminating.

11.7 Repeat 11.2 to 11.4 for each route indication at the signal.

12. Junction Indicators fitted with Five Dorman LED Light Modules

NOTE: *This task might not be possible in Plug and Plug Area.*

12.1 Arrange with the Signaller to display an agreed route indication. Check the indication is displayed and the main signal shows a proceed aspect.

12.2 Disconnect the links to the modules until only two are illuminated.

12.3 Check the lamp-proving relay de-energises and the main signal shows a red aspect.

On CBI areas check that an alarm is raised.

12.4 Reconnect the link to one module.

12.5 Check the lamp-proving relay re-energises and the main signal shows a proceed aspect.

12.6 Reconnect the remaining links.

12.7 Check that all the light modules are illuminated.

12.8 Repeat items 12.1 to 12.7 for each available route indication at the signal.

13. Ansaldo Five Lamp Position Light Junction Indicators

NOTE: *The lamps are paired: 3 and 5, 2 and 4 and each pair is driven by a single POT. The pivot lamp (lamp 1) has its own POT, see NR/SMS/Appendix/02 (General Information on Ansaldo Signalling Equipment).*

13.1 Liaise with the Signaller before carrying out these tasks.

13.2 Arrange with the Signaller to display a proceed aspect with an agreed route indication.

13.3 Remove the pivot lamp and check that the signal is still showing a proceed aspect .

13.4 Remove one other lamp and check that the corresponding lamp in the pair extinguishes. The associated POT has shut down.

13.5 Check that the signal has reverted to RED.

13.6 Replace the lamps and request the Signaller to reset the signal and display the previously agreed proceed aspect with an agreed route indication.

13.7 Check that all the lamps are illuminated. The associated POTs have powered-up.

13.8 Remove one non-pivot lamp and check that the corresponding lamp in the pair extinguishes. The associated POT has shut down.

13.9 Remove one lamp from the other pair and check that the corresponding lamp extinguishes. The associated POT has shut down leaving only the pivot illuminated.

13.10 Check that the signal has reverted to a RED aspect.

13.11 Replace the lamps and request the Signaller to reset the signal and display the previously agreed precede aspect with an agreed route indication.

13.12 Check that all the lamps are illuminated, and the associated POTs have powered-up.

13.13 Repeat items 13.1 to 13.11 for each available route indication at the signal.

14. Ansaldo Ground Position Light Signal

14.1 Arrange with the Signaller to display an ON indication.

14.2 Check that the Main ON lamp is illuminated.

14.3 Remove the Main ON lamp and check that the Auxiliary ON lamp illuminates.

14.4 Replace the Main ON lamp and request the Signaller to re-set the signal.

14.5 Check that the Main ON lamp illuminates and that the Auxiliary ON lamp extinguishes.

14.6 Arrange with the Signaller to display an OFF indication.

14.7 Remove the OFF lamp and check that the signal is 'black', no aspect is displayed.

14.8 Check that the alarm is activated.

14.9 Replace the OFF lamp and request the Signaller to re-set the signal.

14.10 Check that the OFF lamp illuminates and that the alarm is silenced.

15. LED Multi Aspect, Position Light, and Route Indicators Invensys Rail Westrace SOM24 fed.

15.1 Check drawings as some LED PLS are not lamp proved.

15.2 Check that the relevant input LED on the SOM24 is illuminated indicating voltage free contact proving.

15.3 Disconnect the plug coupler in the OC or MEH to the signal or route indicator under test.

15.4 Liaise with the Signaller to obtain the required aspect/indication.

15.5 Check that the relevant input LED on the SOM24 extinguishes indicating no voltage free contact proving.

15.6 Reconnect the plug coupler in the OC or MEH to the signal or route indicator under test and check that the relevant input LED on the SOM24 illuminates indicating voltage free contact proving.

15.7 Check that the correct aspect/indication is displayed.

15.8 Check that the plug coupler is securely fitted, and its retaining clip is engaged fully.

END

1. Signal Post Replacement Switch (SPRS) Test

1.1 Check that the signal is displaying a proceed aspect.

1.2 Request permission from the Signaller to operate the signal post replacement switch.

1.3 Check, with the switch turned to ‘RED’, the signal returns to a red aspect.

1.4 Check, with the switch turned to ‘AUTO’, the signal displays a proceed aspect.

2. Signal Box ERS Test (Automatic Signals)

2.1 Check that the signal is displaying a proceed aspect.

2.2 Request the Signaller to operate the emergency replacement switch.

2.3 Check the signal returns to a red aspect.

2.4 Confirm the ‘signal at red’ indication is illuminated at the signal box.

2.5 Request the Signaller to restore the switch to the ‘AUTO’ position.

2.6 Check the signal displays a proceed aspect.

2.7 Confirm the ‘signal at red’ indication is extinguished at the signal box.

3. SPAD Indicator Test

3.1 Test the SPAD function by slipping the test link.

a) Observe the SPAD indicator illuminates.

b) Observe the Technicians test lamp is lit.

3.2 Check the following:

a) The flasher is operating.

b) The treadle is operating correctly.

c) The over-ride plunger has not stuck up.

d) The timer (SPAD GR) is correctly set.

3.3 Check that an alarm entry with a RED symbol is displayed in the relevant trackside object alarm window.

3.4 Acknowledge or remove the alarm condition and check that the audible alarm is silenced and that the symbol changes to YELLOW.

3.5 Check that the alarm and symbol display is cleared when the alarm has been resolved (when the track circuit in advance of the signal has cleared).

3.6 Return the signal (SPAD alarm) to service operation.

4. SPAD Alarm on Ansaldo Signals (Test 2)

4.1 Agree with the Signaller, the particular signal (SPAD alarm) to be tested and simulate a SPAD situation.

NOTE: *This can be achieved by operating the relevant track circuits on the maintainers' desk.*

4.2 Check the associated audible alarm activates immediately and an alarm entry with a RED symbol is displayed in the relevant trackside object alarm window.

4.3 Resolve the alarm (without acknowledgement). Clear the track circuit in advance of the signal.

4.4 Check the alarm has self-restored and that the symbol has changed to GREEN.

4.5 Return the signal (SPAD alarm) to service operation.

5. SPAD Alarm on Ansaldo Signals (Test 3)

5.1 Agree with the Signaller, the particular signal (SPAD alarm) to be tested and simulate a multiple SPAD situation.

NOTE: *This can be achieved by operating the relevant track circuits on the maintainers' desk.*

5.2 Check that the associated audible alarms activate immediately and that the volume and/or tone of the audible alarm is distinctive, dissimilar, and acceptable to the Signaller. Arrange adjustment with your SM(S).

5.3 Check an alarm entry with a RED symbol is displayed in each relevant trackside object alarm window.

5.4 Check that acknowledgement silences all the audible alarms and that each symbol only changes to YELLOW when its associated alarm entry is acknowledged.

5.5 Check that each alarm and symbol display is only cleared when its associated alarm has been resolved (when the track circuit in advance of the particular signal has cleared).

5.6 Return the signals (SPAD alarms) to service operation.

6. Flasher Unit Test (Flashing Aspects)

6.1 To avoid interference with signal aspect sequences and relay stick circuits, the TEST and RESET buttons shall only be operated under the following conditions:

a) Check the four flasher unit indication lamps are extinguished.

b) Check the flasher unit proving relay (FECR) is de- energised.

<u>SIGNALS CAPABLE OF DISPLAYING A FLASHING DOUBLE YELLOW ASPECT:</u>

6.2 With the signal at danger and the first track circuit ahead of the signal occupied:

a) Press the TEST button, check the four indication lamps are lit and the FECR is de-energised.

b) Press the RESET button, check the four indication lamps extinguish and the FECR re-energises.

<u>SIGNALS CAPABLE OF DISPLAYING A FLASHING SINGLE YELLOW ASPECT:</u>

6.3 With the signal not displaying a flashing aspect:

a) Press the TEST button, check the four indication lamps are lit and the FECR is de-energised.

b) Press the RESET button, check the four indication lamps extinguish and the FECR re-energises.

END

General

Standard strength inductors are coloured yellow and can operate at 12VDC, 24VDC and 110VAC.

On lines employing third or fourth rail DC traction, extra strength inductors are used, which are coloured green these can also operate at 12VDC, 24VDC, 60VDC, 100/110VDC or 110VAC.

Corresponding yellow and green S&P meters are available for testing each type.

When testing yellow magnets, the yellow S&P meter shall be placed upright in the centre of the top surface of the magnet. When testing green magnets, the green S&P meter shall be stood on a 46mm wooden plinth upright in the centre of the top surface of the magnet. This applies to both permanent magnets and electro-magnets.

Some AWS Inductors can be wired for parallel or series operation check the local diagrams for details.

Inductors can be fitted with plug couplers and if they are provided, voltage and current measurements shall be taken at the inductor by the use of an approved “breakout” connector.

If a Vortok Electro-Magnet or Suppressor Magnet is being tested, there is not a controlling relay to check, depending on the type of interlocking/trackside equipment in use. Contact the Signaller and arrange for the routes to be set to energise/de-energise the magnets during the tests.

NOTE: *The Vortok AWS magnets are designed with spark quench diodes as part of the internal circuitry and there is no requirement to perform this test.*

1. Permanent Magnet

1.1 Test permanent magnet flux strength using the S&P meter.

The pointer should move to the green position, with the letter ‘P’ displayed.

If the pointer only moves to the yellow position with a letter ‘P’, the magnet shall be replaced as soon as possible.

If the pointer remains in the red position, the magnet shall be reported as a failure to the Signaller as this can lead to a wrong side failure.

2. Electro-Magnet

2.1 Test electro-inductor flux strength using the S&P meter for caution and proceed signal aspects or positions.

Check that the inductor remains de-energised for R, Y & YY signal aspects (and distant arm ON). The pointer should remain in the red position.

For a green aspect (or distant arm OFF), the pointer should move to the green position, with the letter ‘E’ displayed.

If the pointer only moves to the yellow position with a letter ‘E’, the magnet shall be replaced as soon as possible.

If the pointer remains in the red position, the magnet shall be reported as a failure to the Signaller and as a corrective maintenance item.

2.2 At the electro-inductor terminals Measure the electro-inductor voltage for both caution and proceed signal aspects. A “breakout box” shall be used if required.

Check that 0v is present for R, Y & YY aspects (or distant arm ON). Check that the energised voltage is within 10% of nominal voltage. Voltages are detailed in NR/SMS/Part/Z08 (Train Protection - Reference Values).

2.3 Measure the electro-inductor current for green aspects (and distant arm OFF). A “breakout box” shall be used if required.

3. Suppressor Magnet

3.1 At the inductor terminals measure the suppressor inductor voltage. A “breakout box” shall be used if required.

Voltages are detailed in NR/SMS/Part/Z08 (Train Protection - Reference Values).

A suppressed inductor can be energised by requesting the Signaller to set a route over the inductor in the opposite direction to that for which the de-energised inductor is used. It might be necessary to drop the track circuit over the inductor, as power saving controls are sometimes used.

3.2 Test suppressor flux strength using the S&P meter.

a) Check the controlling relay is energised, or if no relay present, check the controlling equipment is driving the suppressor magnet. The permanent magnet should be suppressed.

b) Test suppressor flux strength using the S&P meter.

The pointer should remain in the red position.

c) Check the controlling relay is de-energised, or if no relay present, check the controlling equipment is not driving the suppressor magnet. The permanent magnet should not be suppressed.

d) Test suppressor flux strength using the S&P meter.

The pointer should move to the green position, with the letter 'P' displayed.

The permanent magnet field should be present (see Section 1).

3.3 Measure the current flow through the inductor.

a) Check the controlling relay is energised, or if no relay present, check the controlling equipment is driving the suppressor magnet. The permanent magnet should be suppressed.

b) Test the current flow through the suppressor.

The suppressor magnet should be energised, and the permanent magnet should be suppressed. The meter should measure current flowing.

c) Check the controlling relay is de-energised, or if no relay present, check the controlling equipment is not driving the suppressor magnet. The permanent magnet should not be suppressed.

d) Test the current flow through the suppressor.

The permanent magnet field should be present and there should be no current flowing.

4. Records

4.1 Record all the results on the record card.

5. Spark Quench

Where an external spark quench diode is present and during a fault investigation carrying out this test might assist with the fault diagnosis.

a) Disconnect one leg and test the diode or resistor spark quench.

On electronic meters the diode test function should be used to test the spark quench diode (audible beep one way, nothing on the other).

If you are using an analogue meter, the resistance range should be used (low, typically 100Ω one way and high, typically several thousand the other).

The spark quench resistor should be tested using the resistance range on both types of meter. Resistor values should correspond with the diagrams.

b) Reconnect the disconnected leg.

END

Includes:	Vehicle Identification System used in the Sheffield Tram-Train Project Network Rail mainline infrastructure, between the Sheffield Supertram network and Parkgate Tram Stop.
Excludes:	Vehicle Identification System used on the Sheffield Supertram Network

GENERAL

The following process should be used when a particular loop requires replacement or reactive maintenance.

The process explains how to tune the loop to the 147 kHz frequency providing the maximum signal strength at the loop, by adjustment of the Tuner Unit links.

1. Loop Tuning Setup

1.1 Check the loop and feeder cables are connected and no links LK1 – LK10 are fitted.

1.2 Connect a test ribbon cable with the 10-way dip switch in test connector.

1.3 Check that the 10-way switch is switched OFF in reset condition.

1.4 Now connect the oscilloscope, loop test meter box or multi meter (capable of reading a high frequency) to the loop feeder cable in loop tuner unit.

1.5 The aim is to set the maximum reading by changing the switch position starting from switch 10 towards switch 1.

1.6 Switches 1-5 select a low capacitance, and these have very little effect, whereas switches 6-10 select higher values of capacitance and thus have a greater effect on the tuning.

1.7 Initially note down the loop voltage reading in the start condition.

1.8 Now turn ON switch 10 and make sure the corresponding reading is increased from the start condition. If it is increased, then switch 10 is kept set to the ON position.

1.9 If the reading is decreased from the start value, then turn switch 10 to the OFF position.

1.10 Now turn on switch 9. If it increases the output from the previous value then keep switch 9 on and now turn off switch 10 and check if the reading increases, if yes then turn off switch 10 and turn on switch 9 alone. If it decreases, then both switch 9 and 10 are kept on.

1.11 Repeat step 1.7. to 1.10 for all the switches positions from 8 to 1.

1.12 Note down the switch position that are ON and make sure the corresponding link headers in the Tuner Unit are fitted in the corresponding positions.

1.13 Remove the test ribbon cable and re-fit the Tuner Unit cover.

1.14 Any unused left-over link headers are stored for future use.

1.15 After completion of the tuning adjust the related Loop card potentiometer VR2 clockwise or anticlockwise to set the loop voltage to the level as per Table 1.

Rack Voltage			**Loop Tuner Feeder**			**Loop Tuner Loop**		
Fluke	**Meter Box**	**Oscilloscope**	**Fluke**	**Meter Box**	**Oscilloscope**	**Fluke**	**Meter Box**	**Oscilloscope**
3.7V	70	10V	3.6V	70	10V	7.5V	FSD	22.4V
3.7V	70	10V	3.7V	70	10V	8.1V	FSD	24V

Table 1 – Loop Voltages

1.16 Finally phase the loop and simulate trams using the tram simulator to make sure the loop is fully functional.

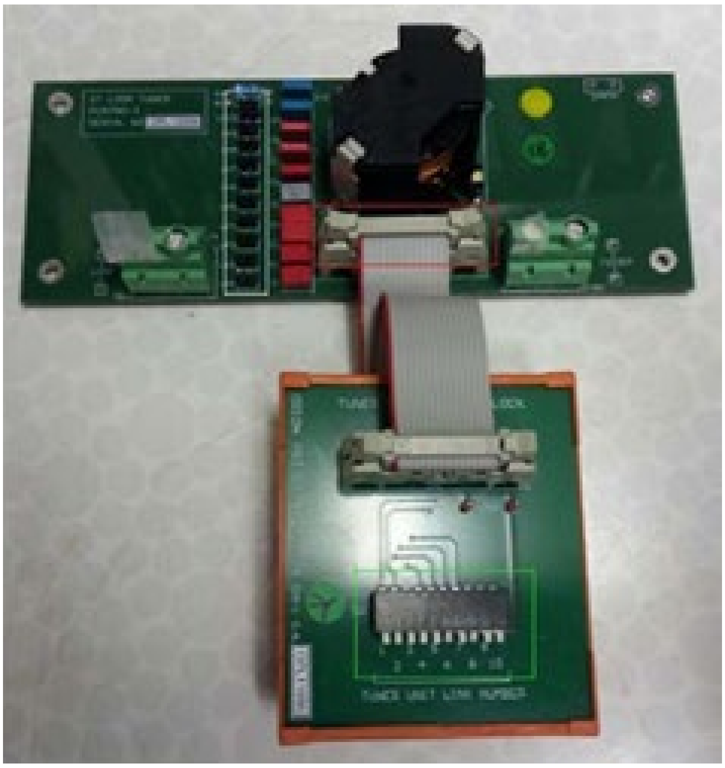


Figure 1 - Loop Tuner with 10-way DIP switch

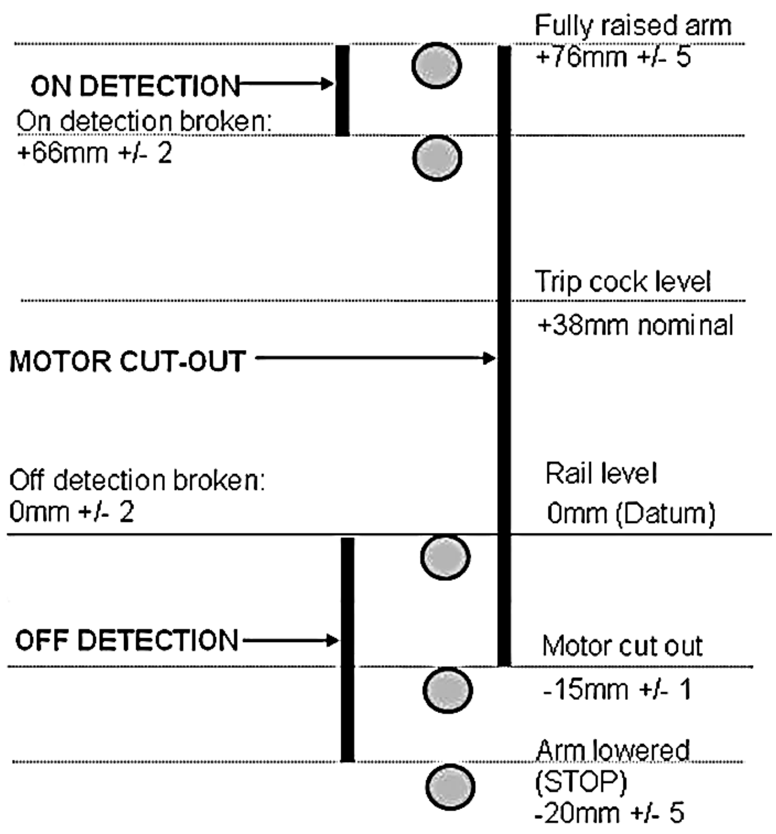
END

Includes:	Electro-hydraulic Trainstops
Excludes:	All other Trainstops

1. Test

1.1 Manually operate the trainstop and Check the following:

- With stop arm fully raised: 'ON' detection is made.
- 'ON' detection is lost when stop arm is depressed by 10mm (± 2mm).
- When stop arm is fully lowered, 'OFF' detection is made.
- 'OFF' detection is maintained from the fully lowered position until the stop arm is raised to rail level (± 2mm).
- Check that motor cut out contacts are set to break when stop arm is 5mm (± 1) above the fully lowered position.



End

Includes:	Siemens JE Trainstop.
Excludes:	All other types and styles of Trainstop .

Trainstops contain moving parts which can cause severe personal injury.

1. Trainstop Test

1.1 Check the tail cables, Earth Bond and power supply is reconnected.

1.2 Confirm with the signaller that the signal associated with the train stop is at danger and confirm what indication he/she has for the Trainstop.

1.3 Request the Signaller to clear the signal associated with the Trainstop to a proceed aspect.

1.4 Observe the trainstop moves completely to the lowered position.

1.5 Check that the motor cuts out prior to the Trip Arm hitting the lower stop.

1.6 Ask the Signaller to confirm the indication.

1.7 Request the Signaller to place the signal associated with the Trainstop back to danger.

1.8 Observe the trainstop moves completely to the raised position.

1.9 Ask the Signaller to confirm the indication.

End

Includes:	Siemens Style JE Trainstop.
Excludes:	All other types and styles of Trainstop .

Trainstops contain moving parts which can cause severe personal injury.

1 Positioning Check

1.1 Check the Trip Arm is the correct distance from the running rail.

The distance from the inside of the running rail to the centre of the Trip Arm must be 222 mm +/- 3mm, as shown in Figure 1. In areas with conductor rails a non-metallic rule shall be used.

If necessary slacken the Trainstop fixings and adjust the position of the Trainstop. If it is still not possible to set the correct distance:

- Suspect damage or distortion to the Trainstop.

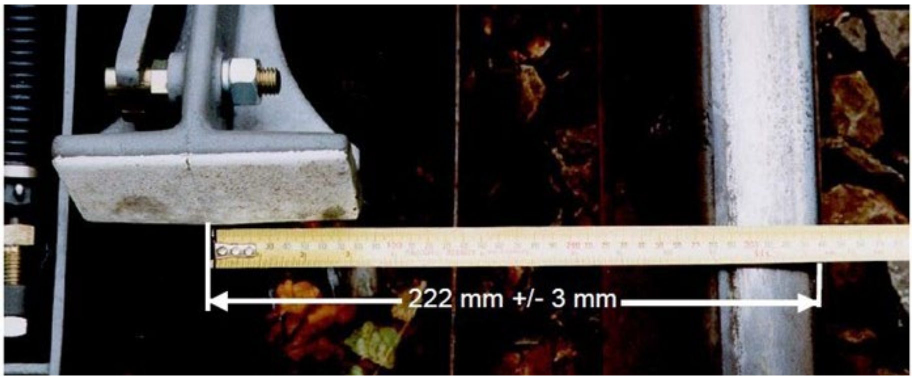


Figure 1 – Distance from Rail

1.2 Using the Trip Arm Gauge, check the height of the top of the raised Trip Arm is 76 mm +/- 3 mm above a line joining the tops of the running rails (see Figure 2).

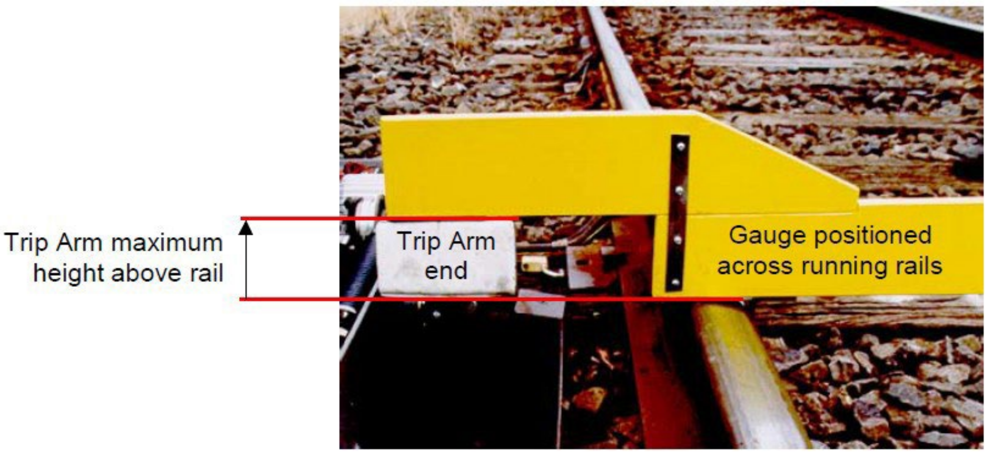


Figure 2 – Height of Trip Arm Checked with Gauge

1.3 If the height is out of tolerance, add or remove Packer Plates (Figure 3).

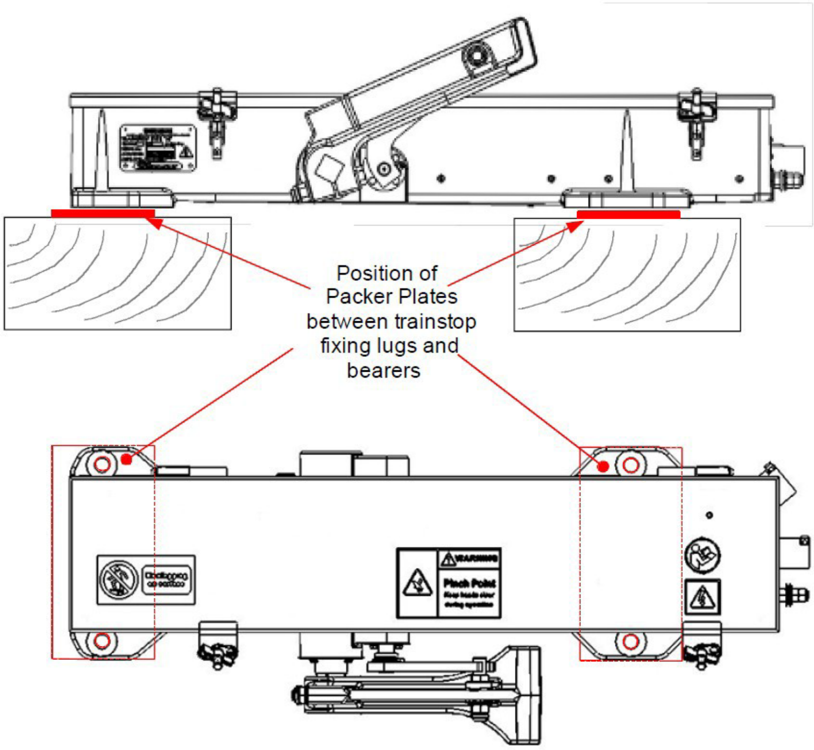


Figure 3 – Position of Packer Plates

If a Sole Plate (B54132/1) is used Packers will be fitted (if required) between the Sole Plate and the Casing Foot.

1.4 If any adjustments have been made carry out SMS Test 027 – JE Style Trainstop Detection Test

End

General

Anti-static precautions shall be taken.

Tools: The following equipment is required to carry out these tests:

- Modulator/Output board extender card. (See Figure 1).
- 1000:1 Current probe.
- Digital voltmeter (DVM).

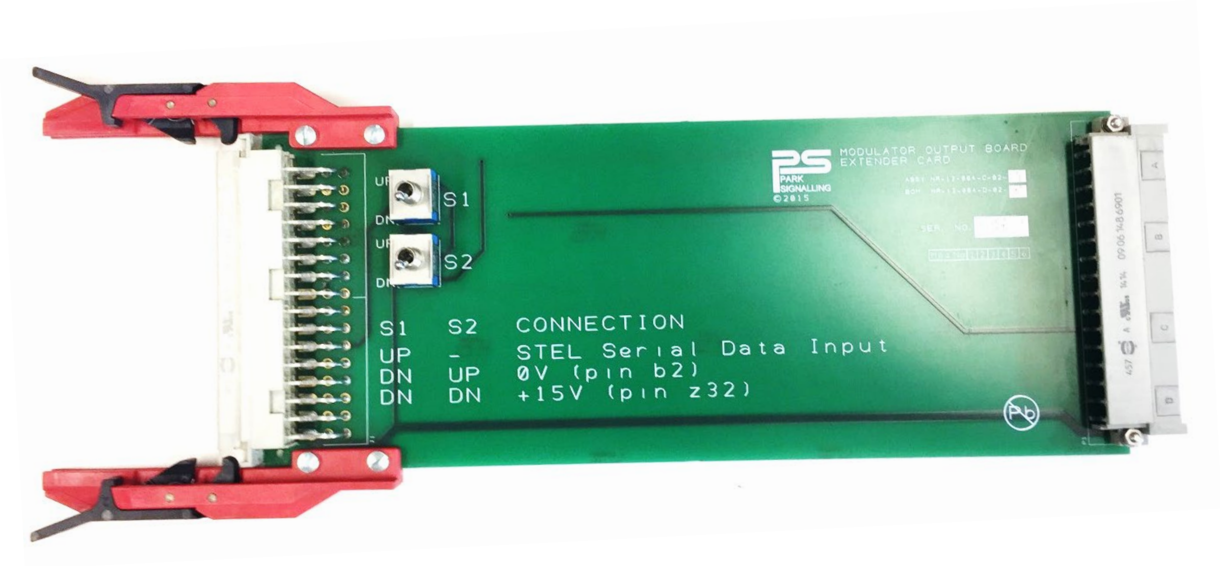


Figure 1 - Modulator/Output board extender card

1. Loop Test

This test shall only be carried out if a card has been changed

1.1 Take off the cover of the LEU, remove the Modulator/Output board and replace it with an extender card. Plug the Modulator/Output board into the end of the extender card.

1.2 Clip a 1000:1 current probe around the loop cable and connect a DVM to read a current in the range 50-250μA. Verify that both switches on the extender card are in the up position.

1.3 Move switch one to the down position and leave switch two in the up position.

1.4 On the Modulator/Output board adjust the screw in potentiometer L1 to obtain the highest possible meter reading (minimum of 100 μA).

1.5 Leave switch one in the down position and move switch two to the up position.

1.6 On the Modulator/Output board adjust the screw in potentiometer L1 to obtain the highest possible meter reading (minimum of 100 μA).

1.7 Repeat 1.4 & 1.6 until the two reading are as close as possible and still exceed 100 μA.

1.8 Observe that the LED on the Modulator/Output board is illuminated and not flickering. If it is not illuminated or is flickering, repeat the test from 1.3.

1.9 Remove the extender card and replace the Modulator/Output board in the LEU.

1.10 Record the loop current on the ATP record card.

1.11 Remove the current probe and replace the cover.

END

Includes:	AzL Series Axle Counters
Excludes:	All other types of AzLM and AzLE

The system locations details show sites that use the detailed procedure; other unlisted sites may use the same procedure. If you are in ant doubt, ask your SM(S).

1. AzL Series, Procedure 01 - Wembley Control Centre

This axle counter installation has a co-operative reset facility. The circuit makes sure that the technician and the signaller follow the correct resetting procedure.

The reset circuit is fitted with an incremental counter at the evaluator.

Isolate the Axle Counter:

1.1 Contact the signaller and get permission to start. Fill in part A of the axle counter restoration form.

1.2 Write down the restoration counter reading in part A.

1.3 Remove the TPR isolation link. This disconnects the axle counter from the interlocking. Check the 'INT OCC' indication is lit (red).

Reset the Axle Counter:

1.4 Contact the signaller and confirm that no trains are in the section. Fill in part 1 of the axle counter restoration form.

1.5 Turn the key-switch to the 'R' reset position.

1.6 If the red LED is lit on the GRDFR card in the evaluator counter, you shall reset the card and Check that the LED goes out. If the LED is not lit, proceed to the next step

1.7 Press the 'Reset' button. The 'AC CLEAR' indication will light up (green).

Restore the Axle Counter:

1.8 Tell the signaller that you are ready to restore the axle counter. Fill in part 2 of the axle counter restoration form. (Stay on the phone and guide the signaller through the final stage).

The signaller is responsible for making sure that the section is clear before the axle counter is restored.

1.9 Turn the key switch back to the 'N' position and replace the TPR isolation link.

1.10 Press and hold the 'Restore' button. The 'Restoration available' indication will start to flash (red).

1.11 Check the signaller has now got a flashing red in the correct axle counter button on his panel. Ask the signaller to pull his button and hold.

1.12 Check the 'Restoration available' indication goes out and the 'Restoration taking place' indication is lit (red).

1.13 Check the signaller's button indication has also gone steady; continue to hold.

1.14 After 10 seconds, the restoration relays will reset.

1.15 The 'Restoration taking place' and 'INT OCC' indications will go out. The 'INT CLEAR' will light up (green).

1.16 The 'Restore' button can now be released.

1.17 Check the restoration counter has increased by one.

1.18 The axle counter has now reset. The indications should be as follows:

Indication	Colour	State
INT Clear	Green	Illuminated
AC Clear	Green	Illuminated
All Others		Extinguished

Fill in part 3 of the restoration form and write down the restoration counter number.

Where possible, watch the first train through the section.

2. AzL Series, Procedure 02 - Crewe Junction Signal Box

This axle counter installation has a co-operative reset facility. The circuit makes sure that the technician and the signaller follow the correct resetting procedure.

The reset circuit is fitted with an incremental counter at the evaluator.

Isolate the Axle Counter

2.1 Contact the signaller and get permission to start.

2.2 Write down the restoration counter reading.

2.3 Remove the TPR isolation link. This disconnects the axle counter from the interlocking. Check the 'AC OCC' indication is lit (red).

Reset the Axle Counter

2.4 Contact the signaller and confirm that no trains are in the section.

2.5 Turn the 'Reset' key-switch to the reset position and hold.

2.6 If the red LED is lit on the GRDFR card in the evaluator counter, you shall reset the card and Check that the LED goes out. If the LED is not lit, proceed to the next step

2.7 Press and release the ‘Reset’ button. The ‘AC CLEAR’ indication will light up (green).

Restore the Axle Counter

2.8 Turn the ‘Reset’ key-switch back to the ‘N’ position and remove the key. Check that the counter has reset.

2.9 Tell the signaller that you are ready to restore the axle counter. Fill in the axle counter restoration form parts 1 and 2, including the serial number given to you by the signaller. (Stay on the phone and guide the signaller through the final stage).

The signaller is responsible for making sure that the section is clear before the axle counter is restored.

2.10 When the signaller gives you permission, re-connect the TPR isolation link.

2.11 Check the signaller has now got a flashing red in the correct axle counter button on his panel. Ask the signaller to push his button and hold.

2.12 After 10 seconds, the restoration relays will reset and the ‘AC CLEAR’ will illuminate (green)

2.13 Check the restoration counter has increased by one.

2.14 The axle counter has now reset. Check with the signaller that the track indication is clear and the flashing indicator on the panel has gone out.

2.15 Complete the remainder of the axle counter restoration form and file it in the logbook.

2.16 If the reset is associated with a failure, tell ICC the axle counter reset number and also write it down on your fault report.

2.17 Where possible: Watch the first train through the section.

3. AzL Series, Procedure 03 - Bearley Junction Signal Box

This axle counter installation has a co-operative reset facility. The circuit makes sure that the technician and the signaller follow the correct resetting procedure.

The reset circuit is fitted with an incremental counter at the evaluator.

Isolate the Axle Counter

3.1 Contact the signaller and get permission to start.

3.2 Write down the restoration counter reading.

3.3 Remove the TPR isolation link.

3.4 This disconnects the axle counter from the interlocking. Check the ‘AC OCC’ and ‘INT OCC’ indications are illuminated (red).

Reset the Axle Counter

3.5 Contact the signaller and confirm that no trains are in the section.

3.6 Turn the ‘Reset’ key-switch to the reset position.

3.7 If the red LED is lit on the GRDFR card in the evaluator counter, you shall reset the card and Check that the LED goes out. If the LED is not lit, proceed to the next step

3.8 Press and release the ‘Reset’ button. The ‘AC CLEAR’ indication will illuminate (green).

Restore the Axle Counter

3.9 Turn the ‘Reset’ key-switch back to the ‘N’ position and remove the key. Check that the counter has reset.

3.10 Tell the signaller that you are ready to restore the axle counter. Fill in the axle counter restoration form parts 1 and 2, including the serial number given to you by the signaller. (Stay on the phone and guide the signaller through the final stage).

The signaller is responsible for making sure that the section is clear before the axle counter is restored.

3.11 When the signaller gives you permission, re-connect the TPR isolation link.

3.12 Press and hold the ‘RESTORE’ button.

3.13 The ‘RESET RELEASE’ left hand indication will flash red.

3.14 Check the signaller now has a flashing red in the correct axle counter button on his panel. Ask the signaller to push his button and hold.

3.15 After 10 seconds, the restoration relays will reset.

3.16 The ‘RESET RELEASE’ will illuminate (red) and the ‘INT CLEAR’ indication will illuminate (green).

3.17 The ‘RESTORE’ button can now be released.

3.18 Check the restoration counter has increased by one.

3.19 Check the only indications are as follows:

Indication	Colour	State
INT Clear	Green	Illuminated
AC Clear	Green	Illuminated
All Others		Extinguished

3.20 The axle counter has now reset. Check with the signaller that the track indication is clear and the flashing indicator on the panel has gone out. Complete the remainder of the axle counter restoration form and file it in the logbook.

3.21 If the reset is associated with a failure, tell ICC the axle counter reset number and also write it down on your fault report.

3.22 Where possible: Watch the first train through the section.

4. AzL Series, Procedure 04 - Heath Junction, Caerphilly, Severn Tunnel, and Cwmbran

This axle counter installation has a co-operative reset facility. The circuit makes sure that the technician and the signaller follow the correct resetting procedure.

The reset circuit is fitted with an incremental counter at the evaluator.

Isolate the Axle Counter

4.1 Contact the signaller and get permission to start.

4.2 Remove the TPR isolation link.

4.3 This disconnects the axle counter from the interlocking. Check the ‘Section OC’ indication is illuminated (red).

Reset the Axle Counter

4.4 Contact the signaller and confirm that no trains are in the section.

4.5 Turn the key-switch to the ‘Isolate’ position.

4.6 If the red LED is lit on the GRDFR card in the evaluator counter, you shall reset the card and Check that the LED goes out. If the LED is not illuminated, proceed to the next step

4.7 Press the ‘Reset’ button. The ‘Evaluator clear’ indication will illuminate (green).

Restore the Axle Counter

4.8 Tell the signaller that you are ready to restore the axle counter. The signaller should stamp his train register with the axle counter reset stamp. (Stay on the phone and guide the signaller through the final stage).

The signaller is responsible for making sure that the section is clear before the axle counter is restored.

4.9 Turn the key switch back to the ‘N’ position and replace the TPR isolation link.

4.10 Press and hold the ‘Restore’ button. The ‘Offered’ indication will start to flash (red).

4.11 Check the signaller now has a flashing red in the correct axle counter button on his panel. Ask the signaller to push his button and hold. Check the signaller's indication has gone steady; continue to hold.

4.12 After 10 seconds, the restoration relays will reset.

4.13 The 'Restoration in progress' and 'Section Occupied' indications will extinguish and the 'Section Clear' will illuminate (green).

4.14 The 'Restore button' may now be released.

4.15 Check with the signaller that the restoration counter has increased by one.

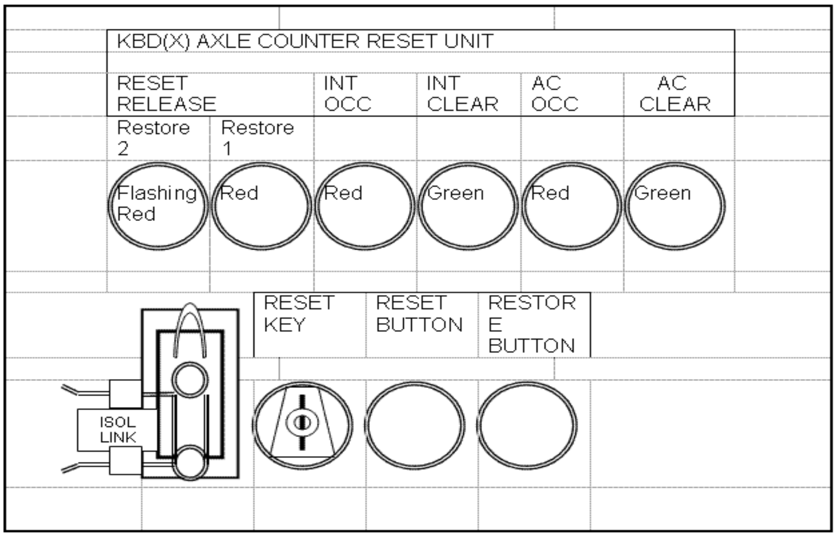
4.16 The axle counter has now reset. The indications should be:

Indication	Colour	State
Section Clear	Green	Illuminated
Evaluator Clear	Green	Illuminated
All Others		Extinguished

4.17 Where possible: Watch the first train through the section.

5. AzL Series, Procedure 05 - Swale

- Reset Unit Diagram (not to scale)



Isolate the Axle Counter

5.1 Contact the signaller and get permission to start.

5.2 Write down the restoration counter reading.

5.3 Remove the TPR Isolation Link (this disconnects the axle counter from the interlocking).

5.4 Check the "INT OCC" indicator is lit (red).

Reset the Axle Counter

5.5 Contact the signaller again and confirm that no trains are in the section.

5.6 Complete Part 1 of the axle counter restoration form.

5.7 Turn the key-switch to the reset position. (The 3 0'Clock Position)

5.8 Press the "RESET BUTTON". The "AC CLEAR" indication will light up (green).

5.9 Restore the Axle Counter

5.10 Tell the signaller you are ready to restore the axle counter. Fill in part 2 of the axle counter restoration form. (Stay on the phone and guide the signaller through the final stage).

5.11 The signaller is responsible for making sure that the section is clear before the axle counter is restored.

5.12 When the signaller gives you permission, turn the key-switch back to the normal position (The 6 0'Clock Position) and replace the TPR Isolation Link.

5.13 Press and hold the "RESTORE BUTTON". The signallers axle counter restoration button indication will start to flash (red). The "RESET RELEASE" (Restore 1) steady light is lit (red) in the REB. The restore button SHALL be held in until Step 5.16 below.

5.14 Ask the signaller to press and release his button. The "RESET RELEASE" (Restore 2) indication starts to flash (red) in the REB.

5.15 Ask the signaller to press and release his button again at no less than 10-seconds and no greater than 20-seconds after his initial press in step 5.14 above. (The timing is critical to the restore process). The "INT CLEAR" indication will light up (green). Check the only indications are as follows:

Indication	Colour	State
INT CLEAR	Green	Illuminated
AC CLEAR	Green	Illuminated
All Others		Extinguished

5.16 The axle counter has now reset. The technician can now release the "RESTORE BUTTON". Check with the signaller that the track indication is clear and that the axle restoration counter has incremented by one. Complete part 2 of the axle counter restoration form.

Note: The route will set but the signal(s) will not clear for the first train through the section following an axle counter reset/restoration.

END

Includes:	All Types of Thales Axle Counters
Excludes:	All other types of Axle Counter

GENERAL

Functional tests using the dummy wheel shall require appropriate protection/possession arrangements and liaison with the Signaler.

Specialist Equipment

a) Laptop loaded with the Thales Diagnostic Software (If applicable).

b) Laptop Leads (If applicable).

This test should be carried out when directed (preferred option). In exceptional circumstances it is acceptable, and if a train is available (within 20 minutes), to use the passage of that train.

Refer to NR/SMS/Appendix/15 (General Information on the Thales Axle Counter Systems) for more details on the system.

1. Functional Test with Dummy Wheel (All Types)

This test applies to all affected Detection Points and their associated sections.

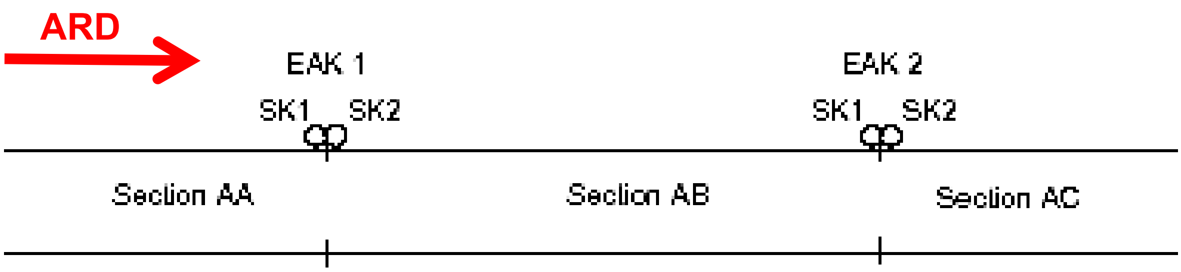


Figure 1 - Typical axle counter section (double rail contacts only)

1.1 Identify the Axle Counter Reference Direction (ARD).

All testing of the sections will be carried in sequence in the reference direction.

1.2 Confirm that the sections to be tested are showing clear.

This should be done using the indications on the ACE / Diagnostic software or by liaising with the Signaller.

1.3 Using the dummy wheel sweep three axles in the direction ARD (in this case of Figure 1 from section AA to section AB).

It should be noted that the sweeping in of the axles will leave section AA in a disturbed state (Shows occupied on the Signaller's panel) and this condition will need to be rectified after the testing is completed

1.4 Check that section AB is showing 'occupied'.

1.5 Confirm with the Signaller and/or indication on ACE or laptop.

1.6 Using the dummy wheel sweep three axles in the opposite direction to the ARD (in this case of Figure 1 from section AB to section AA).

1.7 Check that section AB is showing 'clear'.

1.8 Confirm with the Signaller and/or indication on ACE or laptop.

At boundaries additional factors should be taken into consideration when testing the ARD and other ACE's can be affected.

1.9 On completion of the testing check that all sections are Reset/Clear

END

GENERAL

There are several current variations of Frauscher FAdC in service with Network Rail. Select the Method below that is applicable to your system.

METHOD 1
This method should be used on all Axle counters that are NOT fitted with Counting Head Control (CHC) and/or Supervisor Track Sections (STS) OR those fitted with CHC where the application of EPR's inhibit CHC and/or STS.

METHOD 2
This method should be used on Axle counters that are fitted with Counting Head Control (CHC) where the application of an EPR does NOT inhibit CHC and STS is not configured.

METHOD B - EAST SUFFOLK LINES ONLY
This method is suitable where it is not practicable to observe a train traversing the section to complete the occupancy test.

METHOD 1

1. Before proceeding

1.1 Arrange an EPR with the Signaller.

This task will disturb one or both axle counter sections related to a single wheel sensor and completing this task will cause an error code to occur on one of the axle counter sections associated with the wheel sensor.

This error requires the Signaller's reset procedure to be completed to clear.

2. Sweep Test

2.1 Identify the AEB related to the axle counter sensor to be tested and confirm the section is indicating clear.

2.2 Place the PB200 testing plate on the railhead to the left of the axle counter wheel sensor in the start position (Figure 1).

NOTE: The AEB card should have two green power LEDs lit. Sys 1 and Sys 2 should not be lit / flashing.

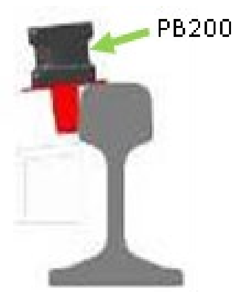


Figure 1 – PB200

2.3 Move (slide) the PB200 slowly in direction of arrow and stop over the first wheel sensor system (Figure 2).

Figure 2 – System 1

Figure 3 – AEB Card

2.4 Check the LED indications SYS1 on the AEB are illuminated (Figure 3).

2.5 Move (slide) the PB200 slowly in direction of the arrow and stop in between the two-wheel sensor systems (Figure 4).

2.6 Check the LED indications SYS1 and SYS2 on the AEB are illuminated (Figure 5).

Figure 4 – Between Systems

Figure 5 – AEB Card

2.7 Move (slide) the PB200 slowly in direction of arrow and stop over the second wheel sensor system (Figure 6).

2.8 Observe the indication SYS1 has extinguished and SYS2 remains illuminated (Figure 7).

Figure 6 – System 2

Figure 7 – AEB Card

2.9 Move (slide) the PB200 slowly away from the sensor to end the simulation. When the PB200 testing plate has passed beyond the sensor check the SYS2 LED has extinguished.

2.10 Check the correct axle counter section has become occupied.

NOTE: *This can be done by either by checking the ASD or by contacting the Signaller. LED A1 or A2 should be permanently lit on the AEB evaluating the section (A1 corresponds to Track Section (FMA1) on AEB and A2 corresponds to Track Section (FMA2)).*

2.11 The PB200 shall now be traversed over the axle counter sensors in the reverse direction to clear the section.

2.12 Confirm the correct axle counter section has cleared.

NOTE: *This can be done by either by checking the ASD or by contacting the Signaller.*

2.13 The Signaller shall now be requested to reset the adjacent axle counter section, if disturbed, and confirm that the section is showing clear.

3. When using the AEB with counting head outputs (e.g. treadle)

3.1 Observe that the system connected to the AEB, COM-XXX shows the following behaviour:

The counting head outputs are output by switching of the counting head outputs from the AEB optocouplers or the IO-EXB relays, or output as an element of the vital protocol of the COM-XXX.

END

METHOD 2

4. Before Proceeding

4.1 Arrange an EPR with the Signaller.

This task will disturb one or both axle counter sections related to a single wheel sensor and completing this task will cause an error code to occur on one of the axle counter sections associated with the wheel sensor.

This error requires the Signaller's reset procedure to be completed to clear.

5. Sweep Test

5.1 Identify the AEB related to the axle counter sensor to be tested and confirm the section is indicating clear.

5.2 Place the PB200 testing plate on the railhead to the left of the axle counter wheel sensor in the start position (Figure 8).

NOTE: *The AEB card should display two green power LEDs lit. LED's A1 and A2 will be flashing ON 50ms OFF 1000ms. AEB is desensitised (CHC active) and FMA Section is clear.*

Figure 8 – PB200

5.3 Move (slide) the PB200 slowly in direction of arrow and stop over the first wheel sensor system (Figure 9).

5.4 Check the LED indications SYS1 on the AEB are illuminated (Figure 10).

Figure 9 – System 1

Figure 10 – AEB Card

5.5 Move (slide) the PB200 slowly in direction of the arrow and stop in between the two wheel sensor systems (Figure 11).

5.6 Check the LED indications SYS1 and SYS2 on the AEB are illuminated (Figure 12).

Figure 11 – Mid Position

Figure 12 – AEB Card

5.7 Move (slide) the PB200 slowly in direction of arrow and stop over the second wheel sensor system (Figure 13).

5.8 Observe the indication SYS1 has extinguished and SYS2 remains illuminated (Figure 14).

Figure 11 – System 2

Figure 12 – AEB Card

5.9 Move (slide) the PB200 slowly away from the sensor to end the simulation. When the PB200 testing plate has passed beyond the sensor check the SYS2 LED has extinguished.

NOTE: *Each sweep must be carried out within 30 seconds to ensure CHC remains inactive.*

5.10 Repeat steps 5.2 to 5.9 to correspond with CHC value, (the CHC value is predetermined by the signalling scheme design of the head under test) LEDS A1 and A2 will stop flashing once the AEB is sensitised (CHC inactive).

5.11 Check the correct axle counter section has become occupied.

NOTE: *This can be done by either by checking the ASD or by contacting the Signaller. LED A1 or A2 should be permanently lit on the AEB evaluating the section (A1 corresponds to Track Section (FMA1) on AEB and A2 corresponds to Track Section (FMA2)).*

5.12 The PB200 shall now be traversed over the axle counter sensor systems in the reverse direction to clear the section.

5.13 Confirm the correct axle counter section has cleared.

NOTE: *This can be done by either by checking the ASD, or by contacting the Signaller.*

5.14 The Signaller shall now be requested to reset any axle counter sections that have been disturbed following the sweep test and confirm that the sections are showing clear.

NOTE: *LED's A1 and A2 will be flashing ON 50ms OFF 1000ms. AEB is desensitised (CHC active) and FMA Section is clear.*

END

<u>METHOD B - EAST SUFFOLK LINES ONLY</u>

This method is suitable where it is not practicable to observe a train traversing the section to complete the occupancy test.

6. Before Proceeding

6.1 Arrange an EPR with the Signaller.

This task will disturb one or both axle counter sections related to a single wheel sensor system and completing this task will cause an error code to occur on one of the axle counter sections associated with the wheel sensor system.

This error requires the Signaller's reset procedure to be completed to clear.

7. Sweep Test

7.1 Identify the adjacent wheel sensor system and AEB related to it and confirm the section is indicating clear.

NOTE: *This is the adjacent section to the one you are testing.*

7.2 Place a PB200 testing plate on the rail head over the centre of the wheel sensor system (Figure 18) and leave in situ to log a permanent occupancy status in the system.

NOTE: *The adjacent section being in a disturbed state supresses the CHC function on the adjacent wheel sensors enabling the occupancy detection capability test to be undertaken.*

7.3 Identify the AEB related to the axle counter sensor to be tested and confirm the section is indicating clear.

7.4 Place the PB200 testing plate on the railhead to the left of the axle counter wheel sensor system in the start position (Figure 15).

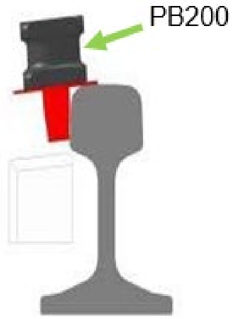


Figure 13 – PB200

NOTE: *The AEB card should have two green power LEDs lit. Sys 1 and Sys 2 should not be lit / flashing.*

7.5 Move (slide) the PB200 slowly in direction of arrow and stop over the first wheel sensor system (Figure 16).

7.6 Check the LED indications SYS1 on the AEB are illuminated (Figure 17).

Figure 14 – System 1

Figure 15 – AEB Card

7.7 Move (slide) the PB200 slowly in direction of the arrow and stop in between the two wheel sensor systems (Figure 18).

7.8 Check the LED indications SYS1 and SYS2 on the AEB are illuminated (Figure 19).

Figure 16 – Mid Position

Figure 17 – AEB Card

7.9 Move (slide) the PB200 slowly in direction of arrow and stop over the second wheel sensor system (Figure 20).

7.10 Observe the indication SYS1 has extinguished and SYS2 remains illuminated (Figure 21).

Figure 18 – System 2

Figure 19 – AEB Card

7.11 Move (slide) the PB200 slowly away from the sensor to end the simulation. When the PB200 testing plate has passed beyond the sensor check the SYS2 LED has extinguished.

7.12 Check the correct axle counter section has become occupied.

NOTE: *This can be done by either by checking the ASD or by contacting the Signaller. LED A1 or A2 should be permanently lit on the AEB evaluating the section (A1 corresponds to Track Section (FMA1) on AEB and A2 corresponds to Track Section (FMA2)).*

7.13 The PB200 shall now be traversed over the axle counter sensor systems in the reverse direction to clear the section.

7.14 Confirm the correct axle counter section has cleared.

NOTE: *This can be done by either by checking the ASD or by contacting the Signaller.*

7.15 The Signaller shall now be requested to reset the adjacent axle counter section, if disturbed, and confirm that the section is showing clear.

END

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/Part B/Test/038		
Siemens Axle Counter ACM 100 - Calibration of Wheel Detector		
Issue No. 04	Issue Date: 03/03/18	Compliance Date: 31/05/18

Includes:	ACM 100 (ACM module and WSD wheel detector)
Excludes:	AzS 350 U, AZM, ZP D 43 and ZP 43 V, WSR and WSS

This test requires a Fluke 771 Milliamp Process Clamp Meter. Other clamp meters shall not be used during this test as these can give inaccurate measurements. The clamp meter shall be reset to zero before use.

Keep switched on mobile phones 3m away from the counting heads whilst undertaking maintenance as they can cause false-counts/readings.

Keep metallic objects at least 20cm away from the counting heads. The movement of metallic objects including tools, steel toe-cap boots and jewellery across the upper surface of the counting heads may cause occupation of the track sections.

Do not step directly across the top of the wheel sensor during the calibration process.

If during installation the temperature of the wheel detector differs by more than 10°C from the temperature of the rail, it shall be allowed to equalise before calibration is performed. This could potentially be an issue when moving a WSD from Vehicle to Rail.

All wires of the connecting cable to the wheel detector can be subject to interference voltages. Do not touch live parts. This is particularly to be observed when working on the junction box (attaching wires, performing checks).

1. Calibration of the Wheel Sensor

1.1 Make suitable arrangements with the signaller for possession of the relevant axle counter sections.

One wheel detector can affect more than one section.

1.2 Connect the clamp meter around wire 1 of the wheel detector.

A current of approximately 5mA should be expected if the wheel sensor has been working in service. Other currents might be seen with uncalibrated wheel sensors.

1.3 Disconnect wire 1 of the wheel detector.
This can usually be achieved by opening a link in the trackside disconnection box.

Steps 1.4 to 1.6 are timed steps.

1.4 After at least 5 seconds of wire 1 being disconnected, reconnect wire 1 then wait approximately 30 seconds (minimum 15 seconds, maximum 45 seconds) and check that the current measured is now between 1.3mA and 7mA. If the reading is outside of this range, check the sensor is fitted correctly to the rail and no metallic objects are interfering with the measurement then return to step 1.1.

1.5 Place the adjustment gauge (1) on the top of the wheel detector as shown in figure 1.

a) The green metal strip **(2)** should be on the bottom of the adjustment gauge against the WSD.

b) The adjustment gauge should rest against the rail head.

c) The "Cal." **(3)** marking should coincide with the centre marking **(4)** on the wheel detector housing.

Do not move the position of the adjustment gauge after it has been placed on the sensor.

Check the clamp meter indicates a current consumption between 1.2 mA and 2.99 mA.

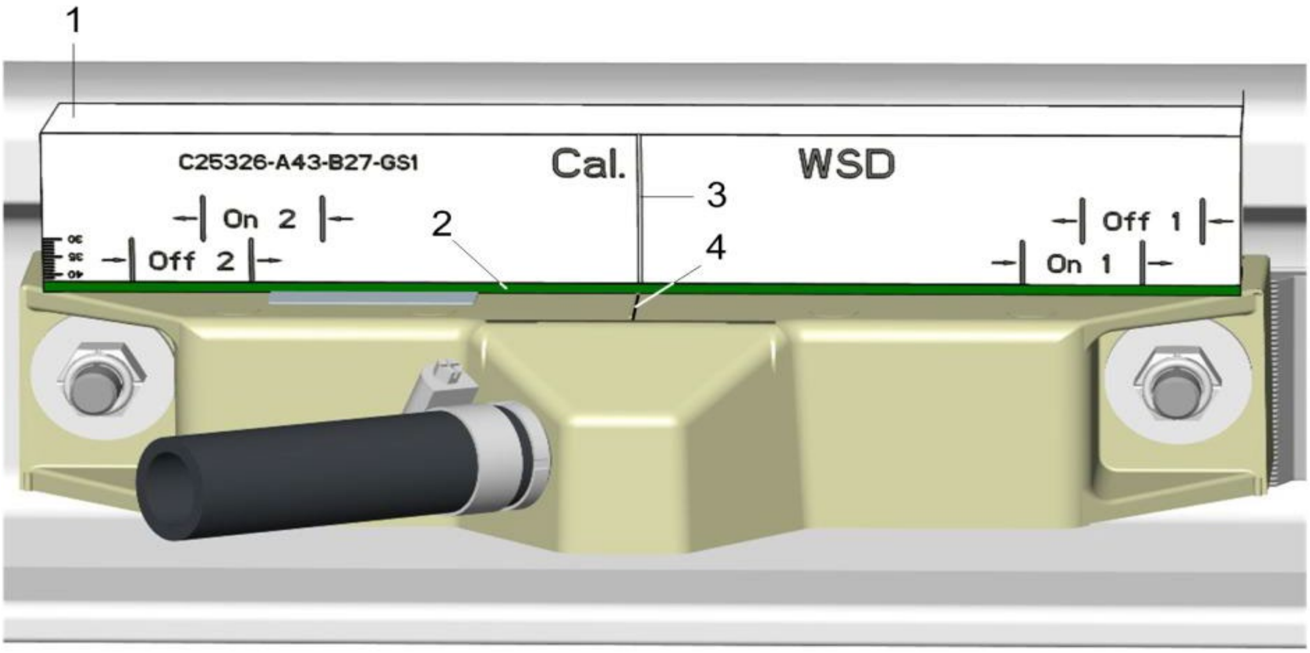


Figure 1 – Positioning of the adjustment gauge on the wheel detector

1.6 Leave the adjustment gauge on the wheel detector for approximately 30 seconds (minimum 15 seconds, maximum 40 seconds) before completely removing it from the wheel detector.

Approximately 25 seconds after removing the block the wheel detector adopts the calibrated value. Check the current reading now reads between 4.75 mA and 5.25 mA.

The calibration of subsystem 1 is now complete.

1.7 Move the clamp meter from wire 1 to wire 4

1.8 Disconnect wire 4 of the wheel detector.
This can normally be achieved by opening a link in the trackside disconnection box.

Steps 1.9 to 1.11 are timed steps

1.9 After at least 5 seconds of wire 4 being disconnected reconnect wire 4, wait approximately 30 seconds (minimum 15 seconds, maximum 45 seconds). Check that the current measured during this period is between 1.3mA and 7mA. If the reading is outside of this range check the sensor is fitted correctly to the rail and no metallic objects are interfering with the measurement then return to step 1.8.

1.10 Place the adjustment gauge (1) on the top of the wheel detector as shown in figure 1.

a) The green metal strip **(2)** should be on the bottom of the adjustment gauge.
b) The adjustment gauge should rest against the rail head.
c) The "Cal." **(3)** marking should coincide with the center marking **(4)** on the wheel detector housing.

Do not move the position of the adjustment gauge after it has been placed on the wheel sensor.

Check the clamp meter indicates a current consumption of the wheel detector between 1.2 mA and 2.99 mA.

1.11 Leave the adjustment gauge on the wheel detector for approximately 30 seconds (minimum 15 seconds, maximum 40 seconds) before completely removing it from the wheel detector.

Approximately 25 seconds after removing the block the wheel detector adopts the calibrated value. Check the current reading now reads between 4.75 mA and 5.25 mA.

1.12 Remove the clamp meter from wire 4.

The calibration of subsystem 2 is now complete.

1.13 Perform a functional test of the wheel sensor [NR/SMS/Test/039] before returning to service.

End

Includes:	ACM 100 (ACM module and WSD wheel detector)
Excludes:	AzS 350 U, AZM, ZP D 43, ZP 43 V, WSR and WSS

This test requires a Fluke 771 Milliamp Process Clamp Meter, Other clamp meters shall not be used during this test as these can give inaccurate measurements. The clamp meter shall be reset to zero before use.

Keep switched on mobile phones 3m away from the counting heads whilst undertaking maintenance as they can cause false-counts/readings.

Keep metallic objects at least 20cm away from the counting heads. The movement of metallic objects including tools, steel toe-cap boots and jewellery across the upper surface of the counting heads may cause occupation of the track sections.

Do not step directly across the top of the wheel sensor during the calibration process.

All wires of the connecting cable to the wheel detector can be subject to interference voltages. Do not touch live parts. This is particularly to be observed when working on the junction box (attaching wires, performing checks).

Test of the Wheel Sensor

This procedure describes the functional test of the WSD wheel detector. It shall be used immediately after a calibration has been carried out to prove the calibration was successful. It can also be used at other times to assess the performance of the wheel sensor.

Do not disconnect any wires or remove any links before or during functional testing.

1.1 Make suitable arrangements with the signaller for possession of the relevant axle counter sections.

One wheel detector can affect more than one section.

1.2 Connect the clamp meter to wire 1 of the wheel detector. The current clamp reading should indicate a current between 4.75 mA and 5.25 mA.

If a negative value is indicated, this is because of the physical orientation of the clamp meter on the wire and does not affect the accuracy of the measurement. If this occurs, readings can continue to be made and the negative sign ignored.

1.3 Place the adjustment gauge on the top (see figure 1) of the wheel detector as follows:

a) The adjustment gauge **(1)** should rest against the rail head.

b) The green sheet-metal strip **(2)** should be located on the side facing away from the rail head.

The clamp meter should now indicate a value between 1.3 mA and 2.99 mA. Record the value on the Wheel Detector Record Card.

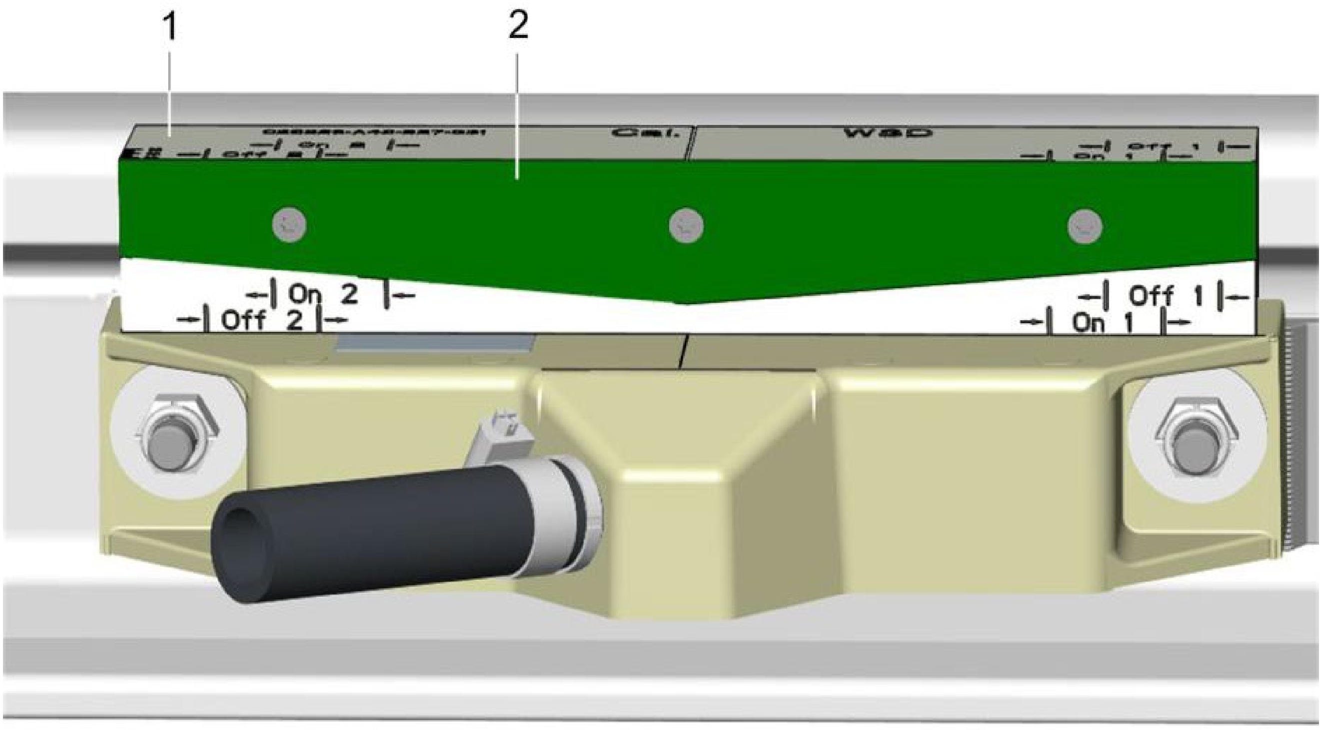


Figure 1 – Positioning of the adjustment gauge on the wheel detector

1.4 Move the adjustment gauge along the rail over the wheel detector in direction A (see figure 2). The adjustment gauge should be in contact with the wheel detector and rail when doing so.

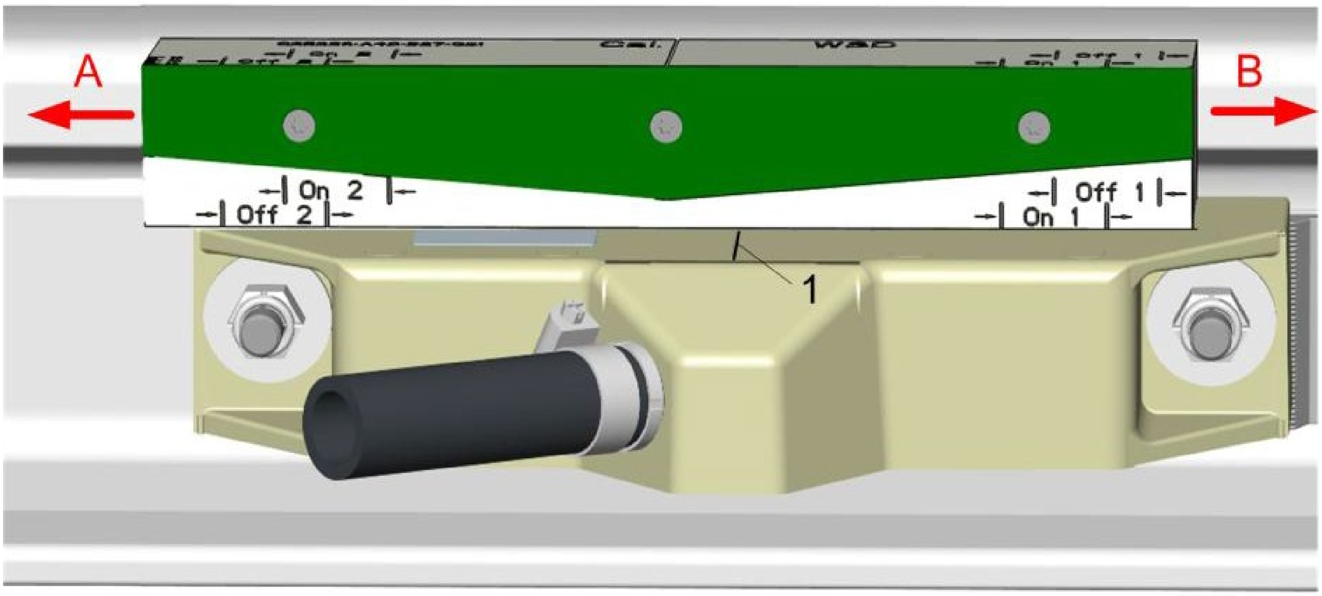


Figure 2 – Movement of the adjustment gauge towards A

1.5 Continue to move the adjustment gauge in direction A (see figure 3) until the measured current rises to a value between 4.75 mA and 5.25 mA. Then check whether the centre marking (1) on the wheel detector is between the "Off 1" markings on the adjustment gauge. A tolerance of 10 mm on both sides of the "Off 1" markings is permissible (see figure 3). Record the result of the test on the Wheel Detector Record Card.

Do not leave the adjustment gauge in position continue and complete functional testing with step more than 1.6 within 40 seconds

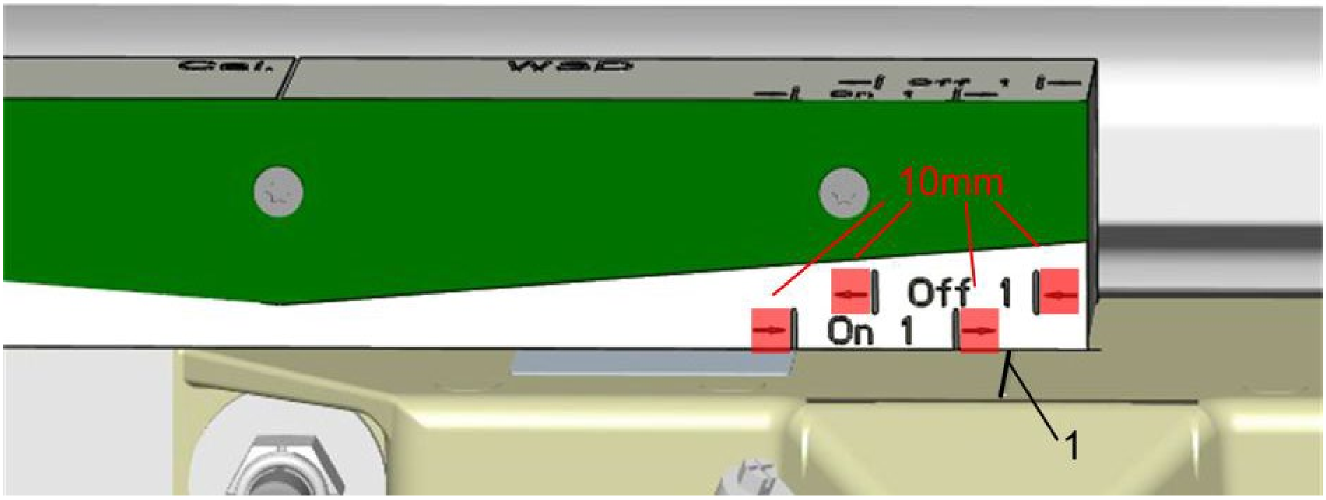


Figure 3 – Continued movement of the adjustment gauge towards A

1.6 Move the adjustment gauge back in direction B until the measured current has dropped again to a value between 1.3 mA and 2.99 mA. Then check whether the center marking (1) on the wheel detector is between the "On 1" markings on the adjustment gauge. A tolerance of 10 mm on both sides of the "On 1" markings is permissible.

Record the result of the test on the Wheel Detector Record Card

1.7 Return the adjustment gauge to its initial position (see figure 1 and Step 1.3).

1.8 Remove the clamp meter from wire 1.

1.9 Connect the clamp meter to wire 4. The clamp meter shall indicate a value between 1.3 mA and 2.99 mA.

Record the value on the Wheel Detector Record Card.

1.10 Move the adjustment gauge along the rail over the wheel detector in direction B. The adjustment gauge should be in contact with the wheel detector and rail when doing so

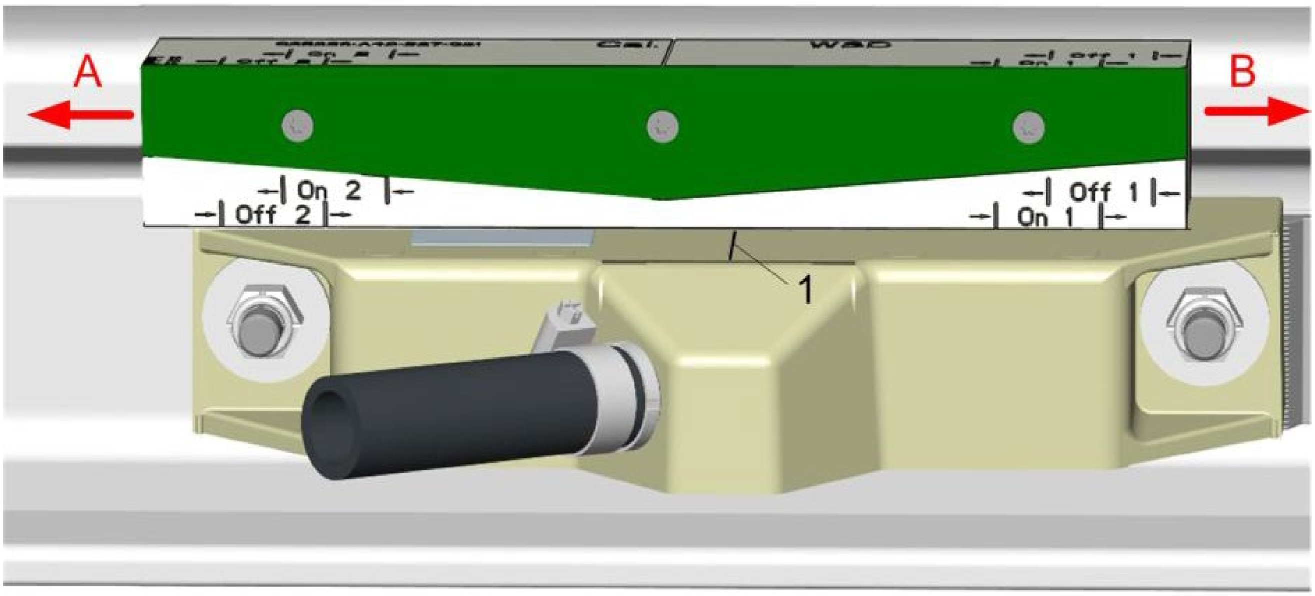


Figure 4 – Movment back towards A

Continue moving the adjustment gauge in direction B until the measured current rises to a value between 4.75 mA and 5.25 mA. Then check whether the center marking (1) on the wheel detector is between the "Off 2" markings on the adjustment gauge. A tolerance of 10 mm on both sides of the "Off 2" markings is permissible. Record the result of the test on the Wheel Detector Record Card.

Do not leave the adjustment gauge in position continue and complete functional testing with step more than 1.11 within 40 seconds

1.11 Move the adjustment gauge back in direction A (see figure 4)until the measured current has dropped to a value between 1.3 mA and 2.99 mA. Then check whether the center marking (1) on the wheel detector is between the "On 2" markings on the adjustment gauge. A tolerance of 10 mm on both sides of the "On 2" markings is permissible.

Record the result of the test on the Wheel Detector Record Card

1.12 Remove the adjustment gauge from the wheel detector and clamp meter from wire 4.

1.13 The wheel detector will function correctly if the gauge has been within the permitted range during tests for “On” and “Off” on both System 1 and System 2. If the gauge is outside the permitted range the wheel detector requires recalibration. If unsuccessful after recalibration replace the wheel detector as corrective maintenance.

1.14 Simulate two train wheels passing over the sensor. To pass a simulated wheel, start with the test block in position (1) shown in the diagram below, pass through position (2) to position (3) before removing the test block. Note that the test block must be orientated as shown in figure 5, with the green metal plate on the side away from the rail head.

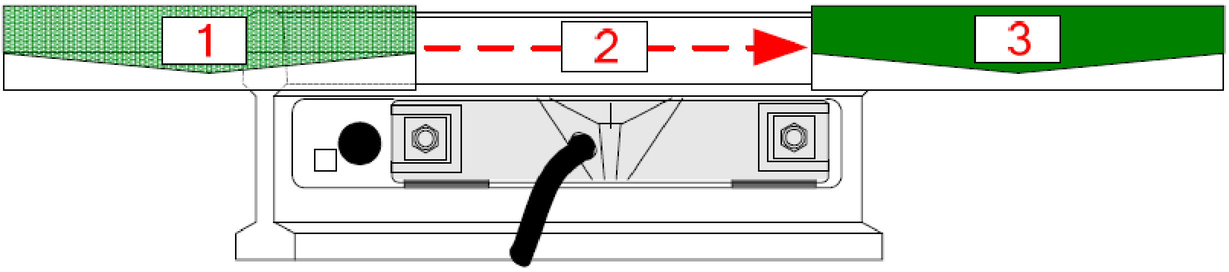


Figure 5 – Simulate Train

1.15 Check that the WSD LEDs on the ACM100 module for the affected sensor are showing solid green. If they are flashing green, repeat step 1.14. Only once the WSD LEDs are solid green, the signaller can be informed that work is complete and the section may be reset.

End

Includes:	RSR 123 Wheel sensors associated with Frauscher Advanced Evaluation Boards (AEB)
Excludes:	RSR123 Wheel sensors associated with IMC Boards

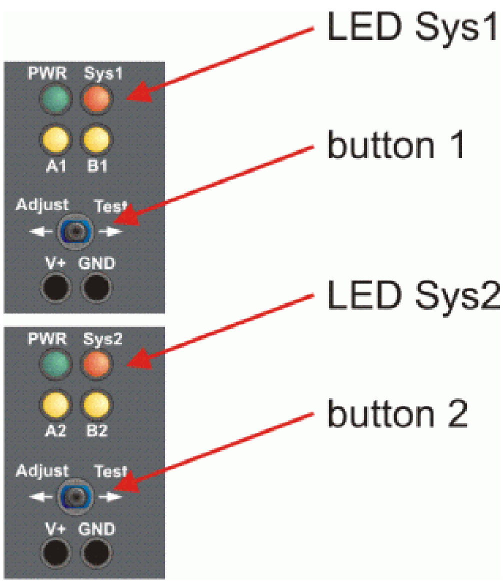
General

Before adjustment, check that wheel sensor RSR123 attached to the AEB is correctly mounted.

During adjustment, check that the wheel sensor RSR123 attached to the AEB is not occupied.

1. The button actuation sequence:

1.1 Push both buttons to the left (direction "Adjust") within half a second.



1.2 Retain both buttons in this position for at least half a second.

1.3 Release both buttons within half a second.

1.4 Retain both buttons in the normal position for a maximum of 2 seconds.

1.5 Push both buttons to the right (direction "Test") within half a second.

1.6 Retain both buttons in this position for at least half a second.

1.7 Release both buttons within half a second.

After the correct initiation of the adjustment sequence, Sys1 and Sys2 LEDs illuminate for between 20 to 80 seconds. Once adjustment has been carried out successfully, Sys1 and Sys2 LEDs go out.

If the adjustment is unsuccessful, the Sys1 and Sys2 LEDs flash rapidly (10 times per second), for 2 seconds.

To start a new adjustment, recommence the actuation sequence (points 1 to 7) from the start. The actuation sequence should prevent accidental actuation of one or both buttons starting an adjustment process.

1.8 The Signaller should now be requested to reset the axle counter section.

1.9 Carry out NR/SMS/PartB/Test/037 (Frauscher: RSR123 Wheel Sensor Occupancy Detection Capability Test).

END

GENERAL

The purpose of this test is to determine whether any fishplates or bolts of an insulated joint are in electrical contact with either rail.

When a track repair or insulated IBJ is changed a full test shall be carried out. Record details on the Record Card.

Select one of the following Tests:

1. IRJ Tester

1.1 Test insulated rail joints using IRJ tester.

Follow the user instructions provided with the equipment. Only use testers on authorised TC types.

1.2 List each rail joint that results in a red or yellow reading and forward the results to your SM(S).

2. 220Ω Shunt Resistance Test

This test can be carried out on all DC track circuits and the WR Quick Release Track Circuit (for which AC voltage should be measured).

2.1 For double rail track circuits, strap out the opposite IRJ.

2.2 Connect a 220Ω (+/- 10%) shunt across the meter.

2.3 Measure and record voltages V1, V2 & V3. The results and outcomes are as follows:

a) If V2 and V3 are less than or equal to 10% of V1, the IRJ is satisfactory.

b) If V2 or V3 are between 11% and 50% of V1 then the IRJ is degrading and shall be monitored.

c) If V2 or V3 are greater than 50% of V1 then the IRJ has failed and shall be reported as requiring replacement.

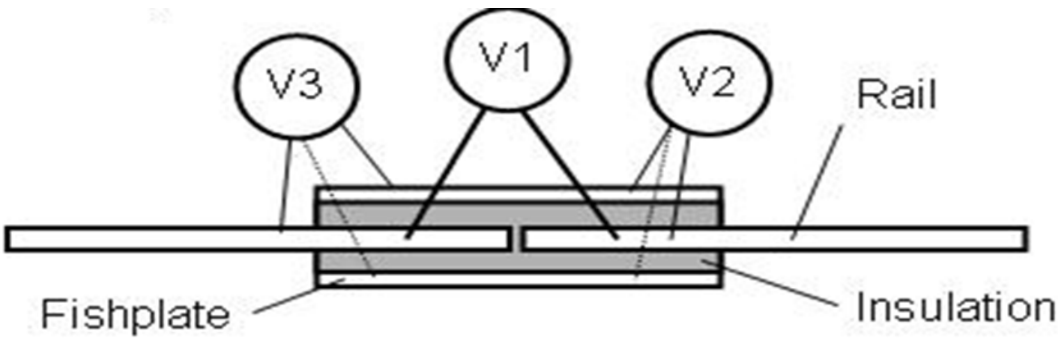


Figure 1 – Measurements V2 and V3 apply to both the inner and outer plates of the IRJ

3. Current Probe Test

3.1 Secure the probe connected to a digital meter around the rail adjacent to the IRJ and between the IRJ and any track connection.

3.2 Check the current value is less than 5mA.

3.3 If any readings are greater than 5mA or any other defects are noted, the joint is faulty and shall be reported. It is essential for the continued correct operation of the track circuit that the joint is repaired or replaced as soon as reasonably practicable.

4. Resistance checks

4.1 HVI tracks only: Power down prior to testing to prevent possible damage to meter.

4.2 Check test prods are sharp to improve electrical contact.

4.3 Remove any rail end burrs and visually inspect end post.

4.4 Remove any swarf or metallic debris.

4.5 Where possible use a shiny part of the wheel-rail contact area as a test point.

4.6 Where another surface is to be used, scrape contact surface and loop test with both prods to confirm good electrical contact before resistance testing is carried out.

4.7 Check that the resistance between each rail and the inner fishplate is at least 150ohms.

4.8 Check that the resistance between each fishplate bolt and the rail it bolts through is at least 150ohms.

4.9 Check that the resistance between each rail and the outer fishplate is at least 150ohms.

5. AC Track Circuits

This test is for use with IRJ's on 50Hz AC track circuits only.

Operational track circuits on the other side of the insulated rail joint can be AC, TI21, FS2600 or Reed type. HVI tracks should be powered down prior to testing to prevent possible damage to meter.

The test does not apply to insulated rail joints such as the Treble 6 or Permali that use split fishplates.

Use an AVO8 or similar low impedance moving coil type meter set to Ohms range. Electronic meters do not give good open circuit readings.

Test prods should be sharp to improve electrical contact.

5.1 Remove any rail end burrs and visually inspect end post. Remove any swarf or metallic debris.

5.2 Where possible use a shiny part of the wheel-rail contact area as a test point.

Where another surface is to be used, scrape contact surface and loop test with both prods to confirm good electrical contact before resistance testing is carried out.

5.3 Check that the resistance between each rail and the inner fishplate is at least 150Ω.

5.4 Check that the resistance between each inner fishplate bolt and the rail it bolts through is at least 150Ω.

5.5 Check that the resistance between each rail and the outer fishplate is at least 150Ω.

5.6 Check that the resistance between each outer fishplate bolt and the rail it bolts through is at least 150Ω.

5.7 If any readings are below 150Ω or any other defects are noted that part of the joint is faulty and shall be reported as a corrective maintenance item. It is essential for the continued correct operation of the track circuit that the joint is repaired or replaced as soon as reasonably practicable.

APPENDIX A - Photographic Examples of Insulated Block Joints

Figure 2 shows an IBJ in good condition (no lipping or contamination).

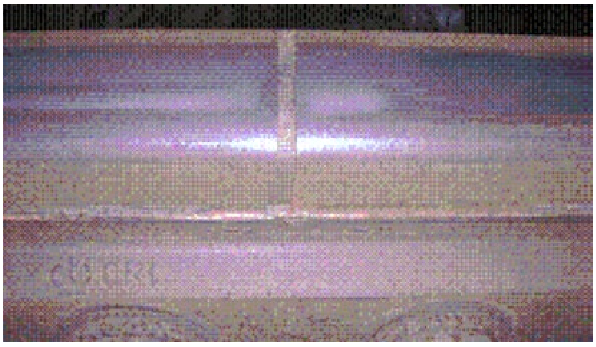


Figure 2 - Good Condition

Figure 3 shows how the wrong clips used can short circuit around the insulation.

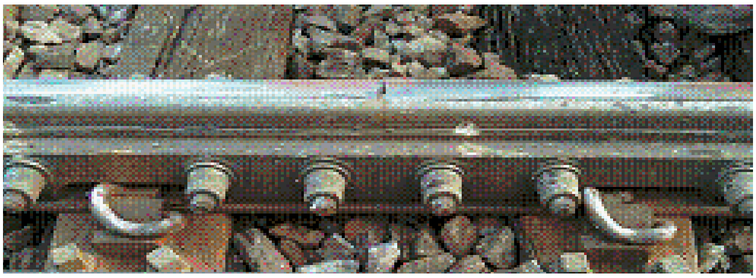


Figure 3 – Wrong Clips

Figure 4 illustrates that the IBJ could not be installed correctly because the sleeper spacing is incorrect which places the baseplates in the wrong position and makes it impossible to fit one pair of Clips and Insulators.

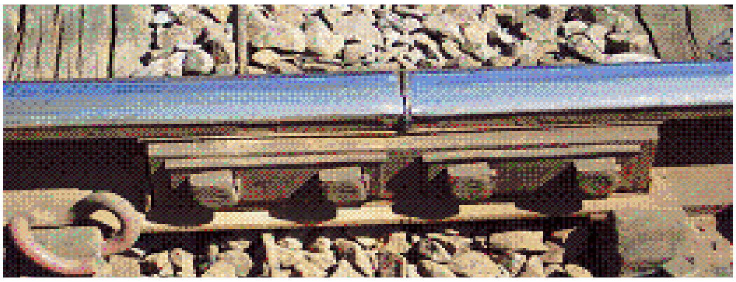


Figure 4 – Incorrect sleeper spacing

Figure 5 shows a lipped joint which causes a track circuit to fail and should be rectified when found

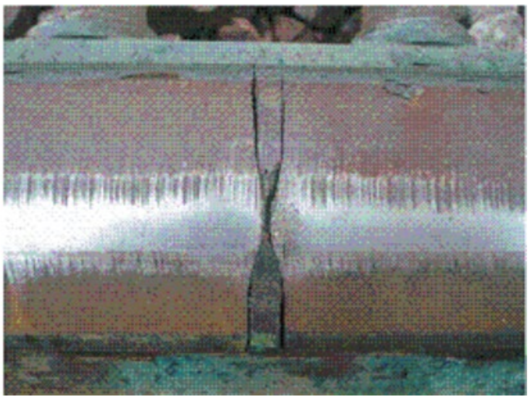


Figure 5 – Lipped Joint

Figure 6 shows a block joint suffering from metallic contamination which causes a track circuit and be rectified when found.

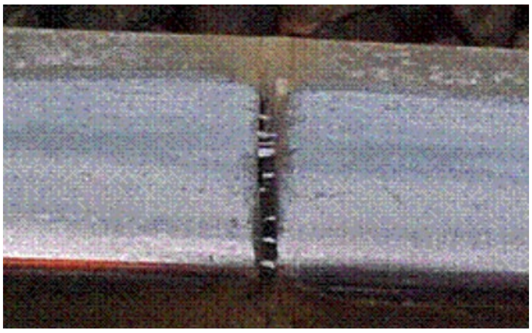


Figure 6 – Metallic Contamination

Figure 7 shows a joint with the end post missing. Often the bottom section of the end post can be found lying beneath the joint where it has been forced out. This causes a track circuit failure and needs rectifying as soon as possible

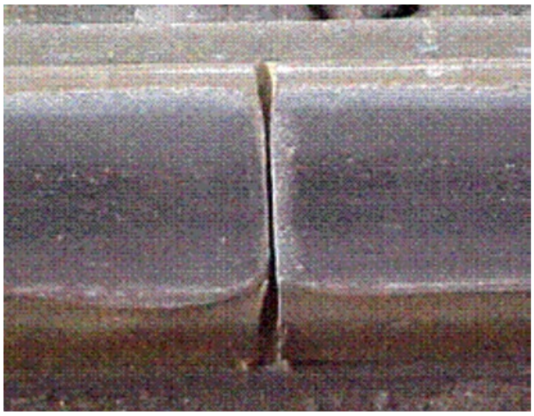


Figure 7 – End Post Missing

END

Includes:	AzL70 Single Rail Contacts with EAK Junction Box, AzL70 and AzL70/30 & AzL70/30S Double Rail Contacts with EAK30 Junction Box
Excludes:	All other types of AzLM and AzLE

Functional tests using the dummy wheel require protection/possession arrangements and liaison with the Signaller first.

These tests are required when the rail contacts are moved or re-aligned. They also usually form part of the annual test of axle counters.

Refer to NR/SMS/Appendix/15 for additional system details.

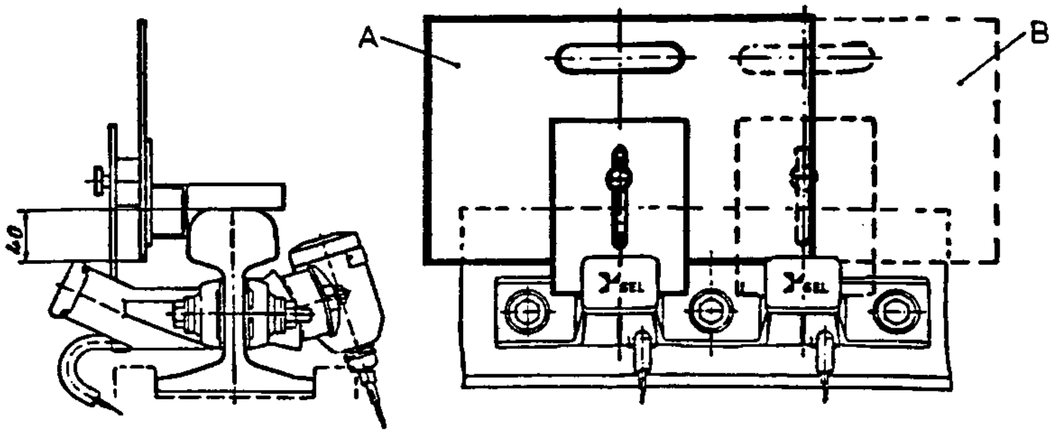


Figure 1 - Position of Dummy Wheel during Testing

Right hand diagram shows a side on view and the left shows the dummy wheel place over rail contact SK1(marked A) and over SK2 (marked B).

To simulate a wheel on an axle counter a dummy wheel supplied by the manufacturer is used. It consists of a metal plate with three plastic brackets.

The bottom edge of the plate is to be adjusted to 30mm for single rail contacts and 40mm for all double rail contacts.

The two brackets are swung out 90° to the metal plate and rest on the top rail.

The third bracket is flat and parallel to the metal plate. It holds the metal plate in the correct position by resting on one of the Rx coils to influence a count head or in double rail contacts across both Rx coils to influence both heads simultaneously.

If it is required to simulate several wheels passing over the rail contacts, loosen the knurled nut and raise the flat bracket so that it is clear of the Rx coils while the device is passing over the heads.

The cut out notch on the third bracket should be aligned with the center mark on the received head when readings are being taken.

All measurements shall be recorded on the record card.

AzL70 Single Rail Contacts with EAK Junction Box (Only)

1. Phase Reversal Test

1.1 Check that the cable cores on the power cable are twisted together. Also check that each Tx and Rx cable have their respective cores twisted together to the point 25mm of termination point.

1.2 Connect a meter to the terminations within the lineside amplifier with the +ve lead to AL4/3 and the –ve lead to AL4/4. Check the voltage is between 400mV to 600mV.

1.3 Insert the dummy wheel (adjusted to a depth of 30mm) over SK1 rail contact on the 6ft rail and check the reading is less than 50mV.

If this voltage reading is not achieved the count head will require adjusting up or down to obtain this.

1.4 Remove the dummy wheel from over SK1 count head and observe that the voltage reading returns to its original value.

1.5 Change the meter connections to the +ve lead to AL4/1 and the –ve lead to AL4/2 and repeat 1.1 to 1.3 with the dummy wheel over SK2 rail contact on the cess rail.

2. Adjustment of Count Heads

2.1 Note which step the relevant TX head is on, slacken the head adjusting bolts and move the head up or down one step.

2.2 Tighten the head adjusting bolts and repeat 1.1 and 1.2.

2.3 Compare the readings between 1.1 and 1.2, if the voltage is now less than 50mV go to 2.4. If the voltage is still outside this limit repeat 2.1

If after adjustments of the count head it is not possible to obtain a voltage of less than 50mV, obtain the lowest difference possible and inform your SM(S).

2.4 Check that after adjusting the rail contacts all adjusting nuts are tightened.

AzL70, AzL70/30, AzL70/30S Double Rail Contacts with EAK30 Junction Box (Only)

3. Phase Reversal Test

3.1 Check that the cable cores on the power cable are twisted together. Also check that each Tx and Rx cable have their respective cores twisted together to the point 25mm of termination point.

3.2 Connect either the Thales Test Unit (silver suitcase) or the BR designed lineside test switch box connected to a meter to the LtAnp card in the EAK30 junction box.

3.3 Select position 10 (MESSAB 1) on the switch box and check the reading is between +55mV to +1000mV.

3.4 Insert the dummy wheel (adjusted to a depth of 40mm) between SK1 TX/RX count head and check the reading is between -55mV to -1000mV.

3.5 Compare the readings between 3.2 and 3.3, if they are within 25mV of each other (with opposite polarities) proceed to 3.5. If the voltage is outside this limit go to section 4.

3.6 Select position 12 (MESSAB 2) and repeat sections 3.2 and 3.3 for the SK2 count head.

3.7 Compare the readings between 3.2 and 3.3, if they are within 25mV of each other (with opposite polarities) proceed to section 5 if the voltage is outside this limit go to section 4.

4. Adjustment of Count Heads

4.1 Note which step the relevant TX head is on, slacken the head adjusting bolts and move the head up one step if the positive reading was higher than the negative one, conversely move the head down one step if the positive reading was lower than the negative one.

4.2 Tighten the head adjusting bolts and repeat 3.2 and 3.3 remembering to select MESSAB 1 for head SK1 and MESSAB 2 for head SK2.

4.3 Compare the readings between 3.2 and 3.3, if they are now within 25mV of each other proceed to section 5. If the voltage is still outside this limit repeat 4.1.

If after adjustments of the count head it is not possible to obtain a voltage of less than 50mV, obtain the lowest difference possible and inform your SM(S).

4.4 Check that after adjusting the rail contacts all adjusting nuts are tightened.

5. Adjustment of PEGUE

5.1 Remove the dummy wheel from the count heads and select position 10 (MESSAB 1) on the test box and measure the reading.

5.2 Select position 11 (PEGUE 1) on the test box and if necessary, by means of the potentiometer on the SE01 card adjust the voltage until the PEGUE 1 reading is the same as the MESSAB 1 reading.

5.3 Repeat 5.1 using position 12 (MESSAB 2).

5.4 Repeat 5.2 using position 13 (PEGUE 2) and if necessary, adjusting the potentiometer on the SE02 card.

6. Output Voltage Checks

6.1 Observe that both green LEDs on the SE01 and 02 cards are lit (flashing on 70/30S), connect the meter to the LTG1 terminals on the lineside test box and select the AC voltage range.

6.2 Insert the dummy wheel at the SK1 head, observe the LED’s on card SE01 shows red and SE02 is extinguished. Measure the output voltage and frequency and check the readings are as follows:

a) 400mV to 550mV AC @ 4.15 kHz ±2% (70/30).

b) 400mV to 550mV AC @ 2.04kHz ±2% (70/30S).

6.3 Move the dummy wheel to the SK2 head and observe the LED’s now show SE01 extinguished and SE02 red. Measure the output voltage and frequency and check the readings are as follows:

a) 400mV to 550mV AC @ 5.06 kHz ±2% (70/30).

b) 400mV to 550mV AC @ 2.52kHz ±2% (70/30S).

6.4 Remove the dummy wheel and measure the output voltage, check the readings are as follows:

a) 700mV to 1100mV AC (70/30).

b) 600mV to 900mV AC (70/30S).

6.5 Place the dummy wheel over both count heads, observe that both red LED’s are lit and the green LED’s are extinguished. Measure the voltage at the LTG1 terminals on the test box and check it is less than 100mV AC.

If the voltage is greater than this, switch off the battery charger feeding the EAK and test again. If the voltage is still greater, the cause shall be investigated as corrective maintenance.

6.6 Remove the dummy wheel and observe that both the red LEDs are extinguished and both the green LEDs are lit (flashing on type 70/30S).

END

GENERAL

This test requires the use of the TCAID tester.

1. Preparations for Testing

1.1 Isolate track circuit supply.

1.2 Open the dis-box and, in turn, move each of the sliding links and secure in the open circuit position.

1.3 Fit the four coloured test leads into the TCAID tester matching coloured sockets.

2. Connecting the TCAID Tester

2.1 Connect the tester as shown below (Fig 1- non directional MOD 0-2 versions, Fig 2- non directional MOD 3 versions, Fig 3 – directional), checking that any un-terminated leads are isolated from each other and terminals / metalwork.

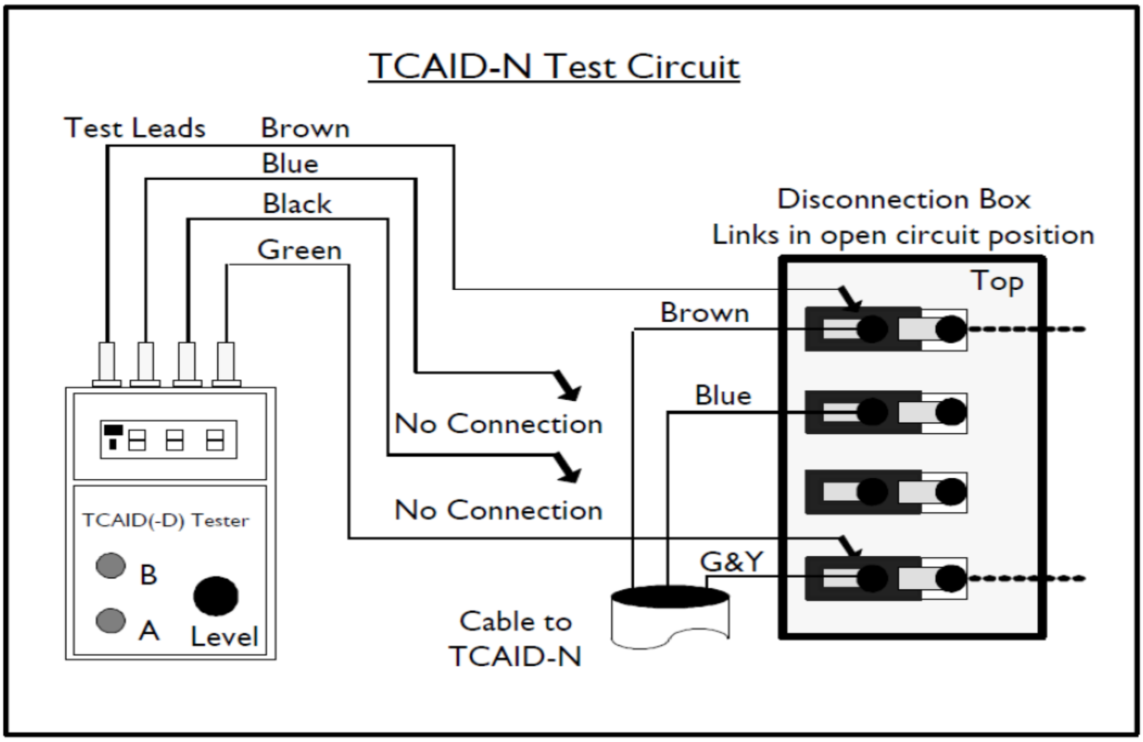


Figure 1 - Tester set up (non-directional) for MOD 0-2 versions

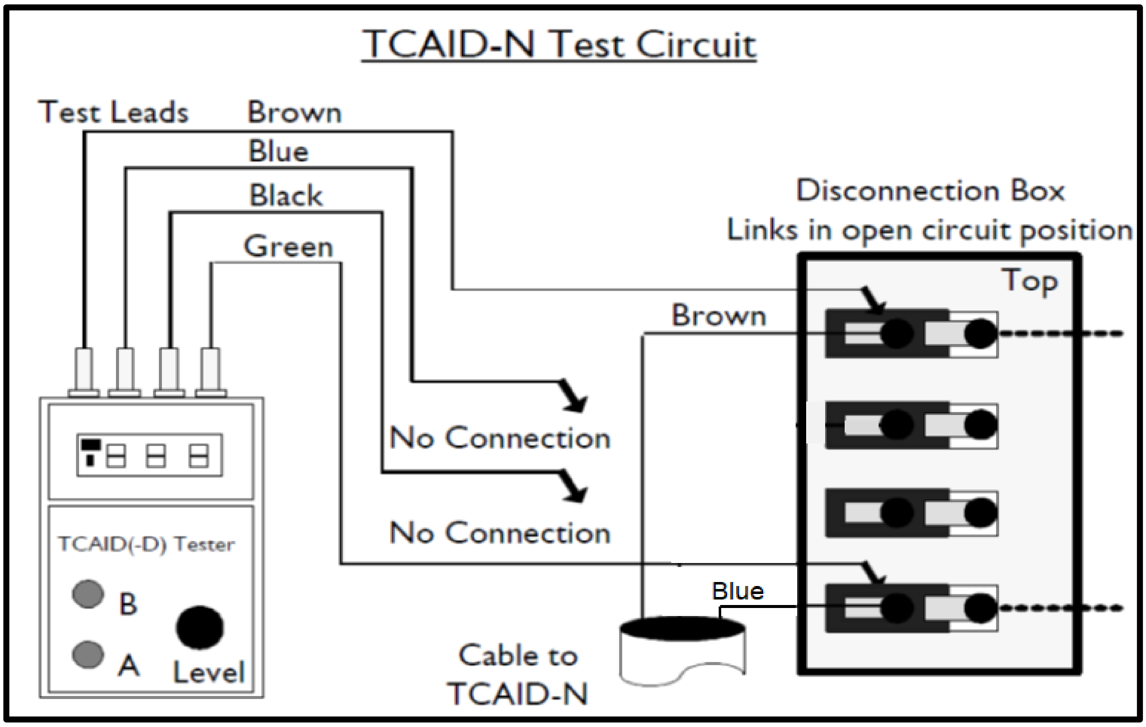


Figure 2 - Tester set up (non-directional) for MOD 3 versions

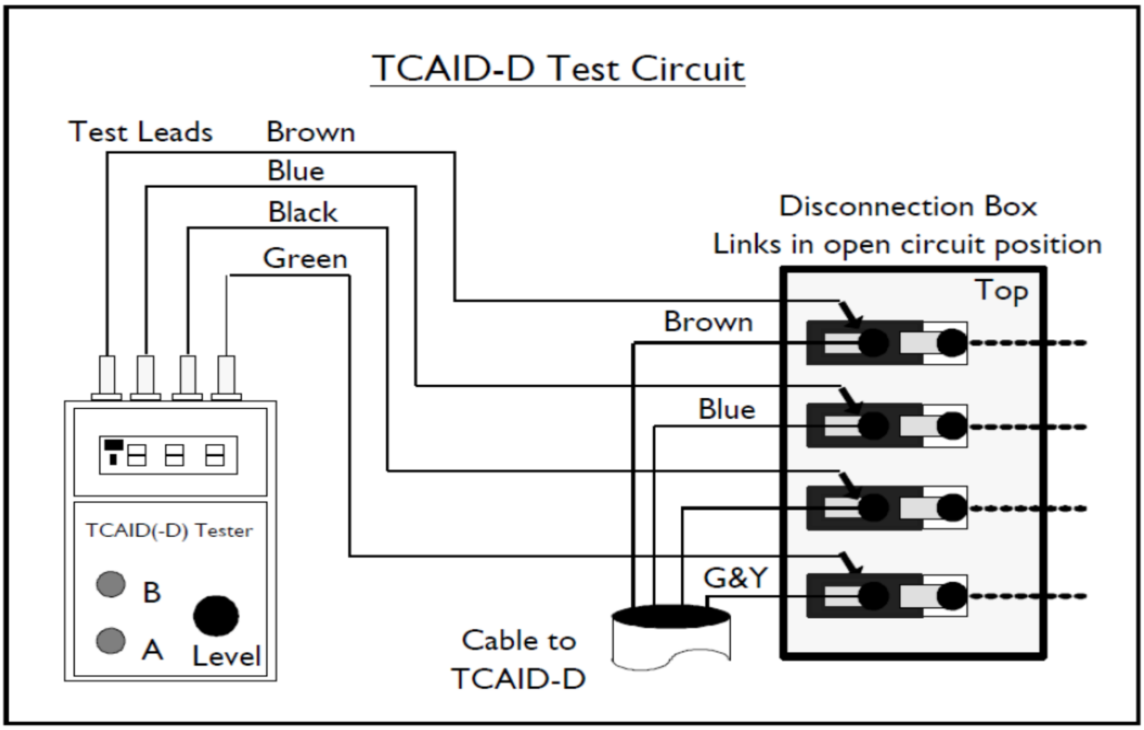


Figure 3 - Tester set up (directional) for all MOD versions

3. Test Procedure for all types of TCAID

A TCAID is only considered healthy if it passes all the tests described for it.

3.1 Using the TCAID tester rotate the level control fully anti-clockwise and press and hold down the PHASE A button - the display can become active.

The button shall be held down for the duration of the first part of the test. If the display goes blank, the test shall be re-started from step 3.1.

3.2 Slowly rotate the level control clockwise until the TCAID OPERATED symbol appears on the display. Note the reading on the display and check it is within the values shown in Table 1:

TCAID Type	Mk1	Mk2
TCAID-N Activates	325mV to 360mV	315mV to 385mV
TCAID-D Activates	405mV to 460mV	315mV to 385mV

Table 1 - Test Limits Activation

Readings outside these limits indicate a failed TCAID.

3.3 Slowly rotate the level control back (anti-clockwise) until the TCAID OPERATED symbol disappears. Note the reading on the display and check it is within the values shown in Table 2:

TCAID Type	Mk1	Mk2
TCAID-N De-Activates	335mV to 265mV	190mV to 270mV
TCAID-D De-Activates	300mV to 330mV	190mV to 270mV

Table 2 - Test Limits De-Activation

Readings outside these limits indicate a failed TCAID.

3.4 Compare the two readings; the first shall be greater than the second by at least 50mV.

The PHASE A button can now be released.

4. Additional test for TCAID-D only

4.1 Using the TCAID tester turn the level control fully anti-clockwise. Press and hold down the PHASE B button, the display becomes active.

The button shall be held down for the duration of the first part of the test. If the display goes blank, the test shall be re-started from Step 4.1.

4.2 Slowly rotate the level control clockwise until it reaches, the fully clockwise position. If at any time, the TCAID operated symbol appears on the display, the TCAID-D has failed the test and shall be considered faulty.

The PHASE B button can now be released.

5. Reconnection of the TCAID

5.1 When the TCAID has passed all the tests, the tester shall be disconnected and then the disconnection links individually moved back and secured in the closed-circuit position, starting from the top downwards.

5.2 Close and lock the disconnection box.

END

Includes:	Single arm (Cautor) and Double arm (Forfex) types
Excludes:	Any other type of mechanical or electronic treadle

This requires possession of the line, because connected control equipment activates. Re-set any effected controls after treadle timing (e.g. automatic level crossings).

The timing adjustment screw may be used to adjust the time. Do not over-tighten or remove the screw from the dashpot.

TESTS

1. Single Arm Treadles

1.1 Bridge out the normally made contacts with a meter set to mA.

1.2 Depress, release and time the movement of the operating arm to the normal position.

1.3 Check the time and adjust if required.

The time is normally 6-8 seconds but can vary at certain installations, refer to the diagrams.

1.4 Remove the meter bridging connection.

2. Double Arm Treadles

2.1 Bridge out the normally made contacts with a meter set to mA.

2.2 Depress and hold down operating arm ‘1’.

2.3 Depress, release, and time the movement of the operating arm ‘2’ to the normal position.

2.4 Check the time and adjust as required.

The time is normally 6-8 seconds but can vary at certain installations, refer to the diagrams.

Adjust arm 2 adjustment screw, as shown in Appendix A.

2.5 Repeat the procedure for the other arm, i.e. hold down arm ‘2’ whilst timing arm ‘1’.

2.6 Depress both arms fully and release simultaneously. The time between simultaneously releasing the arms and the point at which the control rod falls to the bottom of the ‘V’ shall be within 6 to 10 seconds, regardless of the order in which the arms are lowered.

a) If either of the values is lower (or higher) than this, screw up (unscrew) the adjustment screw for the last arm lowered (arm 2 for direction 1 to 2).

b) If both values are lower (or higher) adjust both of the screws.

2.7 Remove the meter bridging connection.

APPENDIX A - Timing Adjustments

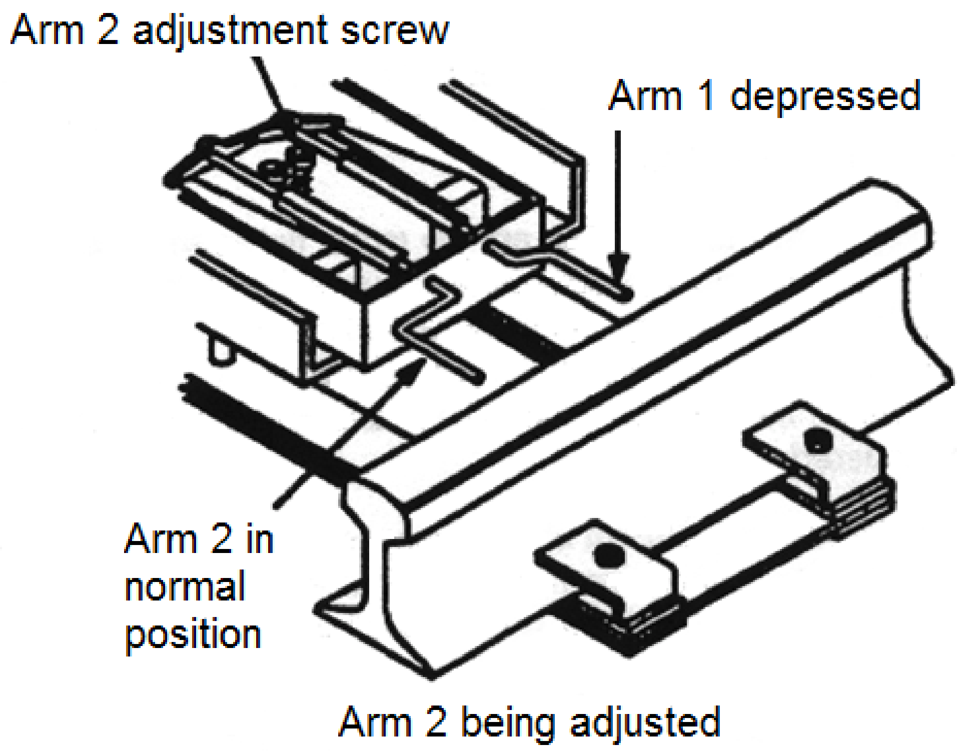


Figure 1 - Timing Adjustments on a Double Arm Treadle

END

Includes:	All AzLM Rail Contacts
Excludes:	All other types of AzL Rail Contact

GENERAL

Functional tests using the dummy wheel shall require relevant protection/possession arrangements and liaison with the Signaller.

These tests are required when the rail contacts are moved or re-aligned. They also usually form part of the annual test of axle counters.

Refer to NR/SMS/Appendix/15 (General Information on the Thales Axle Counter Systems) for additional system details.

All measurements are to be recorded on the appropriate paper or digital record card.

1. SK30H Dummy Wheel Positioning

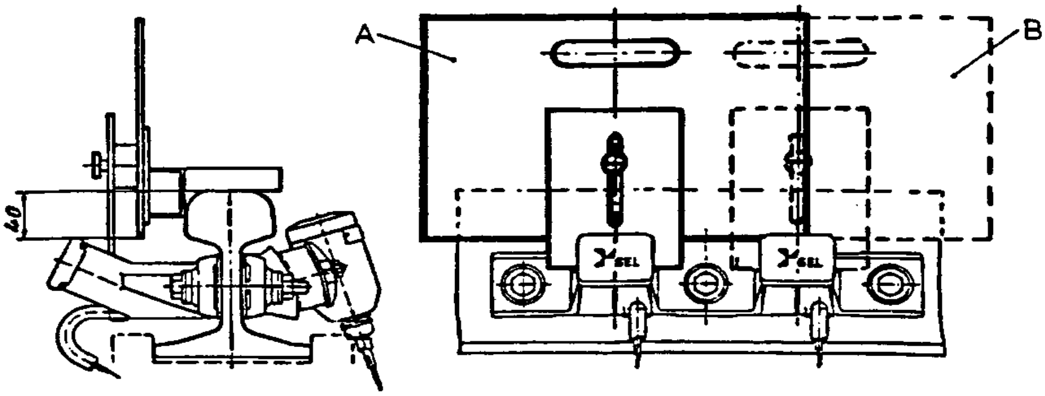


Figure 1 - Position of Dummy Wheel during Testing SK30H

Figure 1 left hand diagram shows a side on view and the right shows the dummy wheel placed over rail contacts SK1(marked A) and over SK2 (marked B).

2. SK30K Dummy Wheel Positioning

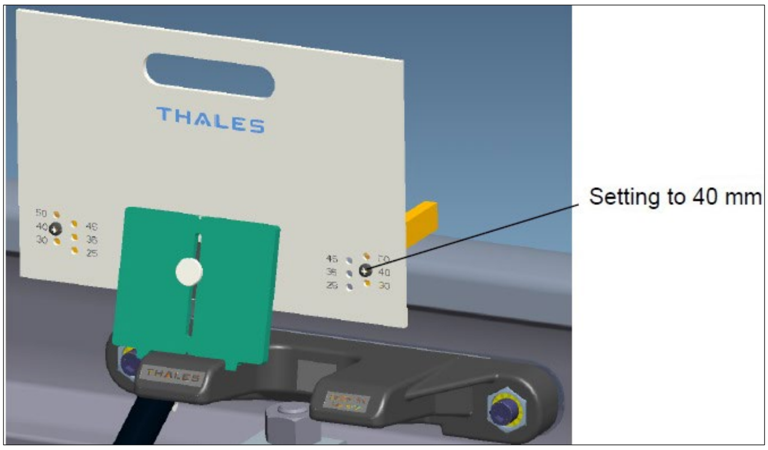


Figure 2 - Position of Dummy Wheel during Testing SK30K

3. All Rail Contacts

To simulate a wheel on an axle counter a dummy wheel supplied by the manufacturer is used. It consists of a metal plate with three plastic brackets.

The bottom edge of the plate is to be adjusted to 40mm for all double rail contacts.

The two brackets are swung out 90° to the metal plate and rest on the top rail.

The third bracket is flat and parallel to the metal plate. It holds the metal plate in the correct position by resting on one of the Rx coils to influence a count head

If it is required to simulate several wheels passing over the rail contacts, loosen the knurled nut and raise the flat bracket so that it is clear of the Rx coils while the device is passing over the heads.

The cut out notch on the third bracket should be aligned with the center mark on the received head when readings are being taken.

4. General Information Relating to SK30H Count Heads

The detection points for AzLM axle counters are fitted with a circuit to detect “drift” in each of the rail contacts.

On earlier versions of the Analogue card and ACE software a problem was identified where drift warnings can become stuck and continue to be reported after the fault has been cleared.

These faults are characterized by the History file downloaded from the Evaluator showing repeated, identical drift warnings every 5 minutes. This is no longer a requirement from ACE software version 6.1.3.

It is possible to fit an SK30K to an EAK30H with a new analogue card.

The SK30K has no mechanical setup and is set up using the potentiometers in the EAK only.

The set-up procedure can cause the associated sections (s) to become disturbed. Therefore, the appropriate protection/possession shall be agreed prior to work commencing

The dummy wheel 3JA 84532 AAAA is suitable for all rail contacts, Sk30, Sk30H and Sk30K

The former dummy wheel 19982 3100x is NOT suitable for Sk30K rail contacts.

5. Set up Procedure for EAK 30 H with SK30H:

A tested ESD strap shall be used to prevent damage to PCB's.

The three M12 rail mounting bolts shall be torqued to 45Nm.

5.1 Before making any adjustments to the SK30H: Using a multi-meter set to ohms, measure the resistance between each of the rail mounted RX heads and the running rail, and RX heads to the M12 bolts. If the resistance is below 2M ohms the rail mountings need to be cleaned or replaced

5.2 Check that the Evaluator (Digital) and analogue cards are fully home in the EAK sub rack if applicable.

5.3 Plug in the Thales 'Axle Counter Test Box' to the EAK.

5.4 Check that the cable cores on the power cable are twisted together. Also check that each Tx and Rx cable have their respective cores twisted together to the point 25mm of termination point.

Select switch position 3 on the test box to measure stabilised power channel 1 and switch position 4 to measure stablised power channel 2 and check they are both between 22Vdc and 35Vdc. If either of them is out of this range then there is a potential fault with the analogue card and this shall be replaced.

Inside the `Axle Counter Test Box`, select switch position 10, SK1 Received Rectified Voltage (+ve MESSAB 1) which shall be between +80 mV DC and +1000mV DC.

Place the dummy centrally over RX1 and measure –ve MESSAB 1, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 1).

5.5 Compare the reading taken in step 4 and 5 these shall be within 10mv of each other (+ve MESSAB 1 shall be slightly higher), if it is proceed to step 5.13.

5.6 Reset the potentiometer R2 until the voltage +ve MESSAB 1 has its greatest value.

5.7 Undo the M8 nuts and adjust the TX head up / down until +ve MESSAB 1 and –ve MESSAB 1 are as near the same amplitude as possible. The +ve MESSAB shall be higher than the –ve MESSAB.

5.8 The rail contactor shall not touch the head of the rail.

5.9 The M8 nuts shall be re-tightened to a Torque setting of 25Nm.

5.10 If, after adjusting the TX head, the difference between +ve MESSAB 1 and –ve MESSAB 1 is more than 10mv then adjust R2 until +ve MESSAB 1 and –ve MESSAB 1 are within 10mv.

5.11 Check the +ve MESSAB is higher than the-ve MESSAB.

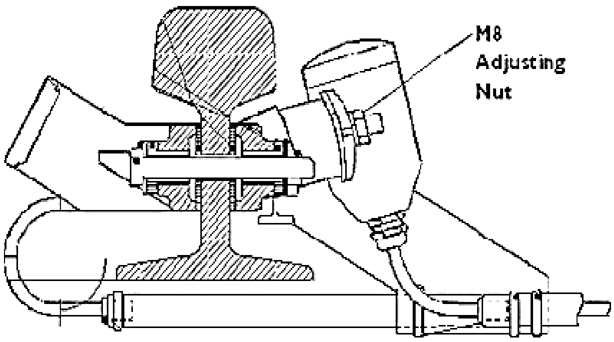


Figure 3 - SK30H M8 Adjustment nuts

5.12 Inside the `Axle Counter Test Box`, select switch position 11, reference voltage (PEGUE 1). Adjust potentiometer R1 (PEGUE 1) so that the reading is equal to +ve MESSAB 1 +/- 2%.

5.13 Check that that green LED H1/2 is flashing continuously.

5.14 Inside the `Axle Counter Test Box`, select switch position 12, SK2 Received Rectified Voltage (+ve MESSAB 2) which shall be between +80 mV DC and +1000mV DC.

5.15 Place the dummy centrally over RX2 and measure –ve MESSAB 2, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 2).

5.16 Compare the reading taken in step 14 and 15 these shall be within 10mv of each other (+ve MESSAB 2 shall be slightly higher), if it is proceed to step 5.24

5.17 Reset the potentiometer R4 until the voltage +ve MESSAB 2 has its greatest value.

5.18 Undo the M8 nuts and adjust the TX head up / down until +ve MESSAB 2 and –ve MESSAB 2 are as near the same amplitude as possible. The +ve MESSAB shall be higher than the –ve MESSAB.

5.19 The rail contactor shall not touch the head of the rail.

5.20 The M8 nuts shall be re-tightened to a Torque setting of 25Nm.

5.21 If, after adjusting the TX head, the difference between +ve MESSAB 2 and –ve MESSAB 2 is more than 10mv then adjust R4 until +ve MESSAB 2 and –ve MESSAB 2 are within 10mv.

5.22 Check the +ve MESSAB is higher than the-ve MESSAB.

5.23 Inside the `Axle Counter Test Box`, select switch position 13 reference voltage (PEGUE 2).

5.24 Adjust potentiometer R3 (PEGUE 2) so that the reading is equal to +ve MESSAB 2 +/- 2%.

5.25 Check that green LED H2/2 is flashing continuously.

5.26 Measure the voltage and frequency of SK1 and SK2.

* Range (A): Analogue cards before version 3CR 01836 AEAA.

** Range (B): Analogue cards including and after version 3CR 01836 AEAA.

Test	Terminals	Range (A) *	Range (B) **
SK1 Voltage	Sk1/S1	40V to 64V AC	40V to 85V AC
SK1 Freq.	Sk1/S2	30 to 31.25kHz	29.8 to 31.3kHz
SK2 Voltage	Sk2/S1	40V to 64V AC	40V to 85V AC
SK2 Freq.	Sk2/S2	27.4 to 28.6kHz	26.8 to 28.6kHz

Table 1 - The Voltage and Frequencies Ranges of the Rail Contacts

6. Setting up and Adjustment of EAK 30H with SK30K Count Heads

A tested ESD strap shall be used to prevent damage to PCB's.

The two M12 rail mounting bolts shall be torqued to 58Nm.

6.1 Check that the Evaluator (Digital) and analogue cards are fully home in the EAK sub rack if applicable.

6.2 Plug in the Thales 'Axle Counter Test Box' to the EAK.

6.3 Check that the cable cores on the power cable are twisted together. Also check that each Tx and Rx cable have their respective cores twisted together to the point 25mm of termination point.

6.4 Check the silica / desiccant bag is not saturated with water and is fitted to each EAK.

6.5 Select switch position 3 on the test box to measure stabilised power channel 1 and switch position 4 to measure stablised power channel 2 and check they are both between 22Vdc and 35Vdc. If either of them are out of this range then there is a potential fault with the analogue card and this shall be replaced.

6.6 Inside the `Axle Counter Test Box`, select switch position 10, SK1 Received Rectified Voltage (+ve MESSAB 1) which shall be between +80 mV DC and +1000mV DC.

6.7 Place the dummy centrally over RX1 and measure –ve MESSAB 1, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 1).

6.8 If the difference between +ve MESSAB 1 and –ve MESSAB 1 is more than 10mv then adjust R2 until +ve MESSAB 1 and –ve MESSAB 1 are within 10mv.

6.9 Check the +ve MESSAB is higher than the-ve MESSAB.

6.10 Inside the `Axle Counter Test Box`, select switch position 11, reference voltage (PEGUE 1). Adjust potentiometer R1 (PEGUE 1) so that the reading is equal to +ve MESSAB 1 +/- 2%.

6.11 Check that that green LED H1/2 is flashing continuously.

6.12 Inside the `Axle Counter Test Box`, select switch position 12, SK2 Received Rectified Voltage (+ve MESSAB 2) which shall be between +80 mV DC and +1000mV DC.

6.13 Place the dummy centrally over RX2 and measure –ve MESSAB 2, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 2).

6.14 If the difference between +ve MESSAB 2 and –ve MESSAB 2is more than 10mv then adjust R4 until +ve MESSAB 2 and –ve MESSAB 2 are within 10mv.

6.15 Check the +ve MESSAB is higher than the-ve MESSAB.

6.16 Inside the `Axle Counter Test Box`, select switch position 13, reference voltage (PEGUE 2). Adjust potentiometer R3 (PEGUE 2) so that the reading is equal to +ve MESSAB 2 +/- 2%.

6.17 Check that green LED H2/2 is flashing continuously.

6.18 Measure the voltage and frequency of SK1 and SK2.

* Range (A): Analogue cards before version 3CR 01836 AEAA.

** Range (B): Analogue cards including and after version 3CR 01836 AEAA.

Test	Terminals	Range (A) *	Range (B) **
SK1 Voltage	Sk1/S1 Sk1/S2	40V to 64V AC	40V to 85V AC
SK1 Freq.		30 to 31.25kHz	29.8 to 31.3kHz
SK2 Voltage	Sk2/S1 Sk2/S2	40V to 64V AC	40V to 85V AC
SK2 Freq.		27.4 to 28.6kHz	26.8 to 28.6kHz

Table 2 - The Voltage and Frequencies Ranges of the Rail Contacts

7. Setting up and Adjustment of EAK 30K with SK30K Count Heads

A tested ESD strap shall be used to prevent damage to PCB’s.

The molded TX cable is always connected to SK1 inside the rail sensor if the direction needs to be change this can be achieved be adjusting the ARD plug (X600).

<u>EAK Switches</u>

The switches S1 and S2 shall be set to position 1 to activate the electrical adjustment. S3 should be set to H (For High), see Figure 4.

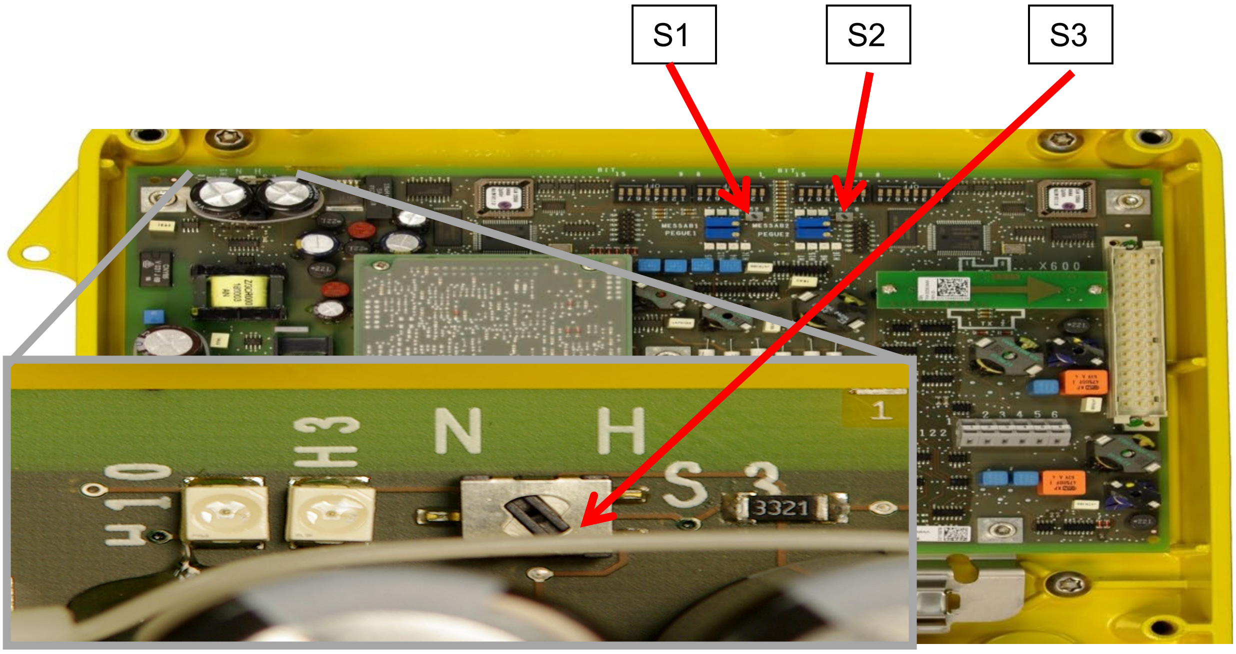


Figure 4 – Inside of the EAK

7.1 Check that the cable cores on the power cable are twisted together. Also check that each Tx and Rx cable have their respective cores twisted together to the point 25mm of termination point.

7.2 Check the silica / desiccant bag is not saturated with water and is fitted to each EAK.

7.3 Select switch position 3 on the test box to measure stabilised power channel 1 and switch position 4 to measure stablised power channel 2 and check they are both between 22Vdc and 35Vdc. If either of them is outside of this range then there is a potential fault with the analogue card and this shall be replaced.

7.4 Inside the `Axle Counter Test Box`, select switch position 10, SK1 Received Rectified Voltage (+ve MESSAB 1) which shall be between +80 mV DC and +1000mV DC.

7.5 Place the dummy centrally over RX1 and measure –ve MESSAB 1, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 1).

7.6 If the difference between +ve MESSAB 1 and –ve MESSAB 1 is more than 10mv then adjust R2 until +ve MESSAB 1 and –ve MESSAB 1 are within 10mv.

7.7 Check the +ve MESSAB is higher than the-ve MESSAB.

7.8 Inside the `Axle Counter Test Box`, select switch position 11, reference voltage (PEGUE 1). Adjust potentiometer R1 (PEGUE 1) so that the reading is equal to +ve MESSAB 1 +/- 2%.

7.9 Check that green LED H1 is flashing continuously.

7.10 Inside the `Axle Counter Test Box`, select switch position 12, SK2 Received Rectified Voltage (+ve MESSAB 2) which shall be between +80 mV DC and +1000mV DC.

7.11 Place the dummy centrally over RX2 and measure –ve MESSAB 2, which shall be between -80 mV DC and -1000mV DC i.e. with the same amplitude but opposite polarity as the received rectified signal with no dummy wheel present (+ve MESSAB 2).

7.12 If the difference between +ve MESSAB 2 and –ve MESSAB 2 is more than 10mv then adjust R4 until +ve MESSAB 2 and –ve MESSAB 2 are within 10mv.

7.13 Check the +ve MESSAB is higher than the-ve MESSAB.

7.14 Inside the `Axle Counter Test Box`, select switch position 13, reference voltage (PEGUE 2). Adjust potentiometer R3 (PEGUE 2) so that the reading is equal to +ve MESSAB 2 +/- 2%.

7.15 Check that green LED H2 is flashing continuously.

7.16 Measure the voltage and frequency of SK1 and SK2, see Table 3.

Test	Terminal Block X106	Terminal Block X106 with Rail Contact Adapter	Reading
SK1 Voltage	Black & White 1 & 2	1 & 3	40V to 85V AC
SK1 Freq.			29.8 to 31.3kHz
SK2 Voltage	Yellow & Brown 7 & 8	6 & 8	40V to 85V AC
SK2 Freq.			26.8 to28.6kHz

Table 3 - The Voltage and Frequencies Ranges of the Rail Contacts

END

High voltages are present in the camera housing, extreme caution shall be taken (See NR/SMS/ EL00 Hazards Associated with Electrical Supplies).

Always obtain permission of the signaller before lowering or adjusting the camera.

Check that the signaller is using the camera that is not under test.

General

Only the Marconi V327 camera has a Camera Control Unit (CCU).

At some locations this is positioned with the camera, which requires it to be lowered first to gain access to the unit, otherwise the CCU will be accessible in the camera rack in the equipment room.

Installations using CCD cameras (e.g. Grundig) and Marconi V332 or Pye super lynx will not have this unit.

Most installations will have a Video Relay and Test Unit (VRTU).

The signaller's controls will override any that are selected on the VRTU. If this unit is not provided connection will have to be obtained via the camera coaxial lead (this will disable the camera from the signaller's control) and function tests on the equipment will have to be performed from the monitoring point.

Equipment Required

- TV Monitor.
- Oscilloscope (Not required for CCD camera's) (A general purpose TV type is suitable).
- BNC leads and BNC 'T' connectors.

1. Maintenance Test

Installations with a combined CCU or CCD cameras and no VRTU

1.1 Connect the test equipment (monitor or oscilloscope) using the BNC leads and connectors to the test socket (were provided) or to the camera coax lead.

1.2 Obtain a picture on the monitor and trace on the oscilloscope by operation of the appropriate test switches (where provided) or by request to the signaller.

Installations with a separate CCU and a VRTU

1.3 Connect the test equipment (monitor and oscilloscope) using the BNC leads and connectors to the video test socket on the VRTU. Obtain a picture and trace by operation of 'On Test' and 'Picture' buttons.

Vidicon cameras require a period of time to 'warm up' before a picture or trace is obtained.

All Installations

1.4 Check (where provided) that on operation of the push buttons on the VRTU the internal illuminations function.

1.5 Check that 'In Use' indication illuminates when that particular camera is selected by the signaller.

1.6 Check (where provided) the operation of the shutter by use of the 'Shutter' button on the VRTU or by selection by the signaller.

1.7 Set the camera for night time viewing by operation of the 'Iris' button on the VRTU or by selection by the signaller. Check the picture remains in focus.

1.8 Examine the resolution (picture detail) in each corner and the centre of the picture.

Crossing fencing can be used the check the horizontal resolution and the running rails the vertical resolution.

If the picture resolution is not satisfactory, the electrical focus, beam or black level may require adjustment. Refer to Appendix B for details of these adjustments.

CCD cameras do not have these adjustments therefore the camera itself may have to be replaced to resolve any problems.

1.9 Set the camera back to daytime viewing by operation of the 'Iris' button or by selection by the signaller and Check the following items:

- The area of the crossing between the barriers is clearly defined.
- The road stop lines (where provided) are clearly visible.
- The crossing area is reasonably central in the picture without the presence of a skyline.
- The picture is complete and without any vertical or horizontal disturbance and is a good representation of the crossing scene.
- The field of view is not obstructed by the camera housing, screen wiper or shutter.
- There is not any streaking, flaring, ringing or negative image on any part of the picture.
- Moving objects do not smear and any small objects (e.g. children) are clearly discernible.

Some cameras are fitted with 'Fisheye' lenses that will give a greater view of the crossing area with a slight proportional distortion.

1.10 Operate the shutter on the camera and set the monitor contrast to maximum.

This will give an image of the Vidicon tube faceplate image burn. If this is found to be severe, arrangements should be made to replace the camera.

1.11 Lower the camera and open the housing. Check the following items (these tests are not applicable to CCD cameras):

- Correct operation of the lens motor by operation of the 'Iris' button or by request to the signaller.
- The settings of the iris are at f/5.6 for daytime and f/1.4 for night time.
- The lens motor limit switches and contact pillars are secure.
- When on night time setting the iris is fully open and does not obstruct the lens aperture in any way.
- When on daytime setting the iris is closed to a aperture of no smaller than 3mm diameter.

Take care when conducting these tests and do not touch the lens or the adjacent heater.

1.12 Close the camera housing and raise the camera.

1.13 Obtain a trace of the composite video signal on the oscilloscope. Check that the values of the signal components are as given in Appendix A. Adjustments to the signal components are given in Appendix B. No adjustments are possible on CCD cameras.

1.14 At the monitoring point check that a satisfactory picture is obtained on the signallers monitor (to correctly set up a monitor see Appendix C).
In liaison with the signaller check the following:

- A person standing at and walking between each corner of the crossing is clearly visible.
- The selections of lens and wiper controls are effective.
- The wiper when switched off parks correctly outside the field of view.
- Check that all functions work correctly on the alternative monitor.

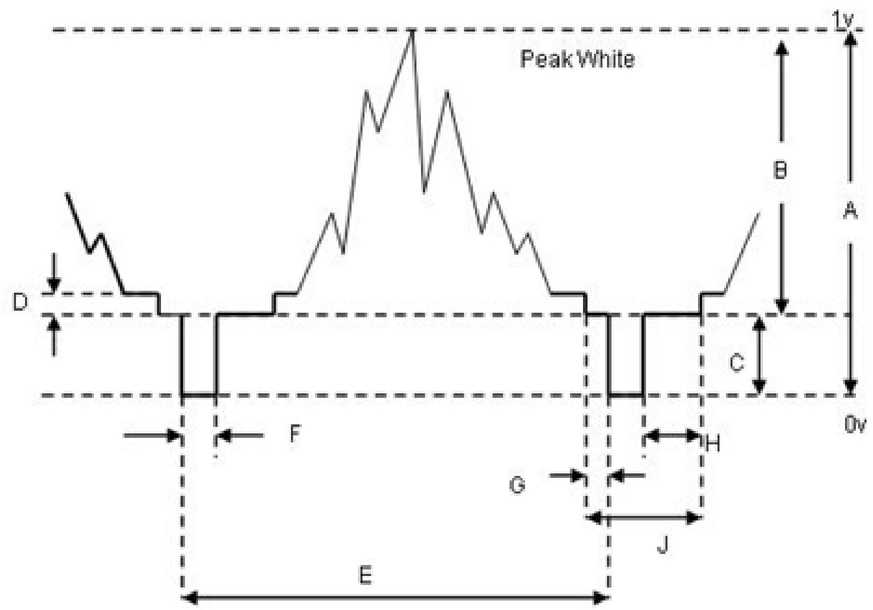
1.15 Repeat 1.1 to 1.14 for the other camera.

1.16 On completion of testing, check that on the VRTU the ‘On Test’ button is left deselected. If left selected the camera will always be ‘On’ even if it is not selected by the signaller.

1.17 Arrange for a check on the quality of the pictures from both cameras during the hours of darkness.

APPENDIX A

Composite Video Signal



A. Composite video signal 1v peak-to-peak (100%).

B. Video component of signal 0.7v (70%).

C. Sync component of signal 0.3v (30%).

D. Black Level 50mV.

E. Complete Line period 64µs

F. Line Synchronising pulse 5µs.

G. Front porch 1.5µs

H. Back porch 7µs

I. Line blanking interval 12µs.

The composite video signal consists of a video signal that has had synchronising pulses added. The ratio of amplitude of video to sync can vary but in the standard 1volt peak-to- peak composite video it is 70:30.

If the sync component of the signal is set at 0.3v then the maximum amplitude of the video will be 0.7v, so that the peak white is at the 1v level and correspondingly the bottom of the sync pulse is at 0v.

APPENDIX B

Focus Adjustment

Set the lens to infinity. Adjust mechanically the Vidicon racking (yoke focus adjusting screw and lock nut) lens screws or lens mount as appropriate.

Obtain the optimum focus by sliding the assembly forwards or backwards then retighten all the fastenings. Set the lens back to its original setting.

If a satisfactory focus cannot be achieved by this method, adjust the electrical focus on the camera or CCU in addition to the mechanical focus to obtain the optimum focus.

Beam Adjustment

This control adjusts the number of electrons forming the beam. Firstly, turn the control on the camera or CCU anti- clockwise to remove the entire picture.

Then slowly advance the control clockwise until all the picture detail including highlights (white portions of the picture) are clearly defined, then advance the control a further 30° or until the focus begins to deteriorate (whichever is sooner).

On the oscilloscope, the video component of the displayed signal should be 0.7v (70%) of the 1v peak-to-peak composite video signal.

Black Level Adjustment

This control affects the processing of the video signal from the target. It operates by cutting off any voltage below a certain level (Black).

It controls the DC level of the darkest part of the waveform with respect to the blanking level (sync pulse base line). It should be adjusted to be 50mV above the blanking level.

On a monitor, this should give detail in the darkest areas of the picture.

Target Bias Adjustment

This control sets the maximum electrical sensitivity of the vidicon tube. If it is set to high, it will allow rapid vidicon ‘image’ burn.

Adjust only with reference to the cameras manufacture’s manual

All adjustments need to be a compromise between correct voltage levels and optimum displayed picture.

APPENDIX C

Monitor Setting Up Procedure

1. Obtain a picture on the monitor. Check the pilot light (if fitted) is illuminated.

2. Set the Brightness and Contrast controls fully anti- clockwise.

3. Advance the Brightness control slowly clockwise until the raster is just visible.

   The raster is the structure of the scanning lines without a visible picture (on most monitors)

4. Advance the Contrast control slowly clockwise until a satisfactory picture is obtained with the highlight details still clearly visible.

   Note that the setting of these controls may vary between individual viewers.

5. Check that the monitor coaxial output is terminated with a 75Ω BNC terminating plug or (if provided) the switch is set to 75Ω.

6. Only where external controls are provided adjust the following to obtain a satisfactory picture:

   - Vertical Hold.
   - Horizontal Hold.
   - Focus.
   - Scan.
   - Sync.
   - Height.

If a satisfactory picture cannot be obtained on a monitor after setting up, it should be replaced. No attempt is to be made to make adjustments within the monitor housing.

End

ANALOGUE HIGH FREQUENCY SYSTEMS

There are several different types of High Frequency (HF) Transmission systems covered by this SMS. Conventional systems include Marconi, Rediffusion, and Philips. Phillips uses Frequency Modulation (FM) while the others use Amplitude Modulation (AM)).

Although the modulation differs between these makes, the principle of operation remains the same for all. The Baseband signal from a CCTV camera is very wideband ranging from 20Hz to over 5MHz.

This signal will not travel far along a cable before the high frequency portions attenuate leaving only the lower frequencies. Simple amplification cannot recover the distorted signal. If the distance between crossing and Signalbox is over 4Km the practice was to install a dedicated HF carrier system from one of the companies above.

The HF system reduces the problem from higher frequencies attenuating faster and makes the transmission system workable up to maximum distances around 30-50Km depending on the system used.

Line Amplifiers are still needed every 3-4Km to boost the signal. An oscilloscope is always needed to monitor both the HF and video signals. A TV monitor can only be connected where there is a “Demodulated” output. There is always a Demodulated output at the signal box end for the Signaller but most HF systems had no intermediate demodulated output at line amplifiers.

The exception is the Marconi HF system which used the same item of equipment as both a line amplifier and as the final “Demodulator” at the Signalbox.

On these systems there is a demodulated output available at each line amplifier that can be used for setting up and fault finding. Some systems have a simple LED indication on the front if the signal level being received is sufficient. This can generally be a help for tracing faults, but can be fooled in certain cases by excessive noise in the system.

Testing and fault finding should generally proceed from the TX end to the RX end. It is advisable to use a pattern generator for the tests on the transmission system rather than relying on a camera picture.

On these systems, the tests will require a possession of the CCTV system.

OPTICAL SYSTEMS

The Coe 300 system uses an optical fibre cable to link the transmitter and receiver of the system; the signals are transmitted by laser technology via a HF FM carrier at 400MHz.

Because of the technology of this system, it differs in its method of operation from the ‘conventional’ systems (no repeaters required for long distances) required for making the system more efficient and reliable and also requiring less maintenance.

GENERAL TEST EQUIPMENT REQUIRED FOR ALL CONVENTIONAL HF SYSTEMS

- Suitable multi-range meter.
- TV Monitor.
- Oscilloscope (Usually 20MHz Bandwidth, but Rediffusion Mk13 up to 50MHz)
- BNC leads and BNC ‘T’ connectors.
- 75ohms BNC terminator plug.
- Insulation tester.
- A monochrome TV pattern generator producing a 1V peak-to-peak/75Ω staircase video signal or similar.

When connecting the oscilloscope to take measurements, it should be done using the BNC ‘T’ piece and the 75Ω terminator plug.

MARCONI / GEC 14.5MHZ AM HF SYSTEM

Details of expected waveforms are in the typical voltage/waveform section.

1. Transmitter (Level Crossing) End

1.1 Check the supply voltage and ripple voltage from the power supply units to the modulator and (if fitted) launch amplifier:

a) Modulator voltage - 12vDC ±0.25V DC, Ripple voltage <50mV (pk-pk).

b) Launch Amp – 28V or 24V DC ±0.25V DC, Ripple voltage <50mV (pk-pk).

1.2 Check any LED indications are correctly illuminated. Power, Carrier etc.

1.3 Disconnect the camera input to the modulator and Check by means of the oscilloscope carrier output signal.

1.4 Connect the TV pattern generator to the modulator input and Check by means of the oscilloscope and/or the monitor the input signal.

1.5 Check by means of the oscilloscope the output signal from the modulator. Check there is no ripple present.

1.6 If fitted Check by means of the oscilloscope the output signal from the launch amplifier. Check there is no ripple present.

1.7 If any of the signals/waveforms are not as depicted in the appendices, the cause will be required to be investigated and rectified before proceeding with the test.

2. Line Amplifiers(s) (If Provided)

2.1 Check at each line repeater location the supply voltage and ripple voltage from the power supply unit to the Line amplifier and (if fitted) launch amplifier:

a) Line Amp - 12vDC ±0.25V DC, Ripple voltage <50mV (pk-pk).

b) Launch Amp – 28V or 24V DC ±0.25V DC, Ripple voltage <50mV (pk-pk).

2.2 Check any LED indications are correctly illuminated. Power, Carrier etc.

2.3 Check by means of the oscilloscope the input and output signal to/from the line amplifier and launch amplifier (if fitted). Check there is no ripple present.

2.4 If a video output socket is available, Check with the monitor the quality of the received video.

2.5 If any of the signals/waveforms are not as depicted in the appendices, the cause shall be investigated and rectified before proceeding with the test.

3. Receiver (Monitoring Point) End

3.1 Check the supply voltage and ripple voltage from the power supply unit to the Demodulator (Line amplifier):

a) Demodulator -+12V DC ±0.25V, Ripple voltage <50mV (pk-pk)

3.2 Check any LED indications are correctly illuminated. Power, Carrier etc.

3.3 Check by means of the oscilloscope and/or monitor the output signal of the demodulator.

3.4 If any of the signals/waveforms are not as depicted in typical voltages/waveforms table below and Appendix C, the cause shall be be investigated and rectified.

4. Final

4.1 At the transmission end of the system disconnect the pattern generator and re-connect the camera output to the modulator.

4.2 Check that the received picture at the monitoring point is of satisfactory quality.

Typical Voltages / Waveforms

Location	Voltage/Waveform
Input to modulator	1Vpk-pk composite video
Output from modulator	3V pk-pk (1V RMS) modulated
Output from launch amp	12Vpk-pk (4V RMS) modulated
Output from Line amp	3V pk-pk (1V RMS) modulated
Output from demodulator	1V pk-pk composite video

Table 1 – typical volumes/waveforms

PHILIPS FM HF SYSTEM EXTRA EQUIPMENT REQUIRED

- A monochrome TV pattern generator producing a staircase video signal and a Multiburst test pattern (both 1V peak-to-peak/75Ω signal).
- Portable Philips FM demodulator unit.

5 Transmission (Level Crossing) End

5.1 Check that the red LED on the power supply module is illuminated and the ‘Carrier Fail’ LED on the ‘FM Rx’ (demodulator) is extinguished.

5.2 Disconnect the camera input to the modulator and Check by means of the oscilloscope the unmodulated carrier signal at the FM output socket at the rear of the modulator frame (1V pk-pk ±0.1V undistorted sine wave at approximately 3.4MHz). Check there is no ripple present.

5.3 Connect the TV pattern generator set to a ‘staircase’ pattern to the modulator input and Check by means of the oscilloscope the input signal (Appendix C).

5.4 Check by means of the oscilloscope the modulated output signal of the modulator (Appendix C). Check there is no ripple present.

5.5 Check by means of the oscilloscope or TV monitor the output of the demodulated video test socket (Appendix C).

6 Transmitter End Launch Amplifiers (If Provided)

6.1 Switch the pattern generator to ‘multiburst’ and connect it to the launch amplifiers input socket. Connect the oscilloscope to the output socket (75ohms terminated) and Check the waveform.

Check the amplitude of the waveform increases linearly with frequency at each multiburst signal step (Appendix C). Check there is no ripple present.

6.2 Reconnect the modulator output to the launch amplifiers input and the output back to line.

7 Repeaters (If Provided)

7.1 Repeaters should not be adjusted during normal maintenance. However if adjustment is deemed necessary (low measurements at the receiver end), details on how to do this are contained in Appendix D.

8 Receiver (Monitoring Point) End

8.1 Check that the red LED on the power supply module is illuminated.

8.2 Check that with the transmission system operating normally (picture being transmitted) the ‘Carrier Fail’ LED on the ‘FM Rx’ (demodulator) module is extinguished. Disconnect the FM input and Check the LED illuminates.

8.3 Check by means of the oscilloscope the demodulated waveform at the 'Test Video O/P' socket (Appendix B).

8.4 Check a picture has been called.

8.5 Connect the monitor to the 'Processed Video O/P, socket. Check that a satisfactory picture is obtained. Check a picture has been called

8.6 Check the switch on the rear of the monitor is set to 'terminated'.

9 Final Checks

9.1 Check that all the cables in the system are correctly refitted and all test equipment is removed.

9.2 Check that the pictures obtained on the signaller's monitors are satisfactory.

COE 300 SYSTEM

Includes:	Earlier Coe 120 System
Excludes:	All other systems

This product contains a class 1 laser. There is no risk to eyesight in normal use. However use of a magnifying glass or a microscope to deliberately examine the laser output could be a hazard and shall not be attempted.

10 Transmitter End

10.1 Check that the Green Power LED Indication is lit and the Red Laser Alarm LED is out.

11 Receiver End

11.1 Check that the Green Video Detect LED Indication is lit and the Red Optical Alarm LED is out.

11.2 Check the received picture quality on the Signallers Monitor.

12 Testing Following Alterations

Whenever alterations have been carried out to the system which can affect the settings, such as a module replaced after failure or a repair to the fibre cable, then the following additional tasks shall be carried out.

12.1 Measure the voltage on the 12V Power supplies. These should be 12V ± 0.5V.

12.2 Using an oscilloscope to monitor the video output at the Signal box, terminated in 75 Ohms, adjust the "Video level Set" on the Receiver to give a Video output of 1V Pk to Pk while there is a signal of 1V Pk to Pk being input at the transmitter. Check the resulting picture on the Signallers Monitor.

APPENDIX A – Block Diagram of a Typical Generic Hf Tx System

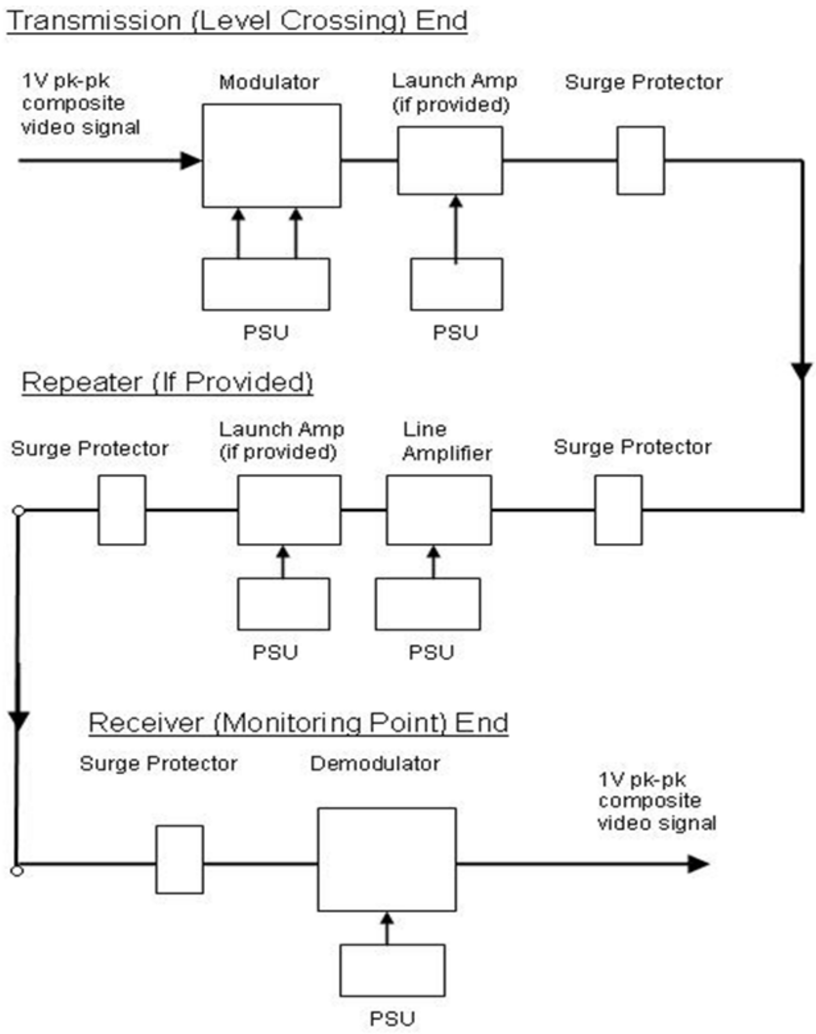


Figure 1 – Block Diagram of a Typical Generic HF TX System

APPENDIX B - Block Diagram of a Coe 300 System

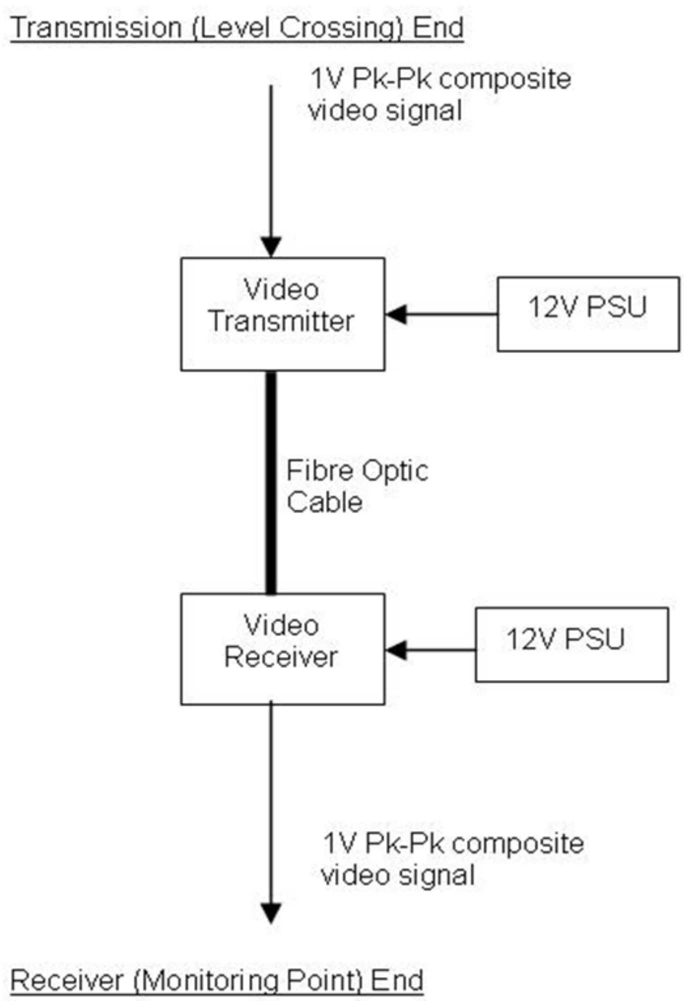


Figure 2 – Block Diagram of a Coe 300 System

APPENDIX C - Waveforms

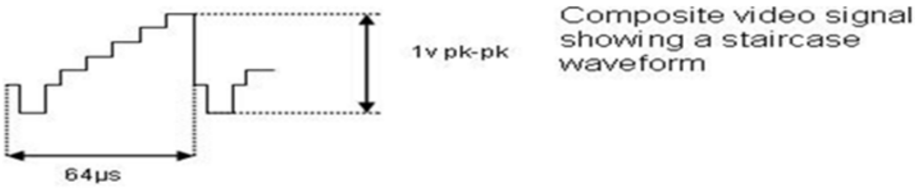


Figure 3 – Staircase waveform

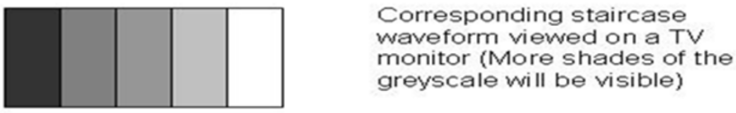


Figure 4 – Staircase waveform (viewed on tv monitor)

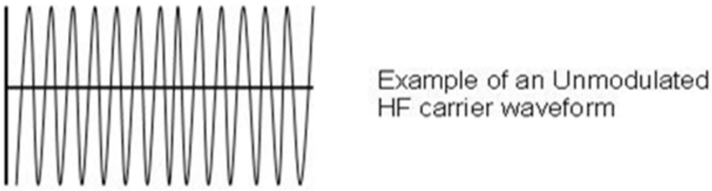


Figure 5 – Unmodulated HF carrier waveform

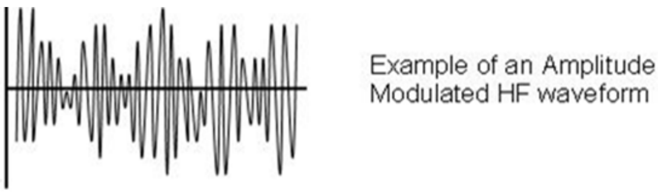


Figure 6 – Amplitude Modulated HF waveform

Figure 7 – Frequency modulated HF waveform

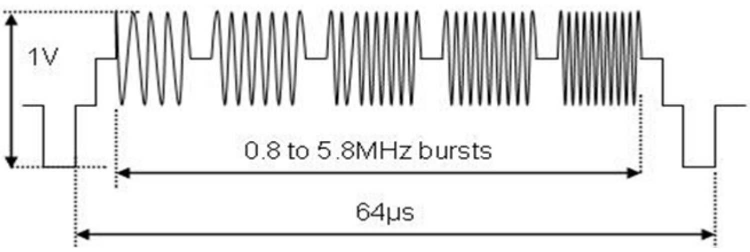


Figure 8 – Multiburst waveform

The bursts are at 0.8, 1.8, 2.8, 3.8, 4.8 & 5.8MHz. Not all are shown on the diagram.

The output from a launch amplifier can have the bursts increasing in amplitude linearly with each step from low to high frequency.

APPENDIX D - Repeaters on Philips FM Systems

Repeaters should only be tested or adjusted if deemed necessary by poor reception, if you are in doubt ask your SM(S).

It is important that the repeaters are tested in the correct order (from first to last). Note that a repeater amplifier is sometimes fitted at the demodulator location.

Testing

a. Isolate the coaxial cable between the repeater and transmission modulator (or previous repeater if not the first). Using a suitable meter (e.g. megger)

   Measure the DC loop resistance and insulation resistance of the cable (Inner to outer, inner to earth and outer to earth).

   - Use a test voltage of 500V.
   - Discharge any residual voltage on the cable after this test.

b. Reconnect the coaxial cable at both ends.

c. Check that the neon indicator on the front panel on/off rocker switch is illuminated.

d. At the previous location in the system, (transmission modulator or repeater) connect the pattern generator set to multiburst to the equipment side of the outgoing surge protection module.

   At the repeater under test, connect the oscilloscope to the ‘Video Output’ (75Ω terminated) socket of the repeater.

e. Check the waveform (Appendix B) and the waveform amplitude (1V pk-pk). If it is not correct, the repeater can be adjusted to achieve a uniform frequency response and signal amplitude (C 11). Check there is no 50 or 100Hz ripple on the waveform.

   TI21 audio frequency track circuits can cause interference on the waveform.

f. At the previous location, set the pattern generator to staircase.

g. Measure using the oscilloscope the FM signal level at the output of the repeater (1V pk-pk). Adjust the repeaters ‘Set Gain’ control if necessary.

h. Connect the portable demodulator and monitor to the output of the repeater. Check that a satisfactory picture is obtained.

   - The monitoring signal box will have to call a picture via the signaller’s controls.

- The picture quality can deteriorate slightly on the output of each successive repeater.

- Check that the switch on the rear of the monitor is set to 'terminated'.

i. Reconnect all cabling at the repeater for normal working.

j. Repeat a) to i) for all other repeaters in the system.

Adjustment

- Set all the controls (Set Gain, HF1, LF, HF2, MF, HF3) fully counter clock wise.

- Adjust the Set Gain control to give approximately 0.3V sync pulse amplitude.

- Adjust LF to eliminate 'tilt' in the signal (e.g. the front and back porch of the sync pulse at the same DC level).

- Adjust MF gain to set 0.8MHz burst to approximately 0.7V.

- Adjust HF2, HF1 and HF3 to give overall a 0.8 to 5.8MHz multiburst level of 0.7V, as flat as possible.

- Make small adjustments, if necessary to MF and Set Gain to set the overall signal amplitude to 1V pk-pk.

End

General

You shall always obtain permission of the Signaller before accessing or adjusting the camera. On duplicated systems Check that the signaller is using the camera that is not under test.

Installations have a Video Relay and Test Unit (VRTU). The signaller's controls can override any that are selected on the VRTU.

Equipment Required

- Colour TV Monitor.
- Oscilloscope (a general purpose TV type is suitable).
- BNC leads and BNC 'T' connectors.

1. Maintenance Test

1.1 Connect the test equipment (monitor and oscilloscope) using the BNC leads and connectors to the video test socket on the VRTU. Obtain a picture and oscilloscope trace by operation of 'On Test' and 'Picture' rocker switches on the VRTU.

The monitor and oscilloscope shall be connected in a 'daisy chain' arrangement, with the last item in the chain terminated in 75Ω. This is easiest done with the monitor as the last item in the chain.

1.2 Check that upon operation of the push buttons on the VRTU, the indication lights function.

1.3 Check that the 'In Use' indication illuminates when that particular camera is selected by the Signaller.

1.4 Examine the resolution (fine picture detail) of the picture.

For example, use vertical fencing or railings for checking horizontal resolution and horizontal sleepers for checking vertical resolution.

If the picture resolution is not satisfactory, the camera itself may have to be replaced to resolve any problems.

1.5 Check the following items:

a) The red tail lamps at the rear of all trains stopped at the platform are clearly visible.

b) The red tail lamps of non-stop trains are clearly visible.

c) The tail lamp area of stationary trains reasonably central in the picture and that there is little (if any) sky visible in the picture.

d) The picture is complete and without any vertical or horizontal disturbance, or patterning and is a good representation of the actual scene.

e) The field of view is not obstructed by the camera housing, screen wiper or shutter.

f) There is no streaking, flaring, ringing or negative image on any part of the picture.

If necessary, the lens focus and focal length settings can be adjusted, as shown in Appendices B & C.

If two cameras are provided they can have different ‘zoom’ lens focal length settings, to allow clear views of trains of differing lengths.

1.6 Access the camera and open the housing. Check the following items:

a) The locking screws for the lens iris and focal length adjusting rings are tight.

b) The 15-way “D” type and BNC connectors are securely mated with the camera.

c) The plug at the end of the cable coming from the lens/lens iris drive adaptor is securely mated with the camera.

d) The camera is securely fixed in position within the weatherproof housing.

Care shall be taken when conducting these tests not to touch the front of the lens or the adjacent screen demisting heater.

1.7 Close up the camera housing.

1.8 Obtain a trace of the composite video signal on the oscilloscope. Check that the values of the signal components are as given in Appendix A.

No adjustments are possible on CCD cameras.

1.9 At the monitoring point Check that a satisfactory picture is obtained on the Signallers monitor in use in liaison with the signaller, check the following:

a) The tail lamps of trains are clearly visible.

b) The wiper controls are effective.

c) The wiper when switched off parks correctly outside the field of view.

d) Check all functions work correctly on the alternative monitor.

To correctly set up a monitor see Appendix D

1.10 If provided, repeat 1.1 to 1.9 for the other camera.

1.11 On completion of testing, check that on the VRTU the ‘On Test’ button is left deselected.

If left selected the camera is always ‘ON’ even if it is not selected by the signaller.

Arrange for a check on the quality of the pictures from both cameras during the hours of darkness.

APPENDIX A - Composite Video Signal

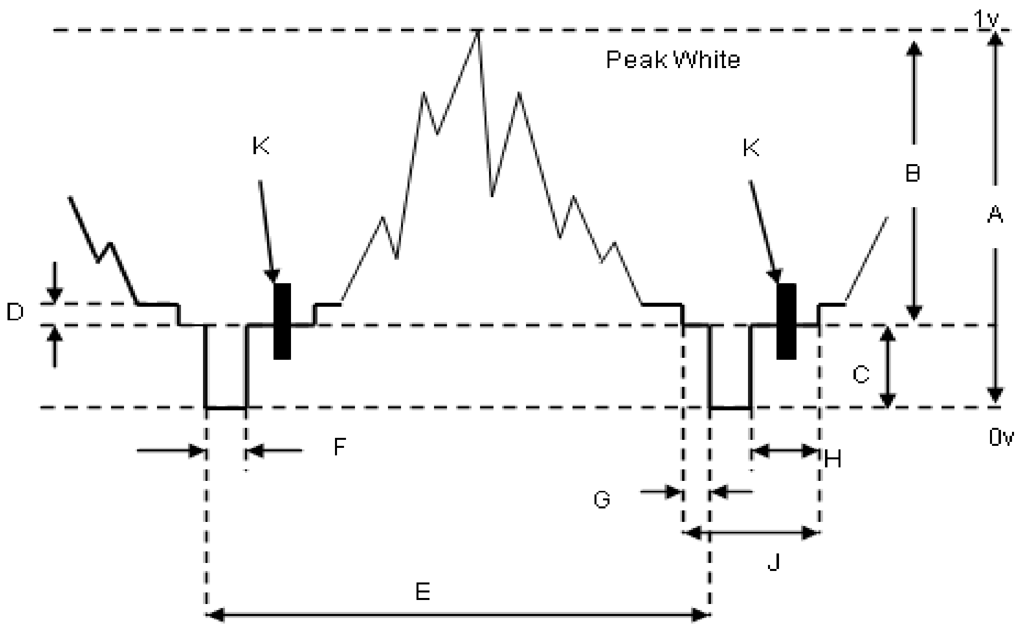


Figure 1 – Composite Video Signal

- A: Composite video signal 1v peak-to-peak (100%).
- B: Video component of signal 0.7v (70%).
- C: Sync component of signal 0.3v (30%).
- D: Black Level 50mV (approximate).
- E: Complete Line period 64µs.
- F: Line synchronising pulse 5µs.
- G: Front porch 1.5µs.
- H: Back porch 7µs.
- J: Line blanking interval 12µs.
- K: Colour burst (a 4.43MHz sinewave) signal

The composite video signal consists of a video signal that has had synchronising pulses added.

The ratio of amplitude of video to sync can vary but in the standard 1volt peak-to-peak composite video it is 70:30.

If the sync component of the signal is set at 0.3v then the maximum amplitude of the video can be 0.7v, so that the peak white is at the 1v level and correspondingly the bottom of the sync pulse is at 0v.

APPENDIX B - Lens Optical Focus Adjustment

Slacken the locking screw on the lens focus ring and slowly adjust (rotate) the focus ring to give a sharp image of the rear of trains standing at the platform.

Tighten the locking screw.

APPENDIX C - Lens Focal Length (zoom) adjustment

Slacken the locking screw on the lens focal length ring and slowly adjust (rotate) the ring to give the correct area of view.

The ring white reference line on it and the adjacent scale is marked in several focal length settings (millimetres).

It can also be necessary to adjust the optical focus ring in order to retain a well-focussed picture.

The 'zoom' setting of each camera can be different, in order to give the best view of tails lamps, for trains of varying lengths.

Tighten the locking screw.

APPENDIX D - Monitor Setting up Procedure

This applies to 'TEW' TFT LCD types only, details on other type monitors can be found in NR/SMS/Test/046 Appendix C

1. Obtain a picture on the monitor. Check the 'pilot' light is illuminated.
2. Call up the on-screen menu. Set the Brightness and Contrast controls ranges to minimum (zero).
3. Advance the Brightness level until the screen is just illuminated.
4. Advance the Contrast level slowly until a satisfactory picture is obtained with the highlight (brightest areas) details still clearly visible.

The setting of these controls can vary between individual viewers.

Call up the sharpness adjustment and set it to give a picture with sharp vertical trailing edges.

Excessive use of sharpness can cause a "black after white" effect.

5 Check that, on the monitor with two coaxial leads connected (usually Monitor 1), the small “slider” switch by the BNC sockets is set to “bridged” and that on the other monitor (usually Monitor 2), the switch is set to the “terminated/75Ω” position.

It should not be necessary to adjust any other setting in the monitor’s ‘on screen’ menu system If a satisfactory picture cannot be obtained on a monitor after setting up, it shall be replaced.

No attempt shall be made to make adjustments within the monitor housing.

The plastic screen on TFT monitors should only be cleaned in accordance with the manufacturer’s recommendations. Use of inappropriate cleaning materials (cloths, liquids and sprays) can cause permanent damage to it.

END

Includes:	Ultra If the Circuit Contact Box
Excludes:	All other types of Circuit controller box

Contact Setting procedure

1. Secure the inclinometer to the barrier.

2. Connect a suitable buzzer or meter across the micro-switch under adjustment.

3. Lift and hold the barrier at the desired angle.

4. Rotate the cam until the switch contacts just make.

5. Secure the cam on the lever shaft by torque tightening the first grub screw at 3.0 to 3.5 Nm.

   Raise or lower the barrier to gain access to the second grub screw and repeat the tightening procedure.

   It may be necessary to temporarily disconnect the barrier from the barrier box lever to gain access to the second grub screw.

6. Only tighten 2 out of the 3 grub screws for each cam.

7. Apply firm thumb pressure to each cam to confirm security to the lever shaft.

8. Check the switch operating correctly? If it is move to step 10.

9. If the switch is making when it should be breaking, loosen the grub screws and go back to step 3 using other contact slope on the cam.

10. Does the switch make at the correct angle? If not refer to the table below for fine tuning adjustments.

    The fine adjustment screw should be adjusted in increments of ¼ turn or less.

11. Repeat the process in flowchart 1 until satisfactory results are obtained.

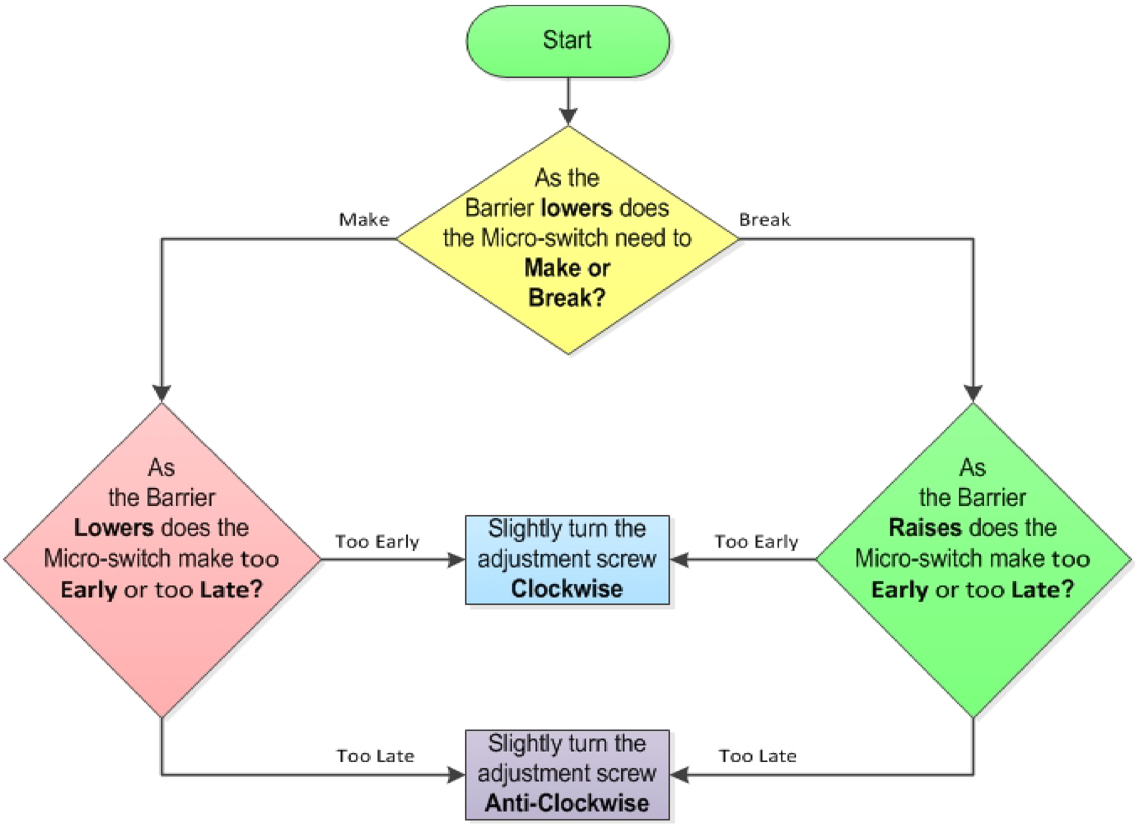
12. If satisfactory results cannot be gained, reset the fine adjustment screw to mid position as follows:

    a) Fully tighten the fine adjustment screw such that the switch mounting plate is in contact with the brass spacer.

    b) Slacken the adjustment screw by one and one quarter (1¼) full turns.

    c) The switch should now be at mid position of its fine adjustment.

    d) Slacken the two grub screws securing the cam to the lever shaft & return to step 3.



Flowchart 1 – Micro-switch adjustment process

13. Once a satisfactory result has been achieved for the micro-switch, repeat the above procedure for all remaining micro-switches.

End

Includes:	Busbar Earth Tests
Excludes:	All Busbar fitted with an Electronic Monitoring Device.

The tests require to be carried out on busbars that do not exceed a nominal 110V AC or 120V DC.

General

These tests are not normally required on equipment that is continuously monitored; see NR/SMS/PartC/EL00 - Electrical Equipment General, for further details. If you are in doubt, ask your SM(S).

The definition 'busbar' includes all power fed from a supply to equipment/circuits.

Signalling Circuits that are Intentionally Connected to Earth

These circuits (e.g. earth return circuits) do not need testing by the methodology in this test. If a second earth fault occurs, the affected circuit might not operate or operate irregularly indicating the problem.

Earth Values

Earth test values are detailed in NR/SMS/PartZ/Z07 – Earth Leakage Reference Values.

The reportable earth test result is the value that should be reported to your SM(S).

The maximum acceptable earth test result relates to the minimum insulation value that a signalling circuit is expected to meet to continue to operate safely.

The safety maximum earth test result relates to an insulation value, less than the acceptable value, below which the margin of safety provided is considered inadequate for the continued safe operation of the signalling equipment.

Investigation of Earth Faults

There is a zero tolerance to earth faults outside the defined acceptable limits across the network.

Report all test results indicating earth problems, at any level, to your SM(S), to be dealt with as detailed in NR/SMS/PartC/EL21 – Trackside Apparatus Case and NR/SMS/PartC/EL31 - Equipment and Relay Rooms.

1 DC Earth Test up to a Nominal 120V

Use a calibrated electronic meter with an input impedance of >1MΩ fitted with a 150kΩ shunt.

1.1 Measure the busbar voltage, record the results.

1.2 Connect one meter lead to the positive busbar, the other to earth, record the voltage (V1) – ignore polarity.

1.3 Connect one meter lead to the negative busbar, the other to earth, record the voltage (V2) – ignore polarity.

1.4 Disconnect the meter and compare the results with the safety values detailed in NR/SMS/PartZ/Z07 - Earth Leakage Reference Values.

If the required busbar voltage is not shown, use the next available lower voltage.

1.5 Investigate any readings that are outside the required values shown in the tables in Part Z. Any investigations shall be reported to your SM(S).

2 AC Earth Test up to a Nominal 110V

Use an electronic meter with an input impedance of >1MΩ (Do not use the 150kΩ shunt). Also use the AC busbar earth test adapter.

2.1 Connect the meter set to volts dc to the red and one of the black terminals of the earth test adapter.

2.2 Connect the green and other black terminal of the earth test adapter together and record the battery voltage (Vb). Renew the battery if the reading is less than 8V.

2.3 Connect the green terminal to earth and the black terminal to either the BX or NX busbar. Record voltage V1.

2.4 Reverse the leads to the same busbar (i.e. the black lead connected to earth and the green to the busbar) and Record voltage V2.

2.5 Disconnect the test equipment and compare the results with the relative Vb safety values in NR/SMS/PartZ/Z07 - Earth Leakage Reference Values.

If the required voltage Vb is not shown, use the next available lower voltage.

2.6 Investigate any readings that are outside the required values shown in the tables in Part Z. Any investigations shall be reported to your SM(S).

END

General

Dynamic Earth Testing is broken into Un-monitored and Electronically Monitored Busbars.

Only one of the tests should be completed.

The tester should choose the type depending on the equipment to be tested.

Method for connecting test equipment is as NR/SMS/PartB/Test/051 (Busbar Earth Tests) - Section 1 for DC circuits and Section 2 for AC circuits.

UN-MONITORED BUSBARS

1. Power Worked Points

1.1 Whilst the points are moved from both N-R and R-N measure and record the maximum positive and negative drive voltage between busbar and earth.

1.2 Measure and record the voltage across each leg of the detection circuit.

1.3 Measure and record the voltage between each leg of the detection circuit and earth for each lie of the points.

1.4 Compare the results with the table in NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

1.5 Investigate any readings that are outside the required values shown in the tables in Part Z.

1.6 This test shall be repeated following the investigation / clearance of any earths.

Any investigations shall be reported to your SM(S).

2. Level Crossing Barriers

2.1 Measure and record the maximum positive and negative drive voltage between 24v busbar and earth during a complete cycle of the crossing.

2.2 Compare the results with the table in NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

2.3 Investigate any readings that are outside the required values shown in the tables in Part Z.

2.4 This test shall be repeated following the investigation / clearance of any earths.

Any investigations shall be reported to your SM(S).

3. Generic Dynamic Earth Test (Including AWS Electro magnets)

3.1 Liaise with the Signaller to set up the conditions by asset to be tested is energised.

3.2 Measure and record the voltage across each leg of the magnet feed circuit as the equipment changes state.

3.3 Compare the results with the table in NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

3.4 Investigate any readings that are outside the required values shown in the tables in Part Z.

3.5 This test shall be repeated following the investigation / clearance of any earths.

Any investigations shall be reported to your SM(S).

ELECTRONICALLY MONITORED BUSBARS

4. Power Worked Points

4.1 Observe the readings displayed by the Electronic Monitoring Device whilst the points are moved from both N-R and R-N twice.

4.2 Record and investigate any alarms that are triggered.

4.3 This test shall be repeated following the investigation / clearance of any earths.

Any investigations shall be reported to your SM(S).

5. Level Crossing Barriers

5.1 Observe the readings displayed by the Electronic Monitoring Device whilst the barriers are raised and lowered twice.

5.2 Record and investigate any alarms that are triggered.

5.3 This test shall be repeated following the investigation / clearance of any earths.

Any investigations shall be reported to your SM(S).

END

Includes:	930 Type, P Style Units, Bender IR145, Bender IR425
Excludes:	All other ELD's and Bender units

GENERAL

Due to the number of different styles of Earth Leakage Detector (ELD) that are now fitted across the Network this test is broken into three parts.

The tester carrying out this task should identify the type of ELD they are testing from the list below and only carry out the tasks within that test and its Setup Appendix (if required):

- **Part A** - 930 Type and P Style Units.
- **Part B** - Bender IR145.
- **Part C** - Bender IR425.
- **Part D** – Siemens ELD.

PART A - 930 Type and P Style Units

Equipment Identification

Figure 2 - 930 Style ELD

Figure 1 - P Type ELD

1. Function Test - 930 Type and P Style Units

1.1 Measure and record the busbar voltage/s on the record card.

1.2 Check and record the indications shown on the earth leakage detector.

1.3 If an earth fault is indicated, attempt to clear the indication and record the result.

Where fault persists, investigate the cause, and carry out NR/SMS/PartB/Test/051 (Earth Busbar Test).

Rectify any earth faults above the reportable limit. NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

All faults shall be reported to your SM(S).

If the fault is unrectified your SM(S) shall be advised within 24 hours.

2. Calibration Test - 930 Type and P Style Units

2.1 Remove the ELD using the correct SMTH test plan.

2.2 Measure and record the voltage across each busbar.

2.3 Carry out NR/SMS/PartB/Test/051 (Earth Busbar Test) on each busbar.

Rectify any earth faults above the reportable limit. NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

All faults shall be reported to your SM(S).

If the fault is unrectified your SM(S) shall be advised within 24 hours.

2.4 Re-instate ELD using the SMTH Test Plan.

2.5 Observe the ELD shows earth free indication.

2.6 Connect an electronic calibrated meter on resistance range to the inputs of the 22K ohms resistor box. Record the reading. If the reading is not within 22K ±5% then do not use and report this to your SM(S).

2.7 Connect the 22Kohms resistor (earth fault) between:

a) Earth to each monitored busbar in turn (DC circuits).

b) or Earth and one busbar (AC circuits) for a maximum of 7 seconds.

Observe the ELD correctly indicates the earth fault. Some units indicate after one second, some can take up to six seconds, if you are in doubt about the units you are testing, ask your SM(S).

2.8 Operate ELD test button and observe the ‘Earth Fault’ indication, for one leg of the supply.

2.9 Reset the ELD and repeat for the other leg of the supply.

2.10 If a DC ELD does not operate correctly, it might require adjustment (See Appendix A).

If the unit fails to operate on the test buttons, this can be due to a faulty main earth or test earth connection.

2.11 Reset to restore the ELD to service.

If the ELD is found to be defective:

a) Isolate the defective ELD safely from the operational busbar and label it as faulty.

b) Immediately carry out NR/SMS/PartB/Test/051 (Earth Busbar Test).

c) Treat circuits as not monitored by ELD until remedial action is completed.

Rectify any earth faults above the reportable limit. NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

All faults shall be reported to your SM(S).

If the fault is unrectified your SM(S) shall be advised within 24 hours.

PART B – IR145 Bender Units

Equipment Identification

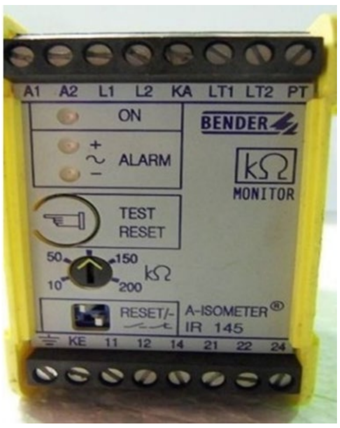


Figure 3 - IR145 Bender Unit

3. Operation

Within the IR145Y a measuring signal is generated which is connected to the system via the terminals L1/L2 and is connected to ground via the terminals /KE.

These connections are monitored continuously. If one of these connections is interrupted, this is indicated by flashing alarm LEDs and alarm relay.

4. Function Test - IR145 Bender Units

4.1 Measure and record the busbar voltage/s on the record card.

4.2 Check and record the indications shown on the earth leakage detector.

4.3 Check the green power on LED is illuminated.

4.4 Push and hold depressed the “Test / Reset” button for more than 2.5 seconds.

During a successful test both fault LEDs should illuminate while the button is depressed and extinguished when it is released.

4.5 If either of the fault LED’s fails to illuminate during the test or remains lit after the button has been released it shall be investigated as a fault.

4.6 If you are unable to eliminate the fault condition, then the following action shall be taken:

a) Isolate the defective ELD safely from the operational busbar and label it as faulty

b) Carry out NR/SMS/PartB/Test/051 (Busbar Earth Test) Immediately.

c) Advise your SM(S).

d) Treat the circuits as unmonitored by ELD until remedial action has been completed.

4.7 Reset the unit by pressing the “Test / Reset” button for less than 1 second. Observe the ELD unit for a period of 60 seconds for further alarms.

5. Calibration Test - IR145 Bender Units

5.1 Measure and record the voltage across each busbar.

5.2 Observe the unit alarm indications are clear.

5.3 Connect an electronic meter on resistance range to the inputs of the 22K ohms resistor box. Record the reading. If the reading is not within 22K ±5% then do not use and report this to your SM(S).

5.4 Connect the 22Kohms resistor (earth fault) between:

a) Earth to each monitored busbar in turn (DC circuits).

b) or Earth and one busbar (AC circuits) for a maximum of 7 seconds.

5.5 Observe the alarm Illuminate.

5.6 If none of the Fault LED's illuminate, then the following action shall be taken:

a) Remove and label the failed ELD.

b) Immediately carry out NR/SMS/PartB/Test/051 (Earth Busbar Test on each busbar).

c) Advise your SM(S).

d) Treat the circuits as unmonitored by ELD until remedial action has been completed.

5.7 Reset the unit by pressing the "Test / Reset" button for less than 1 second. Observe the ELD unit for a period of 60 seconds for further alarms.

PART C – IR425 Bender Units

Equipment Identification

Figure 4 – IR425 Bender Unit

6. Operation

The IR425 generates a pulsating measuring voltage which is superimposed on the power supply system being monitored via the terminals L1/L2 and KE/earth.

The current measured insulation resistance is shown on the display of the device.

A distinction is made between insulation faults on the AC or DC side. In the event of insulation faults on the plus or minus conductor, the corresponding +/- symbol is activated on the display.

7. Function Test – IR425 Bender Unit

7.1 Measure and record the busbar voltage/s on the record card.

7.2 Check and record the indications shown on the earth leakage detector.

7.3 Push and hold depressed the “T” button for 2.5 seconds.

The display should now indicate “TES” followed, after a short period by all three LED’s illuminating. This indicates a successfully completed test.

In the case of the unit failing this test all three LED’s flash and an error code is displayed. The meanings of these error codes are as follows:

a) E01 = PE connection fault, indicating a low-resistance connection between “E” and “KE” terminals.

b) E02 = System connection fault a low-resistance connection between “L1” and “L2” terminals.

c) E03...Exx = An Internal Device error.

7.4 Investigate and rectify all faults, if you are unable to eliminate the fault condition then the following action shall be taken:

a) Isolate the defective ELD safely from the operational busbar and label as faulty.

b) Carry out NR/SMS/PartB/Test/051 (Busbar Earth Test) immediately.

c) Advise your SM(S);

d) Treat the circuits as unmonitored by ELD until remedial action has been completed.

7.5 Reset the unit by pressing the "R" reset button for more than 1.5 sec. Observe the ELD unit for a period of 60 seconds for further alarms.

8. Calibration Test – IR425 Bender Unit

8.1 Measure and record the busbar voltage/s on the record card.

8.2 Check and record the indications shown on the earth leakage detector.

8.3 Observe the unit alarm indications are clear.

8.4 Observe the current resistance reading on the display, if the reading is smaller than 100K ohms, investigate the cause, if unable to find the cause report this to your SM(S), isolate the ELD and carry out NR/SMS/PartB/Test/051 (Earth Busbar Test).

If the current resistance reading is equal to or more than 100K ohms then proceed to the next step.

8.5 Connect an electronic calibrated meter on resistance range to the inputs of the 22K ohms resistor box. Record the reading. If the reading is not within 22K ±5% then do not use and report this to your SM(S).

8.6 Connect the 22Kohms resistor (earth fault) between:

a) Earth to each monitored busbar in turn (DC circuits).

b) or Earth and one busbar (AC circuits) for a maximum of 7 seconds.

8.7 Observe the following:

a) For monitoring supply >72v alarm 1 & alarm 2 LEDs are lit.

b) For monitoring supply <72v alarm 1 LED is lit.

Alarm 1 might not trigger if the current resistance reading displayed is showing >500K ohms on the display.

If this is the case observe the resistance reading on the display with the 22K ohm resistor connected, if the reading falls gradually to just below 22K ohms but higher than 20K ohms then record this test as ok.

Some units can have a delay setting of more than 7 seconds, in this case Alarm1 and/or Alarm 2 might not light within the seven seconds.

If this is the case, then do the test as in Step 8.5 (b) above by observing the resistance reading.

8.8 If any of the tests carried out in Step 8.5 have failed, then the following action shall be taken:

a) Isolate the defective ELD safely from the operational busbar and label it as faulty.

b) Carry out NR/SMS/PartB/Test/051 (Busbar Earth Test) Immediately.

c) Advise your SM(S).

d) Treat the circuits as unmonitored by ELD until remedial action has been completed.

8.9 Reset the unit by pressing the "R" reset button for more than 1.5 sec. Observe the ELD unit for a period of 60 seconds for further alarms.

PART D – Siemens ELD

Equipment Identification

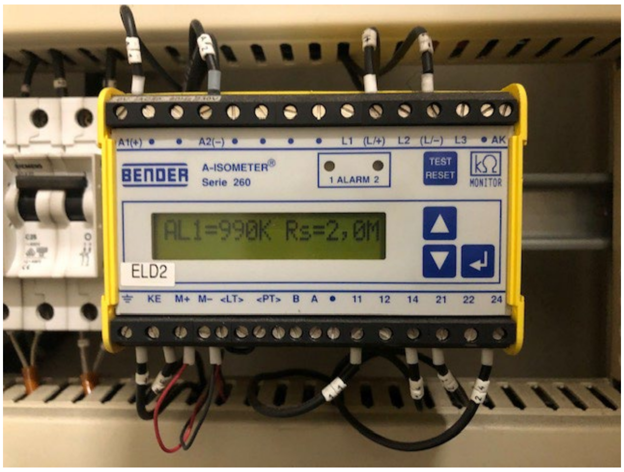


Figure 5 – Siemens ELD

9. Function Test - Siemens ELD

Visual Settings Configuration Check

9.1 Visually confirm that LED 1 is a standard type (no DC label present) and that ELD 2 is a high-speed type (DC label on the front panel).

9.2 Visually confirm that each earth leakage detector has been configured as follows:

Earth Leakage Detector 1 - Point Detection Circuit

9.3 Sensitivity setting: confirm that the kΩ rotary control is set to 40kΩ.

If the setting looks incorrect, do not adjust the control by eye; the completed Calibration Test shall be performed.

9.4 DIP switches: confirm that top DIP switch “Reset” is in the left position and the bottom DIP switch for the output relay mode is in the right position.

Earth Leakage Detector 2 - Point Machine Power

9.5 Sensitivity setting: confirm that the kΩ rotary control is set to 50kΩ. If the setting looks incorrect, do not adjust the control by eye; the completed recalibration process shall be performed.

9.6 DIP switches: confirm that top DIP switch "Reset" is in the left position and the bottom DIP switch for the output relay mode is in the right position

Trip Operation Confirmation

> The PAM auxiliary supply shall be live during this test. All resistors used in this procedure might be +/- 10% of their nominal value and the wattage =>0.25 W. Care shall be taken when connecting the probes to check that the correct terminals are used as other terminals nearby might be live.

This test requires a simulated earth fault to be connected between the monitored cables and earth. This is to confirm that the alarm activates when required.

To conduct these tests a resistor box shall be used (alternatively a series of resistors of correct value could be used).

One end of the resistor is connected to an earth terminal in the PAM using a lead terminated in a crocodile clip. The other end of the resistor is connected to a terminal on the earth device using a lead terminated with a male test probe.

Earth Leakage Detector 1: Point Detection Supply

9.7 In the case of the earth leakage detector being set to the lower level, use an 8kΩ resistor in place of the 30kΩ and an 18kΩ in place of the 68kΩ.

9.8 Disconnect links 54 and 55 to isolate the auxiliary supply.

9.9 Remove lightning suppressors 10 and 11 to disconnect the ELD from the detection circuit.

9.10 Reconnect links 54 and 55 to restore the auxiliary supply.

9.11 Using the 30kΩ resistor, connect the crocodile clip to earth. Confirm that the earth leakage detector is powered up and not showing an alarm condition.

9.12 Touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. Within 5 seconds both yellow alarm LEDs should light up.

9.13 Remove the probe and reset the fault on the detector. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. Within 5 seconds both yellow alarm LEDs should light up.

9.14 Remove the probe, reset the fault on the detector and change the resistor to 68kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. After 15 seconds NEITHER yellow alarm LED should have illuminated on the ELD.

9.15 Remove the probe. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. After 15 seconds NEITHER yellow alarm LED should have illuminated on the ELD.

9.16 Disconnect links 54 and 55 to isolate the auxiliary supply.

9.17 Replace lightning suppressors 10 and 11.

9.18 Reconnect links 54 and 55 to restore the auxiliary supply.

<u>Earth Leakage Detector 2: Point Machine Power</u>

9.19 In the case of the earth leakage detector being set to the lower level, use an 18kΩ resistor in place of the 39kΩ and a 27kΩ in place of the 82kΩ.

9.20 Disconnect links 54 and 55 to isolate the auxiliary supply.

9.21 Remove lightning suppressors 7, 8 and 9 to disconnect the ELD from the point machine power circuit.

9.22 Remove and retain the 10kΩ ELD dummy load module from the WAGO terminal position 36A and replace with a temporary 1kΩ ELD calibration dummy load module.

9.23 Reconnect links 54 and 55 to restore the auxiliary supply.

9.24 Using the 39 kΩ resistor connect the croc clip to earth. Confirm that the earth leakage detector is powered up and not showing an alarm condition.

9.25 Touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. Within 2 seconds the 'Alarm +' yellow alarm LED should light up.

9.26 Remove the probe and reset the fault on the detector. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. Within 2 seconds the 'Alarm -' yellow alarm LED should light up.

9.27 Remove the probe, reset the fault on the detector and change the resistor to 82kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. After 10 seconds neither yellow alarm LED should have illuminated on the ELD.

9.28 Remove the probe. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. After 10 seconds neither yellow alarm LED should have illuminated on the ELD.

9.29 Disconnect links 54 and 55 to isolate the auxiliary supply.

9.30 Remove and retain the temporary 1kΩ ELD calibration dummy load module from the WAGO terminal position 36A and replace with the 10kΩ ELD dummy load module.

9.31 Replace lightning suppressors 7, 8 and 9.

9.32 Reconnect links 54 and 55 to restore the auxiliary supply.

NOTE: *If a move is called with the 1kΩ ELD calibration dummy load module connected then it might be damaged. Confirm that it is disconnected before moving the points.*

10. Calibration Test - Siemens ELD

Calibration requires a simulated earth fault to be connected between the monitored cables and earth. This is to confirm that the alarm activates when required.

To conduct these tests a resistor box shall be used (alternatively a series of resistors of correct value could be used).

One end of the resistor is connected to an earth terminal in the PAM using a lead terminated in a croc clip. The other end of the resistor is connected to a terminal on the earth device using a lead terminated with a male test probe.

<u>Earth Leakage Detector 1: Point Detection Supply</u>

10.1 In the case of the earth leakage detector being set to the lower level, use an 8kΩ resistor in place of the 30kΩ, an 11kΩ in place of the 40kΩ and an 18kΩ in place of the 68kΩ.

10.2 Disconnect links 54 and 55 to isolate the auxiliary supply.

10.3 Remove lightning suppressors 10 and 11 to disconnect the ELD from the detection circuit.

10.4 Reconnect links 54 and 55 to restore the auxiliary supply.

10.5 Check that the small switches on the front of the ELD are set to top switch left and bottom switch right. Turn the ELD calibration knob to approximately 30kΩ.

10.6 Using the 40kΩ resistor, connect the crocodile clip to earth. Confirm that the earth leakage detector is powered up and not showing an alarm condition. Touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector.

10.7 Turn the ELD calibration knob very slowly clockwise (upwards) until the ELD unit just produces a fault. Note that the response time of the ELD unit is 5 s, so it is necessary to move the control a little at a time, waiting at least 5 seconds before moving it again.

10.8 Remove the probe, reset the fault on the detector and change the resistor to 30 kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. Within 5 seconds both yellow alarm LEDs should illuminate.

10.9 Remove the probe and reset the fault on the ELD. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. Within 5 seconds both yellow alarm LEDs should Illuminate.

10.10 Remove the probe, reset the fault on the detector and change the resistor to 68 kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. After 15 seconds neither yellow alarm LED should have illuminated on the ELD.

10.11 Remove the probe. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. After 15 seconds neither yellow alarm LED should have illuminated on the ELD.

10.12 Check the setting of the calibration control on the ELD graduated scale. If it appears to be more than 10kΩ from the setting of 40kΩ desired, then suspect there is a problem with the detector or wiring. Investigate and correct as necessary.

10.13 Disconnect links 54 and 55 to isolate the auxiliary supply.

10.14 Replace lightning suppressors 10 and 11.

10.15 Reconnect links 54 and 55 to restore the auxiliary supply.

<u>Earth Leakage Detector 2: Point Machine Power</u>

In the case of the earth leakage detector being set to the lower level, use an 18kΩ resistor in place of the 39kΩ, a 22kΩ in place of the 50kΩ and a27 kΩ in place of the 82kΩ

10.16 Disconnect links 54 and 55 to isolate the auxiliary supply.

10.17 Remove lightning suppressors 7, 8 and 9 to disconnect the ELD from the point machine power circuit.

10.18 Remove and retain 10kΩ ELD dummy load module from the WAGO terminal position 36A and replace with a temporary 1kΩ ELD calibration dummy load module.

10.19 Reconnect links 54 and 55 to restore the auxiliary supply.

10.20 Check that the small switches on the front of the ELD are set to top switch left and bottom switch right. Turn the ELD calibration knob to approximately 40kΩ.

10.21 Using the 50kΩ resistor, connect the crocodile clip to earth. Confirm that the earth leakage detector is powered up and not showing an alarm condition. Touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector.

10.22 Turn the ELD calibration knob very slowly clockwise (upwards) until the ELD unit just produces a fault.

NOTE: *The response time of the ELD unit is 2 s, so it is necessary to move the control a little at a time, waiting at least 2 seconds before moving it again.*

10.23 Remove the probe, reset the fault on the detector and change the resistor to 39kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. Within 2 seconds the "Alarm +" yellow alarm LED should illuminate.

10.24 Remove the probe and reset the fault on the ELD. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. Within 2 seconds the "Alarm -" yellow alarm LED should illuminate.

10.25 Remove the probe, reset the fault on the detector and change the resistor to 82kΩ. Then touch and hold the probe end of the resistor lead to the L1 terminal of the earth leakage detector. After 10 seconds neither yellow alarm LED should have illuminated on the ELD.

10.26 Remove the probe. Then touch and hold the probe end of the resistor lead to the L2 terminal of the earth leakage detector. After 10 seconds neither yellow alarm LED should have illuminated on the ELD.

10.27 Check the setting of the calibration control on the ELD graduated scale. If it appears to be more than 10kΩ from the desired setting of 50kΩ, desired then suspect there is a problem with the detector or wiring. Investigate and correct as necessary.

10.28 Disconnect links 54 and 55 to isolate the auxiliary supply.

10.29 Remove and retain the temporary 1kΩ ELD calibration dummy load module from the WAGO terminal position 36A and replace with a 10kΩ ELD dummy load module.

10.30 Replace lightning suppressors 7, 8 and 9.

10.31 Reconnect links 54 and 55 to restore the auxiliary supply.

> ***NOTE:*** *If a move is called with the 1KΩ ELD calibration dummy load module connected then it might be damaged. Confirm that it is disconnected before moving the points.*

APPENDIX A - Calibration and Adjustment - 930 Type and P Style Units

This test is only applicable to Type DC ELK (S)1 and DC ELK(S)2 for DC supplies (pin code 239).

This test shall only be undertaken at times when train movements have stopped, as the set up requires an earth fault to be simulated.

If automatic reset straps are fitted (C6 C7 C8), these shall be removed for the duration of the adjustment test and reconnected on completion.

1. Check the signalling supply is earth free before any adjustments are made by carrying out NR/SMS/PartB/Test/051 (Busbar Earth Test).

   Rectify any earth faults above the reportable limit. NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).

   All faults shall be reported to your SM(S).

   If the fault is unrectified your SM(S) shall be advised within 24 hours.

   The calibration shall not be carried out on a supply with an earth, as the adjustment made would mask the presence of the earth.

2. For the 50V DC supply, connect a 50KΩ resistor of at least 0.25W, between B50 and main earth.

   These connections shall be made at positions A3 and B3.

3. For the 120V DC supply, connect a 33KΩ resistor of at least 2W, between B120 and main earth.

   These connections shall be made at positions A1 and B1.

4. Whilst pressing the (B) test button, carefully set the left hand “adjust” screw, so that the point is reached at which the fault indication is only just given.

   For the 50V DC supply, connect the resistor between C3 and B3.

   For the 130V DC supply, connect the resistor between C1 and B1.

5. Whilst pressing the (N) test button, carefully set the left hand “adjust” screw, so that the point is reached at which the fault indication is only just given.

6. Remove resistor.

7. Reset to restore the ELD to service.

APPENDIX B - Unit Controls, Indications and Connections- IR145

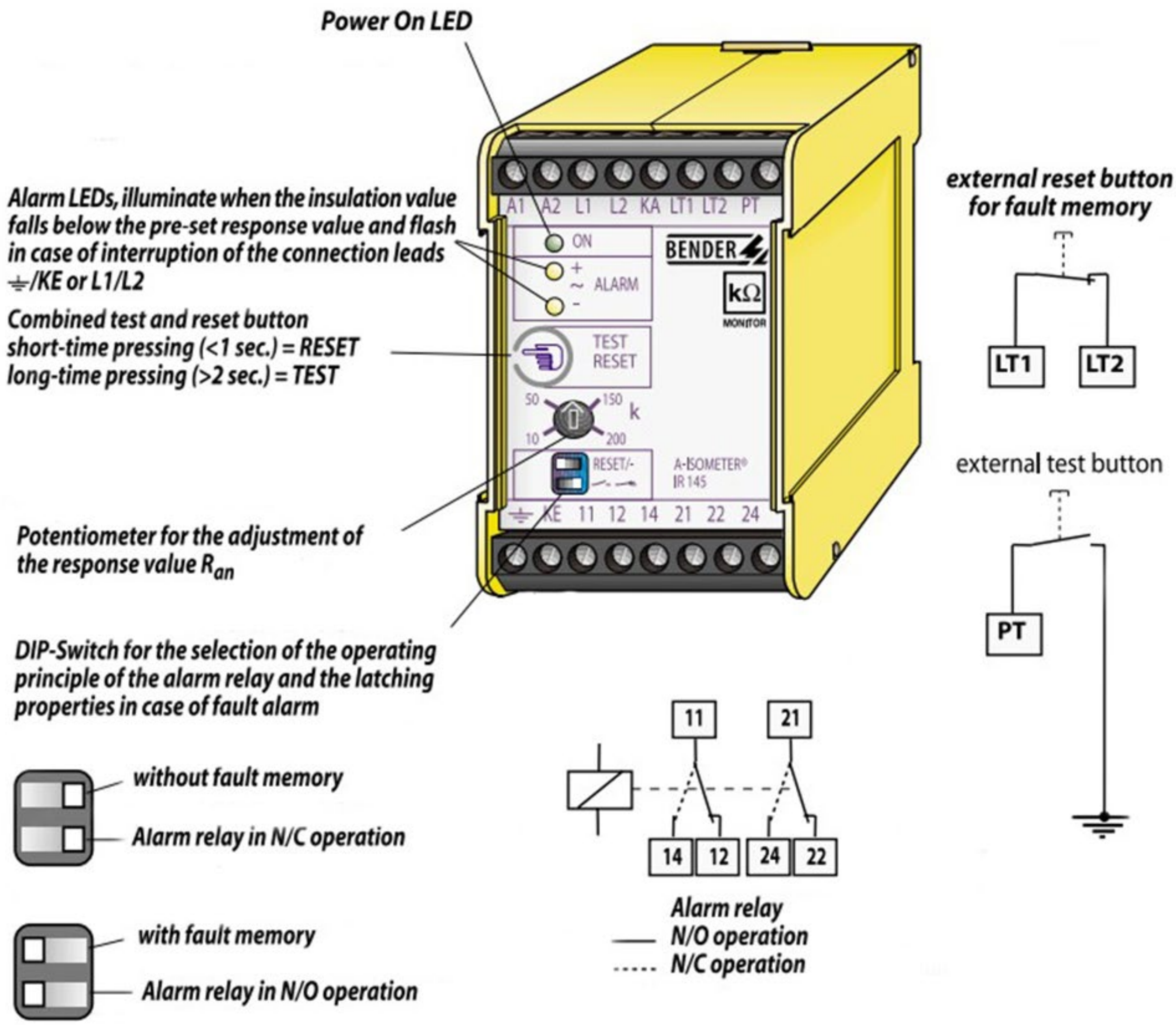


Figure 6 - IR145 Layout

1. Activating / Deactivating the Fault Memory

   The fault memory is Activated / Deactivated using the top toggle switch on the front of the unit as indicated in Figure 5.

2. Alarm Relay

   This option is used to change the behaviour of the contacts between normally closed (N/C) (non-failsafe) mode and normally open (N/O) (failsafe) mode.

   The contact operation is controlled by using the bottom toggle switch on the front of the unit as indicated in Figure 5.

APPENDIX C - Unit Controls and Indications IR425 Bender Units

1. LED power "ON", (flashes in case of interruption of the connecting leads E/KE or L1/L2).

2. Alarm LED "AL1", lights when the value falls below the set response value Alarm 1 and flashes in case of interruption of the connecting leads E/KE or L1/L2.

3. Alarm LED "AL2", lights when the value falls below the set response value Alarm 2 and flashes in case of interruption of the connecting leads E/KE or L1/L2.

4. LC display.

5. Test button "T": to call up the self-test.

   Arrow up button: parameter change, to move up in the menu.

6. Reset button "R": to delete stored insulation fault alarms.

   Arrow down button: parameter change, to move down in the menu.

7. Menu button "MENU": to call up the menu system. Enter button: Confirms parameter changes.

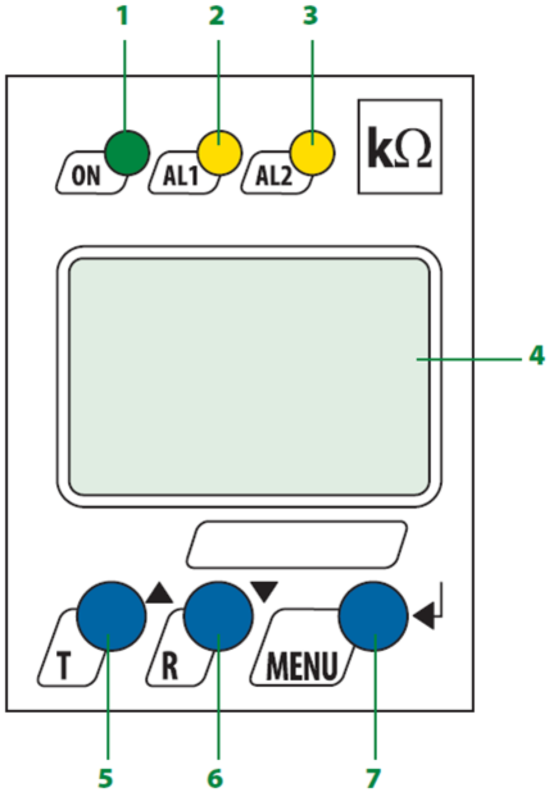


Figure 7 –IR425 Bender Units

APPENDIX D - Setting up the Parameters – Bender Unit IR425-D4M1C

WARNING Default Settings

After connecting the unit to both the power supply to be monitored and the supply voltage for the first time, the following default setting are applied:

Response value (R2)	>72V = 23 kΩ ≤72V = 10 kΩ
Operating Mode R2	N/O operation
R2 Fault memory	Deactivated
M1C current output	0-20mA
Starting delay	t=0s
Response delay	t_{on}=0s
Password	1, disabled

Table 1 – Default Setting

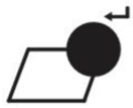
If the unit is reset the default settings automatically become active again.

The default response values are not acceptable on Network Rail Infrastructure and shall be adjusted to meet the Network Rail Parameters, using the process explained in this Appendix.

<u>Parameter R2</u>

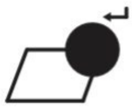
1. From the Monitoring Screen.

2. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds.

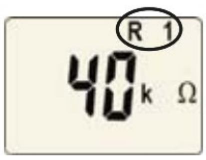


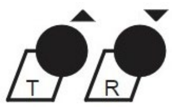
3. A flashing "AL" symbol appears on the screen.

4. This is the Alarm Mode screen. Press the MENU/Enter button for less than 1.5 seconds.



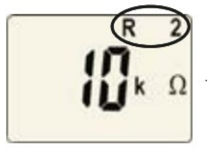
5. The parameter R1 flashes.



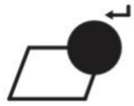


6. Press the R / Down key to select the parameter R2.

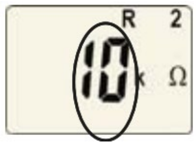
7. The parameter R2 flashes.



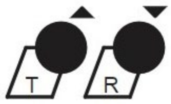
8. Confirm this by pressing the MENU/Enter button for less than 1.5 seconds.

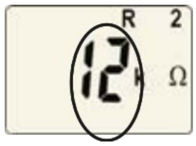


9. The current R2 value in kΩ then flashes.

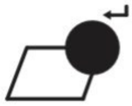


10. Use the T / Up or R / Down key to adjust the parameter value to the require figure.

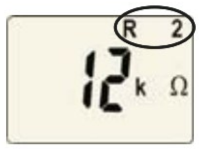




11. Press the MENU/Enter button for more than 1.5 seconds.



12. The parameter R 2 flashes.

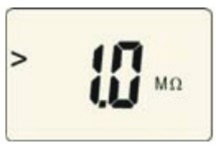


13. The new parameter is now set, and you can exit the menu by:

    a) pressing the Enter key for more than 1.5 seconds to reach the next higher level.

    b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

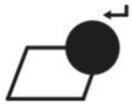
14. This returns you to the Monitoring Screen.



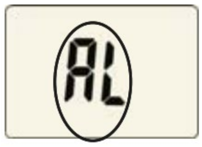
<u>Current Output Parameter (M1C)</u>

15. From the Monitoring Screen.

16. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds.

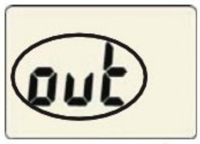


17. A flashing "AL" symbol appears on the screen.

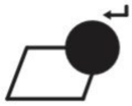


18. Press the R / Down button once.

19. The word "out" appears and flashes.



20. To enter the current output, press the MENU/Enter once for less than 1.5 seconds.



    On or OFF appears (as appendix C section7).

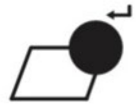
    Press the R / Down button twice.

21. The display "0.20mA" or "4.20mA" appears steady with a flashing **I**.

22. Press the MENU/Enter once for less than 1.5 seconds.

23. Select the required range (4.20mA). The display continues to flash during this process.

24. Press the MENU/Enter once for more than 1.5 seconds.

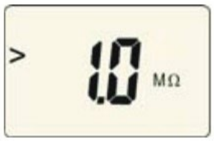


25. The new parameter is now set, and you can exit the menu by:

    a) pressing the Enter key for more than 1.5 seconds to reach the next higher level.

    b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

26. This returns you to the Monitoring Screen.



APPENDIX E - Setting up the Parameters – Bender Unit IR425 (Not D4M1C type)

WARNING Default Settings

After connecting the unit to both the power supply to be monitored and the supply voltage for the first time, the response values Ran1/Ran2 (Alarm 1/2) are automatically set to the following:

For voltages greater than 72 V

- Response value 1 = 46 kΩ
- Response value 2 = 23 kΩ

For voltages less than or equal to 72 V

- Response value 1 = 20 kΩ
- Response value 2 = 10 kΩ

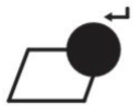
If the unit is reset the default settings automatically become active again.

These values are not acceptable on Network Rail Infrastructure and shall be adjusted meet the Network Rail Parameters, using the process explained in this Appendix.

Parameter R2

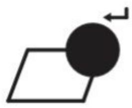
1. From the Monitoring Screen.

2. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds,

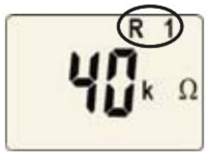


3. A flashing “AL” symbol appears on the screen.

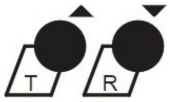
4. This is the Alarm Mode screen. Press the MENU/Enter button for less than 1.5 seconds.



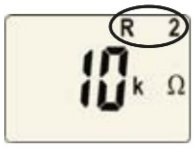
5. The parameter R1 flashes.



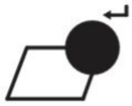
6. Press the R / Down key to select the parameter R2.



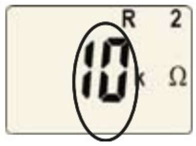
7. The parameter R2 flashes.

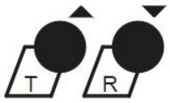


8. Confirm this by pressing the MENU/Enter button for less than 1.5 seconds.

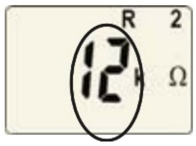


9. The current R2 value in kΩ flashes.

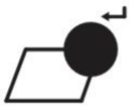




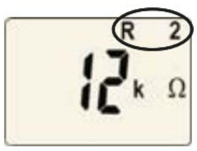
10. Use the T / Up or R / Down key to adjust the parameter value to the require figure shown in NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).



11. Press the MENU/Enter button for more than 1.5 seconds.



12. R 2 flashes.

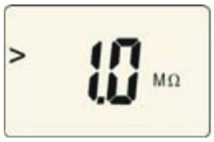


13. The new parameter is now set, and you can exit the menu by:

    a) pressing the Enter key for more than 1.5 seconds to reach the next higher level.

    b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

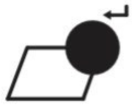
14. This returns you to the Monitoring Screen.



Parameter R1

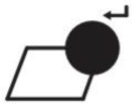
15. From the Monitoring Screen.

16. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds.

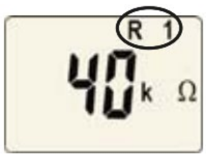


17. A flashing “AL” symbol appears on the screen.

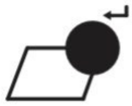
18. This is the Alarm Mode screen. Press the MENU/Enter button for less than 1.5 seconds.



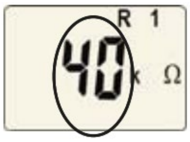
19. The parameter R1 flashes.



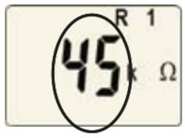
20. Confirm this is the parameter you want to adjust by pressing the MENU/Enter button for less than 1.5 seconds.



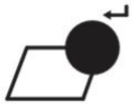
21. The current R1 value in kΩ then flashes.



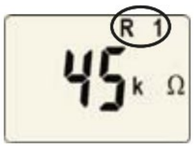
22. Use the T / Up or R / Down key to adjust the parameter value to the require figure shown in NR/SMS/PartZ/Z07 (Earth Leakage – Reference Values).



23. Press the MENU/Enter button for more than 1.5 seconds.



24. R 1 flashes.



25. The new parameter is now set, and you can exit the menu by:

   a) pressing the Enter key for more than 1.5 seconds to reach the next higher level.

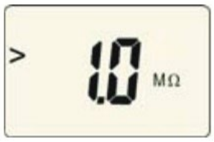
   b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

26. This returns you to the Monitoring Screen.

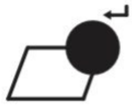
APPENDIX F - Activating / Deactivating the Fault Memory- All IR425 Bender Units

Changing this setting to "ON" causes the IR420-D4 to latch in the event of an alarm and require a manual reset if the alarm clears. Changing this setting to "OFF" causes the IR425 to automatically reset if the alarm clears. For location cases utilising the Atkins Signalling Method the fault memory should be set to "OFF".

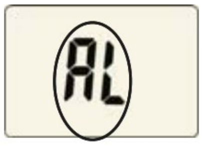
1. From the Monitoring Screen.



2. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds.

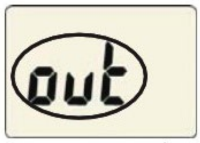


3. A flashing AL symbol appears on the screen.

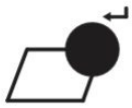


4. Press the R / Down button once.

5. The word "out" appears and flashes.

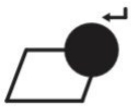


6. To enter the Latching Mode (Fault Memory), press the MENU/Enter once for less than 1.5 seconds.

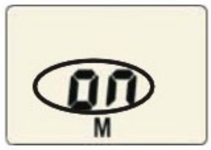


7. The word "on" or "off" appears with a flashing "M" under it. This indicates you are in the Latching Mode.

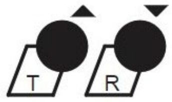
8. Press the MENU/Enter once for less than 1.5 seconds.



9. The word “on” or “off” appears and starts to flash.

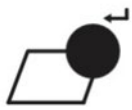


10. The T / Up or the R / Down buttons can now be used to move the Latching Mode (Fault Memory) to the required position. The display continues to flash during this process.



11. Once the required position is set.

12. Press the MENU/Enter once for more than 1.5 seconds.

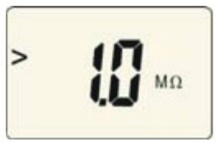


13. The new parameter is now set, and you can exit the menu by:

    a) pressing the Enter key for more than 1.5 seconds to reach the next higher level;

    b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

14. This returns you to the Monitoring Screen.

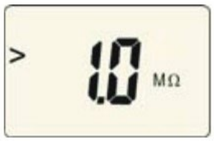


APPENDIX G - Contact operation – All Bender IR425 Units

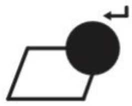
Use this option to change the behaviour of the contacts between normally deenergized (non-failsafe) mode and normally energized (failsafe) mode.

Note that the IR425 labels normally deenergized operation as “N/O” and normally energized operation as “N/C”. For location cases utilising the Atkins Signalling Method the R2 contact output should be normally energised “N/C”.

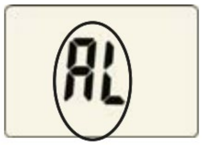
1. From the Monitoring Screen.



2. To enter the Menu Mode, press the MENU/Enter button on the front display for more than 1.5 seconds.

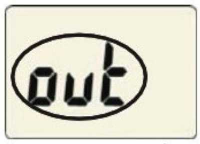


3. A flashing AL symbol appears on the screen.

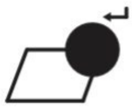


4. Press the R / Down button once.

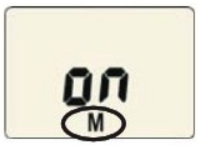
5. The word “out” appears and flashes.



6. To enter the Latching Mode (Fault Memory), press the MENU/Enter once for less than 1.5 seconds.



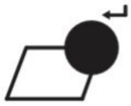
7. The word “on” or “off” appears with a flashing “M” under it. This indicates you are in the Latching Mode.



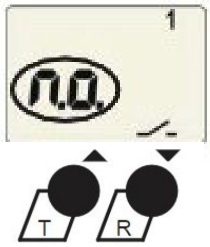
8. Press the R / Down button once.

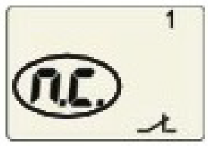
9. This screen shows the current position of the contacts “n.o.” (Normally Open) with a flashing open contact graphic and the contact number.

10. To adjust the contact operation, press the MENU/Enter once for less than 1.5 seconds.

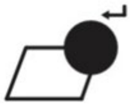


11. With the “n.o.” now flashing the T / Up or the R / Down buttons can be used to set the contacts to the “nc” (Normally Closed) position. The display continues to flash during this process.





12. Press the MENU/Enter once for more than 1.5 seconds.

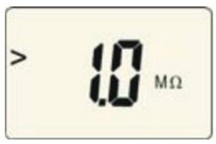


13. The new parameter is now set, and you can exit the menu by:

   a) pressing the Enter key for more than 1.5 seconds to reach the next higher level;

   b) or selecting the menu item ESC and confirming with Enter to reach the next higher level.

14. This returns you to the Monitoring Screen.



END

Includes:	Existing Cables and when bringing spare cores back into use. Cables being replaced under Signal Maintenance Testing Handbook CA02 and CA07
Excludes:	New cables shall be tested using Signalling Works Test Handbook TS3-01

General

Insulation testing shall be undertaken where cable insulation values cannot be checked by earth busbar testing or by reference to an ELD indication.

It is more onerous than busbar testing as it requires the isolation of the whole cable or specific cores, before testing.

Insulation testing is usually restricted to the following cables:

a) Earth balanced / return circuits:e.g. telephones, block circuits.

b) Power cables: With a nominal voltage greater than 110V AC or 120V DC.

Cables that have a voltage greater than 175V shall be disconnected and isolated in accordance with authorised electrical safety procedures.

c) Defective cables: In connection with NR/SMTH.

A 1000V insulation tester (e.g. Megger) shall be used to test power cables.

A minimum of a 250V insulation tester shall be used to test lineside cables. For telecom cables carrying signalling circuits, reference shall be made to NR/L2/TEL/30070.

Testing should be avoided during dry or frosty weather.

Section 1, 2, and 3 are for all cables except those carrying vital FDM systems which are covered in sections 4 & 5.

If you are in any doubt about the functionality of the cable you are testing, ask your SM(S).

See NR/SMS/PartZ/Z05 (Cable Reference Values) for typical cable values.

Previous results on the NR/SMS record card might give you an indication of the state of the cable insulation (see also NR/SMS/Part/R – Maintenance Record Cards).

Check the record card for any trends. If the previous results are in the ‘good’ range and you now find readings are in the ‘acceptable’ or ‘defective’ range, then its most likely the insulation has been damaged.

Includes:	All cables carrying signalling circuits and non-vital FDM circuits
Excludes:	Cables carrying vital FDM circuits

1. Maintenance Test (Signalling circuits and non-vital FDM circuits only)

1.1 Carry out a continuity test between the earth terminal to be used during this test and earth.

1.2 For a test to be valid, the number of spare cores that need to be tested in each cable is as follows:

a) Less than10 cores: 2 spares.

b) 10-21 cores: 3 spares.

c) Greater than 21cores: 4 spares.

If inadequate spare cores are available, then working conductors shall be disconnected to make up the difference.

1.3 Isolate the cable cores by slipping links at both ends but leave the conductors connected to the terminals.

1.4 Measure the resistance between conductors connected together and earth.

1.5 Measure the core-to-core resistance.

If any results are less than 1M ohm a Full Insulation Test shall be carried out.

1.6 Record the test results on the record card. Actions detailed in Table 1 shall be taken in line with the obtained results:

Obtained Values	Actions
Greater than 10M ohms	This indicates that the insulation is in **Good Condition** and no further action is required.
Between 1M ohm and 10M ohms	This indicates that the insulation is in **Acceptable Condition** and no immediate action is required.
Below 1M ohm	This indicates that the insulation has degraded or is **Defective**. It shall be reported to your SM(S) immediately and shall not be left in service without the relevant authority (see NR/SMS/PartZ/Z05 (Cable Reference Values).

Table 1 – Maintenance Test Actions Table

1.7 Under the direction of the SM(S) divert circuits onto good / acceptable spare cores as shown in NR/SMTH/Part01/Module/12 (The Diversion of a Circuit/Relay Contact or Emergency Equipment Relocation).

Append the local site diagrams with details of the diversions and the Technician's name, date and signature of when the diversion was applied.

2. Full Insulation Test (Signalling circuits and non-vital FDM circuits only)

This test shall be undertaken if measurements taken in the maintenance test are less than 1Mohm.

2.1 Confirm that the earth terminal to be used during this test is connected to earth.

2.2 Test all cores in the cable.

2.3 Isolate the cable cores by slipping links at both ends but leave the conductors connected to the terminals.

2.4 Measure the resistance between conductors connected together and earth.

2.5 Measure the core-to-core resistance.

2.6 Record the test results on the record card. The actions detailed in Table 2 shall be taken in line with the obtained results:

Obtained Values	Actions
Greater than 10M ohms	This indicates that the insulation is in **Good Condition** and no further action is required
Between 1Mohm and 10M ohms	This indicates that the insulation is in **Acceptable Condition** and no immediate action is required.
Below 1M ohm	This indicates that the insulation has degraded or is **Defective**. It shall be reported to your SM(S) immediately and shall not be left in service without the relevant authority (see NR/SMS/PartZ/Z05 (Cable Reference Values).

Table 2 – Full Test Actions Table

2.7 Under the direction of the SM(S) divert circuits onto good/acceptable spare cores as shown in NR/SMTH/Part01/Module/12 (The Diversion of a Circuit/Relay Contact or Emergency Equipment Relocation).

Append the local site diagrams with details of the diversions and the Technician's name, date and signature of when the diversion was applied.

3. Cables Carrying Vital Reed FDM Circuits

Includes:	Cables carrying vital FDM circuits.
Excludes:	Cables carrying vital or non-vital FDM circuits on routes Running Parallel to FS2600 Track Circuits or on Routes Carrying Class 92 or Class 373 Trains (See section 4).

There are three ways of testing these cables (Table 3):

Method	Details
A	Reed non-intrusive earth leakage adaptor & digital multi-meter
B	Reed earth leakage tester
C	As detailed in section1

Table 3 – Testing Methods

Methods A and B are preferred as they test all the components connected to the cable as well as the cable itself.

It also has the advantage of not having to take the cable out of service during the tests.

The readings for both methods A&B should be taken on the line amplifier and the line-isolating transformer for each individual circuit.

3.1 Connect the adaptor/tester (Appendix A). Test the cable and record the results on the record card. Table 4 details actions that shall be taken on results obtained for existing cables:

Method	Acceptable Reading	Report to SSM	Treat as Defective
A&C	3M Ω & above	Between 1M Ω & 3M Ω	Less Than 1M Ω
B	3M Ω or above	Between 1.5M Ω & 2.9M Ω	1.5M Ω or Less

Table 4 – Actions One

4. Reed FDM Cables Carrying Vital or non-Vital Circuits Running Parallel to FS2600 Track Circuits or on Routes Carrying Class 92 or Class 373 Trains

Includes:	Cables carrying vital or non-vital FDM circuits on routes Running Parallel to FS2600 Track Circuits or on Routes Carrying Class 92 or Class 373 Trains only
Excludes:	Any other cables

4.1 Connect the adaptor/tester (Appendix A). Test the cable and record the results. Table 5 details actions that shall be taken on results obtained for existing cables:

Method	**Acceptable Reading**	**Report to SM(S)**	**Treat as Defective**
A&C	6M Ω & above	Between 1M Ω & 6M Ω	Less Than 1M Ω
B	3M Ω or above	Between 0.7M Ω & 2.9M Ω	0.7M Ω or Less

Table 5 – Actions Two

APPENDIX A - Testing Methods

Method A - Testing using the Reed Non-Intrusive Earth Leakage Adaptor and digital multi-meter

1. Confirm that the earth terminal to be used during this test is connected to earth.

2. Select DC volts on the meter and connect it to the adapter. Connect the red and green leads together and check the meter reading. If less than 9V, replace the batteries.

3. Connect the green lead to the test earth and the red lead to the circuit under test. Note the meter reading as V1.

4. Connect the red lead at the adaptor end to the terminals on the adaptor in turn in the following order (Table 6):

Order	Terminal	Reference Resistance
1st	White	1M Ω
2nd	Brown	3M Ω
3rd	Yellow	6M Ω
4th	Green	10M Ω
5th	Blue	15M Ω

Table 6 – Testing Order

The meter reading from each terminal should be noted as V2. This should reduce as the resistance value increases.

5. When V2 is lower than V1 the cable resistance to earth is lower than the reference resistance for that terminal.

Line Resistance

This can be worked out using the Reed Non-Intrusive Earth Leakage Adaptor and digital multi-meter. The method is as follows:

6. Measure the voltage across resistor R15 with the red lead strapped to the green lead. This is V1.

7. Measure the voltage across resistor R15 with the red lead connected to the cable under test and the green lead connected to earth. This is V2.

8. The resistance value (RC) can now be worked out from the application of the following formula: RC = 5 x 106 [V1/V2 – 1]. The result is shown in Ohms.

Method B - Testing using the Reed Earth Leakage Tester Values

9. Confirm that the earth terminal to be used during this test is connected to earth.

10. Connect the tester between the test earth and the circuit under test. Operate the tester and note the value on the scale. Table 7 gives the equivalent resistance to earth for the scale on the meter (Figure 1).

Meter Reading	Earth %	Equivalent ohms to Earth
Red	100%	0 Ω
9	90%	55.5k Ω
8	80%	125k Ω
7	70%	214k Ω
6	60%	333k Ω
5	50%	500k Ω
4	40%	700k Ω
3	30%	1.2M Ω
2	20%	2M Ω
1	10%	4.5M Ω
0.5	5%	9.5M Ω

Table 7 - Resistance to earth for the scale

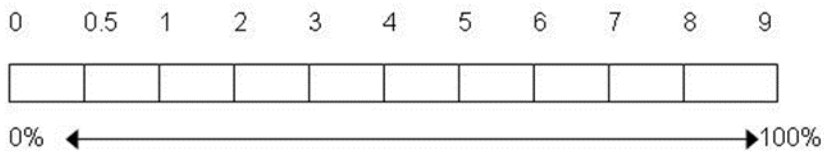


Figure 1 - Meter Scale

END

General

NR/SMS/PartC/EL00 (Secondary Cell Test) details the risks associated with testing secondary cells.

Liaise with the Signaller before turning any battery chargers off as power/equipment failure indications can be given.

1. Lead Acid / Alkaline Secondary Cells (Unsealed)

1.1 Switch the battery charger off and measure each individual cell voltage.

Allow a few minutes for the cell voltages to stabilize before taking the readings.

Cell Type	Nominal Voltage	Minimum Voltage
Lead Acid	2.2V	2V
Alkaline	1.1V	1V

Table 1 – Cell Voltages

1.2 Record the lowest reading on the record card and arrange for cells below the minimum to be replaced.

Alkaline cells usually come in banks of 3 or 5 cells (except single TC feeds). It is advisable to replace the whole bank if one is found defective.

1.3 Measure and record the full battery voltage.

1.4 Connect the voltmeter across one cell. Switch the battery charger on.

The cell voltage should rise slightly above the nominal voltage.

This indicates that the charger is working.

The nominal voltage times the number of cells.

2. Cyclon Cells (including Modular Cyclon Cells used on Point Installations)

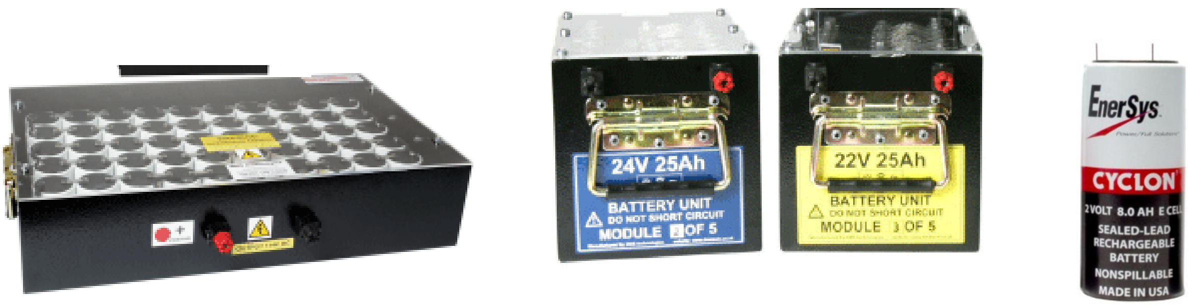


Figure 1 - Types of Cyclon Cells

These cells are 'sealed for life' therefore topping up is not required.

2.1 With battery charger switched on, measure the full battery voltage (2.35 times the number of cells). Record the result.

2.2 Switch the battery charger off. Measure the battery voltage. Check the battery voltage does not significantly deteriorate under load. Record the results.

An ideal time for the batteries to be on load is 30 minutes, although this might not be possible in all circumstances.

2.3 Switch the battery charger on. Check that the battery voltage rises.

3. ALCAD Vantage Cells

3.1 Measure the battery voltage.

3.2 Measure the voltage of each cell, then add the highest and lowest readings together and divide the result by the total number of cells. Record the answer on the record card.

The preferable value is 1.42 to 1.43V per cell with an absolute maximum of 1.43V per cell.

Inform your SM(S) if the value is greater than 1.43V.

Appendix B lists nominal/maximum voltages for batteries. Allow the battery to stabilise if adjusted.

3.3 Switch the battery charger off and measure the battery voltage again.

Check the battery voltage does not significantly deteriorate under load.

An ideal time for the batteries to be on load is 30 minutes, although this might not be possible in all circumstances.

3.4 Record the time "on load" on the record card.

3.5 Check electrolyte levels and note the following:

- Any cells where the level that has moved significantly down from maximum towards minimum top up to the maximum line (Appendix A).

- Any cells that are below minimum but above warning level, and by how much – reported to your SM(S).
- Any cells below the warning level – report as corrective maintenance.

3.6 Measure the battery voltage after 30 minutes and compare with previous readings.

3.7 Switch the charger back on.

4. Power Box (PB) (Modular) Cells

These are 'sealed for life' cells, therefore no topping up is required.

If this test is being carried out as part of testing a replaced battery pack, it should be carried out after allowing the battery to build up its charge.

4.1 With battery charger switched on, Measure the full battery voltage on the Battery Pack between monitoring points Red 1 and Black 5.

Record the result on the record card.

4.2 Switch the battery charger off. Measure the battery voltage on the Battery Pack between monitoring points Red 1 and Black 5.

4.3 Check the battery voltage does not significantly deteriorate under load.

4.4 Record the time "on load" on the record card.

An ideal time for the batteries to be on load is 30 minutes, although this might not be possible in all circumstances

4.5 Switch the battery charger on and check that the battery voltage rises.
Redundant Power Supplies Check

4.6 Switch one of the battery strings OFF. Check that the only indication change is that the associated Battery Charger module's 24V LED changes from green to red.

4.7 Switch the battery string ON and check the associated battery charger module's 24V LED changes back to Green.

4.8 Repeat above process for the other battery string.

APPENDIX A - ALCAD Vantage Cells topping up procedure

Caution: These cells are pressurised

a) Slowly remove pressure vent cap to release pressure Do not place filler neck into cell.

b) Position over vent cap opening and inject water, observing level on external fill lines.

c) Check the vent seal is intact and not damaged before refitting vent cap. Tighten the cap until a positive stop is felt.

d) If the vent seal is not in good condition, report to your SM(S), noting whether the cap is bayonet or thread fitting.

After topping up cells, the fluid level can go up or down as the cell pressurises.

APPENDIX B - Battery Voltages for Vantage Cells

No. of Cells in Battery	Nominal Voltage	Maximum Voltage
1	1.42V	1.43V
2	2.84V	2.86V
3	4.26V	4.29V
5	7.1V	7.15V
10	14.2V	14.3V
15	21.3V	21.45V
20 #1	28.4V	28.6V
25	35.5V	35.75V
30	42.6V	42.9V
35	49.7V	50.05V
40 #2	56.8V	57.2V
45	63.9V	64.35V

No. of Cells in Battery	Nominal Voltage	Maximum Voltage
50	71V	71.5V
55	71.8V	78.65V
60	85.2V	85.8V
65	92.3V	92.95V
70	99.4V	100.1V
75	106.5V	107.25V
80	113.6V	114.4V
85 #3	120V	121.55V
90	127.8V	128.7V
95	134.9V	135.85V
100	142V	143V

#1: 24V Battery.
#2: 50V Battery.
#3: 110V Battery.

END

General

The Avel-Lindberg User Handbook contains information on settings and fault finding.

Inverters can be connected in following modes:

a) Hot standby (inverter running but not on load).

b) Cold standby (inverter not running).

c) Running permanently on load.

The 'hot' standby mode is the preferred method of connection.

Inverter systems can be a single unit only or two units acting as 'master' and 'slave'.

Due to the 'rectified DC' output from some battery chargers, it is advisable not to run the inverters from the output of a charger only as this can lead to damage of the inverter's electronics.

Switching between inverter modes (Main, Standby, Generator) can cause certain circuits (stick, indication etc) to drop and not re-pick. Always liaise with the Signaller and check all circuits are normalised on completion of testing.

All the test results shall be recorded on the record card.

1. Battery Charger

Some cells require a constant voltage charger. NR/SMS/PartC/EL00 (Electrical Equipment - General) gives you more details on these. If in doubt, ask your SM(S).

1.1 Disconnect the battery charger for 5 minutes and then test the batteries - carry out NR/SMS/PartB/Test/055 (Secondary Cell Test).

1.2 Reconnect the battery charger and (if applicable):

Measure the trickle charge current.

The charging rate is controlled electronically and is not adjustable.

1.3 Remove the BX110 and B110 fuses in turn and check that the 'Charger Supply Failed' lamp illuminates after about 10 seconds.

1.4 Replace the fuses and (if applicable) re-check the trickle charge current.

2. Automatic Switching Cabinet (Hot & Cold Standby Modes Only)

2.1 Check that all cut outs on the inverters are 'IN'.

The cut-out switches should be in the left-hand position.

Inverters on cold standby are prone to tripping when an inductive load is switched in.

If an inverter has tripped, you should also look for:

a) A low dc supply voltage, or

b) More than 10% AC ripple.

If the system is master and slave, the slave unit shall be re-set first followed by the master unit.

2.2 Check the indications on the switching cabinet.

The indications provided vary between installations. Any indicated faults shall be dealt with as corrective maintenance.

2.3 With the co-operation of the Signaller, test the standby supply.

Switch off the main power supply at its source. The inverter(s) should switch in after about 250ms. This delay can cause most relays to de-energise.

2.4 Check that a power failure is indicated on the switching cabinet and in the signal box.

2.5 Measure the following power supply values:

a) Input DC volts to the inverter switching cabinet (B110 bus-bar).

b) Output AC volts to equipment.

c) BX110 bus-bar voltage.

2.6 Check that the inverter can maintain the load without any system failures for a period representing 50% of the time that it is expected to cover. After this period, repeat step 2.5.

2.7 Test the load capability of the inverter.

Where a common 110V inverter / point battery exists, operate a double ended set of points both ways for three operations.

2.8 Restore the power supply and check that:

a) The inverters switch off.

b) The charger switches on.

c) Any cut-outs remain 'IN'.

d) Normal indications are obtained.

After carrying out a load test, you should check that the batteries are fully charged. If possible, this check should be on the following day.

3. Automatic Switching Cabinet (Permanently on Load Systems Only)

3.1 With the co-operation of the Signaller; switch off the supply to the inverter battery charger.

3.2 Check that a power failure is indicated on the switching cabinet and in the signal box.

3.3 Measure the following power supply values:

a) Input DC volts to the inverter switching cabinet (B110 bus-bar).

b) Output AC volts to equipment.

c) BX110 bus-bar voltage.

3.4 Check that the inverter can maintain the load without any system failures for a period representing 50% of the time that it is expected to cover. After this period, repeat step 3.3.

3.5 Test the load capability of the inverter.

Operate the equipment the inverter supplies.

3.6 Restore the supply to the inverter charger and operate the RESET button on the switching cabinet. Check that normal indications are received on the switching cabinet and in the signal box.

4. Generator Facility (If Fitted)

Some inverters are fitted with a generator socket.

4.1 Plug in a generator that has a large enough load capacity. Start it up and allow it to settle down.

4.2 Check all indications are normal.

4.3 Get the Signallers co-operation and switch off the main power supply.

This can switch Hot and Cold systems to inverter operation. Permanently on systems only indicate a power failure.

4.4 Turn the switch on the switching cabinet to the ‘Generator’ position to connect the generator supply.

4.5 Check that the generator is supplying satisfactory power to the signalling system. Measure the bus-bar voltages.

4.6 Disconnect the generator by turning the switch on the switching cabinet to the ‘Normal’ position and restore the main power supply.

4.7 Check that the inverter switching cabinet and signal box indications are normal.

Some systems require the operating of the reset button on the switching cabinet.

4.8 Switch off and unplug the generator.

END

Includes:	Uninterruptible Power Supplies, and the Powernetics Systems at Cromer

GENERAL

UPS systems contain mains supply voltages of 230V AC. Relevant safety procedures shall be complied with when working on this equipment.

1. UPS Tests (Not the Powernetics Systems at Cromer).

1.1 Check the indications on the unit so that it is working correctly. Investigate and rectify if any problems are found.

1.2 Simulate a power failure by disconnecting a fuse or link to the input supply of the UPS. Observe that the UPS maintains the load and that the relevant indications of a power failure are given.

1.3 Check that the UPS can maintain the load without any system failures for a period representing 50% of the time that it is expected to cover.

Measure the voltage at the start, middle and end of this period. Use these readings to estimate the UPS voltage at 100% of the expected period (where possible use manufacturers discharge graphs).

If the UPS voltage either falls below the lower supply limit or is predicted to do so it shall be reported to your SM(S).

1.4 Reconnect the power to the UPS and observe that the correct indications are given.

1.5 Where the batteries are external to the UPS, check that after the reconnection of power they are charging, NR/SMS/PartB/Test/055 (Secondary Cell Test).

1.6 Where the batteries are internal to the UPS or are maintenance free, they shall be tested and/or replaced at intervals recommended by the manufacturer.

2. Powernetics UPS at Cromer only UPS

2.1 Select “LOAD ON BYPASS” and operate Manual Bypass Switch to the UPS/BYPASS position.

2.2 Switch unit OFF in the correct sequence.

2.3 Move the Manual Bypass Switch to the BYPASS position.

2.4 Remove unit covers, check that loose earth leads are safely taped up.

2.5 Clean the inside of the unit.

2.6 Carry out a visual inspection of the system (Mechanical Electrical and Electronics, including connectors). Rectify and/or report defects.

2.7 Check PCB's and other components for signs of overheating. Rectify as necessary.

2.8 Check that fans spin freely when operated with finger and that they feel 'smooth'.

3. Batteries

3.1 Check the state of battery terminals. Clean and grease if required.

4. System Parameters

4.1 Move the Manual Bypass switch to the BYPASS/UPS position and power up the unit in the correct sequence.

4.2 Check that all fans turn at full speed.

4.3 Press the Auto Bypass switch to select "LOAD ON BYPASS" and move the Manual Bypass switch to the UPS position.

4.4 Record the following parameters on the NR/SMS Record Card :

a) Supply Voltage.

b) Charger Float Voltage.

c) Load Current (RMS) – with load on bypass.

d) Load Current (PEAK) – with load on bypass.

e) Output Voltage – with load on bypass.

f) Charger Current – after battery hold-up test.

g) End of discharge voltage.

If any adjustments requiring a load are to be done, then these adjustments shall be made using a dummy load, with the manual bypass switch in the BYPASS/UPS position.

4.5 Check that all displays and alarm functions operate satisfactorily. Rectify as necessary.

The common alarm verification can be done by contacting the Signaller.

5. Battery Hold-up Test

5.1 With the normal system load, switch off the I/P supply isolator and record the total battery voltage against elapsed time on the NR/SMS Record Card.

NOTE: *The duration of this test should be 30 minutes.*

6. Final Actions

6.1 If covers have been removed, select LOAD ON BYPASS on the unit and move the Manual Bypass switch to the UPS/BYPASS position. Switch off the unit in the correct sequence. Check that all fans stop slowly.

6.2 Move the Manual Bypass Switch to the BYPASS position.

6.3 Move the unit back to its normal position if it has been moved. If this is the case, check the tightness of incoming and outgoing connections.

6.4 Move the Manual Bypass Switch to the UPS/BYPASS position and power up the unit in the correct sequence.

6.5 When the unit is up and running, transfer the load onto the inverter.

6.6 Upon completion of the maintenance tasks check that all the breakers are in the ON position and all the panel/cover screws are tight.

END

Includes:	SAFT Air Saline Cells and Dry Cells
Excludes:	CEGASA Air Alkaline Cells

Disposal of old cells shall be as per current environmental policy (SMS/Part/A14).

General

Dry battery cells shall be stored in an upright position in a dry and clean environment.

They can deteriorate in storage therefore they shall be tested as below to check they are in a fit state for use.

SAFT air saline cells shall be set up according to the manufactures instructions taking care that the distilled water used to fill them is within the given limits.

Due to the chemical reaction when these cells are ‘activated’ heat is produced which can make the case of the cell hot.

Care shall be taken when handing newly ‘activated’ cells.

When SAFT air saline and dry primary cells are brought into service, caps and breathing holes should be treated as per the manufactures instructions.

Details about the maintenance and the replacement of CEGASA air alkaline cells can be found in NR/SMS/EL00

1. Primary Cell Test

1.1 Using a suitable meter connect an approved 1Ω shunt across the positive and negative terminals. Test the 1Ω shunt on the meters resistance range before use to check it is not open circuit.

Do not use a train shunt box for this task.

1.2 With the approved shunt in place and the meter on the DC volts range Measure the voltage across each primary cell.

1.3 Do not apply the shunt to the cells whilst they are connected in circuit unless you reach an agreement with the signaller.

Due to load put on the cell apply the shunt only momentarily. Do not continually use the shunt for periods of more than five minutes.

1.4 The cell shall be replaced if the obtained reading is at or below 0.9V

In some cases, it is advisable to replace the cell at a higher threshold (e.g. 1.1V) if there is a possibility due to the loading of the cell of it failing before the next maintenance visit

End

Includes:	System installed in the Seven tunnel
Excludes:	Any other emergency pull cable alarm systems

GENERAL

Carry out these tests in liaison with the Signaller during a no train period preferably under a system possession. It is also necessary to have competent person to observe the indications and alarms

TESTS

Severn Tunnel System (Only)

1. Tunnel Emergency Signals Cold Filament Proving

1.1 Ask the Signaller to operate the tunnel protecting signal on the road open to traffic to a proceed aspect.

1.2 Remove the lamp of the first tunnel emergency signal and observe that the tunnel protecting signal reverts to a red aspect.

1.3 Renew the lamp in the tunnel emergency signal and check that the Signaller is able to operate the tunnel protecting signal on the road open to traffic to a proceed aspect.

1.4 Repeat 1.2 and 1.3 for the other tunnel emergency signals.

1.5 Arrange for the tunnel emergency signals to be illuminated. Measure the lamp voltages and check they are within specification NR/SMS/PartB/Test/021 (Filament Signal Lamp Tests).

2. Pull Cable Test

2.1 Start at the beginning of the system (the Welsh portal of the tunnel). Operate the Pull Cable by physically pulling it.

2.2 Check that the Signaller's Pull Cable display and alarm unit at Newport PSB and the Technicians unit at Seven Tunnel Junction interlocking indicate the correct Pullkey activation.

2.3 Check that the Pull Cable failed alarm is also sounded and that the red visual indication is illuminated on the Signaller's panel at Newport PSB.

2.4 In liaison with the Signaller, check that any tunnel protecting signals that were displaying a proceed aspect prior to the test are now displaying a red aspect.

2.5 If visible in the tunnel, check that the tunnel emergency signals have illuminated.

2.6 On the Signaller's panel at Newport PSB check that the tunnel emergency signals are indicating illuminated.

2.7 Check that the two LED indications on the activated Pullkey unit are illuminated.

2.8 Reset the Pullkey unit by rotating the red knob on the front of the unit. Check that the two LED indications extinguish.

2.9 Check that the Pull Cable Display and Alarm units at Newport PSB and Seven Tunnel Junction interlocking are showing a normal indication with no active alarms.

2.10 If visible in the tunnel, check that the tunnel emergency signals have extinguished.

2.11 On the Signallers panel at Newport PSB check that the tunnel emergency signals are indicating extinguished.

2.12 Check that the Signaller's 'Emergency Pull Cable System' failed alarm is now showing a (white) clear indication and that it is possible to operate the tunnel protecting signals and can be cleared to a proceed aspect on the line open to traffic.

2.13 Repeat 2.2 to 2.12 for each of the Pull Cable sections.

<u>Chipping Sodbury Tunnel System (Only)</u>

3. Pull Cable Test

3.1 Start at the beginning of the system. Operate the Pull Cable by physically pulling it.

3.2 Check that the corresponding alarm and indication activate at the controlling signal box and indicate the correct section activation.

3.3 Check that any alarms or indications at any intermediate location are also activated.

3.4 In liaison with the Signaller, check that any tunnel protecting signals that were displaying a proceed aspect prior to the test are now displaying a red aspect.

3.5 Check that the two LED indications on the activated Pullkey unit are illuminated.

3.6 Reset the Pullkey unit by rotating the red knob on the front of the unit. Check that the two LED indications extinguish.

3.7 Check that the corresponding indication at the controlling signal box (and any other intermediate indication point) is showing a normal indication with no active alarms.

3.8 Check that it is possible to operate the tunnel protecting signals can be cleared to a proceed aspect on the line open to traffic.

3.9 Repeat for each of the Pull Cable sections.

END

These tests are only to be carried out during a no-traffic period and with permission of and in liaison with the Signaller.

There are two different systems that enable this function on SSI interlockings, one uses an ESOC relay, and one cuts the feed directly. Westlock Electronic Interlocks perform the function electronically.

With a system using an ESOC relay the Signaller will lose the ‘Emergency Signals on Control’ for the interlocking to be tested. With systems that cut the feed directly all signals within the interlocking area being tested will return to red.

TESTS

1 Systems using an ESOC Relay

Your SM(S) will issue a temporary strap so that you can carry out this test. Return the strap to your SM(S) when you have completed the test.

Only carry out this test if you have been given authority to do so by your SM(S).

This test enables the Emergency Signals On Control (ESOC) facility to be tested without shutting down the SSI interlocking.

Only applies to an SSI interlocking with an ESOC relay function that places all signals to danger by disconnecting the BX110 interlocking supply. For Westlock systems see section 3.

Carry out this test for each SSI interlocking within the signalling centre control area.

Applying the Temporary Strap

1.1. Check the continuity of the test strap using a meter.

1.2. Using the record copy diagrams; identify the ESOC circuit to be tested.

1.3. Strap-out the front contact of the ESOC relay within the BX110V interlocking supply circuit.

Testing the ESOC Relay

1.4. Connect a suitable meter on a resistance (ohms) range across the spare front contact of the ESOC relay.

1.5. Observe that the ESOC relay red LED is illuminated.

Non Ansaldo Systems Only

1.6. Arrange with the Signaller to press and release the ESOC button for the interlocking to be tested. Observe the following:

a) The red LED goes out when the button is pressed.

b) The ESOC relay de-energises, when the button is pressed. Watch the meter connected across the spare front contact.

c) The red LED illuminates when the button is released.

d) The ESOC relay re-energises not less than 15s after the button is released. Time this from the moment the LED illuminates.

e) Record the ESOC test date, interlocking name and relay energisation time (15s) in the site logbook. If the time is less than 15s or has significantly changed from the last test, tell your SM(S).

Ansaldo Systems Only

1.7. Arrange with the Signaller to press the red button at the bottom left of the Signaller's key pad, then press '0' and then 'ENTER' for the interlocking to be tested. Observe the following:

a) The red LED goes out when the red button is pressed.

b) The ESOC relay de-energises, when the red button is pressed. (Watch the meter connected across the spare front contact).

c) The red LED illuminates when 'ENTER' is pressed.

d) The ESOC relay re-energises not less than 15s after 'ENTER' is pressed. (Time this from the moment the LED illuminates).

1.8. Record the ESOC test date, interlocking name and relay energisation time (15s) in the site logbook.

If the time is less than 15s or has significantly changed from the last test, tell your SM(S).

Recovering the Temporary Strap

1.9. Disconnect and put away the temporary strap.

1.10. Ask a second competent signalling technician to check that the temporary strap has been disconnected from the circuit.

1.11. When you have completed the test on each interlocking, return the test strap to your SM(S).

2 Systems that Directly Cut the Feed

This test will return all signals in the interlocking area to red.

In liaison with the Signalman, this test shall only be undertaken when no trains are in or approaching the interlocking area.

Observe at least one of the trackside signals returning to danger

2.1. Check the Technicians terminal for faults. Rectify as necessary before undertaking the test.

2.2. Arrange with the Signaller for an external signal to be cleared on the interlocking to be tested and check by visual observation that the signal has cleared.

2.3. Ask the Signaller to depress the all signals on button for a minimum of 15 seconds.

2.4. Check that all signals on the associated IECC panel have returned to danger.

2.5. Check that the signal that was cleared outside has returned to red.

2.6. Ask Signaller to release button.

2.7. Check that Signaller can clear signals within the interlocking area.

2.8. Check Technician’s terminal for faults.

3 Emergency Signals on Control (ESOC) Test for Westlock Systems

During the test the Signaller will lose the ESOC for the interlocking being tested. For this reason, only carry out this test during a no-traffic period and with the authority of your SM(S)

Do not attempt to test or disconnect ESOC during an ESOC operation.

While the ESOC Test Wizard is running, no other Technician's Controls can be issued.

The ESOC Test Wizard allows the WESTLOCK Technician's Workstation user to test the Emergency Signals On Control (ESOC) button located on the Signaller's workstation, without actually setting the signals to their most restrictive aspect.

It does this by issuing a 'Disconnect ESOC' technician's request, valid for a maximum of five minutes. This allows the user to operate the ESOC button during this period, and to have the operation detected.

To operate the ESOC wizard and test the ESOC button, proceed as follows:

3.1. At the WESTLOCK Technician's Workstation, click in the Controls menu and select 'ESOC Test Wizard'. The 'Disconnect ESOC' dialogue box is displayed (See Figure 1):

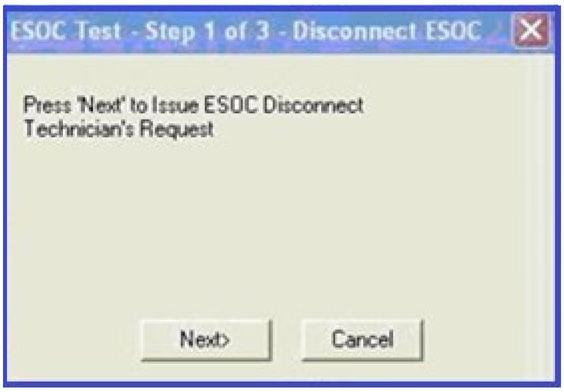


Figure 1 Disconnect ESOC Dialogue Box

3.2. Click 'Next'.

3.3. A Technicians' Request Confirmation dialogue box is displayed (See Figure 2). Type 'CIP' in the 'Confirm' box and click OK to confirm request.

Figure 2 Technician's Request Confirmation Dialogue Box

If the request is not confirmed within a short period, then 'CIP Cancelled Request' result is displayed (See Figure 3):

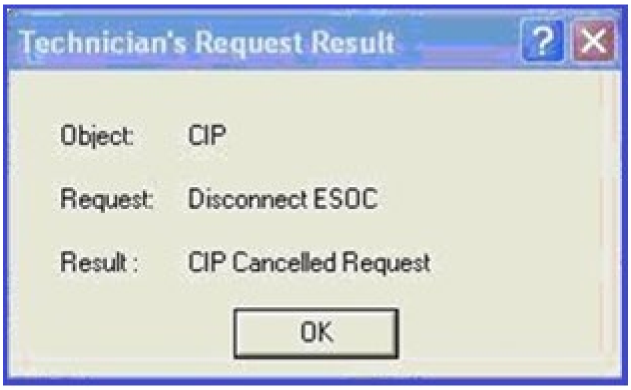


Figure 3 – 'CIP Cancelled Request' Result

If the request confirmation is successful, then 'Request Completed' result is displayed (See Figure 4):

Figure 4 – 'Request Completed' Result

3.4. Click OK. This causes the TW(L) to issue a 'Disconnect ESOC' technician's request.

When the request is successfully completed the 'Test ESOC' dialogue box is displayed (See Figure 5) and a 5 minute timer is started and can be seen to count down. Clicking on 'Cancel' will close the dialogue box and cancel the procedure.

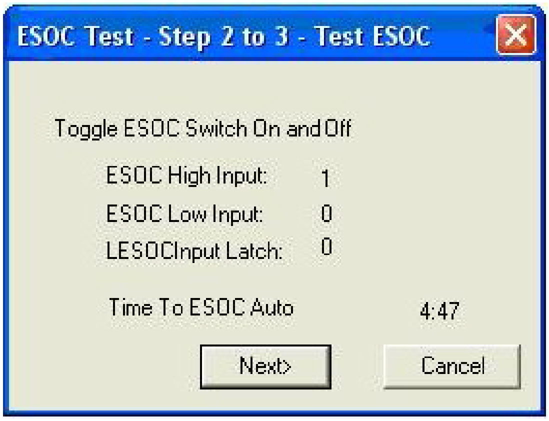


Figure 5 – ESOC Test Dialogue Box

3.5. Observe the dialogue box and check the values shown against the lines are as follows:

a) 'ESOC High Input' 1

b) 'ESOC Low Input' 0

c) 'LESOC Input Latch' 0

3.6. Request the Signaller to operate the ESOC button on his workstation and check the values shown against all three of these lines are updated as follows:

a) 'ESOC High Input' 0

b) 'ESOC Low Input' 1

c) 'LESOC Input Latch' 1

3.7. Request the Signaller to release the ESOC button on his workstation and check the values shown against all three lines in the dialogue box return to their original settings (See Figure 6).

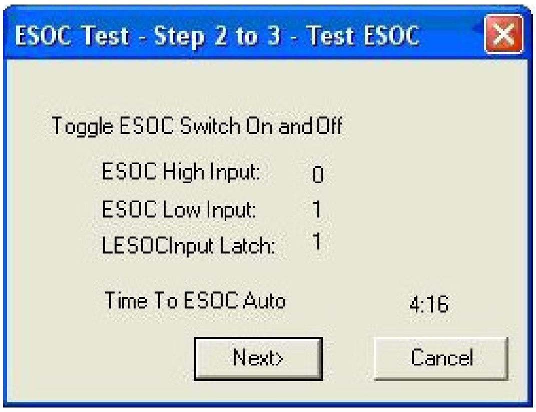


Figure 6 – ESCO Test Dialogue Box

3.8. Repeat 3.3 to 3.5 several times to confirm the operation of the ESOC switch is not intermittent.

It is essential that this is completed within the 5-minute timer period. On completion click 'Next' in the dialogue box.

If the end of the 5-minute period is reached, the ESOC will be automatically re-connected and an 'ESOC Reconnect' dialogue box displayed.

If the signaller presses the ESOC button after this time then the signals will be set to their most restrictive aspect.

The following dialogue box is displayed:

Figure 7 – ESOC Reconnect

3.9. Click on ‘Finish’. An ‘ESOC Connect’ request is issued by the TW(L), and on successful completion the dialogue box is closed, and the procedure is completed.

If the ESOC input is automatically re-connected during the sequence by the 5-minute timer reaching zero, then the ESOC Reconnect dialogue box is displayed. Click on ‘OK’ in the dialogue box to close it.

Figure 8 ESOC Reconnect Dialogue Box

4 Emergency Signals on Control (ESOC) Test for Smartlock Systems Only

During the test the Signaller will lose the ESOC for the interlocking being tested. For this reason, the test shall only be carried out during a no-traffic period and with the authority of your SM(S).

ESOC testing shall not be undertaken if an axle counter has been reset and a sweep train has yet to prove the section clear.

ESOC testing shall not be undertaken if the support system has failed, as the central interlocking (CIXL) requires the support system to be operational in order to perform a restart.

Operation

4.1 Check the current state of the technician's controls against the written record.

4.2 Request that the Signaller press and immediately release one ESOC button.

4.3 Observe that the power is removed from the CIXL and TICC through all their indications being extinguished for at least 15 seconds.

4.4 Request that the Signaller confirms the standard alarms and behaviour for loss of communication between their panel or VDU system and the interlocking.

4.5 Once power has been seen to restore to the power supplies on both the CIXL and TICC(s), repeat steps 4.2 to 4.4 for each ESOC button provided for the CIXL.

It is not necessary for the system to be allowed to boot fully before performing subsequent tests using other ESOC buttons on the same CIXL.

Post ESOC test

Following the final ESOC button operation the system shall be allowed to complete its power up, which will take 2-3 minutes, at which time the technician will observe communication to restart through flashing of the LED indicators on the CIXL I/O cards.

Once started, the interlocking enters a 4-minute timeout, during which the VIXL within the affected CIXL will declare themselves in ‘Timing Out’ mode (‘tim’ on the Redman card's cyclic display and flashing green / grey on the Support System's CIXL mimic).

At the start of this timeout, the Signaller will observe tracks on the panel flood red, and then recover. Some tracks, near internal interlocking boundaries, may take a few seconds longer to clear.

Route locking will be seen to be applied, but this shall release after a timeout providing track sections are clear (or any occupied sections are behind signals). The system will not respond to requests made by the Signaller until this 4-minute timeout has expired.

Upon expiry of the 4-minute timeout, the technician will see the VIXL enter the on-line mode ("On" on the Redman card's cyclic display and green on the Support

System's CIXL mimic). The Signaller's panel, or VDU based system, will then respond to Signaller requests.

4.6 Request that the Signaller key all points to their current positions, and then to centre (or centre then back to their current position) and cancel any emergency replacement of auto signals which were not in place before the test.

4.7 Verify the applied technician’s controls against the written record.

Multiple CIXL

4.8 Repeat steps 4.6 to 4.7 for each CIXL.

END

This test is applicable to all safety related timing function relays including:

- Level crossing timers (HJR, CON JR, reset timers etc).

This is usually done as part of LC annual test.

- Approach Locking Timers (e.g. ALSR).
- Track circuit timers (e.g. TJR).
- Signal approach control timers (e.g. AJR).
- Other Interlocking timers (OJR, USJR etc).

1. Test

1.1 Arrange for the function to be operated to cause the timer relay to run.

1.2 Check the timer operates within the required time cycle (i.e. the time specified on the signalling record). Adjust as necessary.

1.3 Record the result on the NR/SMS record card with the actual time, extent of any adjustment made and initial/ date of test.

If the timer is significantly out of adjustment and it cannot be corrected or replaced immediately, the signaller shall be advised and the relay reported as a fault.

Disconnection of the affected signalling controls shall be considered against the scope of the timing error.

Arrangements shall be made to have the relay replaced.

Point machine cut-out timers (e.g. WJR) are usually tested as part of a point machine service.

End

Includes:	All surge and lightning protection units connected to TDM, FDM, TD, SSI and other electronic equipment

Tests on any line protection units shall not be carried out if there is or the possibility of a thunderstorm in the vicinity of either end of the protected line.

GENERAL

Line Protection Units are used to protect equipment connected by line cables from actual or induced high voltage surges caused by lightning.

They can take the form from a basic 'spark gap' contained within a glass tubes to an electronic unit with LED indications.

They are connected between line cables and earth and under normal conditions they provide a very high resistance or open circuit path to earth.

If high voltages are present on the line, they can provide a low resistance or short circuit path to earth preventing the high voltage damaging the equipment they are protecting.

Line protection units can be connected in series or parallel with the line.

Removing the unit can disconnect the equipment from the line; always liaise with the signaller before attempting any disconnections.

Lightning and other types of extreme electrical surges can stress line protection units whilst they are providing protection. Each surge causes a small amount of degradation which can eventually cause the unit to fail.

In most cases, such a failure will not prevent the equipment it is fitted to working correctly, although surge protection can be reduced or lost leaving the system vulnerable to the next surge.

In electronic systems failed line protection units can cause noise levels to increase leading eventually to failure.

To protect against this line protection units shall be tested (or health unit lights inspected) at the next opportunity where it is known that they have been exposed to a lightning strike or other large electrical surge.

If any units are found to be faulty or not working correctly, report the matter as a corrective maintenance item immediately

1. Surge Arrestors AEI 16 or 26 Series Tubes in Bases

1.1 Remove the tube and examine the spark gaps on the base (use a magnifying glass and torch) for cracking or flaking plating.

a) If any is observed the unit is to be replaced.

b) Measure using a suitable meter on the Ohms range that the surge arrestor is not short circuit.

c) Replace the tube back into its base and replace the cover (if fitted).

Surge arrestor spark gaps are pre-set at the factory.

No attempt shall be made to alter this setting.

These are also now known as Semitron 1026 Series.

2. Surge Arrestors Units on 11 Pin Bases (Usually to BR 1937)

2.1 Unplug the unit. For any type, using a suitable meter Measure the resistance across the respective pins to

Check that the diodes, resistors and gas discharge tube are not short or open circuit as appropriate. (Appendix A).

For the Furse Unit, the Furse ESP PTE 002 test device shall be used since it gives a more accurate health check.

3. Line Connection Units (With Glass Covers)

3.1 Disconnect the LCU, remove the glass cover and remove the lightning protector.

3.2 Using a suitable insulation tester (e.g. Megger) on the 50V range connect the leads between the centre ring and one end of the protector. The obtained reading should be very high (MΩ) to infinity.

3.3 Repeat 3.2 with the insulation tester on the 500V range. The obtained reading should now be very low (Ω) to short circuit.

3.4 Reconnect the LCU to circuit.

4. Other Protection Units (not units with LED indications)

This is a generic test for units not covered by the other sections.

4.1 Disconnect the protection unit from the line.

4.2 Using a suitable insulation tester (e.g. megger) on the 50V range connect the leads between the terminal on the unit that is normally connected to the line and the terminal that is normally connected to earth.

The obtained reading should be very high (MΩ) to infinity.

4.3 Repeat 4.2 with the insulation tester on the 500V range. The obtained reading should now be very low (Ω) to short circuit.

700V or 1000V devices fitted to AC track circuits need to be tested at 1000V.

4.4 Reconnect the protection unit to the line.

5. Line Protection Units with LED Indications

Check the status of the line protection units taking action as stated below:

- Green lit only: No Action Required.
- Green and Red Lit: Replace unit within 7 Days.
- Red lit only: Replace unit immediately.

For units with other LED configurations, establish the equivalent indications from the manufacturer's data sheet.

APPENDIX A – Furse Units

Circuits of SSI Surge Protection Units (Numbers refer to base pins) Clippit Unit.

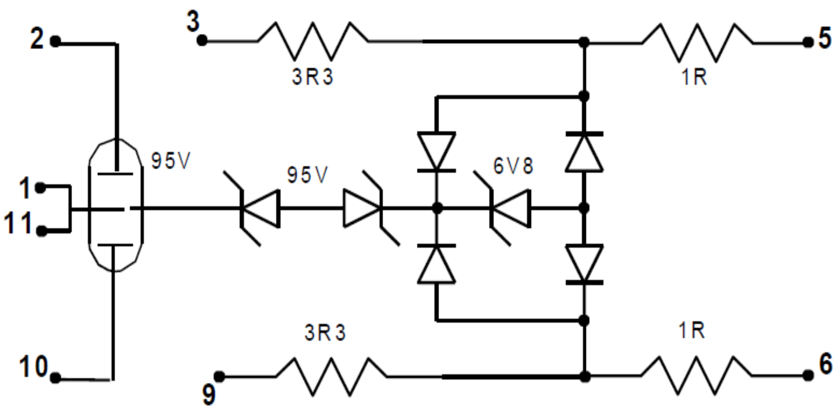


Figure 1 – Furse Unit (post 1994)

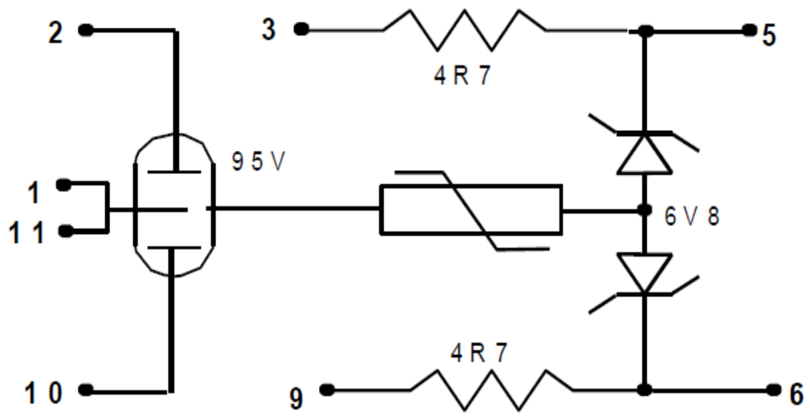


Figure 2 – Pre 1994 Furse units had components with different values.

ISPU

The ISPU is similar to the Furse Unit (post 1994) but has an isolating transformer with its secondary coil connected across pins 5 and 6 and its primary connected across the pair of Zener diodes.

There are several types of ISPU in use, and these differ only in the type of isolating transformer used.

The current model of ISPU is recognised by its orange case.

The ISPU is not interchangeable with the Furse or Clippit units, and shall only be fitted where indicated on the site wiring.

End

System Checks / Tests

1. Signallers Control Console

1.1 Check operation of the handset, headset and desk mic, including the associated PTT switches.

1.2 Check console (Figure 1), headset and loudspeaker volume controls on inbound calls.

Figure 1 – Console Volume Controls

1.3 Check that inbound and outbound audio is clear.

1.4 Check the console LEDs (red Tx LED on outbound calls, green Rx LED on inbound calls), Figure 2.

Figure 2 – Console LEDs

1.5 Check that the connectors to the rear of the console are seated correctly.

1.6 Clean the console touch screen.

2. 2-Wire Dial-Up Interfaces

2.1 Using the Signallers Control Console (Figure 3), carry out a Full System Test over the 4-wire and confirm that a response is received from each site.

2.2 Connect a 2-wire dial-up (the 2-wire icon change to green).

2.3 Disconnect the system 4-wire interface (4-wire icon changes to red).

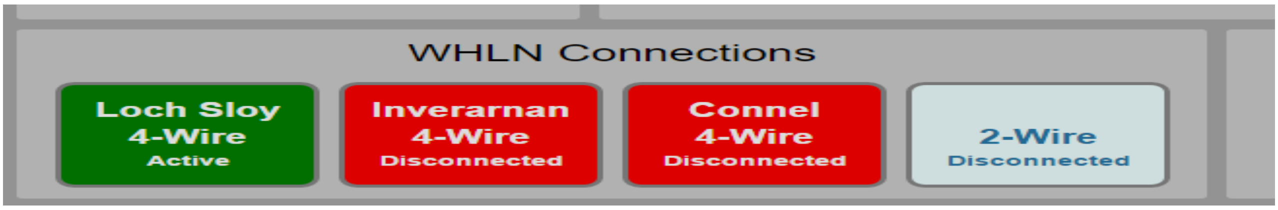


Figure 3 – Signallers Control Console

2.4 Perform audio tests and token exchanges to confirm access to the radio chain.

2.5 Perform a Full System Test over the dial-up and confirm that a response is received from each site.

2.6 Disconnect the dial-up (the 2-wire icon returns to grey).

2.7 Repeat steps 2.1 to 2.6 for each dial-up present on the system.

2.8 Reconnect the 4-wire interface (the 4-wire icon returns to green).

3. Basic Radio Rack Checks

3.1 Dust the cabinet.

3.2 Check that all the shelves and equipment are securely mounted.

3.3 Check that all the cable connectors are secure and undamaged.

3.4 Check the external cables are undamaged and in good condition.

3.5 Check there is satisfactory ventilation around the cabinet and that any cooling fans are working correctly.

3.6 Check any fan filters are clean, replace if necessary.

3.7 Check that the terminal connections to the following 4 items at the back of the rack are secure and in good condition:

a) Wire
b) 2 Wire
c) Signallers console
d) SSI

3.8 Check that the auto test/enable/disable function works for each base station that should be able to be accessed.

4. Extended Radio Rack Checks

4.1 Use the MSS graphing tool to check the system controller internal power supplies, and unit temperature. Compare readings with limits, and with historical data. Identify and report any changes/issues.

4.2 Check that all cables and connectors are secure and undamaged.

4.3 Check that only the green 'Lightning' LED on the power distribution unit (PDU) - (Figure 4) at the rear of the control rack is lit. Investigate if 'polarity' or 'Earth' indicators LEDs are lit. Replace the PDU if necessary.

Figure 4 - PDU

4.4 Check that the 'AC OK' and 'DC OK' LEDs on the two power supply modules (Figure 5) at the front of the rack are green. If any are red, investigate and replace the module if necessary.

Figure 5 – Power Supply Module

4.5 Check that the cooling fans on the PSUs are running and are unobstructed. Clean if necessary.

5. System Current Issues Checks

5.1 Log in to the MSS and select Current Issues.

5.2 Use the filtering options in the left hand pane to select the RETB line of interest, issue types, and timespan.

5.3 Review any logs displayed in the right hand pane. Note any that require immediate attention, e.g. Mains Supply alarm, Battery Low alarm.

6. Network Data Integrity Testing (end-to-end BER testing)

This test is system-invasive and should only be carried out with the co-operation of the signaller.

6.1 Check that the 4-wire interface is connected and all 2-wire dial-ups are disconnected.

6.2 Select MSS > Live System > System Testing > BER.

6.3 Select the radio site at one end of the radio segment of interest from the 'Source ID' pull-down menu, e.g. Mallaig Cell.

6.4 Select the radio site at the other end of the segment from the 'Sink ID' menu, e.g. Banavie SC.

6.5 Click 'Initialise test'.

6.6 Click 'Start test'. A test data packet is sent over the radio network to the radio ID entered. This performs a bit error rate (BER) check.

6.7 If the number of Repeats/Test Runs is set to 1, the following message appears in the small window after a few seconds:

Reply from (for example if using radio unit 1234).

1234, bits: 2176 (expected: 2176), errors: 0

The number of errors should be 0. If it is not, repeat the test a number of times to confirm consistency of bit errors. If bit errors persist then there is a weak point in the radio chain and further testing and diagnostics (e.g. received signal strength (RSS) checks) should be performed over smaller sections to isolate it.

(The number of bits is increment by 2176 for each test run. ‘Initialise test’ resets the bit counter to 0)

6.8 Repeat for remaining segments of the radio network. Record any weak links that need attention.

6.9 Repeat the BER test with 2-wire dial-up connected instead of the 4-wire, and the Source and Sink IDs reversed.

END

On-Site Power Supply Checks

Mains voltages at 240V AC are present in the power supply. Extreme caution shall be taken (See NR/SMS/PartC/EL00 (Electrical Equipment General) - Hazards Associated with Electrical Supplies.

The equipment includes a UPS function - Power might still be present even though external power has been disconnected.

Batteries are present with large current capacity. Care shall be taken not to short battery contacts. For installations with multiple batteries, do not connect batteries together in any other arrangement other than prescribed in the manufacturer's instructions.

Batteries shall have satisfactory ventilation. Explosive gases are released in charging which shall be allowed to dissipate prior to any works. Keep sparks and flames well away.

UPS Reset Procedure

The UPS (Figure 1) shall be reset, if it has shutdown, before any power is applied to the wall-frame. This would be necessary following:

a) Disconnection and then re-connection of a battery, or
b) If a battery is discharge to a very low level and replaced with a charged battery while no mains is present.

Reset is actioned by pressing the Yellow button mounted within the PSU cabinet. The UPS operation can be verified by an orange LED lights on DRU30 unit.

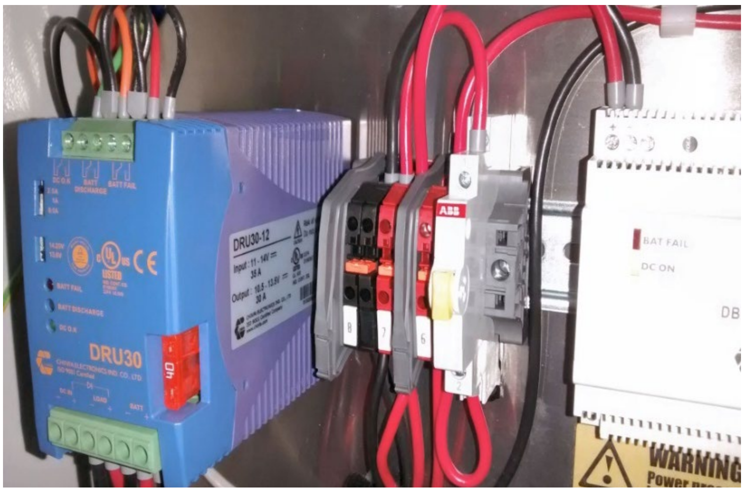


Figure 1 - UPS

Voltage is also present at the output.

1. Equipment Required

a) PSU cabinet key.

b) Digital multimeter (accurate to 0.1V).

c) Battery tester (e.g. Hioki 3554).

Alarms might be heard on the FSI loudspeaker.

Readings outside of the prescribed limits should fault the equipment.

2. PSU In-Service Health Indication Check

2.1 Open the PSU cabinet and check that the LEDs on all PSU modules (DRE240, DBR60, DRU30, Figure 2) are green.

Figure 2 – PSU Modules

2.2 Visually inspect the battery/batteries for signs of swelling or leakage. Replace if damaged.

2.3 Check that the LEDs on the front of the FSI are as follows: AC: green, BATT: off, PSU: green.

2.4 Measure the voltage across the red and black DIN terminals (Figure 3) on the ‘Site Interface’ panel.

Expected voltage: 12.5V (Limits 12.0V to 14.0V).

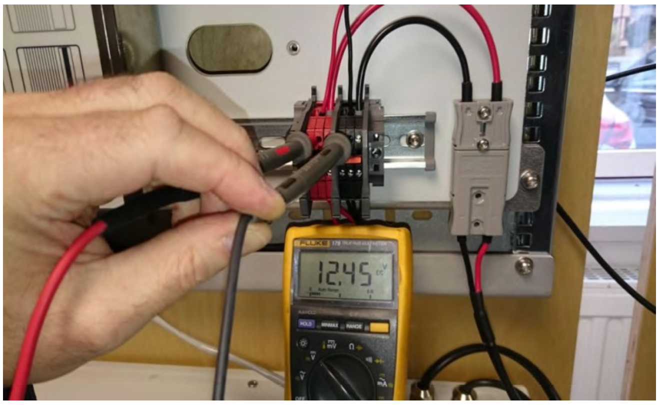


Figure 3 – Red and Black DIN Terminals

3. Basic PSU Output and Alarm Check

3.1 Disconnect the mains.

3.2 Confirm that the Signaller receives a ‘mains failure’ alarm from the site (displayed on console).

3.3 Check that the FSI LED indications change to: AC: off, BATT: green, PSU: green.

3.4 Check that the LED on the DRU30 unit indicates orange.

3.5 Measure the voltage across the red and black DIN terminals on the ‘Site Interface’ panel.

Expected voltage: 12.5V (Limits 12.0 to 14.0V assuming healthy state of charge).

3.6 Reconnect the mains.

3.7 Confirm that the Signaller receives a ‘mains fault cleared’ message from the site.

3.8 Check that the FSI LED indications return to: AC: green, BATT: off, PSU: green.

3.9 Check that the LED on the DRU30 unit returns to green.

4. Battery Tests - Standard Capacity PSU (one 12V battery)

4.1 Disconnect the battery (Figure 4) by separating the grey SBS Anderson connectors inside the cabinet.

Figure 4 – Battery Disconnection

4.2 Visually inspect the battery for signs of swelling or leakage. Replace if damaged.

4.3 Measure the voltage across the battery terminals.

Expected voltage: 12.0V to 13.6V.

4.4 Configure the battery tester for a 20V and 20mΩ range.

4.5 Place the probes onto the battery terminals, wait until a steady reading is established and measure internal resistance.

Model	Good (mΩ)	Warning (mΩ)	Fail (mΩ)
XL12V85	<8.6	8.6-11.5	>11.5

Table 1 – Internal Resistance Values (1)

4.6 If the internal resistance is within the warning zone notify your SM(S).

4.7 If the battery is above the fail limit the battery should be replaced.

4.8 Compare with historical results.

5. Battery Tests - High Capacity PSU (two 6V batteries)

5.1 Disconnect the batteries by separating the yellow SBS Anderson connectors from the “Y” adaptor cable (P1062-CBL-12-03).

Figure 5 – High Capacity PSU

5.2 Visually inspect the batteries for signs of swelling or leakage. Replace if damaged.

5.3 Measure the voltage across the terminals of each battery, in turn.

Expected voltage: 6.0V to 6.8V

5.4 Configure the battery tester for a 20V and 20mΩ range.

5.5 Place the probes onto the terminals of one battery, wait until a steady reading is established and measure internal resistance.

Model	Good (mΩ)	Warning (mΩ)	Fail (mΩ)
XL6V180	<2.4	2.4-3.2	>3.2

Table 2 – Internal Resistance Values (2)

5.6 If the internal resistance is within the warning zone notify your SM(S).

5.7 If the battery is above the fail limit the battery should be replaced.

5.8 Compare with historical results.

5.9 Repeat steps 5.5 to 5.8 for the other battery.

6. Battery Charger Test

6.1 Batteries should still be disconnected following the battery tests above, if required, disconnect the battery(s) by separating the grey SBS Anderson connector inside the PSU cabinet. On a High Capacity PSU, separate the grey connector on the "Y" adaptor cable.

Figure 6 - PSU

6.2 Measure the voltage across the BATT +/- screw terminals on the DRU30 unit (s).

6.3 Expected voltage: 13.6V (Limits: 13.2 to 14.0V).

6.4 Reconnect the battery / batteries to the PSU.

6.5 Reset the UPS (press Yellow button and check Orange LED lights on DRU30 unit).

END

On-Site Antenna System Checks

High power RF signals are generated by the radio equipment. Always disconnect the DC power feed to the fixed station radio or frame before removing or reinstating any connections to the antenna.

Inspection and maintenance of the aerial tower, fall arrest system, antennas, and feeders shall be undertaken as detailed in NR/L2/TEL/30088, by others, and is not part of these checks.

Equipment Required, antenna tester (VSWR meter / Bird Watt Meter).

1. Antenna System Inspection

1.1 Check that the site fixture cabling is secure and undamaged and that all RF connectors are finger tight.

1.2 From ground level, visually inspect the condition of the mast, the security of feeder cables and the antenna elements for obvious defects, including approximate bearing.

2. Antenna VSWR Measurements

2.1 Using the results obtained during Fixed Station Radio & Site Interface Equipment testing - Radio Test – TX Output Power Plot the Forward and Reverse power reading on a VSWR Chart to obtain VSWR Value.

2.2 A VSWR reading in excess of 2.0 should prompt investigation. The reading for each antenna should be compared with historical measurements and the result report by the Maintenance terminal.

2.3 Re-connect the feeder to the bulkhead after making the measurement.

2.4 Repeat for each VHF antenna at the site.

END

Pre-Visit Fixed Site Checks using MSS (Maintenance Support Sub-System)

1. 4-Wire Line Level Check

With the 4-wire connected, check the gains at both ends of the line (Rack and FSI) as follows:

1.1 Select MSS > Live System > System Testing > Line.

1.2 Select the 4-wire interface site, e.g. Crianlarich, from the 'Site' pull-down menu.

1.3 Click 'Test'. The following message should be received:

a) Rx level at Rack: X.X dB, Rx level at FSI: Y.Y dB

b) The target for both reported levels : 0.0 dB (Limits : -1.0 dB to +1.0 dB).

If adjustments are necessary, they are to be made onsite in the FSI configuration.

If the reported Rx level at the Rack is -1.0 dB, then an increase of 1.0 dB is required to the output gain of the FSI.

If the reported Rx level at the FSI is +1.0 dB, a reduction of 1.0 dB in the input gain of the FSI is required.

2. 2-Wire Dial-Up Line Level Check

With the 2-wire connected, check the gains at both ends of the line (Rack and FSI) as follows:

2.1 Select MSS > Live System > System Testing > Line.

2.2 Select the 2-wire interface site, e.g. Buchannan House, from the 'Site' pull-down menu.

2.3 Click 'Test'. The following message should be received:

a) Rx level at Rack: X.X dB, Rx level at FSI: Y.Y dB

b) The target for both reported levels : 0.0 dB (Limits : -1.0 dB to +1.0 dB).

If adjustments are necessary, they are to be made onsite in the FSI configuration. If the reported Rx level at the Rack is -1.0 dB, then an increase of 1.0 dB is required to the output gain of the FSI.

If the reported Rx level at the FSI is +1.0 dB, a reduction of 1.0 dB in the input gain of the FSI is required.

3. Site Interface Parameter Check

3.1 Log in to the MSS, select Graphs and then use the filter in the left hand side pane to select an RETB system, e.g. WHLS.

3.2 Select the site of interest, e.g. Loch Sloy.

3.3 Select ‘Site Interface’, and then select the ‘Supply & temperature’ report type.

3.4 Set the start and end search date and time appropriately, e.g. from date of last service.

3.5 Click ‘Submit’ to plot the graph. Inspect the 3 graphs displayed.

a) Maximum temperature should be < 40 degC.

b) Minimum temperature should be > 0 degC.

c) Supply Voltage should be between 12.0 and 14.0 V.

d) Supply Current should be < 1.0 A.

3.6 Plot the ‘Line levels’ graphs if the site has a line interface. Inspect it for line levels less than 1.0 dB or greater than +1.0 dB.

3.7 Compare the latest FSI graphs with historical data and report any significant changes.

4. Radio Parameter Check

4.1 If present in the Filter tree, select the ‘Cell’.

4.2 Plot the ‘Temperature’ graphs.

a) Maximum Unit and Power Amp temperatures should be < 45 degC.

b) Minimum Unit and Power Amp temperatures should be > 0 degC.

4.3 Plot the ‘Supply & VSWR’ graphs.

a) VSWR is only recorded when the transmitter is active and should be less than 1.7V.

b) Supply Voltage should be between 12.0 and 14.0 V.

c) The supply voltage should dip by no more than 0.5V during keying events.

d) The supply current level when the unit was not keyed should be less than 0.6 A.

e) The supply current level when the unit was keyed should be between 3.5 and 5.0 A, if configured for 25W / +44dBm output power.

4.4 Plot the ‘Interference calls’ graphs.

Note and report any unusually high numbers of interference events.

4.5 Plot the ‘Received signal strength’ graph with ‘Fixed sites’ selected as the ‘Linked site’.

4.6 Check the Mean and Min RSS level reported for the neighbouring Link site(s). The levels should not drop below -95 dBm. Variation should be less than 10 dB.

4.7 Repeat steps 4.2 to 4.6 for each Link radio in the Filter tree. In this case the Linked site is the neighbouring Cell.

On-Site Radio Equipment and Site Interface Checks

Equipment Required:

a) Transportable Token Unit (TTU).

b) Digital multimeter.

c) Engineering Terminal laptop and cables.

5. Installation Checks

5.1 Check that all equipment is clean and tidy. Clean and dust as necessary.

5.2 Check the cabling is secure and undamaged and that all RF connectors are finger tight.

5.3 Check the condition of the BT (or other telecom service provider) to railway internal telephone system connection sockets.

5.4 Check the ‘RJ’ connectors of all inter-unit cables on the fixed site frame are clicked in place. Replace any cables with broken clips.

6. FSI LED Check

6.1 Check that the FSI front panel LEDs indicate a 'No Fault' status as follows (See Table 1):

AC	Green
BATT	Off
PSU	Green
GPS	Green
'Mimic'	Orange (where a radio is fitted)
2W Line	Orange, periodically flashing Red (when the 2-wire dial-up is active)
4W Line	Orange, periodically flashing Red (when the 4-wire interface is active)

Table 1 – FSI Front Panel LEDs

7. FSI Line Level Adjustment (where applicable)

This is only required at sites with 2 or 4-wire line interfaces that require level adjustment, as highlighted by Pre-Visit checks.

7.1 Connect the Engineering Terminal to the FSI using a standard network cable, open the Chrome browser and direct it to 192.168.1.200.

7.2 Select the FSI > Line testing tab.

7.3 If the site has a 4-wire interface, click 'Line test'.

7.4 If the site has a 2-wire dial-up interface, have the signaller connect the dial-up and then click 'Line test'.

Line level figures for Rx Power and Reported Tx Power is displayed in units of dB.

The target for each is 0.0 dB (Limits : -1.0 dB to +1.0 dB).

7.5 If adjustment to either level is necessary, perform the following steps:

a) Click on the FSI > Configuration tab.

b) Click 'Read from device'.

c) To adjust a 4-wire interface, use the '4 wire line output gain' and '4 wire line input gain' controls.

d) To adjust a 2-wire dial-up interface, use the '2 wire line output gain' and '4 wire line input gain' controls.

e) To adjust the 'Rx Power' figure use the INPUT gain (step size = 0.5).

f) To adjust the 'Reported Tx Power' figure use the OUTPUT gain (step size = 1.0).

g) After incrementing or decrementing the required control, click 'Write to device'.

h) Return to the FSI > Line testing tab and re-test the levels. Adjust again if required until both figures are as close to 0.0 as possible.

8. Radio Tests – Reported Parameters

These tests are intrusive or disruptive to network operation and should only be carried out with the co-operation of the signaller.

8.1 Connect the Engineering Terminal to the FSI, if not already connected.

8.2 Click the 'Overview' tab.

8.3 For the first active radio, e.g. a Cell radio, use the 'Tx Key' button to key and de-key the unit.

8.4 The following should be observed on the radio overview (See Table 2):

Supply voltage (idle)	12.0 V min
Supply voltage (keyed)	11.5 V min
Supply current (idle)	0.5 A max
Supply current (keyed)	3.5 to 5.0 A (Tx Power set to +44dBm)
	1.5 to 2.5 A (Tx Power set to +37dBm)
Antenna VSWR (keyed)	< 1.7
Internal temp	> 0 deg C, < 40 deg C
Power amp temp	> 0 deg C, < 45 deg C
Tx disabled	Off (grey) or red for a unit on standby, e.g. White Corries.
Poor VSWR	Off (grey)
Tx protection active	Off (grey)

Table 2 – Radio Overview

8.5 Check that radio is de-keyed (idle).

8.6 Repeat for the remaining radios.

9. Radio Tests – Tx Output Power

Test the output power of each radio fitted on the frame as follows:

9.1 For the first active radio, e.g. a Cell radio, disconnect the antenna feeder at the bulkhead connector at the top of the frame and connect the RF Power Meter to the connector.

9.2 Key the radio using the ‘Tx Key’ button. Note and record the output power indicated by the meter. This should be within +/-1.5 dB of the ‘Tx Power’ setting. Record the result for use during Antenna Systems Testing.

9.3 With the radio De-keyed, change the RF Power Meter element for a lower power rated one and using the TX Button, measure reverse power. Record the result for use during Antenna Systems Testing.

9.4 Disconnect the power meter and re-connect the antenna feeder. Check the connector is finger tight.

9.5 Repeat for the remaining radios.

10. Radio Tests – Received Signal Strength

<u>Sites with a main coverage Cell radio</u>

10.1 Check the received signal strength due to the neighbouring Link site(s) as follows:

a) Select the Cell radio tab (Port 1).

b) Select the Port 1 > ‘History’ tab.

c) Click the ‘Rx Signal strength’ link in the left hand pane to check that the graph is plotting received signal strength.

d) Click ‘Clear graph’.

e) Select the Port 1 > ‘RSS testing’ tab.

f) Set the ‘Neighbour remote key network ID’ to the ID of one of the neighbouring Link radio sites.

g) Click ‘Tx 5 sec silence’ and immediately jump back to the ‘History’ tab.

h) Observe that the ‘Receive’ LED lights green and note the Rx signal strength on the graph whilst the Link site is keyed up. Compare the figure with the historical data recorded in the site documentation.

10.2 Repeat this for the neighbouring Link radio site in the opposite direction (where applicable).

Sites with Link radios

10.3 Check the received signal strength due to the Link's neighbouring Cell site as follows:

a) Select a Link radio tab (Ports 2, 3 or 4).

b) Select the 'History' tab.

c) Click the 'Rx Signal strength' link in the left hand pane to check that the graph is plotting received signal strength.

d) Click 'Clear graph'.

e) Select the 'RSS testing' tab.

f) Set the 'Neighbour remote key network ID' to the ID of the neighbouring Cell radio site.

g) Click 'Tx 5 sec silence' and immediately jump back to the 'History' tab.

h) Observe that the 'Receive' LED lights green and note the Rx signal strength on the graph whilst the Cell site is keyed up. Compare the figure with the historical data recorded in the site documentation.

10.4 Repeat this for the remaining Link radios and their neighbouring Cell, where applicable.

11. Radio Tests – Received Signal Strength at Neighbour Sites

Sites with a main coverage Cell radio

11.1 Check the received signal strength at the neighbouring Link site(s) as follows:

a) Select the Cell radio tab (Port 1).

b) Select the Port 1 > 'RSS testing' tab.

c) Set the 'Target network ID' to the ID of one of the neighbouring Link radio sites.

d) Click 'Get Rx signal strength'.

A signal strength response (e.g. -83 dBm) should be received from the Link with the Target ID.

11.2 Compare the figure with the historical data recorded in the site documentation.

11.3 Repeat this for the neighbouring Link radio site in the opposite direction (where applicable).

<u>Sites with Link radios</u>

11.4 Check the received signal strength at the Link's neighbouring Cell site as follows:

a) Select a Link radio tab (Ports 2, 3 or 4).

b) Select the 'RSS testing' tab.

c) Set the 'Target network ID' to the ID of the neighbouring Cell radio site.

d) Click 'Get Rx signal strength'.

A signal strength response should be received from the Cell with the Target ID. Compare the figure with the historical data recorded in the site documentation.

11.5 Repeat this for the remaining Link radios and their neighbouring Cell, where applicable.

END

Includes:	SELC SET 45 -18 Timer (Level Crossing) and SELC 850 AWCU
Excludes:	All other timers

Equipment Identification Image

Figure 1 - SELC SET Digital Timer

Figure 2 - SELC 850 AWCU

1. SELC SET Digital Timer - Set up Process

NOTE: *These style time clocks restrict the output to the yodels when ON, therefore the times need to reflect this, so the ON & OFF times are the opposite to the older mechanical style time clocks.*

1.1 Press PRG button. “SET” appears with first zero flashing.

1.2 Keep pressing OK button until you set the first security code digit which is 4.

1.3 Press PRG button again.

1.4 Enter second security digit which is 7.

1.5 Press PRG again. Timer can now be set up or checked.

1.6 To check what times are inputted without altering; keep pressing PRG which scrolls through each time for ON & OFF. Dashes (--:--) indicate no time is set and timer ignores the setting, so ALL times are to be set.

1.7 To adjust any times; from step 1.5, press PRG until hour or minute flashes and use the OK button (keep pressing or hold down) to adjust each time.

1.8 Set each time (to local instruction, or to standard time which is ON at 2330 and OFF at 0700).

1.9 Keep pressing the PRG button and set ALL times. Note: the days all flash at the bottom, however these do not change as the programmed times are the same for all days of the week. These timers are factory set for specific railway use.

1.10 After each time has been set, press PRG and the following appears; YEAR > MONTH > DAY> TIME.

1.11 Use the OK button to set any of these if wrong.

1.12 Pressing PRG again shows BST/GMT auto change function by either b 1 (ON) or b 0 (OFF). This shall be set to b 1 to enable automatic BST/GMT yearly changes.

1.13 Note: the timer has built in auto leap-year compensation.

1.14 Press PRG to return to main screen.

1.15 Check the main time is correct; the day is correct and according to the time of the day the ON / OFF icon is showing the correct setting.

1.16 Check all the settings again, especially if any have been changed, paying particular attention to the ON and OFF icon making sure the times are correctly matched.

Additional Notes

a) Pressing PRG and OK buttons together results in the timer being reset and clearing all pre-programmed times and settings, and sets the time and date to 00:00 01/01/12, and BST/GMT setting to b 1 (ON).

b) If no buttons are pressed, the screen times out after 30 seconds.

c) Use the MAN button to change the ON / OFF icon over so the yodal's are louder/quieter to test output or to quieten them during engineering work (during the daytime), remember to change back before leaving site if altered.

d) Battery back-up to keep programmed settings is by a lithium cell and lasts up to five years from date of manufacture. It provides up to 12 months back-up if the mains fail. It is NOT user-changeable, so the timer shall be replaced. If exposed to temperatures of +100 degrees Celsius, the cell is liable to explosion. If no LED's lit on buttons, this signifies mains failure.

2. SELC 850 AWCU – Set up process

2.1 Start Set up process (Figure 3).

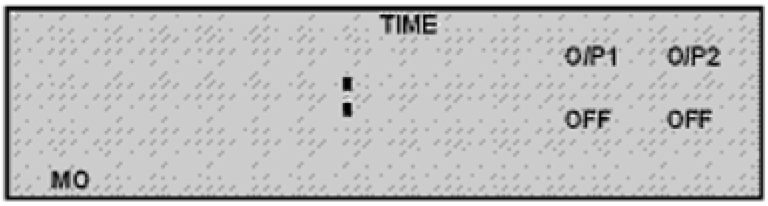


Figure 3 – Start Point

2.2 Output 1 (O/P1) is not used for this application so to move to the Output 2 setup press the MODE button repeatedly until (O/P2) is displayed see (Figure 4).

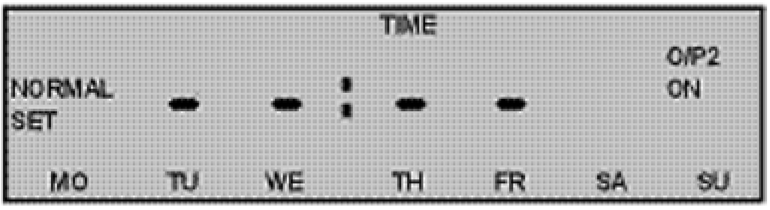


Figure 4 – Output 2 setup

2.3 The hours start to flash (Figure 5)

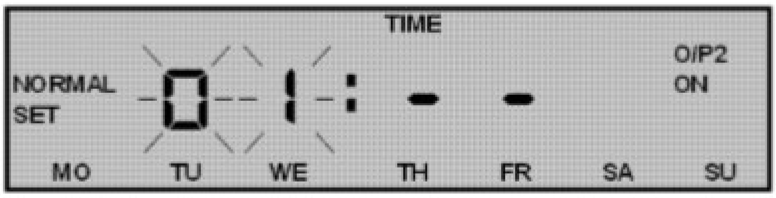


Figure 5 – Hours flashing (Loud)

2.4 Set time for the clock to switch to the loud setting (ON).

2.5 Increase the hours by pressing SET button, once the correct hour is displayed press MODE button once to move to set the minutes (Figure 6).

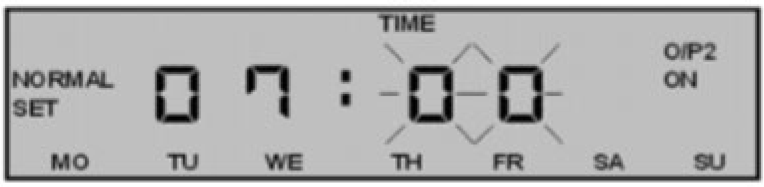


Figure 6 – Minutes flashing (Loud)

2.6 Increase the minutes by pressing the SET button, once the correct minutes are displayed press the MODE button. This causes Monday - Sunday to flash (Figure 7).

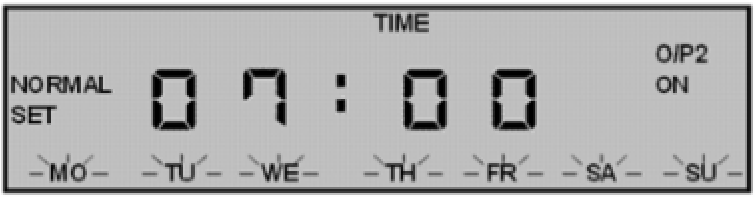


Figure 7 – Days of the week (Loud)

2.7 Press the SET button once, the Monday to Sunday continues to flash now press the SET button again (Figure 8).

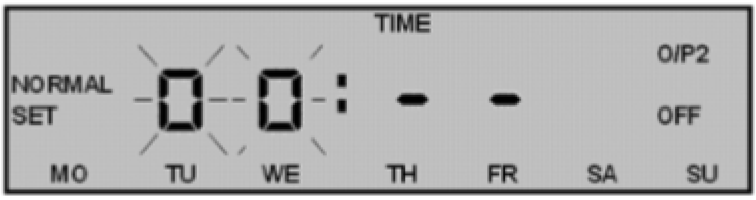


Figure 8 - Set

2.8 Set time for the clock to switch to the quite setting (OFF).

2.9 Increase the hours by pressing the SET button, once the correct hour is displayed press the MODE button once to move to set the minutes.

2.10 Increase the minutes by pressing SET button, once the correct minutes are displayed press MODE button. This causes Monday - Sunday to flash (Figure 9).

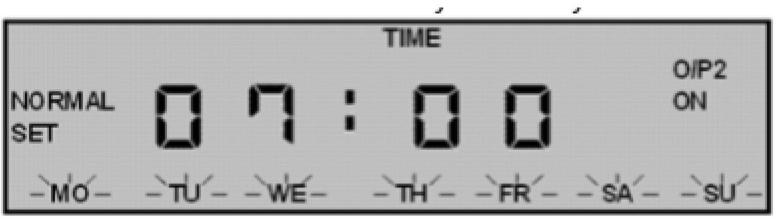


Figure 9 –

2.11 Press SET button once, the Monday to Sunday continues to flash now press SET again.

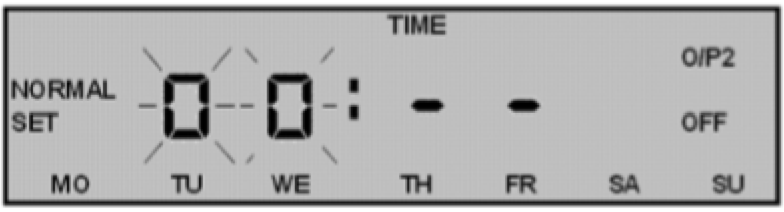


Figure 10

2.12 Set time for the clock to switch to the quite setting

2.13 Increase the hours by pressing SET button, once the correct hour is displayed press MODE button once to move to set the minutes (Figure 10)

2.14 Press the MODE button until Year is displayed (takes several presses)

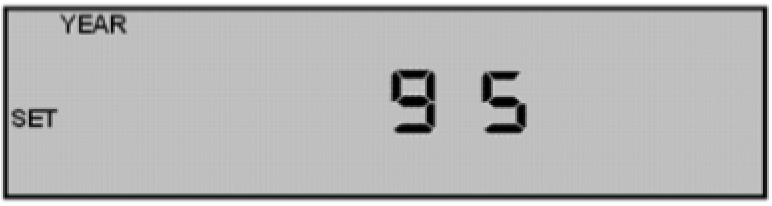


Figure 11

2.15 Press the SET to increase the (Tens) for the year, once the Tens are correct press the MODE button to move to the (Units). (Figure 11)

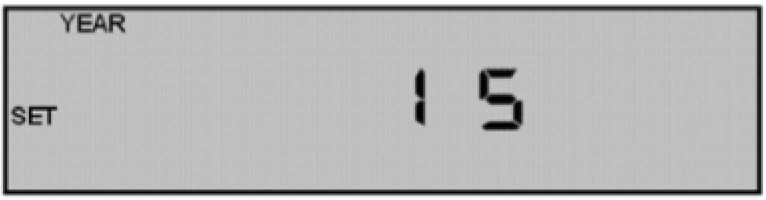


Figure 12

2.16 Press the SET button to increase the (Units) for the year, once the Units are correct press the MODE button to move to Month (Figure 12)

2.17 Press the SET button to increase month (Figure 13)

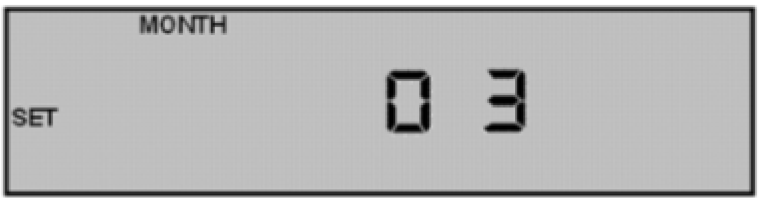


Figure 13

2.18 Once the correct month is displayed press the MODE button to move to the day setup. Press the SET button to increase the day. (Figure 14)

Figure 14

2.19 Once the correct day is displayed press the MODE button to move to the day of the week setup.

2.20 The day of the week flashes (Figure 15)

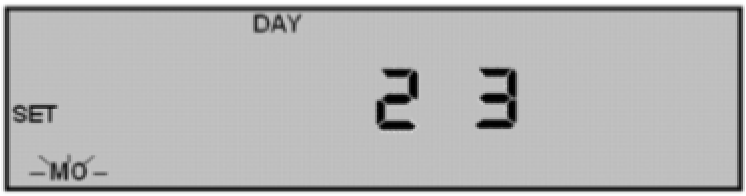


Figure 15

2.21 Press the SET button once, the day of the week continues to flash. Press the MODE button to move to the next day of the week. Once the current day of the week is displayed press the SET button once.

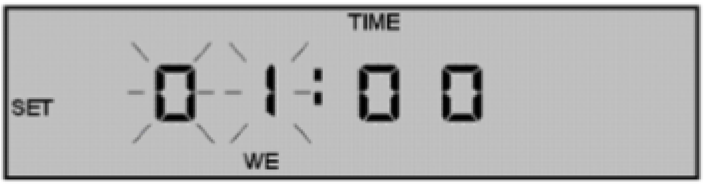


Figure 16

2.22 Press the SET button to increase the hours to display the current hour, then press the MODE button. (Figure 16)

2.23 The minutes now flash

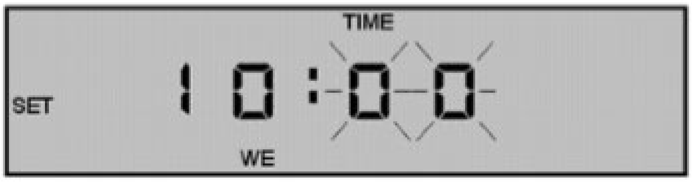


Figure 17

2.24 Press the SET button to increase the minutes to display the current time, then press the MODE button. (Figure 17)

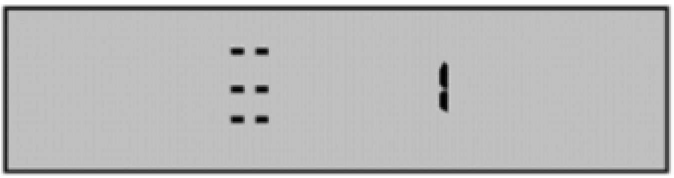


Figure 18

2.25 The screen as displayed above is the setup for BST/GMT changeover and should be left at 1. Press MODE to move to next screen. (Figure 18)

2.26 The next screen is the latitude which should be set at 52. (Figure 19)

Figure 19

2.27 Press the MODE button once which completes the setup and the screen should look something similar to that displayed in Figure 20. (It moves to this screen automatically after a few seconds).

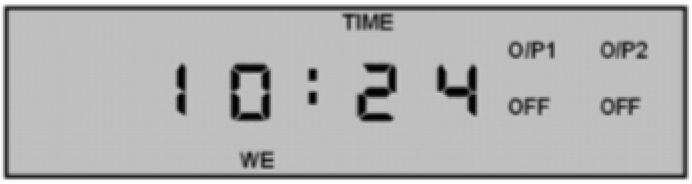


Figure 20

2.28 The state of O/P1 & 2 and the current time is normally displayed.

END

Includes:	All types of Automatic Half Barrier Crossing (AHBC)
Excludes:	All other crossing types

General

Liaise with the Signaller before any tests are carried out.

Check in the crossing control tables for any special controls that affect the automatic control sequence.

On early designs of crossings ATC and Strike in treadle reverse proving is required in the automatic sequence and the crossing sequence starts as soon as the strike in treadles are operated. Check the diagrams.

Where the word EXIT occurs the strike out treadle shall be operated.

On single lines or where bi-directional controls exist, the leaving track circuit shall also be operated.

Where directional proving controls exists the bi-directional strike out treadle shall also be operated in the correct sequence.

Service A - Tests

1. Local Control Sequence

1.1 Operate the LCU to the LOWER position, observe road lights illuminate, audible warnings operate, boom lamps illuminate and the barriers lower.

1.2 Confirm that no trains are approaching.

a) Operate the LCU to the RAISE position.

b) Observe the barriers rise, the road lights extinguish and audible warnings, where designed to sound when barriers are lowered, cease (check diagrams).

1.3 Operate the LCU to the LOWER position, allow the lowering sequence to take place and then operate the LCU switch to the AUTO position.

a) Observe the barriers rise, the road lights extinguish and audible warnings where designed to sound when barriers are lowered cease (check diagrams).

1.4 Close and lock the LCU door.

a) Check the door cannot be locked unless the switch is in the AUTO position.

<u>On BR standard Mk1&2 units (penguin).</u>

b) Check the door cannot be locked unless the AUTO operating lever is in the vertical position and has fully engaged the AUTO button.

2. Automatic Control Sequence

2.1 Simulate an approaching train by shunting a controlling track circuit and/or treadle operation. Observe the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate, and the audible warnings commence concurrently (Yodel alarms at normal warbling rate).

c) After 3 seconds (5 seconds at older installations) all the amber signals extinguish, and all the red road signals and any pedestrian lights start to flash.

d) After approximately a further 4 seconds (8 seconds at older installations) the barriers commence to lower and the boom lamps illuminate.

e) Check sighting of boom lamps.

f) The barriers take 6 to 8 seconds to reach the fully lowered position.

g) Red road lights and any pedestrian lights continue to be illuminated and flash alternately with the road lights.

h) Audible warnings can continue to sound depending on design (check diagrams).

i) When lowering the final 10 to 15 degrees is damped.

j) Check booms are horizontal when completely lowered.

2.2 Operate the exit function and remove the train simulation if controlling track circuit shunted. Observe the following:

a) The barriers begin to rise.

b) The red road lights extinguish and the audible warnings (depending on design check diagrams) cease before the barriers have reached 45° from the horizontal.

c) The boom lights extinguish when the barriers have reached approximately 81° from the horizontal.

d) The barriers do not take more than 7 seconds to reach the fully raised position of between 81° and 85° from the horizontal.

2.3 Repeat 2.1 and 2.2 for the opposite direction on a single line and the other direction on double lines.

3. Double Lines Second Train Approaching Sequence

3.1 Simulate a train striking in on line one as per 2.1.

3.2 Simulate a second train striking in on line two.

Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate where designed to sound when barriers are lowered continues at the normal rate (check diagrams).

3.3 Operate the exit function and remove the simulation for the first train if controlling track circuit shunted. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate where designed to sound when barriers are lowered changes to the increased rate (check diagrams).

3.4 Operate the exit function and remove the simulation for the second train. Observe that the sequence is the same as described in 2.2.

3.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

3.6 Where possible, observe the correct crossing sequence during passage of a train(s).

4. Indications

4.1 Check that the correct indications are received in the monitoring signal box throughout a local control and automatic sequence.

Situation	Indication
Automatic control, no train approaching or no train	Barriers Raised
Crossing on Local Control or any barrier proving contact	Barriers Working Barriers
Automatic control, train approaching or train simulation	Barriers Working

Indications can be by needle instrument or lamp depending on the age of the crossing.

*: Check the diagrams for the contacts in the barrier proving circuit ((Xing)KR).
**: The barriers failed indication occur after 180 seconds on a single line or 240 seconds on a double line along with an audible warning.

Service B – Tests

These tests are for the full annual test of the crossing. NR/SMS/PartD/Index lists the indexes and references to the A4 format (with tick boxes) of this test for the use of the person testing the crossing.

END

Includes:	All types of Automatic Barrier Crossing Controlled Locally (ABCL)
Excludes:	All other types of Level Crossing

Liaise with the Signaller before any tests are carried out. Check in the crossing control tables for any special controls that affect the automatic control sequence. Where the word EXIT occurs, operate the strike out treadle.

On single lines or where bi-directional controls exist, operate the leaving track circuit.

Where directional proving controls exists operate the bi-directional strike out treadle in the correct sequence.

The following abbreviations are used in this service:

- DRL: Driver's Red Light.
- DWL: Driver's White Light.

SERVICE A TESTS

1. Local Control Sequence

1.1 Operate the LCU to the lower position:

a) Observe road lights illuminate, audible warnings operate, crossing headlights illuminate and the barriers lower.

b) Check the DWLs do not illuminate.

1.2 Confirm that no trains are approaching. Operate the LCU to the raise position:

- Observe the barriers rise, the road lights extinguish, the crossing headlights extinguish, and audible warnings cease.

1.3 Operate the LCU to the lower position, allow the lowering sequence to take place and then operate the LCU switch to the auto position:

a) Observe the barriers rise, the road lights extinguish and audible warnings cease.

b) Check that all DRL are flashing.

1.4 Close and lock the LCU door. Check the door cannot be locked unless the switch is in the auto position.

1.5 Check that the DRL is flashing for all signalled directions.

2. Automatic Control Sequence

2.1 Observe, with no train approaching, all DRLs are flashing.

2.2 Simulate an approaching train by shunting a controlling track circuit. Observe the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate, and the audible warnings begin at the same time (Yodalarms at normal warbling rate).

c) After 3 seconds all the amber signals extinguish and all the red road signals and any pedestrian lights start to flash.

d) The crossing headlights illuminate the crossing at the same time the red road lights commence to flash.

e) After approximately a further 4 seconds the barriers commence to lower and the boom lamps illuminate.

f) Check the sighting of the boom lamps.

g) As the barriers commence to lower, the driver's red light extinguishes and the DWL commences to flash for the direction where the train simulation was applied. The DRL continues for the opposing directions.

h) The barriers take 6 to 8 seconds to reach the fully lowered position.

i) The crossing headlights, red road lights and any pedestrian lights continue to be illuminated and audible warnings continue to sound.

2.3 Operate the exit function and remove the train simulation. Observe the following:

a) The barriers begin to rise.

b) The DWL for the direction where the simulation was applied extinguishes and the DRL (if provided) commences to flash.

c) The red road lights and crossing headlights extinguish and the audible warnings cease when the barriers have reached approximately 45° from the horizontal.

d) The boom lights extinguish when the barriers have reached approximately 81° from the horizontal.

e) The barriers do not take more than 7 seconds to reach the fully raised position of between 81° and 85° from the horizontal.

2.4 Repeat steps 2.2 and 2.3 for the opposite direction on a single line and the other direction on double lines.

3. Double Lines Second Train Approaching Sequence

3.1 Simulate a train striking in on line one as per 2.2.

3.2 Simulate a second train striking in on line two. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate continues at the normal rate.

d) The crossing headlights continue to illuminate.

3.3 Operate the exit function and remove the simulation on line one. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate changes to the increased rate.

d) The crossing headlights continue to illuminate.

e) The DWL for the direction of the simulation on line one extinguishes and the DRL commences to flash.

f) The DRL for the simulation on line two extinguishes and the DWL commences to flash.

3.4 Operate the exit function and remove the simulation on line two. Observe that the sequence is the same as described in 2.3.

3.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

3.6 Where possible, Observe the correct crossing sequence during passage of a train(s).

SERVICE B TESTS

These tests are for the full annual test of the crossing. NR/SMS/PartD/Index lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

APPENDIX A - Indications

Table 1 lists the driver indications displayed throughout a local control and automatic sequence.

Situation	Indication
Automatic control, no train approaching, or no train simulation applied	DRL Flashing DWL Extinguished
Crossing on operating on Local Control	
Automatic control, train approaching or train simulation applied, barriers started to lower	DRL Extinguished DWL Flashing
Barriers lowered by train simulation, DWL operating, any DWL proving contact broken, power off *	DRL Flashing DWL Extinguished

Table 1 – Driver Indications Table

Notes:

The DWL should only operate for the direction in which the train is approaching or the train simulation has been applied. The DRL should be operating for all other directions.

* Check the diagrams for the contacts in the DWL control circuit (this includes the (PO)PR function).

END

Includes:	All types of Automatic Open Crossing Locally Monitored (AOCL).
Excludes:	All other types of Crossing

General

Liaise with the signaller before any tests are carried out.
Check in the crossing control tables for any special controls that affect the automatic control sequence.

On early designs of crossings ATC and Strike in treadle reverse proving is required in the automatic sequence and the crossing sequence starts as soon as the strike in treadles are operated. Check the diagrams.

Where the word EXIT occurs, the strike out treadle shall be operated.
On single lines or where, bi-directional controls exists, the leaving track circuit shall also be operated.

Where directional proving controls exists the bi-directional strike out treadle shall also be operated in the correct sequence.

The following abbreviations are used in this service:

- DRL: driver's red light.
- DWL: driver's white light.

Service A

Tests

1. Local Control Sequence (If Provided)

1.1 Operate the LCU to the On position and Observe the road lights and audible warnings operate.

1.2 Check that the DWLs do not illuminate.

1.3 Confirm that no trains are approaching

1.4 Operate the LCU to the Off position and Observe the road lights extinguish and audible warnings cease.

1.5 Operate the LCU to On position, allow the sequence to complete then switch to the Auto position. Observe the road lights extinguish and audible warnings cease.

On modern installations the switch can be put straight to the auto position and the door locked.

1.6 Close and lock the LCU door. Check the door cannot be locked unless the switch is in the Auto position.

1.7 Check (if applicable) that the DRL is flashing for all signalled directions.

2. Automatic Control Sequence

2.1 Observe, with no train approaching, all DRLs (if applicable) are flashing.

2.2 Simulate an approaching train by shunting a controlling track circuit. Observe the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate and the audible warnings commence concurrently (Yodel alarms at normal warbling rate).

c) After 3 seconds (5 seconds at older installations), all the amber signals extinguish and all the red road signals and any pedestrian lights start to flash.

d) The crossing headlights illuminate the crossing at the time the red road lights commence to flash.

e) The DRL (if applicable) extinguishes and the DWL commences to flash for the direction where the train simulation was applied. The DRL (if applicable) continues for the opposing directions.

2.3 Operate the exit function and remove the train simulation. Observe the following:

a) The road lights, any pedestrian lights and audible warnings cease immediately.

b) The DWL for the direction where the simulation was applied extinguishes.

c) The DRL (if applicable) commences to flash.

d) Repeat steps 2.2 and 2.3 for the opposite direction on a single line and the other direction on double lines.

3. Double Lines Second Train Approaching Sequence

3.1 Simulate a train striking in on line one as per 2.2.

3.2 Simulate a second train striking in on line two. Observe the following:

a) The road lights and any pedestrian lights continue to flash.

b) The audible warning rate continues at the normal rate.

c) The crossing headlights continue to illuminate.

3.3 Operate the exit function and remove the simulation for the first train. Observe the following:

a) The road lights and any pedestrian lights continue to flash.

b) The audible warning rate changes to the increased rate.

c) The ATC signs (if Illuminating) illuminate, flash and the words are correct.

d) The crossing headlights continue to illuminate.

e) The DWL for the direction of the simulation on line one extinguishes and the DRL (if applicable) commences to flash.

f) The DRL (if applicable) for the simulation on line two extinguishes and the DWL commences to flash.

3.4 Operate the exit function and remove the simulation on line two. Observe that the sequence is the same as described in 2.4.

3.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

3.6 Where possible, observe the correct crossing sequence during passage of a train(s).

Service B

Tests

These tasks are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tasks for the use of the person testing the crossing.

APPENDIX A-INDICATIONS

The following table lists the driver indications displayed throughout a local control and automatic sequence.

Situation	Indication
Automatic control, no train approaching or no train simulation applied	DRL Flashing* DWL Extinguished
Crossing on operating on Local Control	
Automatic control, train approaching or train simulation applied, road lights operating	DRL Extinguished* DWL Flashing
Crossing operated by train simulation, DWL operating, any DWL proving contact broken, power off**	DRL Flashing* DWL Extinguished

Table 1 – Driver indications

The DWL should only operate for the direction in which the train is approaching or the train simulation has been applied. The DRL should be operating for all other directions.

*: The DRL indications are applicable to installations that are fitted with DRL/DWL units

**: Check the diagrams for the contacts in the DWL control circuit (this includes the (PO)PR function).

End

Includes:	All types of Automatic Open Crossing Remotely Monitored (AOCR).
Excludes:	All other types of Crossing

General

Liaise with the signaller before any tests are carried out Check in the crossing control tables for any special controls that affect the automatic control sequence.

Where the word EXIT occurs the strike out treadle shall be operated.

On single lines or where bi-directional controls exist, the leaving track circuit shall also be operated.

Where directional proving controls exists the bi-directional strike out treadle shall also be operated in the correct sequence.

Service A

Tests

1. Local Control Sequence

1.1 Operate the LCU to the on position:

1.2 Observe road lights and audible warnings operate.

1.3 Confirm that no trains are approaching

1.4 Operate the LCU to the off position and Observe the road lights extinguish and audible warnings cease.

1.5 Operate the LCU to the on position, allow the sequence to complete then switch to the auto position.

1.6 Observe the road lights extinguish and audible warnings cease.

1.7 Close and lock the LCU door. *Check* the door cannot be locked unless the switch is in the auto position.

2. Automatic Control Sequence

2.1 Simulate an approaching train by shunting a controlling track circuit. *Observe* the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate and the audible warnings commence concurrently (Yodel alarms at normal warbling rate).

c) After 3 seconds all the amber signals extinguish and all the red road signals and any pedestrian lights start to flash.

2.2 Operate the exit function and remove the train simulation and *observe* the road lights, any pedestrian lights and audible warnings cease immediately.

2.3 Repeat steps 2.1 and 2.2 for the opposite direction on a single line and the other direction on double lines.

3. Double Lines Second Train Approaching Sequence

3.1 Simulate a train striking in on line one as per 2.1

3.2 Simulate a second train striking in on line two. *Observe* the following:

a) The road lights and any pedestrian lights continue to flash.

b) The audible warning rate continues at the normal rate.

3.3 Operate the exit function and remove the simulation on line one. *Observe* the following:

a) The road lights and any pedestrian lights continue to flash.

b) The audible warning rate changes to the increased rate.

3.4 Operate the exit function and remove the simulation on line two. *Observe* the road lights, any pedestrian lights, and audible warnings cease immediately.

3.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

3.6 Where possible, *observe* the crossing sequence during passage of a train.

4. Indications

4.1 Check that the correct indications are received in the monitoring signal box throughout a local control and automatic sequence.

Situation	Indication
Automatic control, no train approaching or no train simulation applied	In Order* In Order**
Crossing on Local Control or any crossing proving contact broken #2	No Illumination* No Legend** Failed/Local Control* #1 No Legend** #1
Automatic control, train approaching or train simulation applied	No Illumination* No Legend**

Table 1 – Signal box indications

Indications can be by needle instrument or lamp depending on the age of the crossing.

* : Indications given by a lamp type indicator.

** : Indications given by a needle type indicator.

#1: The crossing failed indication occurs after 180 seconds on a single line or 240 seconds on a double line along with an audible warning.

#2: Check the diagrams for the contacts in the crossing proving circuit.

SERVICE B TESTS

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

End

Includes:	All types of Miniature Stop Light Crossing (MSL)
Excludes:	All other types of Crossing

General

Check in the crossing control tables for any special controls that affect the automatic control sequence. Where the word EXIT occurs the strike out treadle (where provided) shall be operated.

If gates or barriers are found open, close to roadway and inform your SM(S).

Tests

1. Sequence Test

1.1 Simulate an approaching train by shunting a controlling track circuit. Observe the following:

a) The green lamps on all light units extinguish and the red lamps illuminate.

b) The audible warnings (if provided) sound.

1.2 Operate the exit function and remove the train simulation. Observe the following:

a) The red lamps on all light units extinguish and the green lamps illuminate.

b) The audible warnings (if provided) cease.

1.3 Repeat steps 1.1 and 1.2 for all other directions where controls are provided.

2. Double Lines Second Train Approaching Sequence

2.1 Simulate an approaching train as in 1.1 on line one.

2.2 Simulate a second train striking in on line two.

2.3 Operate the exit function for the train simulation on line one, observe the following:

- The green lamps on all light units stay extinguished and the red lamps stay illuminated.
- The audible warnings (if provided) changes to the increased rate.

2.4 Operate the exit function for the train simulation on line two and observe that the sequence is as 1.2.

2.5 Repeat steps 2.1 to 2.4 for a train striking in on line two first and a second train striking in on line one.

2.6 Where possible, observe the correct crossing sequence during passage of a train(s).

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

End

Includes:	Manually Controlled Barriers (MCB) & all Derivatives including MCB-CCTV, MCB- OD, MCB-RB, Traincrew Operated Barriers (TOB)
Excludes:	CCTV equipment (see NR/SMS/PartC/TV01 & TV02)

GENERAL

For Signaller's controls at newer installations that have a STOP button on the control unit, one press of the LOWER or RAISE button commences the requested sequence. However some installations have been modified so that the LOWER button has to be kept pressed to continue the sequence. If you are in doubt, check the diagrams or ask your SM(S).

At older installations without a STOP button the LOWER button has to be kept pressed to continue the sequence, but only one press of the RAISE button is required for the raise sequence.

Older MCB crossings do not have local control units. At these sites, the tasks against the LCU do not apply.

At MCB-CCTV installations, the sequence cannot be initiated unless a picture on the monitor is called.

Some MCB-CCTV installations have an auto lower facility (these usually have additional Signaller audible warnings) and/or an auto raise facility.

SERVICE A TESTS

1. Barrier Operation Sequence Signallers Controls

At MCB, MCB-CCTV and MCB-RB crossings the following sequence may be performed by yourself, with permission of the Signaller, or observed whilst the Signaller operates/auto lower initiates the barrier sequence for the passage of a train.

At MCB-CCTV installations, observation can be via the crossing monitor (with on-site assistance for the audible warnings.)

At MCB-OD the tests shall be carried out at site.

1.1 Observe the following sequence as the barriers are lowered:

a) All the Amber lights illuminate and show a steady light.

b) The audible warnings (if fitted) sound when the amber lights illuminate and continue until all the barriers have fully lowered.

c) After approximately 3 to 5 seconds the amber lights extinguish, and all the red lights begin to flash.

d) After approximately 4 to 6 seconds after the red lights have started to flash the barriers begin to lower. At installations with four barriers, check that the nearside barriers (YN& ZN) lower first and are completely lowered before the offside barriers (YO & ZO) begin to lower.

e) The boom lights on each barrier illuminate when the barrier is approximately 80° from the horizontal.

f) Each barrier takes between 6 to 10 seconds to completely lower. Confirm barrier damping (if fitted) is effective when the barrier is approximately 10° from the fully lowered position.

g) The audible warnings (if fitted) cease to sound when all the barriers have fully lowered.

1.2 At MCB, MCB-CCTV and MCB-RB, check that protecting signals cannot be cleared until the ‘crossing clear’ function is operated.

1.3 At MCB-OD crossings, check that, if the crossing is clear, the obstacle detector allows protecting signals to clear approximately 4 seconds after all barriers are detected down (check the DOWN indication in signal box goes from flashing to steady white).

Check that an obstruction on the crossing prevents crossing clear being given (DOWN indication remains flashing, does NOT go steady).

After the barrier management sequence has completed (exit barriers raise and stay raised if crossing is occupied). The Signaller receives an alarm approximately 30 seconds after the exit barriers have raised (by AUTO indication flashing plus an audible alarm).

1.4 Check at MCB-CCTV installations that have auto raise, if this is selected the monitor picture is extinguished when the crossing clear function is operated.

1.5 Observe the following sequence as the barriers are raised:

a) The raise sequence cannot be initiated unless protecting signals are at red.

b) All the barriers begin to rise simultaneously and take 4 to 10 seconds to reach the fully raised position at between 83° and 85° from the horizontal.

c) The flashing red lights continue to show until the barriers have reached approximately 45° from the horizontal.

d) The boom lights extinguish when all the barriers have passed 80° from the horizontal.

2. Additional Checks for MCB-CCTV installations with Auto Lower Facilities

2.1 Check (if provided) an audible warning is given, and a picture is called on the monitor when the crossing sequence is initiated.

2.2 Check (if provided) an audible warning is given when all barriers are fully lowered.

3. Barrier Sequence Operation (Local Control)

These tests are 'If Provided'. At installations that have Auto Lower and/or Auto Raise.

3.1 Check that the manual position is selected for these tests.

3.2 In liaison with the Signaller open the LCU door and switch to local control.

If door proving is fitted, the Signaller receives a failed indication when the door is opened, otherwise it fails when local control is taken.

3.3 Carry out steps and observations as per 1.1 and 1.5.

NOTE: *Because the crossing is now in LCU mode, it will also be failed and so it is not possible for Crossing Clear to be registered or for the protecting signals to clear.*

3.4 Return the crossing control back to the Signaller.

At newer installations when giving local control back, the barriers shall be in the lowered position, then close and lock the LCU door.

The Signaller shall first select LOWER/DOWN (to correspond their controls to the actual barrier position) and can then operate the barriers to the raised position which proves that they have regained control.

4. Barrier Sequence Operation (TMOB)

4.1 Check that the barrier sequence is initiated when the controlling TC is occupied, and the driver's plunger are operated.

4.2 Check that the lowering sequence is as step 1.1.

4.3 Check the DCI (white light) operates only when all barriers are fully lowed for the direction of the applied simulation.

4.4 With the controlling TCs clear, check the raising sequence is as 1.3.

4.5 Check the DCI (white light) is extinguished.

5. Indications (Signallers Controls)

5.1 Check that the correct indications (Table 1) are received on the Signaller's panel throughout a lowering and raising sequence.

SITUATION	INDICATION
Barriers Raised	Barriers Raised
Lower button operated, red road lights operating, barriers raised	Barriers Raised Y Road Lights Z Road Lights
Lower button operated, red road lights operating, barriers lowering	Y Road Lights Z Road Lights
Barriers Lowered	Barriers Lowered Y Road Lights Z Road Lights Crossing Clear*
Barriers Rising	None till all barriers raised; then Barriers Raised
Local Control (if provided)	Barriers Failed

Table 1 – Signallers Indications

* If provided, this will be flashing until the function is operated.

6. Local Control Indications (if provided)

6.1 Check that the correct indications (Table 2) are received on the local control unit throughout a lowering and raising sequence.

Situation	Indication
Signaller Control	No Indication
Local Control	Barriers Raised
Barriers Lowering	No Indication
Barriers Lowered	Barriers Lowered
Barriers Rising	No Indication
Barriers Raised	Barriers Raised

Table 2 – Local Control Indications

SERVICE B TESTS

These tests are for the full annual test of the crossing.

NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

END

Includes:	All types of On Call Barriers (OCB)
Excludes:	All other types of Barrier

General

Check that the signaller receives the correct indications throughout the barrier operation sequence.

Service A

Tests

1. Barrier Operation Sequence

The following sequence can be performed by the technician with permission of the signaller or observed whilst the signaller operates the barriers for the passage of a train.

1.1 Operate the lower switch/button and *Observe* the following:

a) The audible warnings sound.

b) The Barriers commence to fall 8 to10 seconds after the audible warnings commence and are fully lowered in a further 8 to15 seconds.

c) The booms lights illuminate when the barriers are approximately 80° from the horizontal.

d) The audible warnings continue to sound until both barriers are fully lowered.

1.2 Operate the raise switch/button and *Observe* the following:

a) The barriers commence to rise.

b) The boom lights extinguish when the barriers have passed 80° from the horizontal.

c) The barrier cut-off is effective when the barriers reach the fully raised position of between 83° and 85° from the horizontal.

d) The barriers take 8 to 15 seconds to reach the fully raised position.

Service B

Tests

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

End

Includes:	Single white light units.
Excludes:	All other types of Crossing

Service A

1. Sequence Test

1.1 Train shunt the controlling track circuits and Observe that the lamps extinguish. Remove the train shunt and observe that the lamps illuminate.

Directional and/or route setting controls can affect the operation of these lights. If in doubt, ask your SM(S).

End

Includes:	Mechanically Operated Gates, Locked Gates, Keylock Operated Gates, Hand Operated Gates
Excludes:	All other Gates

SERVICE A TESTS

1. Mechanically Operated Gates

The sequence in 1.2 may be performed by yourself with permission of the Signaller or observed whilst the Signaller operates the gates for the passage of a train.

1.1 With the gates closed to rail traffic and open to road traffic, check that the gate stops are effective in holding the gates.

1.2 Operate the gates so that they are open to rail traffic and closed to road traffic. Check the following:

- a) Audible warnings (if provided) operate correctly.
- b) The release and gate stop levers operate without excessive force being required.
- c) The gate stops fall and rise correctly in the correct sequence.
- d) The gates operate without excessive force required on the operating mechanism.
- e) The gates do not catch on the road surface during any part of their movement.
- f) On completion on their movement the gates are held effectively in the gate stops.
- g) The gate stop levers are correctly locked in the frame.

1.3 Repeat 1.2 operating the gate so that they are closed to rail traffic and open to road traffic.

1.4 Check that any locked wickets gates are effective when the locking lever is reversed in the frame. When locked, the gate should not be able to be opened sufficiently to allow a person to pass.

2. Locked Gates (Black's Locks & Bottle Locks)

These tests shall be carried out in liaison with the Signaller or crossing keeper.

2.1 With the gates closed to rail traffic and open to road traffic. Check the following:

a) The gate lock is effective in holding the gates.

b) The frame release lever is locked in the frame.

2.2 Operate the gates so that they are open to rail traffic and closed to road traffic. Check the following:

a) The gates swing without excessive force being required.

b) The gates do not catch on the road surface during any part of their movement.

2.3 When the gates are closed to road traffic, check the following:

a) The bolt enters the locking mechanism smoothly and can be turned without excessive force being required.

b) When both gate bolts are fully engaged in the locking mechanism, the frame release lever can be reversed.

c) When the frame release lever is fully reversed, the gate bolts are locked in the locking mechanism.

2.4 Place the release lever normal in the frame and check the gate bolts can be turned and withdrawn from the locking mechanism smoothly and without excessive force being required.

3. Keylock Gates (not Fortress style)

These tests shall be carried out in liaison with the Signaller or crossing keeper:

3.1 Check that with the gates open for road traffic, the keys are locked in the gate lock units.

3.2 Check the following in the signal box or gate box:

a) Mechanical Signal Boxes - The frame release lever is locked.

b) Panel Signal Boxes - The protecting signals cannot be cleared.

c) Gate Boxes - A release to the controlling signal box cannot be given.

3.3 Close the gates to road traffic and check the following:

a) The gates swing without excessive force being required.

b) The gates do not catch on the road surface during any part of their movement.

3.4 Check that the keys are not released from the lock units until the gate bolt is fully home.

3.5 Check with the keys removed, the gate bolts cannot be withdrawn.

3.6 Place the first key into the release unit in the signal/gate box and turn. Check the conditions remain as in 3.2.

3.7 Place the second key into the release unit and turn. Check that the first key is locked.

3.8 With both keys turned in the release unit check:

a) Mechanical Signal Boxes - The frame release lever is unlocked and can be reversed.

b) Panel Signal Boxes - The protecting signals can be cleared.

c) Gate Boxes - A release to the controlling signal box can be given.

3.9 Check that the keys are locked in the release unit until:

a) Mechanical Signal Boxes - The frame release lever is returned to the normal position.

b) Panel Signal Boxes - The protecting signals are returned to their most restrictive aspect.

c) Gate Boxes - The release from the controlling signal box is given back.

3.10 Remove the keys (in the correct order) from the release unit and check the conditions return to as described in 3.2.

3.11 Replace the keys in the gates and check the gate bolt can be withdrawn.

4. Fortress Key Locks

4.1 For each gate in turn:

a) Close the gate: Operate the bolt and lock to release the key.

b) Check that the key cannot be withdrawn until the bolt is in the unit and that once the key is withdrawn, the bolt cannot be released from the lock.

c) Return the key to the lock and open the gate.

4.2 For each lever fitted with a lock:

a) Check that the lever cannot be released until the key/s is/are put into the lock and turned.

b) Check that the key/s cannot be removed once the lever is moved out of the lock position.

4.3 For each solenoid lock:

a) Check that signals cannot be cleared until the key is put into the lock and turned.

b) If appropriate, check that the key/s cannot be removed once signals have been cleared for a train to approach.

5. Hand Operated Gates

Manned hand gates open across the rails, user operated hand gates open away from the rails.

5.1 Check the following on hand gate operation:

a) If provided, any equipment for calling the gatekeeper operates correctly.

b) The gates swing without excessive force being required.

c) Gates on bridleways have latches that can be operated by mounted horse riders.

d) The gates do not catch on the road surface during any part of their movement.

e) Any gate self-closing mechanism (if provided) is effective.

f) When open to road traffic, (if provided) any gate securing mechanism is effective.

END

Includes:	SD cards in a PLC unit used in EBI Gate 200 Crossing System
Excludes:	All other SD cards

GENERAL

Before any data collection is carried out, power down the EBI Gate 200 System.

The system can be irreparably damaged if the SD Card is removed whilst the system is powered up and working.

Only a SIEMENS SIMATIC memory card can be used.

Downloading the Daylog Data

1. SD Card Removal

1.1 Power down the Panel Fuse on TB2 at the top rear of the lower enclosure.

1.2 Open the SD Card Cover on PLC by pulling gently on the tab on the top right-hand corner of the cover (See Figure 1). This clicks as the cover releases.

Figure 1 – Lower Enclosure

1.3 Remove the SD Card by gently pressing the SD Card inwards and releasing it (See Figure 2). The SD Card slot is sprung-loaded, and the SD Card releases.

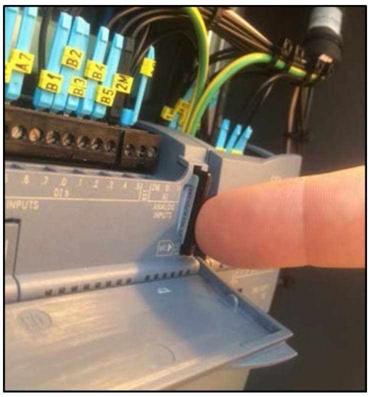


Figure 2 – Press the SD Card inwards

1.4 Downloaded the data to a laptop as described within Section 2.

NOTE: *a replacement SD card of the correct type can be inserted to allow the removed SD Card to be downloaded off site.*

1.5 Re-insert the SD Card back into the PLC. Push gently until you hear the SD Card "click" into place.

2. Copy DayLog Data

2.1 The SD Card (Figure 3) is a standard size and fits into standard SD Card readers/Slots on PC's/Laptops.

Figure 3 – SD Card

2.2 Plug the SD Card into the PC/Laptop SD Slot (Figure 4).

Figure 4 - SD Card into the PC/Laptop SD Slot

2.3 The SIMATIC MC symbol (Figure 5) appears on the desktop.

Click the icon to open.

Figure 5 – SIMATIC MC Symbol

DO NOT Delete or alter the Data or the files on the SD Card. Only copy the data.

2.4 When the SD Card is opened, there are 3 objects in the SD Card Folder (Figure 6).

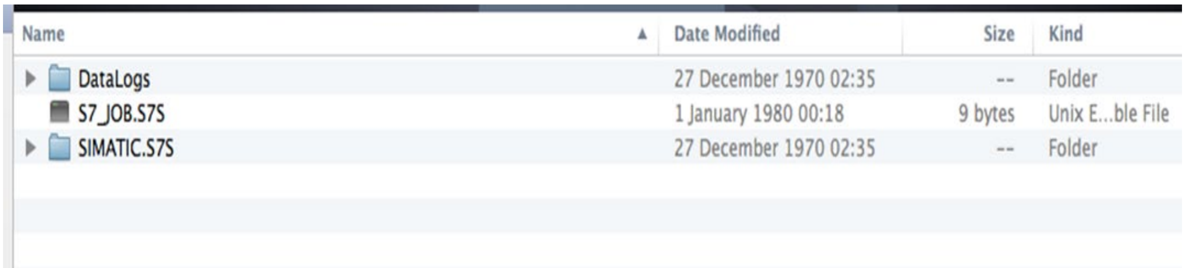


Figure 6 – SD Card Folder

2.5 Open the DataLogs folder, DO NOT open the other files or folders, the DayLog files appear (Figure 7).

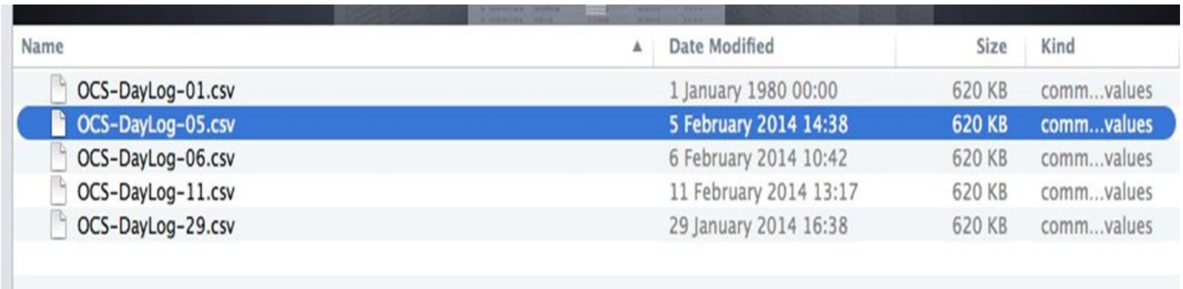
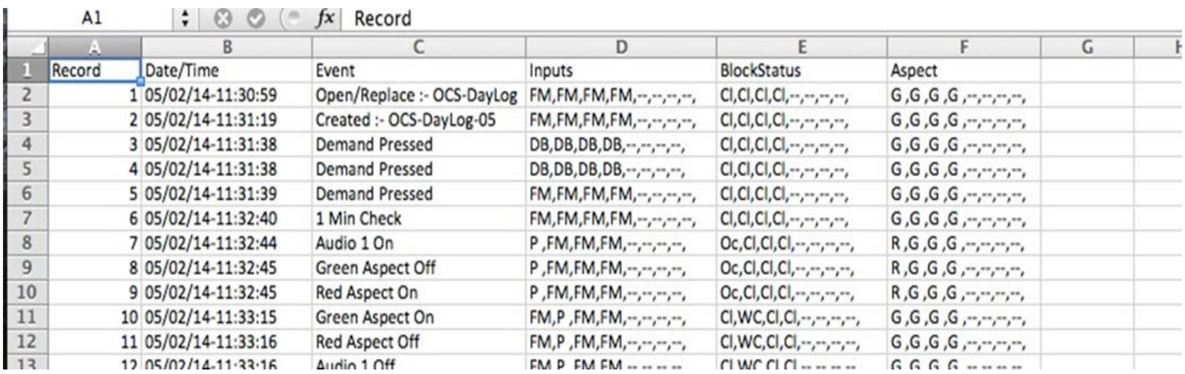


Figure 7 – DayLog Files

The DayLog files are date stamped to the day they were generated. These files are saved in a .csv format and open with Excel software.

2.6 When you open the DayLog files, they look like this (Figure 8).

NOTE: *Information on the Interpretation of the Datalog Files is covered in NR/SMS/Appendix 09 - General information on EBI Gate 200 Level Crossing System.*



A1 fx Record

	A	B	C	D	E	F	G
1	Record	Date/Time	Event	Inputs	BlockStatus	Aspect	
2	1	05/02/14-11:30:59	Open/Replace :- OCS-DayLog	FM,FM,FM,FM,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
3	2	05/02/14-11:31:19	Created :- OCS-DayLog-05	FM,FM,FM,FM,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
4	3	05/02/14-11:31:38	Demand Pressed	DB,DB,DB,DB,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
5	4	05/02/14-11:31:38	Demand Pressed	DB,DB,DB,DB,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
6	5	05/02/14-11:31:39	Demand Pressed	FM,FM,FM,FM,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
7	6	05/02/14-11:32:40	1 Min Check	FM,FM,FM,FM,--,--,--,--,	CI,CI,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
8	7	05/02/14-11:32:44	Audio 1 On	P ,FM,FM,FM,--,--,--,--,	Oc,CI,CI,CI,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	
9	8	05/02/14-11:32:45	Green Aspect Off	P ,FM,FM,FM,--,--,--,--,	Oc,CI,CI,CI,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	
10	9	05/02/14-11:32:45	Red Aspect On	P ,FM,FM,FM,--,--,--,--,	Oc,CI,CI,CI,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	
11	10	05/02/14-11:33:15	Green Aspect On	FM,P ,FM,FM,--,--,--,--,	CI,WC,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
12	11	05/02/14-11:33:16	Red Aspect Off	FM,P ,FM,FM,--,--,--,--,	CI,WC,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
13	12	05/02/14-11:33:16	Audio 1 Off	FM,P ,FM,FM,--,--,--,--,	CI,WC,CI,CI,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Figure 8 – Open DayLog Files

2.7 Save the file to the PC/Laptop for future reference.

2.8 Eject the SD Card from the PC/Laptop. DO NOT just pull it out of the slot, this might damage the data stored on the SD Card.

2.9 If an SD card has not already been inserted, re-insert the SD Card back into the PLC. Push gently until you hear the SD Card "click" into place.

DO NOT power up the system before replacing the SD card.

2.10 Only after the SD Card has been replaced, power up the UPS isolation fuse.

END

Includes:	AHBC controlled by a level crossing predictor
Excludes:	Any other type of AHBC, or other automatic crossing

Service A

Tests

1. Physical Inspections

Any obstructions or conditions likely to prove detrimental to the reliability of the level crossing system shall be dealt with immediately (if practicable) or brought to the notice of the SM(S) and dealt with as soon as possible.

The objective of this examination is to find and remove potential causes of failure and check that, as far as possible, the level crossing can function satisfactorily until the next examination.

This test requires the use of a frequency meter.

1.1 Walk through all approaches and the Island Circuit, and Check the following:

- The integrity of all tail cables and that they are securely attached to the rails as shown on the site set-up sheet.
- The integrity of all fixed and variable shunts and that they are securely attached to the rails.
- The integrity of all bonding within the Predictor approach areas.
- The integrity of cable fasteners on rails and sleepers.
- The integrity of Wideband Joint Couplers and connections.
- That there is at least two turns per foot on twisted pair wiring.
- The frequency of track voltages against the site set-up sheet in the circuit diagrams.
- For insulation deterioration and rail end burring over insulated rail joints.
- Where appropriate, the scorched earth policy is being complied with.
- For metallic or other contaminations on the surface of the rails.
- Check for rust and other contamination on the surface of the rails.
- Check the integrity of rail and clip insulations on the track with concrete or metal sleepers.
- Check the condition of the ballast and report any build-up of ballast against the rails, wet beds in the vicinity or insulated rails joints, and significant

patches of wet ballast.

2. Local Control Sequence

If the frequency of timetabled train services during the test period is such that an extended gap exists between trains on both lines, arrangements should be made for the completion of crossing sequence observations to be carried out on a subsequent visit.

2.1 Operate the LCU to the LOWER position, observe that the road lights illuminate, audible warnings operate, boom lamps illuminate, and the booms lower.

2.2 Confirm that no trains are approaching

2.3 Operate the LCU to the RAISE position, observe that the booms rise, the road lights extinguish and the audible warnings cease.

2.4 Operate the LCU to the LOWER position, allow the lowering sequence to take place and then operate the LCU to the AUTO position. Observe the booms rise, the road lights extinguish, and the audible warnings cease.

2.5 Close and lock the LCU door. Check the door cannot be locked unless the switch is in the AUTO position.

3. Automatic Control Sequence.

During the Automatic Control Sequence tests, Check that trains never reach the level crossing in less than 27 seconds from initiation of the warning sequence.

Any such occurrence should be immediately reported to your SM(S).

As trains approach, check that the loop impedance (EZ – WRSL, RX – GETS) decreases in a steady manner.

3.1 With a train approaching the crossing, Observe that the following sequence takes place:

a) If applicable on double lines that with no other train in section, all amber lights illuminate, and all audible warnings sound at the normal rate.

b) The output of the Level Crossing Predictor is not energised, and that any associated indication is not illuminated.

c) After 3 seconds the amber lights extinguish and all the red flashing road traffic light signals and any pedestrian signals commence to flash, audible warnings continue to sound.

d) After approximately 4 seconds the booms commence to lower and the boom lamps illuminate when the booms are at approximately 80° from the horizontal.

e) The booms take 6 to 8 seconds to reach the lowered position and are horizontal when fully lowered.

f) When the train arrives at the level crossing the associated Island Circuit is de- energised and that any associated indication is not illuminated.

g) The red flashing road traffic light signals and any pedestrian signals are continue to flash and the audible warnings continue to sound.

3.2 When the train has passed over the crossing, Observe the following:

a) The booms begin to rise without significant delayAfter the train has left the crossing the output of the Level Crossing Predictor is restored and that any associated indication is illuminated and the appropriate Island Circuit is restored and that any associated indication is illuminated.

b) Before the booms have reached 45° above the horizontal the red flashing road traffic lights extinguish, and the audible warning ceases.

c) After the booms have reached approximately 81° above the horizontal, the boom lights extinguish.

d) After commencing to rise, the booms reach their final position in no more than 7.5 seconds.

e) When raised, the booms are between 81° and 85° from the horizontal.

3.3 Check that the level crossing operates in accordance with the sequence in 3.1 and 3.2 when repeating these observations for a train approaching from any other direction.

4. Double Line Second Train Approaching Sequence.

4.1 With a train entering the crossing control area on line one, Observe that the sequence is the same as that detailed in 3.1

4.2 When a second train enters the crossing control area on line 2, Observe the following:

a. The booms remain lowered.

b. The road traffic lights and any pedestrian lights continue to flash and the audible warning continues at the normal rate.

4.3 When the leading end of either train passes over the crossing Check that the audible warning rate changes to the increased rate.

4.4 When the train in 4.3 has passed completely over the crossing, Observe the following:

a. The booms remain lowered.

b. The road traffic lights and any pedestrian lights continue to be flash and the audible warning continues at the increased rate.

4.5 When the second train has passed completely over the crossing Observe that the sequence is the same as that detailed in 3.2.

4.6 Where there is a suitable frequency of trains, repeat 4.1 to 4.5 for other combinations of approaching trains.

5. Indications.

5.1 Check that the correct indications are received in the monitoring signal box throughout the local control and automatic sequence tests.

Situation	Indication
Automatic control, no train approaching, or no train simulation applied	Barriers Raised
Crossing on Local Control or in failure #1	Barriers Working Barriers Failed #2
Automatic control, train approaching or train simulation applied	Barriers Working
Power Removed from LCP	Standby In Use

Table 1 – Indications

#1 Check the circuit diagrams for the contacts in the barrier proving circuit.

#2 The Barriers Failed indication occurs no more than 180 seconds after the Barriers Working indication is displayed on a single line, and no more than 240 seconds after the Barriers Working indication is displayed on a double line. The Barriers

Failed indication is accompanied by an audible warning.

Service B

Tests

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of this test for the use of the person testing the crossing

End

Includes:	MSL crossing controlled by a Level Crossing Predictor
Excludes:	Any other type of MSL, or automatic crossing

Service A

Tests

1. Physical Inspections

The objective of this examination is to find and remove potential causes of failure and check that, as far as possible, the level crossing will function satisfactorily until the next examination.

Any obstructions or conditions likely to prove detrimental to the reliability of the level crossing system shall be dealt with immediately (if practicable) or brought to the notice of the SM(S) and dealt with as soon as possible.

This test requires the use of a frequency meter.

1.1 Walk through all approaches and the Island Circuit, and Check the following:

a) The integrity of all tail cables and that they are securely attached to the rails as shown on the site set-up sheet.

b) The integrity of all fixed and variable shunts and that they are securely attached to the rails.

c) The integrity of all bonding within the Predictor approach areas.

d) The integrity of cable fasteners on rails and sleepers.

e) The integrity of Wideband Joint Couplers and connections.

f) That there is at least two turns per foot on twisted pair wiring.

g) The frequency of track voltages against the site set-up sheet in the circuit diagrams.

h) For insulation deterioration and rail end burring over insulated rail joints.

i) Where appropriate, the scorched earth policy is being complied with.

j) For metallic or other contaminations on the surface of the rails.

k) For rust and other contamination on the surface of the rails.

l) The integrity of rail and clip insulations on the track with concrete or metal sleepers.

m) The condition of the ballast and report any build up of ballast against the rails, wet beds in the vicinity or insulated rails joints, and significant patches of wet ballast.

2. Automatic Control Sequence.

2.1 During the Automatic Control Sequence tests, Check that trains never reach the level crossing in less than:

a) 20 seconds from initiation of the warning sequence on a Footpath Crossing,

b) And not less than 40 seconds on a Bridleway or User Worked Crossing.

Any such occurrence shall be immediately reported to your SM(S).

2.2 As trains approach, check that the loop impedance (EZ – WRSL, RX – GETS) decreases in a steady manner.

2.3 With a train approaching the crossing, Observe that the following sequence takes place:

a) If applicable on double lines that with no other train in section, all green lights are extinguished, all red lights illuminate and, where provided, all audible warnings sound.

b) The output of the Level Crossing Predictor is not energised, and that any associated indication is not illuminated.

c) When the train arrives at the level crossing the associated Island Circuit is de-energised and that any associated indication is not illuminated.

d) The red lights signals are illuminated and that, where provided, the audible warnings continue to sound.

2.4 After the train has passed completely over the crossing, observe that the red lights are extinguished, all green lights are illuminated and, where provided the audible warning ceases without significant delay.

2.5 Check that after the train has left the crossing the output of the Level Crossing Predictor is restored and that any associated indication is illuminated.

2.6 Check that the appropriate Island Circuit is restored and that any associated indication is illuminated.

2.7 Check that the level crossing operates in accordance with the sequence in 2.2 to 2.6 when repeating these observations for a train approaching from any other direction.

3. Double Line Second Train Approaching Sequence.

3.1 With a train entering the crossing control area on line one, observe that the sequence is the same as that detailed in 2.1

3.2 When a second train enters the crossing control area on the line 2, Observe the following:

a) The red lights remain illuminated.

b) Where provided, the audible warning continues at the normal rate

3.3 When the leading end of either train passes over the crossing Check where provided that the audible warning rate changes to the increased rate.

3.4 When the train in 3.3 has passed completely over the crossing, Observe the following:

a) The red lights continue to be illuminated.

b) Where provided, the audible warning continues at the increased rate.

3.5 Observe the second train passing completely over the crossing and observe that the sequence is the same as that detailed in 2.2 to 2.6.

3.6 Where there is a suitable frequency of trains, repeat steps 3.1 to 3.4 for other combinations of approaching trains.

Service B

Tests

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of this test for the use of the person testing the crossing.

End

Includes:	Systems fitted with **"both"** IMC & ACB Boards
Excludes:	Systems fitted with **"only"** IMC Boards

General

Before work is undertaken that affects the normal operation of the level crossing system the Signaller shall be informed. Normally a possession of the equipment or a no train period is required.

The tests in sections 1 to 3 are required when wheel sensors are replaced or removed and re-fitted.

1. Frauscher RSR123 Wheel Sensor Test (System Adjustment)

1.1 Before starting work the system shall be powered down by the removal of the main supply fuse in the master post.

1.2 Disconnect the wheel sensor cable in the trackside connection box (GAK unit).

1.3 Connect a multimeter set on 0-1V DC to the AMB001 test box socket (See Figure 1). Press the toggle switch on AMB001 to the battery symbol. The multimeter reading shall be > 0.75 V, if not the battery of the test box AMB001 needs replacing.

Figure 1 – AMB001 Test Box

1.4 Sensor System 1. Connect wire 1 (brown) to the red connector and wire 2 (yellow) to the black connector (See Figure 2). The adjustment procedure starts automatically. After approximately 10 seconds the multimeter shall show a value between 0.49 V and 0.515 V.

Figure 2 - AMB001 Test Box Connected

1.5 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Period Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.6 Within 50 seconds of test step 1.3 place the testing plate PB200 over sensor system 1 (see Figure 3) and check that the multimeter value is between 330mV and 375mV.

Figure 3 – PB200 Over Sys1

1.7 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.8 Reconnect the wires to the trackside connection box to wiring diagrams.

1.9 Sensor System 2. Connect wire 3 (green) to the red connector and wire 4 (white) to the black connector. The adjustment procedure starts automatically. After approximately 10 seconds the multimeter shall show a value between 0.49 V and 0.515 V.

1.10 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.11 Within 50 seconds of test step 1.8 place the testing plate PB200 over sensor system 2 (see Figure 4) and check that the multimeter value is between 330mV and 375mV.

Figure 4 - PB200 Over Sys2

1.12 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task. If this is unsuccessful then the wheel sensor shall be replaced.

1.13 Power up the axle counting system, as described in Section 2 of this document.

1.14 Undertake the wheel sensor detection capability test, as described in Sections 4 & 5 of this document

2. Level Crossing System Power Up

2.1 At the master post replace the main supply fuse to energise the system.

2.2 Check that the Green "DC Okay" LED is illuminated on the 24vDC power supply.

2.3 Check the two 5V LEDs (green) on the ACB board illuminate and observe that the display initially shows LRNO for approximately 5 seconds.

2.4 Observe the ACB display changes to flashing **** for approximately 10 seconds indicating system initialisation. After 10 seconds the ACB display changes to an alternating display of -109 / -209. This indicates that the system is now waiting for the axle counter section to be occupied and cleared.

2.5 Observe the two green PWR LEDs on the IMC evaluator board are illuminated.

2.6 To reset the ACB displays to 0 undertake one of the options, as described in section 3 of this document.

3. Block Section Test and Reset Sequence

3.1 To test and reset the ACB displays to 0, undertake one of the options 3.3 or 3.4.

3.2 To reset all Block Sections simultaneously undertake option 3.5.

3.3 Observe the passage of a train on each line.

a) Observe the number of axles counted in and the ACB Occupied LED (red) is lit.

b) Check all the axles are counted out of the section and the ACB display count shows 0.

c) Check the Occupied LED (red) is extinguished.

3.4 Activate the axle counter heads in sequence using the test plate PB200 over each head for each line.

a) In the normal direction of travel slowly sweep test plate PB200 over a Strike-in wheel sensor. This simulates one axle in block section.

b) check the section ACB display shows 1 and the Occupied LED (red) is lit.

c) In the normal direction of travel slowly sweep the test plate over the section Strike-out head.

d) Check that the ACB for block section 1 shows 0 and the Occupied LED for the section is extinguished.

e) Check the ACB for block section 2 shows 1 and the Occupied LED is lit.

f) In the normal direction of travel slowly sweep the test plate over the Strike-out head for the block section 2.

g) Check that the section ACB display shows 0 and the Occupied LED (red) is extinguished.

3.5 Operate the reset switch.

3.6 The successful completion of either 3.3, 3.4 or 3.5 initialises the system, ready for service.

3.7 Failure of any of the above tests should be reported as corrective maintenance.

4. Wheel Sensor Test for NDI and NDO heads (Detection Capability)

4.1 Identify the Evaluation Board (IMC) related to the axle counter sensor to be tested and check the section is indicating clear. The IMC Board should only have the two green power LEDs lit (Figure 5) and the associated ACB display shows 0 (Figure 6).

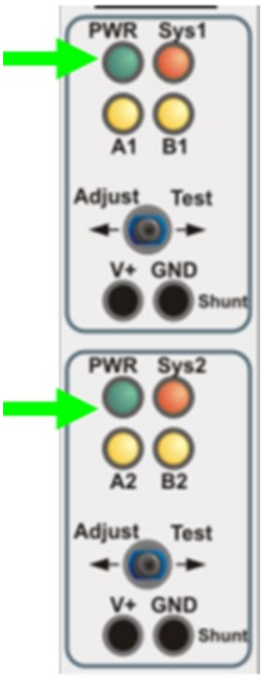


Figure 5 - IMC Board

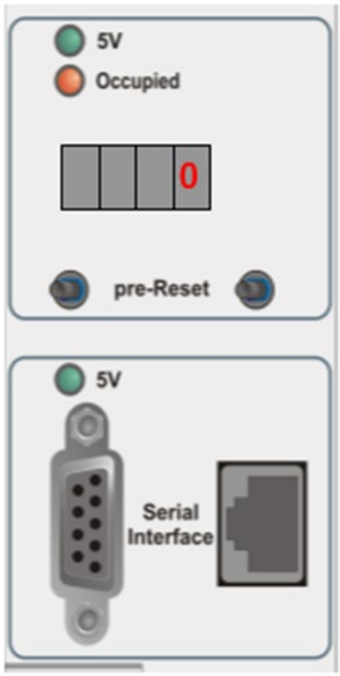


Figure 6 – ACB Board

4.2 Place the PB200 testing plate on the railhead, on the approach side of the axle counter wheel sensor, for a train moving in the normal direction. This is the start position (Figure 7).

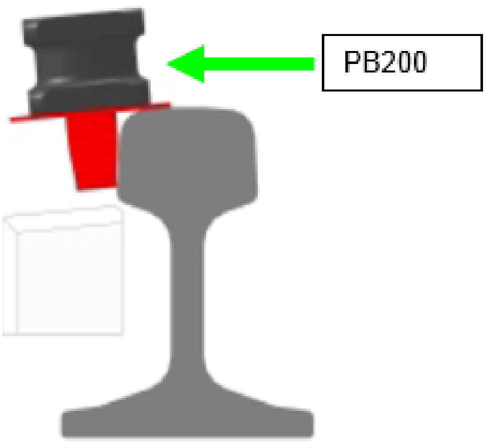


Figure 5 - PB200

4.3 Move (slide) the PB200 slowly in the normal direction of travel and stop over the first wheel sensor (Figure 8).

4.4 Check the LED indications SYS1 and B1 are illuminated (Figure 9) and the ACB display shows <00> (Figure 13). Whilst testing the NDO, BS1/BS3 ACB shows an error code and BS2/BS4 shows as per Figure 10.

Figure 6 – PB200 Over Sys1

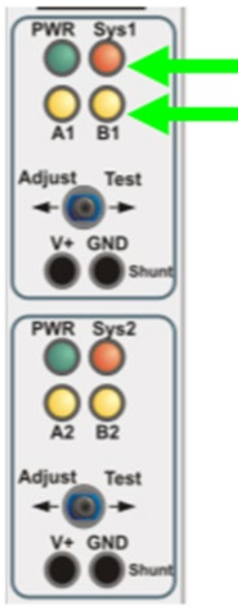


Figure 7 – IMC Board

Figure 8 – ACB Board

4.5 Move (slide) the PB200 slowly in normal direction of travel and stop in between the two wheel sensors systems (Figure 11).

4.6 Check the LED indications SYS1, SYS2 and B1, B2 are illuminated (Figure 12).

Figure 11 – PB200 Mid Position

Figure 12 – IMC Board

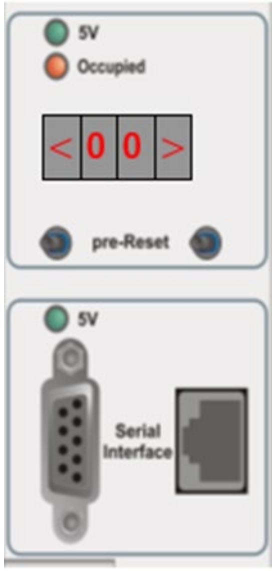


Figure 13 – ABC Board

4.7 Move (slide) the PB200 slowly in normal direction of travel and stop over the second wheel sensor (Figure 14).

4.8 Check the LED indications SYS1 and B1 have extinguished and the LED indications SYS2 and B2 remain illuminated (Figure 15).

Figure 14 – PB200 Over Sys2

Figure 15 – IMC Board

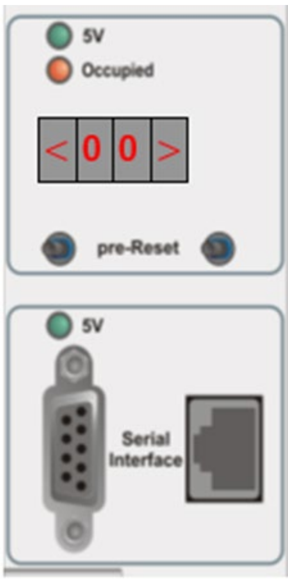


Figure 16 – ACB Board

4.9 At the end of the simulation, when the PB200 testing plate has passed beyond the sensor check the LED indications SYS2 and B2 have extinguished on the IMC Board leaving the two PWR indications illuminated, this indicates that the head/sensor has sensed a complete sweep (Figure 17). Check the ACB Display now indicates a single axle count (Figure 18). Whilst testing the NDO, BS1/BS3 ACB shows an error code and BS2/BS4 ACB displays a count of one.

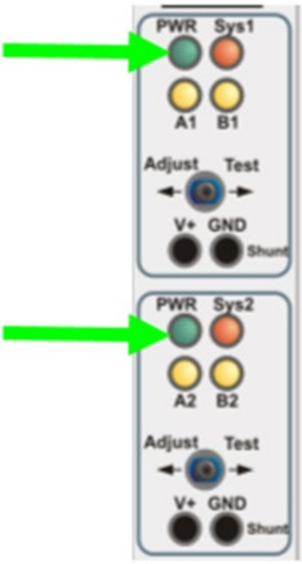


Figure 17 – IMC Board

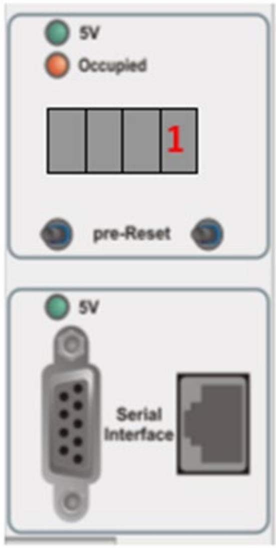


Figure 18 – ACB Board

4.10 The PB200 shall now be traversed over the axle counter sensors in the reverse direction to clear the section / track. When testing the NDO, BS2/BS4 ACB resets to zero and the BS1/BS3 ACB displays an error code.

Figures 8, 11 and 14 illustrate the PB200 moving over a sensor mounted on the cess rail, if the sensor were fitted on the 10ft rail then the direction of travel of the PB200 would be reversed.

4.11 If a wheel sensor detection test is carried out in isolation the on an NDO it is likely to have caused BS1/3 to fail. To clear this issue the system shall be reset.

5. Wheel Sensor Test for XDI heads (Detection Capability)

5.1 Identify the Evaluation Board (IMC) related to the axle counter sensor to be tested and check the section is indicating clear. The IMC Board should only have the two green power LEDs lit (Figure 19) and the associated ACB display shows 0 (Figure20).

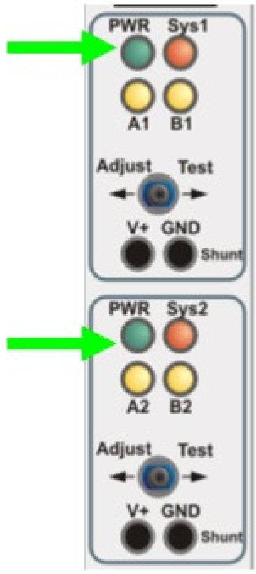


Figure 9 – IMC Board

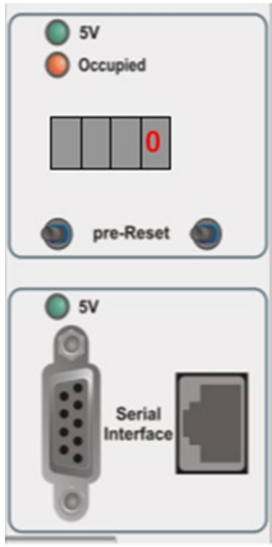


Figure 10 – ACB Board

5.2 Place the PB200 testing plate on the railhead, on the approach side of the axle counter wheel sensor, for a train moving in the wrong direction. This is the start position (Figure 7).

5.3 Move (slide) the PB200 slowly in wrong direction of travel and stop over the first wheel sensor (Figure 21).

5.4 Check the LED indications SYS2 and B2 are illuminated (Figure 22) and the ACB display shows <00> (Figure 23).

Figure 21 – PB200 Over Sys2

Figure 11 - IMC Board

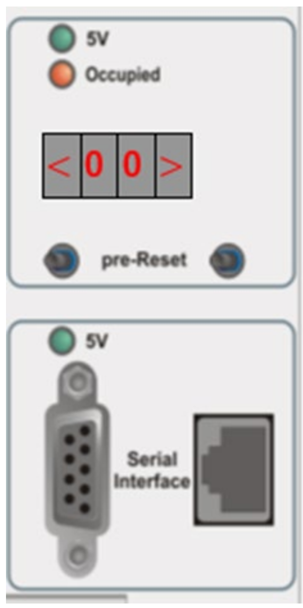


Figure 23 – ACB Board

5.5 Move (slide) the PB200 slowly in wrong direction of travel and stop in between the two wheel sensors systems (Figure 24).

5.6 Check the LED indications SYS1, SYS2 and B1, B2 are illuminated (Figure 25).

Figure 24 – PB200 Mid Position

Figure 12 - IMC Board

Figure 26 – ACB Board

5.7 Move (slide) the PB200 slowly in normal direction of travel stop over the second wheel sensor (Figure 27).

5.8 Check the LED indications SYS1 and B1 have extinguished and the LED indications SYS2 and B2 remain illuminated (Figure 28).

Figure 27 – PB200 Over Sys1

Figure 28 – IMC Board

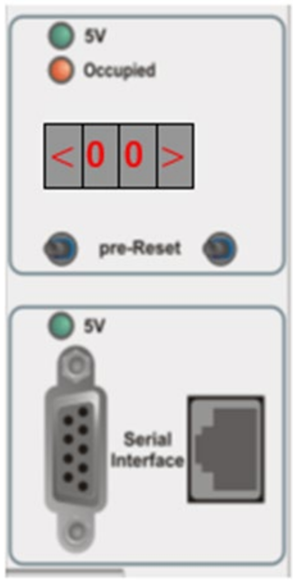


Figure 13 – ACB Board

5.9 At the end of the simulation, when the PB200 testing plate has passed beyond the sensor check the LED indications SYS2 and B2 have extinguished on the IMC Board leaving the two PWR indications illuminated, this indicates that the head/sensor has sensed a complete sweep (Figure 30). Check the ACB Display now indicates a single axle count (Figure 31).

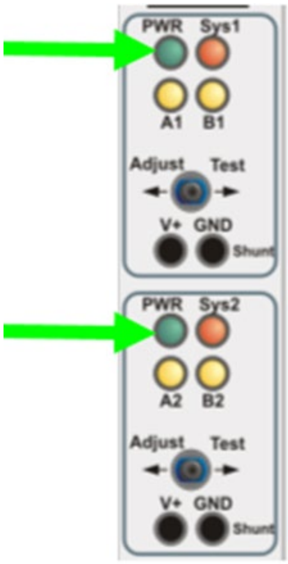


Figure 30 – IMC Board

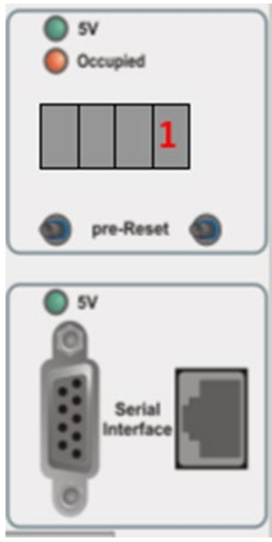


Figure 31 – ACB Board

5.10 The PB200 shall now be traversed over the axle counter sensors in the reverse direction to clear the section/track.

5.11 If a wheel sensor detection test is carried out in isolation the on a single unit it is likely to have caused the associated block section to fail. To clear this issue the system shall be reset using the Test/Reset facility.

Figures 21, 24 and 27 shows the PB20 moving over a sensor mounted on the cess rail, if the sensor were fitted on the 10ft rail then the direction of travel of the PB200 would be reversed.

6. Functional Task – Operational Sequence Test

6.1 Check no train enters the level crossing strike in area from any direction for the duration of test.

6.2 Push the On-Demand button on one of the units if applicable and observe the green lights illuminate in both units. Commence timing the lights and check that the green lights are extinguished after 5 minutes.

6.3 Press the on demand button (if provided). Simulate a train occupying an entrance section by entering one axle using the test switches on a Strike-in evaluator board (IMC). Observe the green lights in both units are extinguished; the red lights illuminate and check the audible warnings sound. Observe the entrance block section ACB display shows 1 and the ACB Occupied LED (red) is illuminated.

6.4 Simulate a train arriving at the crossing and exiting the entrance section by entering one axle using the test switches on the Strike-out evaluator board (IMC) to clear the axle counter section. Observe the crossing lights change from red to green and Check the audible warning ceases. Observe the entrance section ACB display shows 0 and the ACB Occupied LED (red) is extinguished.

Reference should be made to local documentation as the toggle switch sequence is related to the layout of the sensor heads.

Observe the exit block section ACB display shows 1 and the ACB Occupied LED (red) is illuminated.

6.5 To complete the sequence, simulate the train leaving the exit block section. Observe that the ACB display for the exit block section shows 0 and the ACB Occupied LED (red) is extinguished.

6.6 Repeat 6.3 to 6.5 for all other lines (normal direction strike-in), there is no need to wait for 5 minutes to elapse between tests.

7. Double Lines Second Train Approaching Sequence Test

7.1 Push the On-Demand button (if applicable/fitted) on one of the posts and observe the green lights illuminate in both units.

7.2 Simulate a train occupying an entrance section on line 1. Enter two axles using the test switches on a Strike-in evaluator board (IMC) for line 1. Observe the green lights in both units are extinguished the red lights illuminate and check the audible warnings sound. Observe the entrance section ACB display shows 2.

Reference should be made to local documentation as the toggle switch sequence is related to the layout of the sensor heads.

7.3 Simulate a second train occupying an entrance section on line 2. Enter two axles using the test switches on a Strike-in evaluator board (IMC) for line 2. Check the lights continue to show red. Observe the entrance section ACB display for the second line shows 2 and the ACB Occupied LED (red) is illuminated.

7.4 Simulate the train on line 1 arriving at the crossing by entering one axle using the test switches on the entrance section Strike-out evaluator board (IMC) for line 1. Observe the red lights remain illuminated and check the audible warning changes to the increased ATC rate. Observe the entrance section ACB display shows 1.

7.5 Simulate the train on line 1 exiting the entrance section by entering a second axle using the test switches on the Strike-out evaluator board (IMC) for line 1. Observe that the light units continue to show a red light and check the increased audible warning rate continues. Observe the entrance and exit section ACB displays shows 0 and the ACB Occupied LED (red) is extinguished.

7.6 Simulate the train on line 2 arriving and exiting the entrance section by entering two axles using the test switches on the entrance section Strike-out evaluator board (IMC) for line 2. Observe that the red lights are extinguished; the green lights are illuminated and check the audible warning ceases. Observe the entrance section ACB display for the second line shows 0 and the ACB Occupied LED (red) is extinguished.

7.7 At this stage the exit section in the direction of travel, for both lines are occupied. To complete the sequence, simulate the train leaving the exit block section on both lines. Observe that the ACB display for the exit block section shows 0 and the ACB Occupied LED (red) is extinguished.

7.8 Repeat 7.1 to 7.7 for all other normal direction ATC permutations.

END

Includes:	All types of Automatic Open Crossing Locally Monitored plus Barriers (AOCL+B)
Excludes:	All other types of Crossing

Liaise with the Signaller before any tests are carried out

Check in the crossing control tables for any special controls that affect the automatic control sequence.

Where the word EXIT occurs, the strike out treadle shall be operated.

On single lines or where bi-directional controls exist, the leaving track circuit shall also be operated.

Where directional proving controls exists the bi-directional strike out treadle shall also be operated in the correct sequence.

The following abbreviations are used in this service:

- DRL: Driver's Red Light.
- DWL: Driver's White Light

SERVICE A

1. Local Control Sequence (If Provided)

1.1 Operate the Local Control Unit (LCU) to the on/lower/hand position: Observe road lights illuminate, audible warnings operate, crossing headlights illuminate and the barriers lower. Check the DWLs do not illuminate

1.2 Confirm that no trains are approaching before proceeding.

1.3 Operate the LCU to the off position. Observe the barriers rise, the road lights extinguish, the crossing headlights extinguish and audible warnings cease.

1.4 Operate the LCU to the on/lower/hand position, allow the lowering sequence to take place and then operate the LCU switch to the auto position, close and lock the LCU door.

1.5 Observe the barriers rise, the road lights extinguish, and audible warnings cease.

1.6 Check that all DRL are flashing.

1.7 Check the LCU door cannot be locked unless the switch is in the auto position.

1.8 Check that the DRL is flashing for all signalled directions.

2. Automatic Control Sequence

2.1 Observe, with no train approaching, all DRLs are flashing.

2.2 Simulate an approaching train by shunting a controlling track circuit. Observe the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate, and the audible warnings commence concurrently (Yodalarms at normal warbling rate).

c) After 3 seconds all the amber signals extinguish, and all the red road signals and any pedestrian lights start to flash.

d) The crossing headlights illuminate the crossing at the same time the red road lights commence to flash.

e) After approximately a further 4 seconds the barriers commence to lower and the boom lamps illuminate. Check the sighting of the boom lamps.

f) As the barriers commence to lower the driver's red light extinguishes and the DWL commences to flash for the direction where the train simulation was applied. The DRL continues for the opposing directions.

g) The barriers take 6 to 8 seconds to reach the fully lowered position.

h) The crossing headlights, red road lights and any pedestrian lights continue to be illuminated and audible warnings continue to sound.

2.3 Operate the exit function and remove the train simulation. Observe the following:

a) The barriers begin to rise.

b) The DWL for the direction where the simulation was applied extinguishes and the DRL (if provided) commences to flash.

c) The red road lights and crossing headlights extinguish and the audible warnings cease when the barriers have reached approximately 45° from the horizontal.

d) The boom lights extinguish when the barriers have reached approximately 81° from the horizontal.

e) The barriers do not take more than 7 seconds to reach the fully raised position of between 81° and 85° from the horizontal.

2.4 Repeat steps 2.2 and 2.3 for the opposite direction on a single line and the other direction on double lines.

3. Double Lines Second Train Approaching Sequence

3.1 Simulate a train striking in on line one as per 2.2

3.2 Simulate a second train striking in on line two. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate continues at the normal rate.

d) The crossing headlights continue to illuminate.

3.3 Operate the exit function and remove the simulation on line one. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate changes to the increased rate.

d) The crossing headlights continue to illuminate.

e) The DWL for the direction of the simulation on line one extinguishes and the DRL commences to flash.

f) The DWL for the simulation on line two continues to flash.

3.4 Operate the exit function and remove the simulation on line two. Observe that the sequence is the same as described in 2.3.

3.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

3.6 Where possible, observe the correct crossing sequence during passage of a train(s).

SERVICE B

These tests are for the full annual test of the crossing. NR/SMS/PartD/Index lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

APPENDIX A - Indications

Table 1 lists the driver indications displayed throughout a local control and automatic sequence:

Situation	Indication
Automatic control, no train approaching, or no train simulation applied	DRL Flashing DWL Extinguished
Crossing on operating on Local Control	
Automatic control, train approaching, or train simulation applied, barriers started to lower	DRL Extinguished DWL Flashing
Barriers lowered by train simulation, DWL operating, any DWL proving contact broken, power off. *	DRL Flashing DWL Extinguished

Table 1 – Driver Indications

The DWL should only operate for the direction in which the train is approaching, or the train simulation has been applied.

The DRL should be operating for all other directions

* Check the diagrams for the contacts in the DWL control circuit (this includes the (PO)PR function).

END

Do not enter the potential entrapment zone whilst the gate is in operation.

This includes the space between the gate, when open, and any obstruction such as fences, wall and landscaping.

1. Before commencing any adjustment

1.1 Check the gate is properly installed and all nuts are tight.

1.2 Check the top gate rail is horizontal.

1.3 Check the gate swings feely in both directions.

1.4 Check the gate engages and the solenoids lock without binding.

1.5 Check the solenoids sit in the centre of the gate latch jaws.

2. Limit Switch Adjustment

The open and closed limits of the actuator arm may need to be adjusted to guarantee flush fitting of the gate into the solenoid locks when the gate is fully open and fully closed.

The limit switches set the point at which the actuator stops driving.

For testing / adjustment purposes you may find it easier to release the actuator and turn it upside down to access the limit switch adjustment screws which are located on the underside of the actuator unit.

Once adjustments are completed flip the actuator back to the correct final installation position.

2.1 The limit switch adjustments are located on the bottom of the actuator (See Figures 1 and 2):

Figure 1 - Location of limit switches

Figure 2 - Close up

2.2 Remove the dust plug to make adjustments. Only use a small flat blade manual screwdriver.

2.3 Each gate should be tested individually. Disable gate 2 (See Figure 3) by turning to dipswitch SW 4 to the off position.

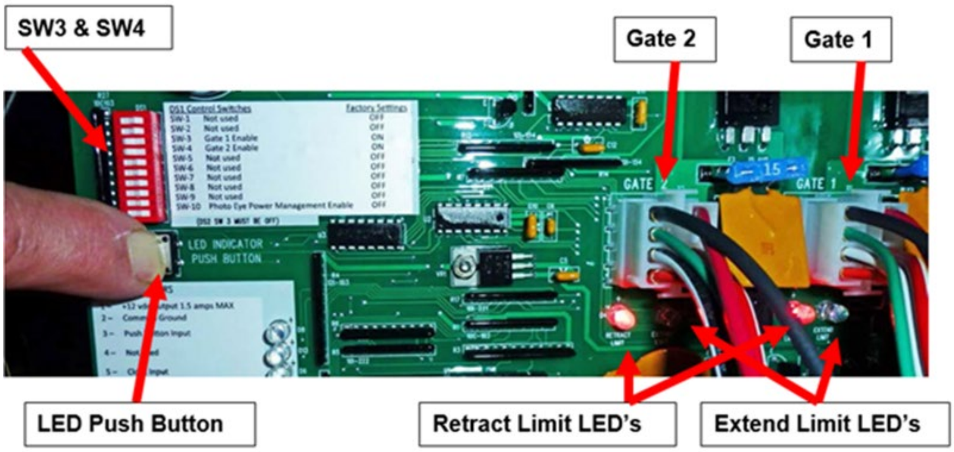


Figure 3 – NR Control Board

Closed Gate Adjustment

2.4 Operate gate 1 to the fully closed position and check it is latched. Press the LED indicator button. This should cause the extend limit LED under gate 1 to illuminate. (if the LED illuminates move to 2.9).

2.5 If the LED fails to illuminate or illuminates before travel is completed, adjust the limit switch to extend or reduce length of the actuators travel.

2.6 To extend (increase) gate travel towards the closure position turn the extend length adjustment screw clockwise. As indicated in red in Figure 4.

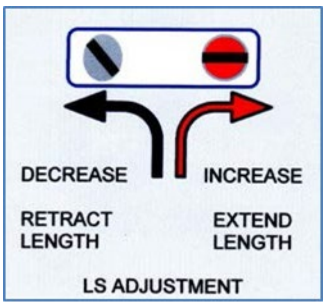


Figure 4 – Extend

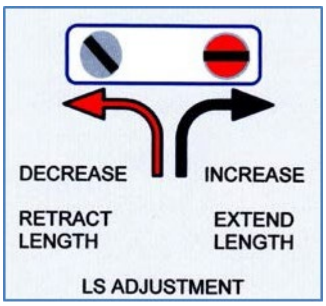


Figure 5 - Retrack

2.7 To reduce (decrease) gate travel towards the closure position turn the extend length adjustment screw counter clockwise. As indicated in red in Figure 5.

2.8 When the actuator is correctly adjusted the extend limit LED illuminates.

<u>Open Gate Adjustment</u>

2.9 Operate gate 1 to the open position and press the LED indicator button this should cause the retract limit LED under gate 1 to illuminate. (if the LED illuminates move to 2.14)

2.10 If the LED fails to illuminate or illuminates before travel is completed, the limit switch requires adjusting to extend or reduce length of the actuators travel.

2.11 To extend (increase) gate travel towards the open position turn the retract length adjustment screw clockwise. As indicated in red in Figure 6.

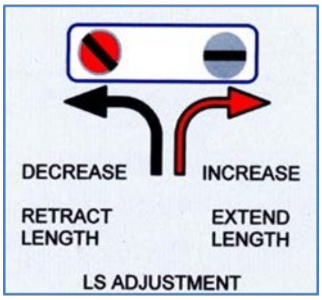


Figure 6 – Extend

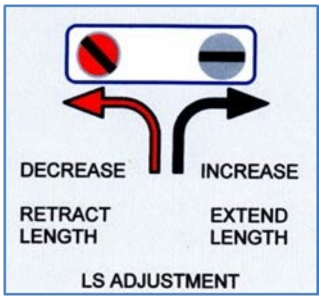


Figure 7 - Retract

2.12 To reduce (decrease) gate travel towards the open position turn the retract length adjustment screw counter clockwise. As indicated in red in Figure 7.

2.13 When the actuator is correctly adjusted the retract limit LED illuminates.

2.14 Replace the dust covers.

Remember to return the actuator to it correct position if you carried out the adjustment with the unit upside down.

3. Gate Reaction Test

3.1 Identify which gate is gate 1 and which is gate 2.

As a rule, gate 1 will be closest to the control panel and is deemed the Master with the gate across the track designated gate 2 and deemed the Slave.

3.2 Attach the 300mm extension spacer to the Closing Force Tester and Check the “ready for measurement” indication is showing (see Figure 8).

Figure 8 – Ready Indication

3.3 Open the Gate fully using the green button or the open/close button on the Control Board.

3.4 Press the Close gate button.

3.5 As the gate closes place the Closing Force Tester between the gate and the "Closed" post so the closing gate applies force to the pressure plate (See Figure 9).

Care should be taken to avoid crushing injuries and the correct PPE should be worn including gloves.

Figure 9 - Force tester in position

3.6 Check and record the reaction time recording the results on approved record card

If you are unsure of how to interpret the indications displayed on the "Closing Force Tester" then you should refer to Appendix A.

The reaction time of the gate shall be less than 0.75 seconds. If the response time exceeds this than the current sensor should be adjusted to lower the reaction time to below 0.75 seconds.

3.7 Report any failure to meet the required standard to your SM(S).

4. Current Sensor Adjustment

If any adjustment is made to a Current Sensor it is a requirement that you carry out a Gate Reaction Test before returning the gate into service. Check you have a serviceable tester before commencing any adjustment.

4.1 To carry out the adjustment you shall identify the correct current sensor potentiometer. These are found on the top edge of the Control Board and are marked as Gate 1 and Gate 2 (circled in Figure 10), one for each gate.

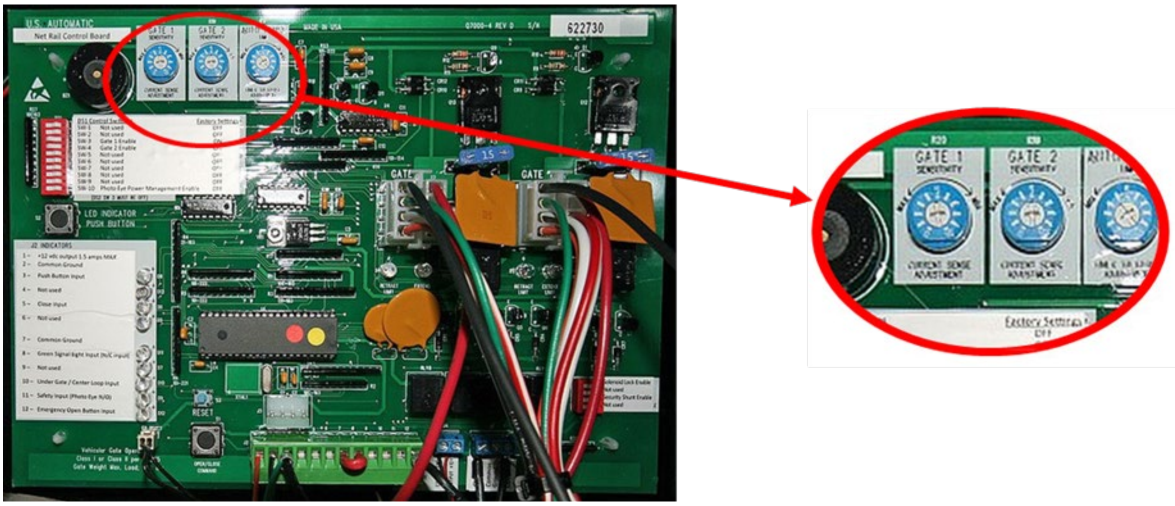


Figure 10 – NR Control Board

4.2 Using a small electrical screwdriver gently adjust the Current Sensor Potentiometer:

- To increase the Force pushing the gate you should adjust anticlockwise.
- To decrease the Force pushing the gate you should adjust clockwise.

4.3 After each adjustment the gate action time shall be rechecked using clauses 3.2 to 3.6.

The gate shall not be left to operate in automatic mode in the event of non-compliance with reaction time test.

APPENDIX A - Closing Force Tester

<u>Interpreting the outputs from the Closing Force Tester</u>

The Closing force Tester produces a series of five readings for completeness. All five are explained below. However only the second and fifth readings are recorded on the record card as explained in Clause's 2 and 5.

1. **The first indication:** This shows the closing force in Nm and is shown as a full number. This can be read directly from the unit when the force has been released.

Figure 11 – Closing Force

The example in Figure 11 shows 326 N.

2. **The second indication:** In addition to the closing force reading. When the second display segment from the left flashes this indicates the dynamic time exceeded 0.75ms.

Figure 12 – Display Segment 2

3. **The third indication:** In addition to the closing force reading. When the third display segment from the left is flashing this indicates the force value exceeded 25 N at the end of the 5 second measurement period.

Figure 13 – Closing Force < 25Nm

4. **The fourth indication:** In addition to the closing force reading. When the third and fourth display segments from the left are both flashing this indicates the force value exceeded 80 N at the end of the 5 second measurement period.

Figure 14 – Closing Force < 80Nm

5. **The fifth indication:** If clause 2 has indicated a measurement in excess of 0.75 seconds then the control button on the Force Tester should be pressed once. The display shows actual dynamic time in milliseconds and this should be entered on to the record card.

Figure 15 – Dynamic Time

The example in Figure 15 shows 740ms.

6. **The sixth Indication:** If clause 3 has indicated a measurement in excess of 25 Newtons then the control button on the Force Tester can be pressed twice. The display shows actual force value in Newton's.

Figure 16 – Actual Force in Newton

The example in Figure 16 shows Zero Newtons.

Pressing the control button returns the user to the initial readings. The tester can be turned off by pressing and holding the button in for 2 seconds. After 5 minutes of inactivity the device powers down.

END

Includes:	Servosafe 7788, 7788R, 7789, 7789R, 8889, 8889R
Excludes:	Servotrim 9909

The tasks in these tests can be carried out by other teams or equipment specialists.

SERVOSAFE SERIES

Previously the alarm levels were checked by using the servo pen recorder. This is no longer possible due to no spares available to enable repair. Also, the pen recorder paper is now obsolete.

To check that the DPU is sending out alarms at the correct level the system has to be fully powered and the transmission link to the Signal Box disconnected (prevents alarms being transmitted whilst the unit is set up).

Connect telephone ‘ear piece’ with connections to R1 & R2 alarm transmitters whilst the alarm levels are being set.

Once alarms are triggered they should be heard as ‘beeps’.

Once the alarm levels are set, the transmission can be turned off, links reconnected, and signaller informed prior to when transmission switched back on.

1. Locator Tests

Inform the Signaller that routine tests are being carried out. Carry out test between trains.

These tests refer to the signal box end of the equipment.

1.1 Switch OFF the 110Vac power supply and check that the system failure alarm operates (15 to 40 seconds). Restore the 110Vac power supply.

1.2 Operate Normal/Failure switch to Failure and check system failure alarm operates. Restore the Normal/Failure switch to Normal.

1.3 Certain Ex BR-WR sites only

a) Remove signal input plug and check system failure alarm operates.

b) Cancel system failure alarm by operating Normal/Failure switch to Failure.

c) Replace signal input plug and check system failure alarm operates.

d) Cancel system failure alarm by operating Normal/Failure switch to Normal.

1.4 Operate the locator reset button and observe that total alarms and axle number displays show zero.

NOTE: *For the following tasks, use the test buttons on the back of the locator:*

- TEST RL 2 (R/H alarm)
- TEST RL 1 (L/H Alarm)
- TEST WHEEL COUNT

1.5 Operate test wheel count push button twelve times.

1.6 Check that 12 is displayed in the axle number counter.

1.7 Check that total alarms remains zero.

1.8 Wait 30 seconds then operate test wheel count button once.

1.9 Observe that the axle number counter resets to 001.

1.10 Enter nine alarms, by using the TEST RL 1 and TEST RL 2 test buttons, interspersed by test wheel counts.

1.11 Check that the hot axle box alarm sounds intermittently.

1.12 Cancel the hot axle box alarm by operating the audible alarms reset button.

1.13 Check that the hot axle box indications appear under the first and last digits in the axle number display.

1.14 Check the results in the total alarms display and axle number display by use of the display selector switch.

1.15 Operate the locator reset button.

2. Calibration Tests

2.1 Make arrangements with the Signaller to enable the apparatus to be disconnected.

2.2 Switch OFF the carrier system and switch the signal box locator to FAILURE.

Calibration Temperature

2.3 Place the thermometer in the shade adjacent to the Scanners.

2.4 Switch the function simulator power and gate switches to the OFF position.

2.5 Connect the function simulator by its cable to the data processing unit and switch the function simulator power switch to the ON position.

Pedestal Pulse

2.6 On the test panel select DIR 1 and RAIL 1 and set the test panel pulse amplitude control to minimum.

NOTE: *The test panel deflection meter should display pedestal pulses of approximately 1.5mm amplitude.*

2.7 Check that the pedestal pulse amplitudes are constant, and no spurious alarms are produced.

2.8 Adjust, if necessary, RAIL 1 Pulse Processor PED ADJ control whilst observing the test panel deflection meter.

2.9 Select RAIL 2 on the test panel and repeat items 2.3 and 2.4. Adjust, if necessary, RAIL 2 pulse processor PED ADJ control.

2.10 Reset the test panel and allow the integrity test to complete.

Absolute Alarm Check (A.M.A. Right Hand Servolarm Unit)

2.11 Remove the fuse on the differential alarm unit. (A.M.D. Left-hand Servolarm Unit).

2.12 On the test panel select DIR 1 and RAIL 1.

2.13 Set the test panel test pulse amplitude control to give 15.5mm reading on the deflection meter.

2.14 On the absolute alarm unit (A.M.A. Right-hand Servolarm Unit), adjust alarm level RAIL 1 potentiometer until the alarm triggers so that there is an intermittent miss in triggering.

2.15 On the test panel increase the test pulse amplitude control to 16mm and check that triggering always occurs. Decrease the test pulse amplitude control to 15mm and check that triggering does not occur.

2.16 On the test panel select RAIL 2 and repeat items 2.9 to 2.12. Adjust the absolute alarm level RAIL 2 potentiometer.

2.17 On the differential alarm unit (A.M.D Left-hand Servolarm unit) restore the fuse.

2.18 Set the test panel pulse amplitude control to minimum.

Differential Alarm Check (A.M.D. Left hand Servolarm Unit).

2.19 On the test panel select RAIL 1.

2.20 Remove the absolute alarm fuse. Set the test pulse amplitude control to give 9.5mm reading on the deflection meter.

2.21 On the differential alarm unit (A.M.D. Left hand Servolarm Unit) adjust alarm level RAIL 1 potentiometer until the alarm triggers so that there is an occasional missing triggering.

2.22 On the test panel increase the test pulse amplitude control to 10mm. Check that triggering always occurs. Decrease the test pulse amplitude control to 9mm. Check that triggering does not occur.

2.23 On the test panel select RAIL 2 and repeat items 2.17 to 2.19. Adjust the Differential Alarm Unit (A.M.D. Left hand Servolarm Unit) Alarm Level RAIL 2 potentiometer. Re-fit the absolute alarm fuse.

2.24 On the test panel set the test pulse amplitude control to minimum. Reset the test panel and allow the integrity test to complete.

Pulse Processor Gain

2.25 Place the function simulator on the step of the RAIL 1 Scanner. For the 7788R system, use the saddle fixture.

2.26 Note the ambient temperature. On the function simulator adjust the coarse and fine temperature controls to indicate a temperature of 130º f above ambient.

2.27 Allow the function simulator about 3 minutes to warm up and then switch the function simulator gate switch to ON.

2.28 On the test panel select RAIL 1.

2.29 Adjust RAIL 1 pulse processor unit GAIN control to give a test panel deflection meter reading of (see Table 1):

<table>
<tr><th>Equipment Type</th><th>Reading</th></tr>
<tr><td>7788</td><td rowspan="2">6mm</td></tr>
<tr><td>7789</td></tr>
<tr><td>7788R</td><td>12.5mm</td></tr>
<tr><td>8889</td><td rowspan="2">12mm</td></tr>
<tr><td>8889R</td></tr>
</table>

Table 1 – Deflection Readings

2.30 Check that the deflection meter reading is steady, any variations should not exceed + 0.5mm.

2.31 Move the function simulator to RAIL 2 and select RAIL 2 on the test panel.

2.32 Repeat items 2.26 to 2.27 and adjust RAIL 2 pulse processor unit GAIN control.

2.33 Remove the function simulator from the scanner.

2.34 Switch the function simulator gate switch off and switch the power switch off.

2.35 Disconnect the function simulator from the data processing unit.

SERVOTRIM SERIES

Includes:	Servotrim 9909
Excludes:	Servosafe 7788, 7788R, 7789, 7789R, 8889, 8889R

SERVICE A TESTS

3. DPU Keypad Tests

3.1 Press * to enable the keypad. Then check the date and time:

a) Press D/ENT/2/ENT/

b) Check that time and date are correct. Press * to clear.

If not correct:

c) Press D/ENT/ - followed by: Month/ENT/Day/ENT/Year/ENT/Hour/ENT/ Minute/ENT/ENT/

d) Check again and press * to clear.

Should the readings have been more than a few minutes out, report it as corrective maintenance.

3.2 Check the alarm level:

a) Press E/ENT/1/ENT

b) Check that alarm level E1 is set to 14.

If wrong, enter the correct value and press:

c) ENT

d) Press /ENT/ again and E2 will be displayed. Continue in this way and check/correct values:

e) E1=14; E2=14; E3=08; E4=08; E5=08; E6=08.

If any values are found to be incorrect, report it as corrective maintenance

3.3 Run the processor and integrity tests:

a) Press C/ENT/3/ENT

b) Check that A1 is displayed.

c) Press * to clear.

3.4 Place thermometer outside in the shade near to the temperature probe and allow to stabilise.

a) Press C/ENT/5/ENT

b) Check that the display corresponds to the thermometer ±2° F. Press * to clear.

3.5 Shut down the keypad:

a) Press F/ENT

3.6 Where practicable, count the number of axles on two trains and check with the Signaller that the signal box received the same.

SERVICE B TESTS

4. Signal Box Display Equipment

4.1 Unplug the transmission line from the back of the modem and check that a ‘Comms Alarm’ is received.

4.2 Replace plug and check that the alarm is cancelled correctly.

4.3 Where the readout is computer based, switch the power off, leave for 10 seconds and power up.

4.4 Check that the computer boots up correctly and, where possible, that the next train is correctly reported.

5. Keyboard

5.1 Check that the system responds to a keyboard command by typing:

S/RETURN

NOTE: *This performs a self-test, and the ensuing report should be examined on the printer (i.e., "system test: passed + date and time).*

6. System Functions

NOTE: *Each time the sensor is adjusted, it is necessary to refresh the display by entering: C/ENT/5/ENT*

6.1 Plug the function simulator cable into the back of the DPU and the function simulator.

6.2 Set the function simulator to 130º F above ambient temperature, turn on the gate switch and power switch, and allow to warm up.

6.3 When the neon indicator is seen to be cycling on/off, place the saddle on the trailing end of rail 1 scanner and place the function simulator onto the saddle.

6.4 On the DPU Keypad press:

a) C/ENT/2/ENT

b) Check that the lowest cycling point on the display is 12.0. If it's not, adjust R58A on the front edge of board 2 of DPU.

6.5 Using a digital voltmeter, measure the voltage between TP61A (+) and TP78A (-)

- 2VDC (±0.05V). If it is outside these limits, adjust R13A to correct.

6.6 Move saddle and function simulator across to rail 2 scanner.

6.7 Check that the lowest cycling point on the display is 12.0. If it's not, adjust using R48A on the front edge of board 2 of the DPU.

6.8 Using a digital voltmeter, Measure the voltage between TP52A (+) and TP78A (-)

- 2VDC (±0.05V). If it is outside these limits, adjust R17A to correct.

NOTE: *It should be borne in mind that the values in 6.4/6.5 and 6.7/6.8 are interrelated and should be rechecked if either pair are adjusted.*

6.9 Switch the function simulator “gate” off and remove the function simulator from the scanner.

6.10 If any adjustments have been made in 6.5; 6.6; 6.7 or 6.8, benchmark the equipment by pressing C/ENT/2/ENT/*

Holding the * in until the function simulator LED on the front panel goes out. Then (within 5 secs) Press C/ENT/1/ENT

This initiate an integrity test.

Record the integrity values displayed. Press * to clear the display and exit.

6.11 Recover the function simulator, saddle, and cable from the track.

CYBERSCAN 2000 (TRIM II)

7. DPU Tests

Use a laptop or desktop PC to carry out these tests via the DPU interface terminal.

Report as corrective maintenance if any of the tests fail.

7.1 Check and Record the DPU time by typing:

NOW/ENT

7.2 Check and Record the system parameters and software installed by typing:

VER/ENT

7.3 Check and Record the system integrity by typing:

I or INTEG/ENT

END

Caution: 7788 HABD Equip is fragile, primarily due to its age. Care shall be taken when working on this equipment.

NOTE: *Excessive power down & up cause component failure.*

Inform the Signaller that routine tests are being carried out.

Carry out test between trains.

These tests refer to the signal box end of the equipment. Before starting the full alignment test check the scanners are aligned to each other.

This confirms that, once all checks have been carried out, the scanners should be looking at the same area, each side of the same axle of the passing train. Until this is achieved the tests will not be effective.

Check the alignment jig to confirm it is not bent, as it is easily mis-shaped due to bad storage or misuse.

Scanner & bolometer lens covers need to be removed. The centre of bolometer lens can now be obtained, and a straight line drawn across rail top. This can be done by using a large T square or the servo alignment jig by looking vertically down at the lens until the edge of the horizontal 'bar' is square to the running rail and aligns with the centre of the bolometer lens. R1 & R2 bolometer rail top marks should align.

Adjust scanner metal base plate to align scanners. Check that the scanner base has not moved backward or forward after this alignment or has been moved up/down or in/out to the rail.

If unable to initially align scanners inform your SM(S).

1. Alignment of transducers and optical alignment of scanners ballast mounted scanners

1.1 Check that the system is either powered down as per notes in the general section of each equipment type or the system is disconnected from the Signal Box.

NOTE: *Appendix A shows the details for Servosafe (Figure 2) rail mounded scanners, Servotrim systems (Figure 3), and Trim II systems (Figure 4). The transducers are marked as A, B & C.*

1.2 Fit the alignment jig & target mirror (Appendix C).

a) Establish the centre of the scanner lid aperture, square to the running rail.

b) Mark across the rail top for this position, complete for both scanners.

c) Check both R1 & R2 rail top marks align.

d) Move scanners to achieve alignment. If unable to align scanners report it as corrective maintenance.

e) Check that the positions of the transducers.

f) Measure ‘Z’ distance from the centre of each bolometer lens, mark on rail top towards ‘A’ & ‘B’ transducers.

g) Mark each rail at this point.

h) Note the measurement (via alignment jig) at which the centre of the fixture post sits, compare this measurement with the fixture bar setting table (Appendix B).

1.3 Report as corrective maintenance if the fixture bar measurements is outside those given in the setting table.

1.4 By use of a ferrous object, establish and mark the magnetic centres of the transducers A and B.

- If Servotrim transducers are used the magnetic centre can be found by use of an Allen key held in the hand.

- If Servopole transducers are used mark the ‘physical’ centre manually.

1.5 The scanner to transducer rail top mark now becomes the datum mark for A & B transducers.

a) Measure from this datum, distance ‘X’, marking the rail top. Then distance ‘Y’ and again mark the rail top. Marks first made on the transducers, in 1.2 should align to the marks on the rail top - distance ‘X’ & ‘Y’.

b) Adjust transducers to confirm alignment.

c) If unable to align, inform SM (S).

1.6 Check the alignment for ‘C’ Transducer. If unable to align, inform SM (S).

1.7 Check that the scanner mounting metal base plate is level by using a spirit level.

a) View the mirror through the hole in the target plate.

b) Check that the red spot appears within the black circle. Section 3 lists actions to be taken if the red spot is outside the black circle.

c) Report as corrective maintenance if any of these actions fail to solve the problem.

1.8 Remove alignment jig & target mirror and refit the lens cover and scanner housing.

1.9 Repeat as per 1.2 to 1.5 for the second scanner (rail top marking only required for the transducer rail).

1.10 Check external anti-vibration mounts are not excessively loose. Visually check, where possible, for deterioration.

1.11 Refit the lens cover and scanner housing.

1.12 Restore the power to the equipment as per notes in the general section of each equipment type or reconnect the system to the Signal Box.

Remember to allow the system to stabilise after being powered down as per the notes in the general section of each equipment type before handing back to the Signaller.

2. Alignment of transducers and optical alignment of scanners rail mounted scanners

2.1 Check that the system is either powered down as per notes in the general section of each equipment type or the system is disconnected from the Signal Box.

NOTE: *Appendix A shows the details for Servosafe rail mounded scanners, Servotrim systems, and Trim II systems. The transducers are marked as A, B & C.*

2.2 Check that the cant nuts are all set to the same number. For 113lb flat bottom vertically inclined rail the lowest number on the cant nut is used (positioned at the top).

2.3 Fit the alignment jig & target mirror (Appendix C).

a) To obtain the scanner to transducer datum mark, position the assembled alignment jig on the scanner/transducer rail.

b) Move the alignment jig towards A & B transducers until the target mirror red dot is within the black circle of the target plate.

c) Check that the alignment jig sits correctly on the rail and the fixture post and target plate are secure when aligned with target.

d) Mark the rail top with the centre of the alignment jig position at this point.

e) Note the measurement (via alignment jig) at which the centre of the fixture post sits and compare this measurement with the fixture bar setting table (Appendix B – Figure 6).

2.4 Report as corrective maintenance if the fixture bar measurements is outside those given in the setting table.

2.5 By use of a ferrous object, establish and mark the magnetic centres of the transducers A and B.

- If Servotrim transducers are used the magnetic centre can be found by use of an Allen key held in the hand.
- If Servopole transducers are used mark the ‘physical’ centre manually.

2.6 The scanner to transducer rail top mark now becomes the datum mark for A & B transducers.

a) Measure from this datum, distance ‘X’, marking the rail top.

b) Then distance ‘Y’ and again mark the rail top. Marks first made on the transducers, in 2.3, should align to the marks on the rail top - distance ‘X’ & ‘Y’.

c) Adjust transducers to confirm alignment.

d) If unable to align, inform SM (S).

2.7 Check the alignment for ‘C’ Transducer. If unable to align, inform SM (S).

2.8 Check that the scanner mounting metal base plate is level by using a spirit level.

a) View the mirror through the hole in the target plate.

b) Check that the red spot appears within the black circle. Section 4 lists actions to be taken if the red spot is outside the black circle.

c) Report as corrective maintenance if any of these actions fail to solve the problem.

2.9 Remove alignment jig & target mirror and refit the lens cover and scanner housing.

2.10 Repeat as per 2.2 to 2.9. for the second scanner (rail top marking only required for the transducer rail).

2.11 Check external anti-vibration mounts are not excessively loose. Visually check, where possible, for deterioration.

2.12 Restore the power to the equipment as per notes in the general section of each equipment type or reconnect the system to the Signal Box.

Remember to allow the system to stabilise after being powered down as per the notes in the general section of each equipment type before handing back to the Signaller.

3. Suggested action to be taken if alignment is incorrect for ballast mounted scanners

This is a list of suggested actions to be taken to correct alignment; they are not mandated actions to be taken in all cases.

3.1 Check the scanner unit mounting base/plates are not obstructed by ballast or other objects preventing adjustment.

3.2 Check that the scanners are still aligned to each other if any additional adjustment is carried out i.e. A combination of adjusting the scanner metal base plate up or down, in or out to the rail, along with the bolometer mounting base, should enable compliance with 1.2.

After adjustment, check that the metal base plate is level by using a spirit level.

3.3 Check the scanner unit mounting base/plates have adjustment available.

Inform your SM(S) if no adjustment available to comply with 1.9.

3.4 Check for damage to the scanner metal base plate i.e. bent, mis-shaped.

Usually after being driven over by RRVs or hit by Tamper's.

Inform your SM(S) if plate is damaged.

3.5 Check for damage to the metal base plate mountings.

Inform your SM(S) if mountings are damaged and or preventing compliance with 1.9.

3.6 Check bolometer anti-vibration mounts are not deteriorated or have been damaged. Replace if necessary.

3.7 Check alignment bar is in correct position i.e. middle of bar aligns with the Z distance (Appendix B) rail top mark.

a) Check fixture post set to correct setting.

b) Check the alignment bar is flush/pushed down onto the rail top.

Alignment checks should be combined with an onsite 'system check'. Other than 'fault conditions' or equipment replacement after track work, is usually undertaken every 12 months'.

4. Suggested action to be taken if alignment is incorrect for rail mounted scanners

4.1 Check the scanner is secure and correctly fitted. Loose fixing bolts or dirt/debris behind the clamps.

4.2 Check that the scanner and is not damaged (e.g. hit by an object hanging from a train). Correctly secure or replace as necessary.

4.3 Check that the correct alignment can be obtained within the tolerances given in Appendix B.

4.4 Check that the railhead does not have a layer of swarf/rust or has burrs. Clean or Rectify as required.

4.5 Check that the scanner mountings are not deteriorated, replace if necessary.

4.6 Check that the internal anti-vibration mounts are not deteriorated or have been damaged. Replace if necessary.

4.7 Check if provided, the scanner cant clamp nut (or cant cam).

On 113lb flat bottom vertically inclined rail this should be at the lowest number, positioned at the top.

If the fixture bar measurements cannot be obtained (with cant nuts correct) and no spare scanner is available, additional special packing pieces (fit between the anti-vibration pads and scanner body) are available to adjust scanner alignment, if required.

Advise your SM(s) if packings are required.

Note that this may have been adjusted previously to obtain correct alignment.

4.8 If none of the previous steps solve the problem, replace the scanner with a known ‘good’ unit and recheck the alignment.

APPENDIX A - Equipment Positions

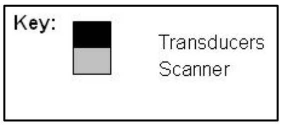


Figure 1 - Positioning of transducers and scanner (not to scale)

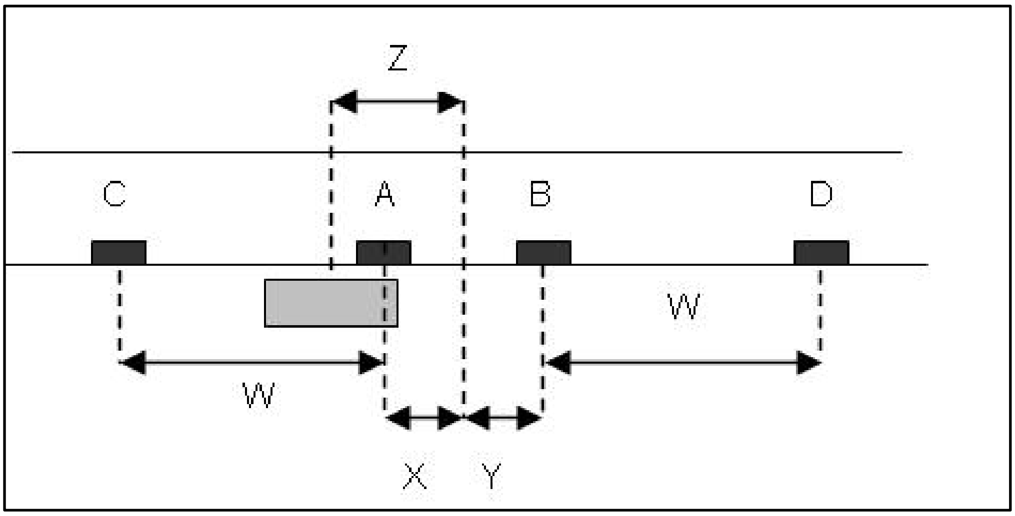


Figure 2 – Servo Safe Series

NOTE: *The Servosafe diagram shows rail mounted scanners*

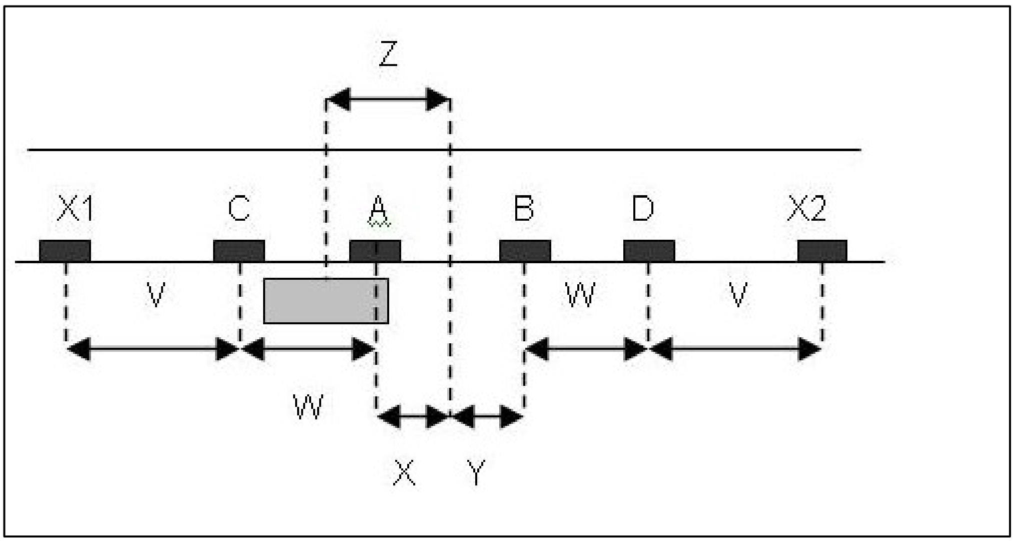


Figure 3 – Servotrim Series

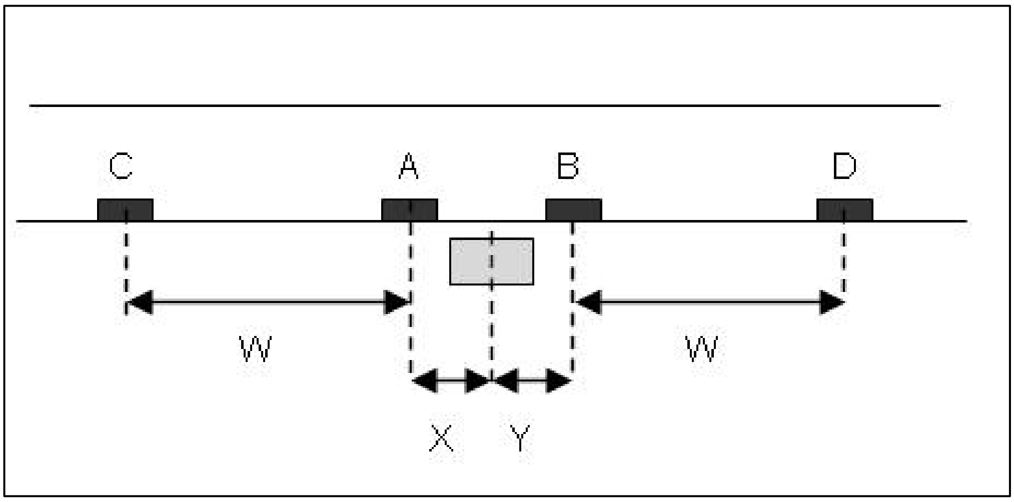


Figure 4 – Trim II Series

APPENDIX B - Setting Tables

Equip. Type	Distance (Inches)				
	W	X	Y	X+Y	Z
7788	433 ±6	10	10	20	35¾
7788R	433 ±6	12	12	24	19½
7789	433 ±6	10	10	20	35¾
8889	433 ±6	12	12	24	19⅓
8889R	433 ±6	12	12	24	20⅔
9909	864 ±6	13½	13½	27	20⅔
Trim II	480 ±6	13½	13½	27	0

Table 1 – Distance Setting Table

NOTE: *Distant Z can vary on older systems, it is important that the scanners are aligned to each other. See the general section.*

Distance Z is between the centre points of X/Y and the centre of the scanner mirror/aperture.

Distance ‘V’ (X1/2 to C/D transducers) is applicable only to the Servotrim 9909 series (transducers X1/2 are on this system only) and is a distance of 500 feet (±10 inches).

Distances V, W, X and Y are between the magnetic centres not the physical centres

Equipment Type	Fixture Bar Setting (inches)
7788 and 7789 rail mounted scanners	14.5
7788 ballast mounted scanners	13.5
7788R	6.75 (+¼ / - ½)
8889	13.125
8889R	6.75 (+¼ / - ½)
9909	6.75 (+¼ / - ½)

Table 2 – Fixture Bar Setting Table

APPENDIX C - Scanner Alignment

NOTE: *The diagrams shows rail mounted scanners:*

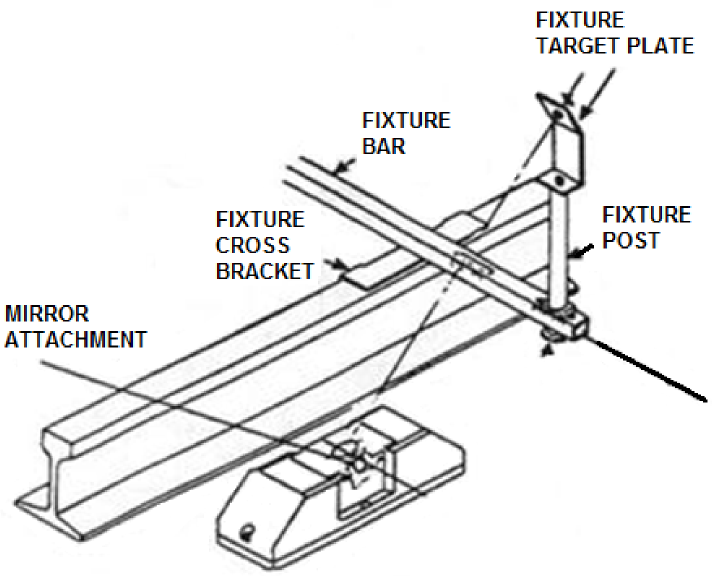


Figure 5 – Scanner Alignment

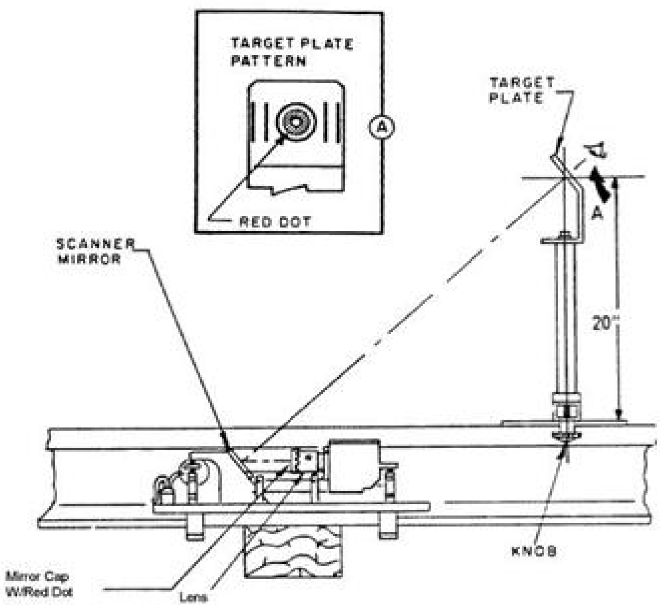


Figure 6 – Scanner Alignment 2

END

Advise the Signaller a functions test is to be performed on the system.

1. Test HOAL

1.1 Set the heat source to 110C + Nom Temp (i.e. 10 degrees higher than the alarm threshold).

Warning: Do not touch the black surface of the heat source.

1.2 Place the heat source above the shutter opening with the heated surface pointing to the shutter opening.

1.3 Use the train simulator unit to simulate the passage of a train with speed set to slow and number of axles set to 32.

1.4 Remove the heat source after 7 seconds and await the unit to finish processing the data.

1.5 Use the Terminal / Menu X / B-last trains / X Showax menu to check the charts of each sensor element is displaying the correct temperature.

1.6 Check the data for the last train (i.e. the simulated train) confirming each axle raised an alarm.

1.7 Check with the Signaller that an alarm has been raised for the correct temperature and number of axles.

1.8 Where necessary undertake any corrective action. This may include re-aligning the sensor elements using the alignment matrix (see NR/SMS/PartE/HO11 – HABD Equipment GETS FUES - Appendix B).

2. Test HOAR

2.1 Repeat steps 1.2 to 1.8.

3. Test FBOA

3.1 Set the heat source to 410C + Nom Temp (ie. 10 degrees higher than the alarm threshold).

3.2 Repeat steps 1.2 to 1.8.

END

Includes:	SSI Datalink
Excludes:	All other types of datalink

GENERAL

Records shall be kept for a minimum of five years.

Health Check Tests

Sections 1 and 2 require the use of a datalink analysis device capable of counting blips and incomplete, damaged, or incorrect telegrams on an SSI datalink. Any unit with this functionality can be used, provided that it has been accepted by Network Rail for attachment to SSI datalink test points for the purpose of datalink monitoring.

Accepted datalink analysis devices available at the time of writing are the PTERTS, the SLA. REMIT detect and REMOSdl.

Section 3 requires use of an SSI datalink interrogator and a digital storage oscilloscope. More details on these appear in the 'DLM Tests' text preceding Section 3.

This monitoring equipment shall only be fitted by an 'Instrumentation Engineer' (Oscilloscope) or a 'Special User' (PTERTS, SLA, REMIT and REMOS) who has been trained in its use.

Before fitment, the engineer shall specifically consider power supply arrangements, connections to the datalinks and any address changing necessary.

In electrified areas, the following tests shall be carried out while a representative electric service is being run (or at least two electric trains shall pass through the testing area during the period of testing).

The SLA does blip detection and telegram error detection simultaneously, thus Clauses 2.1 - 2.3 below are not required.

REMITdetect has been specifically designed to cover the maintenance requirements for data links and hence many of the steps herein are automated by the use of this tool.

The SLA also has an internal logging feature which should be enabled during the testing; the internal log should be provided to your SM(S) if either the blip count or telegram error rate is exceeded.

SERVICE B TESTS

1. Blip Detection

1.1 Follow the manufacturer's operating manual to set up the datalink analysis device. The correct power supply connection is required for both PTERTS and the SLA, dependant on the monitoring time.

1.2 For the PTERTS only, set the unit to count blips.

1.3 Observe that the unit is detecting blips (on the PTERTS an LED indication pulses when a blip is encountered, the SLA shows activity on the display screen and blip and other counts at the top) and leave the unit to obtain a representative count.

1.4 Observe that the unit is detecting blips (the LED indication pulses when blips are detected) and leave the unit to obtain a representative count.

On busy lines, an hour during daytime should be adequate; on lightly used lines, a full day is more appropriate.

1.5 Record the times and count obtained.

If the blip count is greater than 5/hr, further investigation shall be undertaken to determine the cause of the level of errors and corrective actions taken.

2. Telegram Error Detection

If using the SLA or other device that automates the telegram selection; proceed to step 2.3 using the data obtained from Section 1.

2.1 Connect a correct power supply to the datalink analysis device. Set the unit to the local datalink address.

2.2 Connect the datalink analysis device input leads to the system test points (usually at the interlocking but can be at any location on the system).

2.3 Observe that the unit is detecting valid telegrams (the LED indication illuminates when valid telegrams are detected) and leave the unit to obtain a representative count.

On busy lines an hour during daytime should be adequate; on lightly used lines a full day is more appropriate.

2.4 Record the times and count obtained.

A desirable error rate is 0 in a 24-hour period. If the rate is greater than 120 in a 24-hour period, further investigation shall be carried out to explain the rate and remedial action carried out as necessary.

NOTE: *That where separate counts are provided for coding, parity, and corruption errors; check that the test for desirable error rate is carried out using the total telegram error rate.*

3. DLM Baseband Datalink Tests

The following tests are to find damage within the DLMs.

The transmitted signals can appear as asymmetric or a higher output than normal.

In addition, damage to the lines can show as an abnormal attenuation.

Since a 'back-to- back' repeater site can correct any asymmetry and amplitude problems during re-transmission (as can an LDT in the line) it is necessary to test each baseband section of the datalink between repeaters or LDTs separately.

The datalink schematic can be used to decide on a suitable base site for each baseband section (the interlocking should be one site as it does not involve LDTs).

The chosen sites should be used for all subsequent testing as this maintains a useful reference for the readings.

The SSI datalink interrogator and a digital storage or other suitable automated test equipment should be used for the tests.

Where the datalink interrogator method is used this shall be configured to trigger the oscilloscope at the correct time and the equipment shall be connected as per Appendix A.

Refer to the manufacturer's instructions for connection of other automated test equipment.

The planning shall specifically consider the power supply arrangements, earthing and where to connect the datalinks before starting work.

3.1 Select the base site on a metallic link, connect the test equipment in a relevant manner for the equipment being used.

Where applicable for the test equipment, set the interrogator for interlocking (outgoing) telegrams and monitor the address for the base site.

3.2 Measure the amplitude of the telegram transmission or select the relevant test from an automated test tool such as REMOSdl.

While the system can operate with a waveform between 0.5v and 6 v peak to peak readings below 1v and above 5v peak to peak shall be highlighted for further investigation.

3.3 Measure the symmetry of the telegram transmissions. Check they are not distorted.

NOTE: *Up to 50mV peak asymmetry is acceptable.*

Where asymmetric telegrams are found, the DLM associated with this telegram shall be changed.

3.4 Measure the telegram transmissions for pronounced overshoot in the offset waveform after the last edge of the transmission.

- Up to 150mV peak is acceptable.

3.5 Check that there is no line noise between telegrams

- Up to 100mV peak to peak is acceptable.

3.6 Check that the telegram amplitude does not vary within each message.

- Up to 10% of the peak amplitude is acceptable.

3.7 Repeat 3.1 to 3.4 for every DLM on the baseband link (this can be done automatically when using a tool such as REMOSdl, (Appendix B).

As well as review of the reply telegram amplitude against the expected norm for a data link of the relevant length, the readings shall be reviewed against previous actual measurements for the data link concerned. Any discrepancy with either review shall be recorded and investigated further.

3.8 For each section of baseband data link bounded by a DLIT or Back to Back repeater, carry out the Non-Intrusive Earth Leakage Test detailed in section 11.5.4 of NR/GN/SIG/19054-11.

For any cable section where this test method indicates a reading below 10Mohm, further investigation is required to find the cause.

There are many reasons for poor earth readings which include cable damage and surge protection failure. Carry out necessary checks on relevant items and repair or replace as required to achieve a reading of >10Mohm.

3.9 Where readings remain above 10Mohm, the latest measurements shall be compared with previous test results to determine the rate of degradation.

If any increase or sudden change is identified, further investigation shall be planned to address the situation, before the readings fall to levels which might affect stability.

4. LDT Tests

Testing on a system with LDTs is carried out in a manner very similar to baseband links.

4.1 The base site shall be after the LDT link on the metallic section of the system which normally rules out the signal box as the base site.

4.2 It shall be remembered that on systems using LDTs replies are returned to the interlocking in the reply period of the minor cycle subsequent to that in which the initiating outgoing telegram was sent.

4.3 LDTs are treated as for back-to-back repeaters and a single address of a TFM beyond an LDT shall be included in the list compiled from the datalink schematic.

4.4 The same procedure detailed in Section 3 ‘DLM Baseband Datalink Tests’ shall be used for testing a system with LDTs, taking into account the comments in this section.

APPENDIX A - SSI BASEBAND DATALINK TESTING INSTRUMENTATION SET UP

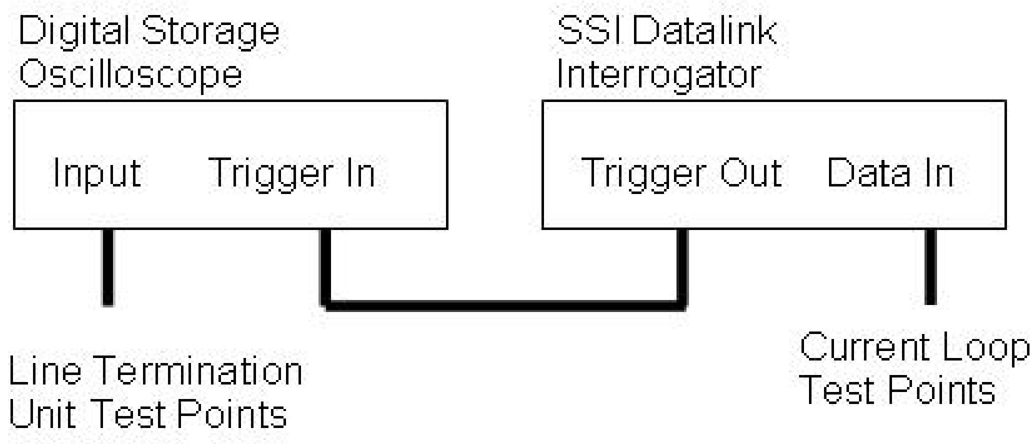


Figure 1 – SSI Baseband Datalink Testing Instrumentation Set Up

APPENDIX B - DLM Baseband Datalink Testing

When an automated test tool is not available, it is required to repeat the test in Section 3 to monitor and record in turn every DLM on the baseband link and hence the requirements of this appendix apply.

1. The datalink schematic should be consulted to produce a list of DLM and TFM addresses. The rules of compiling this list are as follows:

   a) Review the datalink schematic to identify each dlm and then choose one tfm address serviced by it (some dlms service more than one tfm, it is only necessary to see replies from one of those tfms).

   b) If the base site is not the signal box or the origin of the datalink it is necessary to see a reply from a tfm at the base site. This should be added to the list.

   c) Where back-to-back repeaters are provided, it is necessary (to prove the operation of the repeater dlm itself) to select a single address somewhere in the section beyond the repeater. This should be added to the list.

   d) Work through the list setting the datalink interrogator for trackside (incoming) telegrams and its address to each of the tfms on the list taking measurements in turn.

   e) Review the results for the datalink, there should be a gradual decline in the signal levels in line with the distance away from the transmitting tfm. Any measurements outside the specified limits require remedial action.

END

Includes:	GEC Over-Ride System
Excludes:	All other Ove-Ride Systems

General

This test makes sure that the remote control ‘over-ride’ system works when it is required to.

Because it affects the available signalling routes, you shall make arrangements with the signaller before attempting this test.

The signaller is responsible for the safety of trains and shall give you permission to start.

1. Over-Ride Test

1.1 Check that the remote control normal white indication is showing on the control panel.

1.2 When the signaller gives you permission to do so, turn the emergency route setting switch from ‘Normal Working’ to ‘Auto-Working’.

1.3 Check that:

a) The system sets the defined routes.

b) The routes are correctly indicated, and

c) The signals are shown to clear on the signal box panel.

1.4 Turn the emergency route setting switch from ‘Auto- Working’ to ‘Signals On’.

1.5 Check that:

a) All controlled signals return to danger.

b) The signals are correctly indicated on the signal box panel.

1.6 If facilities are provided for selective defined routes, repeat 1.2 to 1.5 for each set of routes.

1.7 Turn the emergency route setting switch to ‘Normal Working’.

1.8 With the signaller’s permission, set the defined routes on the panel buttons.

1.9 Turn the emergency route setting switch to ‘Auto- Working’ and Check that the aspects do not drop back by watching the indications on the signal box panel.

1.10 If facilities are provided for selective defined routes, repeat 1.7 – 1.8 for each set of routes.

1.11 Turn the emergency route setting switch to 'Normal Working' and Check the remote control normal indication is showing.

1.12 Check that routes can be set and cancelled via the normal method of remote control.

End

Includes:	BR Electronic Route Selection Equipment (ERSE) Mk2A and 2B
Excludes:	BR Electronic Route Selection Equipment (ERSE) Mk1

General

Due to operating conditions, not all of these tests may be possible to achieve.

Testing shall be carried out of those allowed by the Signaller with the others noted for testing at a low traffic period or when under a system possession.

1. Signal Box

1.1 Observe that the ERSE alarm indication on the Signaller's panel is extinguished.

Ask the Signaller if they are aware of any faults on the system.

1.2 Press and release an entrance button and observe that the button indication flashes.

Pull and release the button and observe that the button indication extinguishes.

Repeat for all entrance buttons.

1.3 Press and release an entrance button then press and hold a valid exit button for the entrance selected.

Check that after 5 to 30 seconds an audible alarm sounds with a visual indication. Operate the 'Alarm Acknowledge' button or switch and check that the alarm is silenced.

Release the exit button and cancel the route.

1.4 Repeat 1.3 but do not operate the 'Alarm Acknowledge' button or switch.

Release the exit button and check that the alarm cancels 1 second after the button is released.

Cancel the route.

1.5 Operate the Signaller's ERSE by-pass control and check that routes can still be set.

When in ERSE by-pass mode the points in the route must be operated manually via the point keys to the required position before pressing the entrance button only.

Extreme caution shall be observed that all the points in the route are set correctly, the route entrance signal shall clear when the entrance button is pressed irrespective of the lie of the points when in ERSE by-pass.

2. Equipment Room

2.1 Observe the LED and lamp indications on cards and power supply units in the equipment cubicle, check they indicate as follows:

Item	Colour	State
Monitor Units 2/2 or 2/3	Green	Illuminated
	Red TL	Illuminate only during route setting
	Red RP	
Route Cards	Red L1	Illuminate only during route setting
	Red L2	
	Red L3	
	Green L4	Illuminated
	Red L5#	Illuminated only when route is available
Input Cards	Green	Illuminated
PSUs	Red 110V	Illuminated
	Green 15V	

Table 1 - Indications

#: L5 LED is not provided on early versions of route cards.

2.2 Measure using a meter or oscilloscope the following DC output voltages and AC ripple from each power supply:

Supply	Limits	Ripple
15V	14.4V to 15.6V	<15mV
24V	24V to 30V	<3V

Table 2 - Output Voltages

3. Monitor Unit

3.1 On each monitor unit (2/2 or 2/3) press the test reset button.

This will apply a reset to all the route cards.

3.2 Connect a meter between the 0V and TL/RP test points in turn. Check that the following voltages are obtained:

Operation	**Test Point**	**Voltage**
Push Button Ring Free	TL	12V to 15V
	RP	
Push Button Ring In Use	TL	0V
	RP	

Table 3 - Test Point Voltages

4. Power Supplies

4.1 Switch all 15V PSUs off line. Observe that all the indication LEDs on the monitor, route and input cards are extinguished.

4.2 Switch off the 110V supplies. Remove the 15V PSUs from their housing. Visually check the electrolytic capacitors for any signs of leakage, swelling or general deterioration. If any is found, renew the PSU.

Electrolyte from capacitors is hazardous to heath, PPE (e.g. gloves) shall be worn when handing leaking capacitors.

4.3 Visually check the buffer relay 24V PSU electrolytic capacitors as in 4.2.

4.4 Replace the PSU’s into their housing and restore the 110V AC supply.

Switch the PSUs on line and check that all alarms and indications normalise.

Measure the PSU outputs as listed in 2.2.

4.5 Check with the Signaller that route setting is working to their satisfaction.

END

1. Physical Checks

1.1 Check that markers are in place at 90%, 75%, and 50% of the approach length.

2. Detection Linearity Check and Lumped Impedance Adjustment

When carrying out this test, RX should only be expected to change when the termination shunts in use at the crossing are either narrow band shunts (NBS) or frequency selectable shunts (FSS).

No change in RX shunt shall be seen in cases where wide band shunts (WBS) are in use.

If such a change is noted, inform your SM(S) as it may indicate that the WBS in question is faulty.

Where narrow band compensation is in use, disable this for the duration of this test and re-enabled it once the test is complete.

Detection Linearity Check

2.1 With a clear track, set the RX to 100.

2.2 Connect a hard wire shunt at the HXP-3's approach termination and note the RX value; this should reduce to between 85 and 100.

2.3 If RX does not change, or increases with the shunt connection at the termination, move the hard wire shunt to 10% of the approach length inside the termination. RX should now be between 88 and 92.

2.4 Calculate what the expected RX should be at the 50% point. This is half of the RX value in step 2.3.

2.5 Move the hard wire shunt to 50% of the approach length and note the RX value again. If this figure for RX is more than 2 units away from the calculated figure, adjustment is required as described overleaf.

Lumped Impedance Adjustment

2.6 With the shunt at the 50% of the approach, advance to the LIA section of the IDK display by pressing the ADJUST SEL key until the present value for LIA begins to flash. On the "ADJUST" screen.

2.7 Press the ENTER button once so that the LIA prompt begins to flash and the value stops flashing.

2.8 While viewing the RX on the display, press the 2 (up arrow) button to count up, or the 3 (down arrow) button to count down until RX reads within 2 units of the calculated RX derived in step 1.5.

2.9 Press and hold the ENTER button until the LIA stops flashing.

2.10 Remove the test shunt at the 50% point.

2.11 For bi-directional HXP-3s, repeat this process for the opposite approach. When carrying out step 1.8, only make an adjustment when the RX is above the value calculated in step 2.5. Do not raise RX if the value is lower than that calculated for the second approach.

2.12 Repeat steps 2.1 to 2.11 for track 2 where present.

3. Island Check

3.1 Place a hard wire shunt on track 1 somewhere within the island.

3.2 Check that the island relay drive is de-energised and the (red) LOW LED located on the RSI module is on.

3.3 Move the shunt 5m outside the island and check that the (green) HIGH LED is on.

3.4 Check the island relay drive is energised. Remove the shunt.

3.5 If the island does not check out correctly, perform the island adjustment procedure.

END

1. Voltage Test

To check that accurate results are obtained, the following tasks shall always be carried out in the order that they appear in this document.

1.1. Measure and record the battery voltage on the +5V DC Power Supply Module at the + and – terminals of TB1.

If the result obtained is not between 4.5V – 5.5V DC, adjust the 12 volt feed by varying potentiometer R16.

In the event that is unsuccessful, inform your SM(S) such that arrangements can be made for the 5V DC Power Supply Module to be replaced.

1.2. Measure and record the output of the +5V DC Power Supply Module across TPI and TP2 of the Module.

1.3. Measure and record the voltage across TP1 and TP2 on the VLP module, which should be between 4.95V and 5.05V DC.

If the result obtained in task 1.3 is within the specified parameters, subtract the value obtained in task 1.2 from the value obtained in task 1.3 and record this on the record card before moving to clause 1.5.

If the result obtained in task 1.3 is not within the specified parameters, adjust the +5V DC Power Supply Module output voltage.

In the event that this is unsuccessful inform your SM(S) such that arrangements can be made for the +5V DC Power Supply Module to be replaced.

1.4. Operate the Power Supply Switch S1, located on the +5Vdc Power Supply Module, to the “OFF” position.

Measure and record and record the Lithium Battery voltage across TP1 and TP2 on the ACP Module and verify that this is between 3.25V and 3.75 V DC.

Operate the Power Switch S1, located on the +5V DC Power Supply Module, to the “ON” position.

If the result obtained is not within the specified parameters, inform your SM(S) such that arrangements can be made for the ACP module to be replaced.

<u>For Interlocking only</u>

1.5. On the NVIO module measure and record the following voltages:

a) Between TP1 and Com (10 to 38V)

b) Between TP2 and Com (10 to 38V)

END

Caution: where the records show that linearisation adjustment has been previously required, linearisation shall always be performed following calibration.

Calibration and Linearisation

Before proceeding with calibration, check the following:

a) All track bonding is good, and all termination shunts, insulated joint couplers, and track isolation devices (battery chokes etc) are installed in accordance with the design.

b) Due note is taken of the ballast conditions. If the level crossing predictor is calibrated under poor ballast conditions, it may require recalibration when the ballast conditions improve.

c) Enhanced detection is switched off.

d) There are no trains on the approach.

Calibration is required when:

a) Application programming is changed *

b) Modules are changed *

c) There are changes to the track infrastructure

* These tasks should be performed by technical support personnel following application programming change.

Calibration and linearisation should be performed as required by Table 1 in Appendix A.

All keys to be pressed during calibration and linearisation are on the level crossing predictor keypad (LCPK). All references to displays refer to the level crossing predictor display (LCPD).

1. Physical Checks

1.1 Check that markers are in place at 70% and 50% of the approach measured from the crossing.

2. Calibration

2.1 Check in the design details if enhanced detection (ED) is switched on. If ED is not switched on, proceed to Step 2.7

2.2 Press the TRACK 1 key.

2.3 Press the FUNCTION key.

2.4 Press the DOWN ARROW key until 'ENHANCED DETECTION' appears for the appropriate track.

2.5 Press the NEW DATA key.

2.6 Observe that 'ENHANCED DETECTION: OFF' is displayed for the appropriate track.

2.7 Press and hold the SETUP key.

2.8 Observe that 'SETUP T1 for Calibration is displayed.

2.9 Release the SETUP key.

2.10 Press the ENTER key.

2.11 Observe that 'SETUP T1 IN PROGRESS' is displayed.

2.12 After approximately 60 seconds Observe that 'SETUP T1 COMPLETE' is displayed.

2.13 Observe that calibrated values of EZ and EX are displayed.

2.14 Record the values of EZ and EX on the record card.

2.15 If the value of EX is 40 or lower, or the value of EZ is 115 or higher, inform your SM(S) immediately.

2.16 Measure and record the voltage between the Z1 and COM terminals on the appropriate 80012 track transceiver module.

2.17 Measure and record the voltage between the Z2 and COM terminals on the appropriate 80012 track transceiver module.

2.18 If the value of Z1 – COM or Z2 – COM is outside the range 7.5V to 10.0V DC, or the difference between the two values is greater than 0.5V DC, inform your SM(S) immediately.

2.19 Where Track 2 is present, repeat Steps 2.1 to 2.18 for Track 2.

2.20 If Linearisation is not required for either track, proceed to section 4.

3. Linearisation

Perform this section for each track that requires Linearisation.

3.1 Press the TRACK 1 key.

3.2 Press the SETUP key for approximately 3 seconds and then release.

3.3 Repeatedly press the DOWN ARROW key until ‘SETUP T1 FOR LINEARISATION’ is displayed.

3.4 Press the ENTER key.

3.5 Observe that ‘LINEARISATION T1 VALUE:?? EZ:??’ is displayed.

3.6 Press the NEW DATA key.

3.7 Press the UP ARROW key or the DOWN ARROW key until ‘LINEARISATION T1 VALUE:+0 EZ:??’ is displayed.

3.8 Press the ENTER key.

3.9 Place a short circuit across the termination shunt on the normal approach.

3.10 Observe and record the EZ value.

3.11 Calculate and record what the expected EZ should be at the 50% point. This is half of the EZ value in step 3.10.

3.12 Move the short circuit to the marker at 50% of the approach length and record.

3.13 If the level crossing predictor is configured as a unidirectional (or simulated bidirectional) crossing (see the design details) proceed to step 3.18.

3.14 Place a short circuit across the termination shunt on the other approach.

3.15 Observe and record the EZ value.

3.16 Calculate and record what the expected EZ should be at the 50% point. This is half of the EZ value in step 3.15.

3.17 Move the short circuit to 50% of the approach length and record the EZ value.

3.18 Press the SETUP key for approximately 3 seconds and then release.

3.19 Repeatedly press the DOWN ARROW key until 'SETUP T1 FOR APPROACH LENGTH`' is displayed.

3.20 Press the ENTER key.

3.21 Observe that 'TERMINATE T1 APPROACH EZ:??' is displayed.

3.22 Press the NEW DATA key.

3.23 If there is no simulated track inductor on the crossing, enter the smallest EZ number recorded in Steps 3.10 and 3.15. Otherwise enter the EZ value from the approach without the simulated track inductor.

3.24 Press the ENTER key.

3.25 Observe that the display alternates between 'PROGRAM T1 APPROACH: ????' and 'PROGRAM T1 COMPUTED: ????'.

3.26 Record the values computed.

3.27 Note the highest 'NO LINEARISATION' EZ value recorded at the 50% points in Steps 3.12 and 3.17.

3.28 Note the Calculated EZ/2 value for the appropriate approach recorded in Step 2.31 or 2.36.

3.29 Compare the value noted in Step 3.7 with the value noted in Step 3.28. If the two values are within +/- 1 of each other, proceed to section 4.

3.30 Subtract the value noted in Step 3.27 from the value obtained in Step 3.28. Multiply this value by 2. If the value is greater than +/-25 inform your SM(S) immediately.

3.31 Press the SETUP key for approximately 3 seconds and then release.

3.32 Repeatedly press the DOWN ARROW key until 'SETUP T1 FOR LINEARISATION' is displayed.

3.33 Press the ENTER key.

3.34 Observe that 'LINEARISATION T1 VALUE:?? EZ:??' is displayed.

3.35 Press the NEW DATA key.

3.36 Press the UP ARROW key or the DOWN ARROW key until the displayed 'LINEARISATION T1 VALUE:?? EZ:??' value matches the amount noted in Step 3.30 (taking note of the sign of the number).

3.37 Press the ENTER key.

4. Completion

4.1 Check in the design details if enhanced detection (ED) should be switched on. If ED is not required, proceed to Step 4.7.

4.2 Press the TRACK 1 key.

4.3 Press the FUNCTION key.

4.4 Press the DOWN ARROW key until 'ENHANCED DETECTION' appears for the appropriate track.

4.5 Press the NEW DATA key.

4.6 Observe that 'ENHANCED DETECTION: ON' is displayed for the appropriate track.

4.7 Repeat as necessary for the second track.

5. Island Calibration

5.1 Check that the frequency select jumper on the 80211 island module is set in accordance with the wiring details.

5.2 Place a short circuit between the rails at the distance beyond the receiver rail connections specified for the corresponding island frequency in Table 2 in Appendix B.

5.3 Press and hold the island module 'Calibration Select' push button for 2 seconds until 'REL' appears on the module display.

5.4 Release the push button and then press and release it again within 2 seconds.

5.5 Observe that the module display shows 'CAL*'.

5.6 After approximately 6 seconds, observe that the display momentarily shows 'DONE'.

5.7 Observe that the display shows 'BOOT' for approximately 9 seconds.

5.8 Observe that the display alternates between the software version and the pickup delay setting.

5.9 If 'FAIL' appears in the display, turn the Island module power off and then on again, and repeat Steps 5.3 to 5.9 again. If 'FAIL' appears again, the Island module is faulty.

5.10 Once calibration is complete, check that:

a) The displayed frequency matches the design details.

b) The pickup delay setting matches the design details.

c) The island STATUS indicator on the front panel of the level crossing predictor is extinguished.

d) The island relay drive voltage is 0v DC measured across the island relay terminals on the front of the level crossing predictor.

5.11 Remove the short circuit installed in Step 5.2 and then Check that:

a) The Island STATUS indicator on the front panel of the level crossing predictor is illuminated.

b) The island relay drive voltage is greater than 10V DC measured across the island relay terminals on the front of the level crossing predictor.

5.12 Place a 0.5ohm shunt across the rails between the Island Transmit wires.

5.13 Check that the island relay drive is de-energised, the island STATUS indicator on the front panel of the level crossing predictor is extinguished, and the crossing warning sequence is activated.

5.14 Remove the shunt and wait until the crossing warning sequence is reset.

5.15 Place a 0.5ohm shunt across the rails between the island receive wires.

5.16 Check that the island relay drive is de-energised, the island STATUS indicator on the front panel of the level crossing predictor is extinguished, and the crossing warning sequence is activated.

5.17 Remove the shunt.

5.18 Repeat Steps 5.1 to 5.17 for Track 2 where present.

APPENDIX A - Requirement for Calibration and Linearisation

Program Change	Calibration	Linearisation
Increased number of tracks from 1 to 2	Track 2 Only	Track 2 Only
LCP Frequency	Both Tracks	Both Tracks
Unidirectional to Bidirectional Or Bidirectional to Unidirectional	Changed Track Only	Changed Track Only
Transmit Level Changed from: Medium to Maximum Or Maximum to Medium	Changed Track Only	Not Required
Approach Length	Changed Track Only	Changed Track Only
Ballast Compensation Value	Changed Track Only	Not Required

Table 1 - Requirement for Calibration and Linearisation

NOTE: *In the test all actions are written as applicable to Track 1. Where Steps are to be repeated for Track 2, any displayed messages referring to either 'TRACK 1' or 'T1' can be taken to refer to 'TRACK 2' or 'T2' as appropriate.*

Values shown as '??' depend on the installation.

APPENDIX B - Island Frequency and Shunt Distance

Island Frequency (kHz)	Shunt Distance (Feet/Meters)
2.14	84 (25.6m)
2.63	72 (22m)
3.24	55 (16.8m)
4.0	45 (13.7m)
4.9	39 (11.9m)
5.9	32 (9.8m)
7.1	29 (8.8m)
8.3	25 (7.6m)
10.0	22 (6.7m)
11.5	20 (6.1m)
13.2	17 (5.2m)
15.2	15 (4.6m)
17.5	14 (4.3m)
20.2	14 (4.3m)

Table 2 - Island Frequency and Shunt Distance

END

This test checks that both processor modules (PM) are capable of output and input to/from lineside equipment. Hot standby PMs are installed in modular equipment housings (MEH) or object controllers (OC). Refer to installation documentation to ascertain the provision of these facilities.

The test might affect all outputs and inputs to the PMs, therefore protection should be applied to the working railway in liaison with the Signaller and in accordance with technical instructions.

It is also essential that the Technician's facility monitoring the PMs should be manned for the duration of the test.

1. Installations with hot-standby PMs

Where installations have hot-standby PMs, check the changeover facility as follows:

1.1 Obtain a list of faults from the TF(L) or TF(R).

1.2 Check the standby OK LED is illuminated green.

1.3 Press the red changeover button on the front of the active PM to force a changeover.

1.4 Check the standby OK LED on both PMs show red briefly. The Active LED on the deactivated PM is extinguished and the Active LED on the activated PM is lit.

1.5 Check the activated PM is error free and has not created new faults by relisting and comparing the new fault list with the list generated in 1.1.

1.6 Repeat steps 1.2 to 1.5 to check that the changeover works in both directions.

1.7 If the changeover fails in either direction inform your SM(S)

2. Test as part of periodic maintenance

2.1 If this test was carried out as part of periodic maintenance, then repeat steps 1.2. to 1.5 to leave the PM pair on what was the off-line PM.

END

Includes:	Systems fitted with "only" IMC Boards
Excludes:	Systems fitted with "both" IMC & ACB Boards (see SMS/PartB/Test/082)

General

Before work is undertaken that affects the normal operation of the level crossing system, the Signaller shall be informed. Normally a possession of the equipment or a no train period is required.

1. Frauscher RSR123 Wheel Sensor Test (System Adjustment)

1.1 Before starting work, the system shall be powered down by the removal of the main supply fuse in the equipment case.

1.2 Disconnect the wheel sensor cable in the trackside connection box (GAK unit).

1.3 Connect a multimeter set on 0-1V DC to the AMB001 test box socket (See Figure 1). Press the toggle switch on AMB001 to the battery symbol. The multimeter reading shall be > 0.75 V, if not the battery of the test box AMB001 needs replacing.

Figure 1 – AMB001

1.4 Sensor System 1. Connect wire 1 (brown) to the red connector and wire 2 (yellow) to the black connector (See Figure 2). The adjustment procedure starts automatically. After approximately 10 seconds the multimeter shall show a value between 0.49 V and 0.515 V.

Figure 2 – AMB001 Connected

1.5 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.6 Within 50 seconds of test step 1.4, place the testing plate PB200 over sensor system 1 (see Figure 3) and check that the multimeter value is between 330mV and 375mV.

Figure 3 - PB200 Over Sys1

1.7 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.8 Reconnect the wires to the trackside connection box to wiring diagrams.

1.9 Sensor System 2. Connect wire 3 (green) to the red connector and wire 4 (white) to the black connector. The adjustment procedure starts automatically. After approximately 10 seconds the multimeter shall show a value between 0.49 V and 0.515 V.

1.10 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

1.11 Within 50 seconds of test step 1.9, place the testing plate PB200 over sensor system 2 (see Figure 4) and check that the multimeter value is between 330mV and 375mV.

Figure 4 – PB200 Over Sys2

1.12 If the measurements are outside of this range then try re-aligning the head to the centre of the tolerances, reference NR/SMS/PartC/AX40 (Frauscher Advanced Axle Counter) - Periodic Task 3. If this is unsuccessful then the wheel sensor shall be replaced.

2. System Power Up

2.1 At the equipment case replace the main supply fuse to energise the system.

2.2 Check that the following LED indications are illuminated:

- 24vDC power supply - Green “DC Okay”.
- Buffer Module - Green “Status”.
- Telemetry module - Green “Power”.
- IMC Board – Green “Power” (for both channels, on all boards).

2.3 Observe both on-demand LEDs are illuminated momentarily and then go out.

2.4 The red indication LEDs illuminate, and the auditable warning device sounds for 60 seconds before the LEDs go out, the audible warning is silenced, and the crossing reverts to dark mode.

3. Wheel Sensor Test (Detection Capability)

3.1 Identify the Evaluation Board (IMC) related to the wheel sensor to be tested and check the section is indicating clear. The IMC Board should only have the two green power LEDs lit (Figure 5).

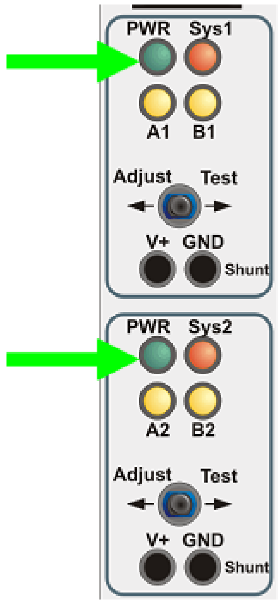


Figure 5 – IMC Board

3.2 Place the PB200 testing plate on the railhead to the left of the axle counter wheel sensor in the start position (Figure 6).

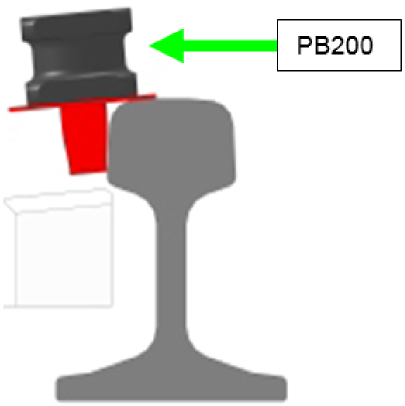


Figure 6 - PB200

3.3 Move (slide) the PB200 slowly in direction of arrow and stop over the first wheel sensor (Figure 7).

In the case of a VAMOS strike-in wheel sensor, Sys1 - Sys2 shall be in the direction of the strike-in.

Figure 7 – PB200 Over Sys1

3.4 Check the LED indications SYS1 and B1 are illuminated (Figure 8).

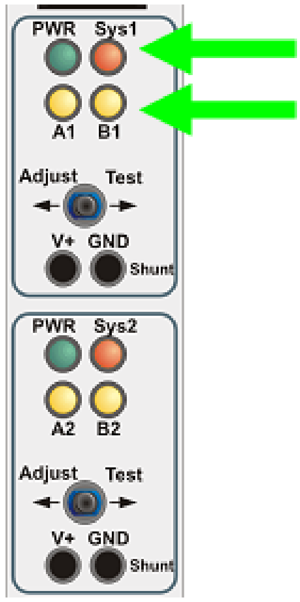


Figure 8 – IMC Board

3.5 Move (slide) the PB200 slowly in direction of arrow and stop at the mid-point between the two wheel sensors systems (Figure 9).

Figure 9 – PB200 over Mid Point

3.6 Check the LED indications SYS1, SYS2 and B1, B2 are illuminated (Figure 10).

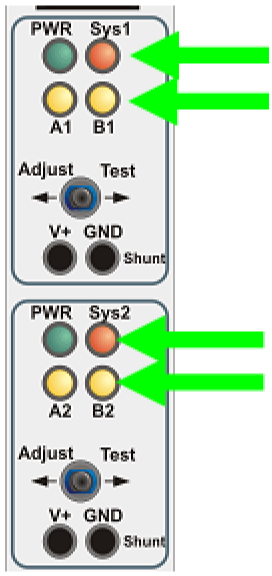


Figure 10 – IMC Board

3.7 Move (slide) the PB200 slowly in direction of arrow and stop over the second wheel sensor (Figure 11).

Figure 11 – PB200 Over Sys2

3.8 Check the LED indications SYS1 and B1 have extinguished and the LED indications SYS2 and B2 remain illuminated (Figure 12).

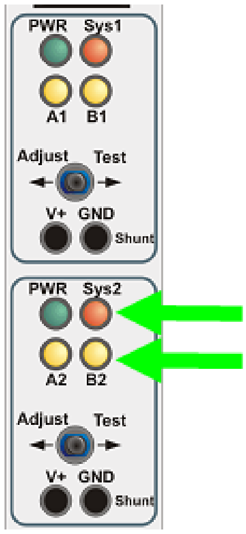


Figure 12 – IMC Board

3.9 At the end of the simulation, when the PB200 testing plate has passed beyond the sensor Check the LED indications SYS2 and B2 have extinguished on the IMC Board leaving the two PWR indications illuminated (Figure 13).

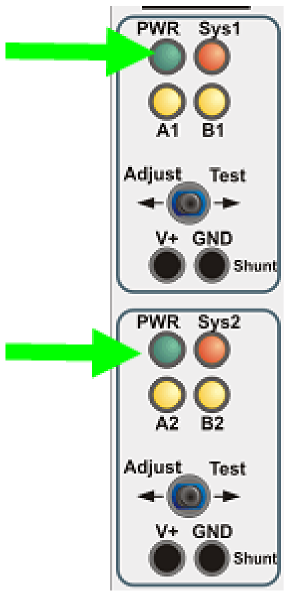


Figure 13 – IMC Board

3.10 There is no requirement to traverse over the wheel sensors in the reverse direction as the occupation times out.

END

Includes:	Vamos Level Crossing System
Excludes:	All other Overlay MSL crossings

GENERAL

The telemetry module has internal storage and writes the data's periodically onto the microSD card. Therefore, it is important to follow this procedure so is not lost.

1. Telemetry Data Logger

1.1 The Vamos System is fitted with a Telemetry Data Logger which both displays and records a number of parameters, making it straight forward to analyse and fault find on the system. (See Figure 1.

The system is fitted with a small screen and navigation buttons, allowing the user to scroll through its 5 screens. Each of the screen is broken into 6 lines each relating to a particular function.

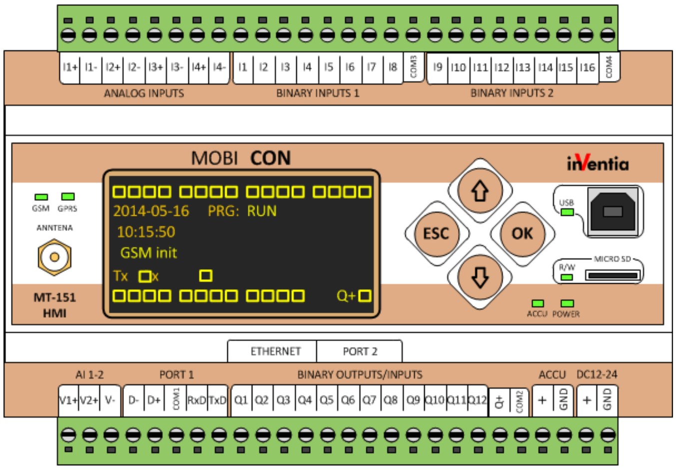


Figure 1 - Telemetry Data Logger

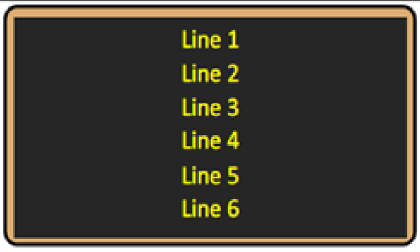
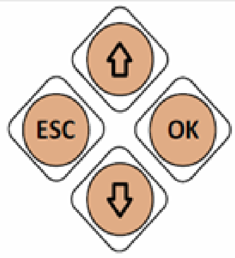
Screen	Navigation Button	Button Meaning/Action	
		⇧	Used to navigate between the 4 screens
		ESC	Used to "freeze" the module state screen (press ESC if module state screen is active)
		OK	used to change the day/night mode (press ok, navigate to Day/Night-Mode, change ⇧⇩)
		⇩	Used to navigate between the 4 screens

Figure 2 – Navigation Screens

1.2 The five screens are (in order):

a) Module status (Figure 2).

b) System Info.

c) Failure page 1.

d) Failure page 2.

e) Main menu (This is reached via the Module Status screen).

2. Removal of the SD Card

2.1 The main menu is accessed by pressing the "OK" button for 3 seconds when the Module State screen is displayed.

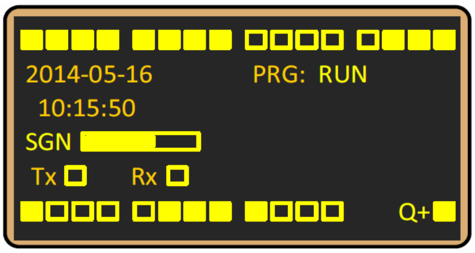


Figure 3 - Module State screen

2.2 By using the up and down arrows move the highlighted bar until "Actions" is highlighted then press the "OK" button. This "Actions" menu allows for the controlled recovery of the data stored on the SD Card.

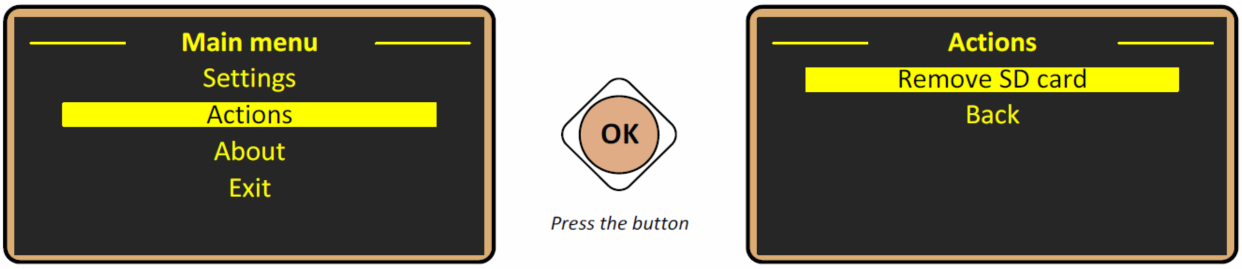


Figure 4 – Main Menu and Actions Screens

2.3 The sequence for the SD Card removal is as follows. Highlight "Remove SD Card" and press "OK".

If you decide not to remove the card at this point highlight "No" and press "OK" this returns you back to the previous menu.

If you intend the remove the card highlight "Yes" and press "OK" this takes you to a new screen which advises you the data is being written to the SD Card and the green LED marked R/W to the left illuminates during this process.

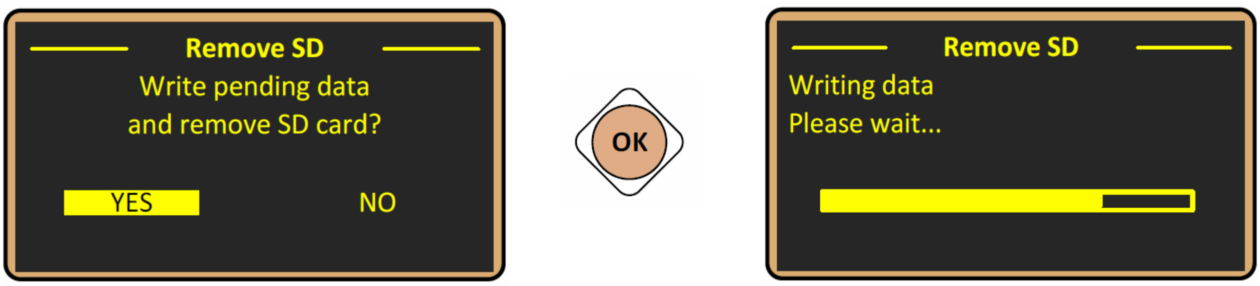


Figure 5 – SD Card Removal Screens

2.4 Once the data transfer is completed you get a message indicating the card can be removed. Remove the card and store securely. The system continues to record data onto the internal memory.

The SD card needs to be returned to the system within 30 minutes or the data recorded internally is lost. If the card is to be out of the system for longer than 30 minutes a new SD card shall be installed.

Figure 6 – SD Card removal Screen

3. Transferring the Data to a Laptop

3.1 The SD card shall be placed into a micro-SD card adapter

Figure 7 – Micro SD Card and Adapter

3.2 The SD adapter card can now be inserted into a standard Network Rail laptop.

Figure 8 – SD Card Insertion

3.3 Click “open folder to view files using windows explorer”, see Figure 9.

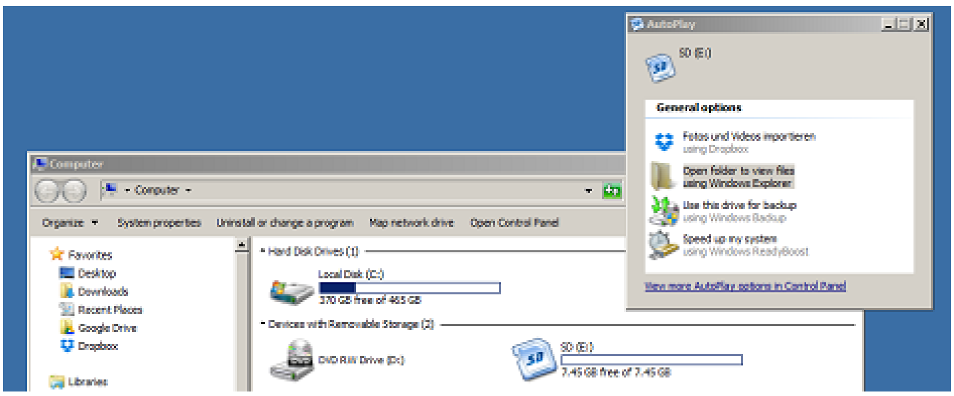


Figure 9 – Windows Explorer View

3.4 With SD card open three folders are displayed. See Figure 10.

3.5 On the laptop create a folder called c:\vamos\backup.

3.6 Copy the Log Converter and LOGFILES folders from the SD Card into the backup folder.

3.7 Safely disconnect and eject the SD card.

3.8 The SD card can now be removed from the SD adaptor and reinserted carefully into the Micro SD card slot of the data-logger. Confirm that the green R/W LED illuminates after you have reinserted the card. It can take up to 2 minutes to recognise the card. The logger can now write to the card again, when the internal memory is full.

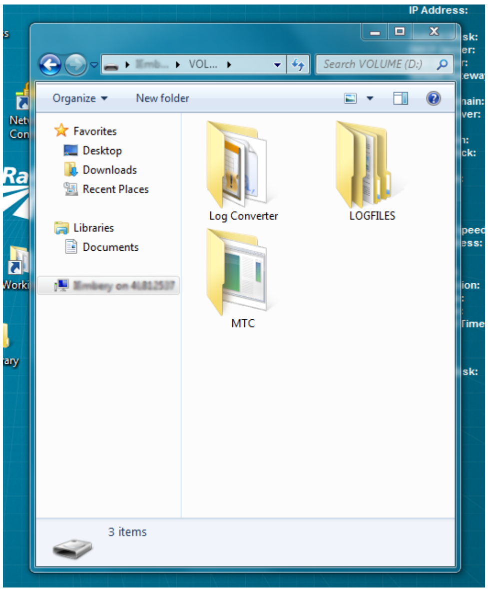


Figure 10 – SD Card Folders

4. Converting the Logger Data.

4.1 Browse to the backup directory and double click the Vamos Logfile Convertor to start it.

Figure 11 - Vamos Logfile Convertor Icon

4.2 Select “Convert” to convert a logfile.

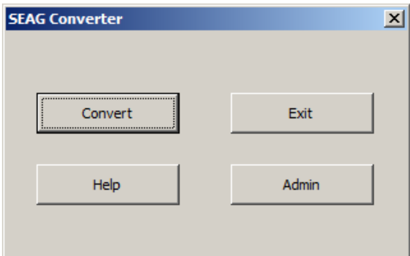


Figure 12 – Converter Screen

NOTE: *If you select “Help” more information is provided about the convertor and how to use it. The “Admin” button is for people with convertor administrator privileges only.*

4.3 Open the “LOGFILES” folder it contains one file for each day.

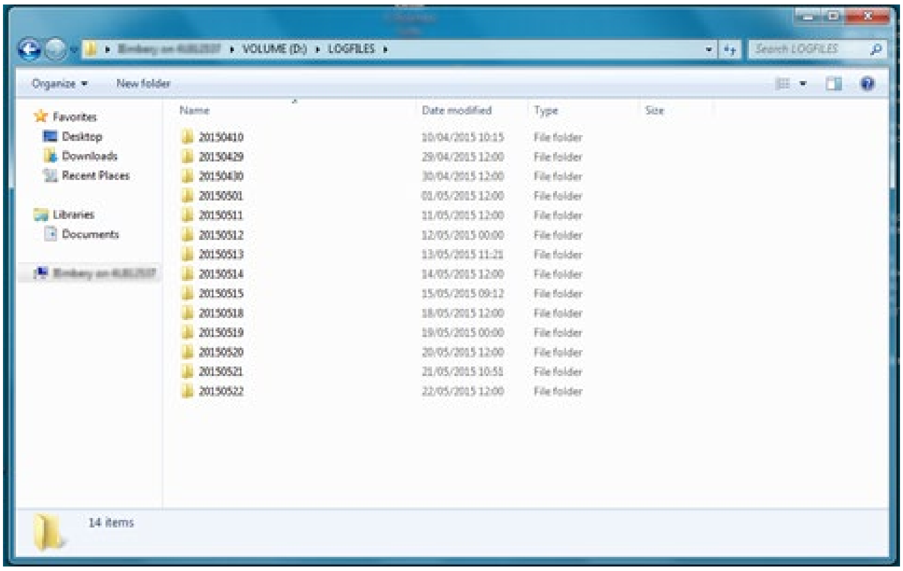


Figure 13 – Log Files Folder

4.4 Double click the file for the day you are interested in.

The file is now converted into a user-friendly spreadsheet, before allowing you to open the file, it shall be saved into the backup folder.

The file appears as shown in Table 1.

Vamos level cross Logfiles:		**Training_unit**		
Date	**Event**	**Time**	**Status**	
12/05/2015	RED aspect FAILURE	12:05:34	ON	
12/05/2015	GREEN aspect FAILURE	12:05:34	OFF	
12/05/2015	Audible Warning FAILURE	12:05:34	OFF	
12/05/2015	System Power	12:05:34	OFF	
12/05/2015	MSL System failure	12:05:34	OFF	
12/05/2015	Track 1 issue	12:05:34	OFF	
12/05/2015	Track 2 issue	12:05:34	OFF	
12/05/2015	OD Parameter fault	12:05:34	OFF	
12/05/2015	Strike-IN Track 1	12:05:34	OFF	
12/05/2015	REVERSE strike-IN Track 1	12:05:34	OFF	
12/05/2015	REVERSE strike-IN Track 2	12:05:34	OFF	
12/05/2015	Strike-IN Track 2	12:05:34	OFF	
12/05/2015	Strike-OUT Track 1	12:05:34	OFF	
12/05/2015	Strike-OUT Track 2	12:05:34	OFF	
12/05/2015	RED aspect	12:05:34	OFF	
12/05/2015	GREEN aspect	12:05:34	OFF	
12/05/2015	RED aspect FAILURE	14:13:29	ON	
12/05/2015	GREEN aspect FAILURE	14:13:29	OFF	

12/05/2015	Audible Warning FAILURE	14:13:29	OFF	
12/05/2015	System Power	14:13:29	OFF	
12/05/2015	MSL System failure	14:13:29	OFF	
12/05/2015	Track 1 issue	14:13:29	OFF	
12/05/2015	Track 2 issue	14:13:29	OFF	
12/05/2015	OD Parameter fault	14:13:29	OFF	
12/05/2015	Strike-IN Track 1	14:13:29	ON	
12/05/2015	REVERSE strike-IN Track 1	14:13:29	OFF	
12/05/2015	REVERSE strike-IN Track 2	14:13:29	OFF	
12/05/2015	Strike-IN Track 2	14:13:29	OFF	
12/05/2015	Strike-OUT Track 1	14:13:29	OFF	
12/05/2015	Strike-OUT Track 2	14:13:29	OFF	
12/05/2015	RED aspect	14:13:29	OFF	
12/05/2015	GREEN aspect	14:13:29	OFF	
12/05/2015	Audible Warning	14:13:29	OFF	

Table 1 – Day File shown in Excel

5. Understanding the Converted Log File

5.1 The top line of each file states that it is a Vamos Level Crossing Logfile and the physical location of the system.

5.2 The Vamos system only records changes of state therefore reducing the need for large amounts of memory.

5.3 The first column contains the **Date** of the entry.

5.4 The second column contains the **Event** (what has changed). Further details are shown in Section 6 - What each “Event” Means.

5.5 The third column contains the **Time** of the entry.

5.6 The fourth column contains **Status**. Either “On” or “Off”.

5.7 The fifth column is only used to indicate that the first 25 lines of data have been transferred from the previous “logfile” to assist with issues that cross the changeover boundaries.

6. What each “Event” Means

6.1 Table 2 provides the NR Rail meaning of each event to assist in the interpretation of the condensed entries found in the LOGFILES. Having a reference copy of each crossing sequence under normal circumstances can be beneficial when investigating any alleged anomalies or incidents.

Logfile event entry	Network Rail meaning
Strike-IN Track x (ON)	Normal direction wheel sensor strike-in Track X (wheel detected)
Strike-IN Track x (OFF)	Normal direction wheel sensor strike-in Track X (wheel no longer detected)
Strike-OUT Track x (ON)	Normal direction wheel sensor strike-out Track X (wheel detected)
Strike-OUT Track x (OFF)	Normal direction wheel sensor strike-out Track X (wheel no longer detected)
REVERSE strike-IN Track x (ON)	Reverse direction wheel sensor strike-in Track X (wheel detected)
REVERSE strike-IN Track x (OFF)	Reverse direction wheel sensor strike-in Track X (wheel no longer detected)
RED aspect (ON)	Red aspect illuminated
RED aspect (OFF)	Red aspect extinguished
RED aspect FAILURE (ON)	Red aspect failed
RED aspect FAILURE (OFF)	Red aspect fault cleared
GREEN aspect (ON)	Green aspect illuminated
GREEN aspect (OFF)	Green aspect extinguished
GREEN aspect FAILURE (ON)	Green aspect failed
GREEN aspect FAILURE (OFF)	Green aspect fault cleared
MSL System FAILURE (ON)	Miniature Stop Light System failed
MSL System FAILURE (OFF)	Miniature Stop Light System fault cleared
VaMoS System AVAILABLE	Vamos System available
Audible Warning (ON)	Audible Warning sounding
Audible Warning (OFF)	Audible Warning silenced
Audible Warning FAILURE (ON)	Audible Warning failed
Audible Warning FAILURE (OFF)	Audible Warning fault cleared
Another Train Coming (ON)	Another Train Coming audible warning sounding
Another Train Coming (OFF)	Another Train Coming audible warning silenced
DARK-Mode (ON)	System in Standby mode (Indication Post LED's Out)
DARK-Mode (OFF)	System in Normal mode (Indication Post LED's Lit)
Track x issue (ON)	Track 1 Issue (failed)
Track x issue (OFF)	Track 1 Issue (fault cleared)
On-demand Button y PRESSED (ON)	On-demand Button y pressed
On-demand Button y PRESSED (OFF)	On-demand Button released
On-demand Button FAILURE (ON)	On-demand Button failed
On-demand Button FAILURE (OFF)	On-demand Button failure cleared
System power (ON)	System power available
System INITIALIZED (ON)	System initializing
System INITIALIZED (OFF)	System initialization complete
System power (OFF)	System power off
GSM network (ON)	GSM network restored
GSM network (OFF)	GSM Network failed
RTC battery empty (ON)	RTC battery discharged
RTC battery empty (OFF)	RTC battery charging / charged
OD Parameter fault (ON)	OD Parameter failed
OD Parameter fault (OFF)	OD parameter failure recovered

Table 2 – Event Meanings

Key		
X	=	Track 1 or Track 2 (Track 1 always Up Road / Direction and Track 2 Down Road / Direction)
Y	=	On Demand button 1 or 2

Table 3 – Key to the Events Meanings Table

END

Includes:	Vamos Crossing system
Excludes:	All other Crossing systems

GENERAL

Before work is undertaken that affects the normal operation of the level crossing system, the Signaller shall be informed. Normally a possession of the equipment or a no train period is required.

1. Operational Sequence Test - No Train

1.1 Check no train is expected to enter the level crossing strike in area from any direction for the duration of this test.

1.2 Confirm the system is in “Standby Mode” (No red or green indicator LED lit).

1.3 Using a timing device, Press/touch the “On-Demand” button on one of the indication posts and start timing.

1.4 Observe that the “On-Demand” LED is extinguished, at the same time the green LEDs illuminate in both indication posts.

1.5 Check that the green LEDs are extinguished after 5 minutes.

1.6 Repeat for the other indication post.

1.7 Check the crossing returns to “Standby Mode” and the “On-Demand” red LEDs are illuminated.

2. Operational Sequence Test - One Train

2.1 Check no train is expected to enter the level crossing strike in area from any direction for the duration of tests.

2.2 Where the “On-Demand” option is fitted:

a) Confirm the system is in “Standby Mode” (No red or green indicator LED lit)

b) Press/touch the “On-Demand” button on one of the indication posts.

c) Observe that the “On-Demand” blue LED is extinguished and changes to yellow whilst touching button, at the same time the green LEDs illuminate in both indication posts.

2.3 Simulate a train “striking in” on a strike in sensor head by operating the test switches on a Strike-in evaluator board (IMC).

2.4 Observe the green LEDs on both indicator posts are extinguished and that the red LED's illuminate.

2.5 Confirm that both audible warnings sounders are working correctly.

2.6 Simulate a train "striking out" on a strike out sensor head on the same line as the "Strike in" sensor by operating the test switches on a Strike-out evaluator board (IMC).

2.7 After a short delay (3-6 seconds), Observe the indicator post LED's change from red to green.

2.8 Confirm the audible warning ceases.

2.9 Repeat steps 2.2 to 2.8 for each direction a train could approach from, including wrong direction moves.

3. Operational Sequence Test - Double Lines Second Train Approaching

3.1 Check no train is expected to enter the level crossing strike in area, from any direction for the duration of tests.

a) Confirm the system is in "Standby Mode" (No red or green indicator LED lit).

b) Press/touch the "On-Demand" button on one of the indication posts.

c) Observe that the "On-Demand" LED is extinguished, at the same time the red LEDs illuminate in both indication posts.

3.2 Simulate a train "striking in" on a strike in sensor head by operating the test switches on a Strike-in evaluator board (IMC).

3.3 Simulate a train "striking in" on a strike in sensor head mounted on 2nd line in the "opposite direction" to the first train, by operating the test switches on a Strike-in evaluator board (IMC).

3.4 Confirm that both audible warnings sounders, do not change to the second train approaching warning.

3.5 Check both indication posts continue to display a red LED.

3.6 Simulate a train "striking out" on first sensor by operating the test switches on a Strike-out evaluator board (IMC).

3.7 Confirm that both audible warnings sounders, now change to the second train approaching warning.

3.8 Check both indication posts continue to display a red LED and the warning continue to sound.

3.9 Simulate a train "striking out" on 2nd line by operating the test switches on a Strike-out evaluator board (IMC).

3.10 After a short delay (3-6 seconds), Observe the indicator post LED's change from red to green.

3.11 Confirm the audible warning ceases.

3.12 The "On-Demand" LED's remains extinguished until the crossing reverts to "Standby Mode".

END

Includes:	All types of Automatic Full Barrier Crossing Locally Monitored (AFBCL)
Excludes:	All other types of Crossing

General

Liaise with the Signaller before any tests are carried out.

Check in the crossing control tables for the amber light time, red light time and any special controls that affect the automatic control sequence.

Where the word EXIT occurs, the strike out treadle shall be operated. On single lines or where bi-directional controls exist, the leaving track circuit shall also be operated.

Where directional proving controls exists the bi-directional strike out treadle shall also be operated in the correct sequence.

The following abbreviations are used in this service:

- DRL: Driver's Red Light.
- DWL: Driver's White Light.
- SPOD: Standing Person Obstacle Detector.

SERVICE A TESTS

1. Local Control Sequence

1.1 Operate the LCU to the lower position and check the following items:

a) All the amber road signals illuminate and the audible warnings commence at the same time (at the normal warbling rate).

b) After the amber time all the amber signals extinguish, all the red flashing road signals & any pedestrian lights start to flash and the crossing headlights illuminate.

c) After the red time the entrance barriers commence to lower and all the boom lamps illuminate. The entrance barriers reach their fully lowered position in 6 to 8 seconds.

d) After the entrance barriers are down the exit barriers start to lower. The exit barriers reach their fully lowered position in 6 to 8 seconds.

e) The crossing headlights, red road lights and any pedestrian lights continue to be illuminated and audible warnings continue to sound.

f) Check that all the DRLs continue to flash and the DWLs do not illuminate.

1.2 Confirm that no trains are approaching.

1.3 Operate the LCU to the raise position and check the following items:

a) All barriers start to rise at the same time and the headlights extinguish.

b) The road lights extinguish when all the barriers are above 42° from the horizontal and the audible warnings turn off.

c) The boom lights extinguish when all the barriers reach 81° from the horizontal.

d) All the barriers reach their fully raised position in less than10 seconds.

1.4 Operate the LCU to the auto position. Observe that a full lowering sequence takes place followed by a full raising sequence. Check that all DRL are flashing.

1.5 Close and lock the LCU door. Check the door cannot be locked unless the switch is in the auto position.

1.6 Check that all the DRLs are flashing.

2. Automatic Control Sequence (Crossing Area Clear)

2.1 Observe, with no train approaching, all DRLs are flashing.

2.2 Simulate an approaching train by shunting a controlling track circuit. Observe the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate and the audible warnings commence at the same time (at the normal warbling rate).

c) After the amber time all the amber signals extinguish, all the red flashing road signals & any pedestrian lights start to flash and the crossing headlights illuminate.

d) After the red time the entrance barriers commence to lower, all the boom lamps illuminate and the SPOD shutters open. The entrance barriers reach their fully lowered position in 6 to 8 seconds.

e) After the entrance barriers are down the exit barriers start to lower and the SPOD shutters close. The exit barriers reach their fully lowered position in 6 to 8 seconds.

f) The crossing headlights, red road lights and any pedestrian lights continue to be illuminated and audible warnings continue to sound.

g) When all the barriers are down the driver's red light extinguishes and the DWL commences to flash for the direction where the train simulation was applied. The DRL continues for all other directions.

h) Check the sighting of the boom lamps.

2.3 Operate the exit function and remove the train simulation. Observe the following:

a) All barriers start to rise at the same time and the headlights extinguish.

b) DWL for the direction where the simulation was applied extinguishes and the DRL (if provided) commences to flash.

c) The road lights extinguish when all the barriers are above 42° from the horizontal and the audible warnings turn off.

d) The boom lights extinguish when all the barriers reach 81° from the horizontal.

e) All the barriers reach their fully raised position in less than10 seconds.

2.4 Repeat steps 2.2 and 2.3 for the opposite direction on a single line and the other direction on double lines.

3. Automatic Control Sequence (Crossing Area Occupied)

3.1 Observe, with no train approaching, all DRLs are flashing.

3.2 Place an obstruction that can be detected by a SPOD on the crossing.

3.3 Simulate an approaching train by shunting a controlling track circuit. Check the following:

a) On double lines 10 seconds elapse before the crossing sequence commences. On single lines the sequence starts immediately.

b) All the amber road signals illuminate and the audible warnings commence at the same time (at the normal warbling rate).

c) After the amber time all the amber signals extinguish, all the red flashing road signals & any pedestrian lights start to flash and the crossing headlights illuminate.

d) After 3 seconds all the amber signals extinguish, and all the red road signals and any pedestrian lights start to flash.

e) After the red time the entrance barriers commence to lower and all the boom lamps illuminate and the SPOD shutters open. The entrance barriers reach their fully lowered position in 6 to 8 seconds.

f) After the entrance barriers are down the exit barriers stay raised.

g) Remove the obstruction. Observe that the exit barriers commence to lower and the SPOD shutters close.

h) The exit barriers reach their fully lowered position in 6 to 8 seconds.

i) When all the barriers are down the driver's red light extinguishes and the DWL commences to flash for the direction where the train simulation was applied. The DRL continues for all other directions.

j) The crossing headlights, red road lights and any pedestrian lights continue to be illuminated and audible warnings continue to sound.

3.4 Operate the exit function and remove the train simulation. Observe the following:

a) All barriers start to rise at the same time and the headlights extinguish.

b) DWL for the direction where the simulation was applied extinguishes and the DRL (if provided) commences to flash.

c) The road lights extinguish when all the barriers are above 42° from the horizontal and the audible warnings turn off.

d) The boom lights extinguish when all the barriers reach 81° from the horizontal.

e) All the barriers reach their fully raised position in less than10 seconds.

4. Double Lines Second Train Approaching Sequence

4.1 Simulate a train striking in on line one as per 2.2.

4.2 Simulate a second train striking in on line two. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate continues at the normal rate.

d) The crossing headlights continue to illuminate.

4.3 Operate the exit function and remove the simulation on line one. Observe the following:

a) The barriers remain lowered.

b) The road lights and any pedestrian lights continue to flash.

c) The audible warning rate changes to the increased rate.

d) The crossing headlights continue to illuminate.

e) The DWL for the direction of the simulation on line one extinguishes and the DRL commences to flash.

f) The DRL for the simulation on line two extinguishes and the DWL commences to flash.

4.4 Operate the exit function and remove the simulation on line two. Observe that the sequence is the same as described in 2.3.

4.5 Repeat steps 3.1 to 3.4 for a train striking in on line two first and a second train striking in on line one.

4.6 Where possible, observe the correct crossing sequence during passage of a train(s).

SERVICE B

Tests

These tests are for the full annual test of the crossing. NR/SMS/Part/D lists the indexes and references to the A4 format (with tick boxes) of these tests for the use of the person testing the crossing.

APPENDIX A - Indications

The following table lists the driver indications displayed throughout a local control and automatic sequence.

Situation	Indication
Automatic control, no train approaching, or no train simulation applied.	DRL Flashing DWL Extinguished
Crossing on operating on Local Control.	
Automatic control, train approaching or train simulation applied, all barriers down.	DRL Extinguished DWL Flashing
Barriers lowered by train simulation, DWL operating, any DWL proving contact broken, power off #	DRL Flashing DWL Extinguished

NOTES: *The DWL should only operate for the direction in which the train is approaching or the train simulation has been applied. The DRL should be operating for all other directions.*

#*: Check the diagrams for the contacts in the DWL control circuit (this includes the (PO)PR function).*

END

Includes:	Flex Crossing system
Excludes:	All other Crossing systems

GENERAL

Before work is undertaken that affects the normal operation of the level crossing system the Signaller shall be informed.

1. Operational Sequence Test - One Train (With Interface Signal Off)

1.1 Check no train is expected to enter the level crossing strike in area from any direction for the duration of the test.

1.2 Confirm any interface signals are showing “proceed”.

1.3 Simulate a train “striking in” on a strike in sensor head by operating the test switches on a Strike-in evaluator board (IMC). Confirm the section shows a count of 1.

1.4 Observe the green LEDs on both indicator posts are extinguished and that the red LED’s illuminate.

1.5 Check both audible warnings sounders are working correctly.

1.6 Simulate a train “striking out” on a strike out sensor head on the same line as the “strike in” sensor by operating the test switches on a strike-out evaluator board (IMC). Confirm the first section shows a count of 1.

1.7 After a short delay (3-6 seconds), observe the indicator post LED’s change from red to green.

1.8 Confirm the audible warning ceases.

1.9 Simulate a train “striking out” on a strike out sensor head of the second section on the same line as the “strike in” sensor by operating the test switches on a strike-out evaluator board (IMC). Confirm the first section shows a count of 0 and second section a count of 0.

1.10 Clauses 1.2 to 1.9 shall be repeated for each direction a train could approach from, including wrong direction moves.

2. Operational Sequence Test - Double Lines Second Train Approaching (With Interface Signal Off)

2.1 Check no train is expected to enter the level crossing strike in area from any direction for the duration of test.

2.2 Confirm any interface signals are showing “proceed”.

2.3 Simulate a train “striking in” on a strike in sensor head by operating the test switches on a strike-in evaluator board (IMC).

2.4 Observe that the red LEDs illuminate in both indication posts. Check both audible warnings sounders sound.

2.5 Simulate a train “striking in” on a strike in sensor head mounted on 2nd line in the “opposite direction” to the first train by operating the test switches on a strike-in evaluator board (IMC).

2.6 Confirm that both audible warning sounders do not change to the second train approaching warning.

2.7 Check both indication posts continue to display a red LED.

2.8 Simulate a train “striking out” on first sensor by operating the test switches on a Strike out evaluator board (IMC).

2.9 Check both audible warning sounders, now change to the second train approaching warning.

2.10 Check both indication posts continue to display a red LED and the warning continues to sound.

2.11 Simulate a train “striking out” on 2nd line by operating the test switches on a strike out evaluator board (IMC).

2.12 After a short delay (3-6 seconds), observe the indicator post LED’s change from red to green.

2.13 Confirm the audible warning ceases.

3. Operational Sequence Test – One Train (With Interface Signal On)

3.1 Check no train is expected to enter the level crossing strike in area from any direction for the duration of the test.

3.2 Confirm the interface signal is at red, and has been at red, for greater than 2 minutes.

3.3 Simulate a train “striking in” on a strike in sensor head by operating the test switches on a strike-in evaluator board (IMC).

3.4 Observe the green LEDs on both indicator posts remain lit.

3.5 Clear the interface signal.

3.6 Observe the green LEDS on both indicator posts are extinguished, and the red LEDS are illuminated.

3.7 Check both the audible warning sounds are working correctly.

3.8 Observe the interface signal clears to proceed aspect, after signal regulation time (if applied, check in the control tables). Refer to record card for timer setting.

3.9 Simulate a train “striking out” on a strike out sensor head on the same line as the “strike in” sensor by operating the test switches on a strike-out evaluator board (IMC).

3.10 After a short delay (3-6 seconds), observe the indicator post LED’s change from red to green.

3.11 Confirm the audible warning ceases.

3.12 Clauses 3.1 to 3.11 shall be repeated for each interfaced signal.

END

1. Test

1.1 Using a meter, check that there is a voltage (110V AC) across terminals 23 and 24 in the T72 point machine.

If none is present:

1.2 Check the power supply to the heater:

- T2 links 1 and 2 in the Junction Box.

If a voltage is present:

1.3 Isolate the heater power supply.

1.4 Fit a strap across terminals 23 and 25 in the T72 point machine.

This bypasses the thermostat.

1.5 Reinstate the heater power supply and using a meter check that there is a voltage across the heater terminals 24 and 25 in the T72 point machine.

If the heater fails to operate, the heater is faulty. Replace this as part of corrective maintenance.

1.6 Remove the strap fitted across terminals 23 and 25 in the T72 point machine.

END

High voltages can be present. The appropriate precautions for working on high voltage equipment shall be implemented and observed (see NR/SMS/PartC/EL00 (Electrical Equipment General).

This test shall not be performed if there is an active earth fault at the PL/DPL. Inform your SM(S) and arrange remedial work.

The test shall be performed on at least one output on each (FIU) Field Isolation Unit in each subrack.

Removing the back plate of the subrack provides access to the 'U-Links' which are used for this test.

Each 'U-Link' is provided with a 'test hole' in its insulation to enable the circuit to be tested without the need to partially withdraw the link thereby risking circuit interruption.

Test Equipment

A calibrated resistance decade box with 'flying' leads (Details are in NR/SMS/Appendix/02).

1. Peripheral Post

Remove the back plates from all the FIU subracks.

1.1 Connect one of the 'flying leads' to the Test Earth.

1.2 Set the decade box to 900kΩ ('less than 1MΩ test').

1.3 Check that the person monitoring the SIM PC and the MOT is in position and is monitoring the correct CNT diagnostic field on the OLD screen.

1.4 Starting from the left, locate the first FIU unit fitted in the subrack.

1.5 Touch the end of the second 'flying lead' on to the test point on any one of the 'U-Links' fitted at the back of the selected FIU unit.

A Critical Alarm shall be registered on the MOT. If not, the system is faulty, and your SM(S) shall be informed immediately, rectification of the problem must be undertaken within 2 days.

1.6 Repeat the test with the decade box set to 90kΩ ('less than 100kΩ test').

1.7 Record the details of the circuits tested and the test results.

1.8 Repeat the above procedure for all of the FIU subracks within the PL/DPL.

END

AC Leakage Test

An AC leakage test shall be carried out on exposed metallic parts after each service.

For further information refer to the GraphXMaster Service Manual - section 2.3 General Guidelines – AC Leakage Test – Cold Check.

Test Equipment

- An Insulation Tester set to 500V DC
- An IEC free test socket with a lead connected to the power and neutral pins.

1. Cold Check

1.1 Check that the projector is switched off and the AC power cable has been removed from the power supply.

1.2 Plug the projector power plug into IEC test socket and connect the lead of IEC test socket into insulation tester.

1.3 Switch the projector AC switch to on.

1.4 Touch other lead of insulation tester on each exposed metallic part. Check that the resistance is >4MΩ

Pay particular attention to any exposed metal part having a return path to the chassis.

If the resistance is below this value, the projector shall be isolated and reported as a corrective maintenance item. The projector shall only be returned to service if the test result is satisfactory.

1.5 Switch the projector off and remove the projector power plug from IEC test socket.

END

There is no provision for a maintenance control to prevent a release being given for the section under test. A safe system of work shall be implemented in liaison with the Signaller.

1. Test

1.1 Obtain the Signaller's permission to test the apparatus.

1.2 Check that the TRAFFIC indicator is illuminated.

1.3 Check that the PATROL push button function is inoperative with the Normal/Operate keyswitch in the NORMAL position.

1.4 Check that the Normal/Operate keyswitch cannot be operated without its unique key.

1.5 Arrange a release with the Signaller and insert the key and turn the Normal/Operate keyswitch to the OPERATE position.

1.6 Check that the key is retained in keyswitch.

1.7 Press the button marked PATROL and Check that the TRAFFIC indicator extinguishes and the PATROL indicator illuminates.

1.8 Confirm with the Signaller that the delimited section is in PATROL mode.

e.g. signal 203 to signal 204.

1.9 Turn the Normal/Operate keyswitch to the NORMAL position and Check that the PATROL indicator remains illuminated.

1.10 Request the Signaller to cancel the release and confirm that the section remains in PATROL mode The PATROL mode indicator remains illuminated.

1.11 Turn the Normal/Operate keyswitch to the OPERATE position and Press the button marked TRAFFIC.

1.12 Check that the PATROL indicator extinguishes and the TRAFFIC indicator illuminates.

1.13 Confirm with the Signaller that the section has been returned to TRAFFIC mode.

1.14 Turn the Normal/Operate keyswitch to the NORMAL position and remove the key.

1.15 If applicable, repeat 1.1 to 1.14 for any adjacent section(s).

1.16 Repeat 1.1 to 1.15 at the other associated control position(s).

END

High voltages can be present. The appropriate precautions for working on high voltage equipment shall be implemented and observed.

The particular equipment being tested shall be electrically isolated by removing the appropriate fuse(s).

Before disconnecting any wiring from the RK170, the voltage on A1, A2, M+, M-, 6 and 7 with respect to earth shall be measured and if greater than 25 volts (AC or DC) shall be rectified as corrective maintenance.

TESTS

1. Function Test

1.1 Agree with the Signaller the identity of the power supply to be tested and the equipment to be affected.

1.2 Record the details of that particular power supply.

1.3 Isolate the ELD and associated RK170 unit by removing the associated fuse(s).

1.4 Check the circuit is isolated by measuring the voltage on A1, A2, M+, M-, 6 and 7 with respect to earth).

If the voltage is greater than 25 volts (ac or dc) go to 1.5 otherwise go to 1.6.

Check the correct fuse(s) have been removed before proceeding

1.5 Disconnect and remove the output from the RK170 (terminals 6 and 7) to the trend controller.

1.6 Connect the auxiliary current source to the output wiring to the trend controller.

1.7 Increase the auxiliary current in incremental steps from 4.1mA to 20mA. (See Table1):

RK170 Output (mA)	Total System Insulation Resistance (kOhm)	RCM 'Insulation Monitoring' Screen Status
4.100	19080	(Green) OK
5.455	1200	
5.570	1103	
5.641	1050	
5.710	1003	
5.795	950	(Amber) WARNING
5.880	901	
6.087	800	
12.00	120	
12.350	110	
12.550	105	
12.730	100	(Red) CRITICAL
12.950	95	
13.150	90	
13.600	80	
20.00	0	

Table 1 – Resistance Value (1)

1.8 At each incremental step:

Record the resistance value (kOhm) and Insulation status displayed on the maintenance desk insulation monitoring screen.

1.9 At each alarm transition threshold:

Check the insulation status changes from:

a) 'OK' to Warning' at 1000kOhm.

b) 'Warning' to 'Critical' at 100kOhm.

If the measured value deviates by more than ±5% from the designated alarm setting 100kOhm (105kOhm – 95kOhm) or 1000kOhm (1050kOhm – 950kOhm) the SM(S) shall be notified.

1.10 When the 20mA increment is reached:

Repeat the test, using the same incremental steps in reverse order, reducing the current from 20mA to 4.1mA. (See table2).

1.11 At each incremental step:

Record the Resistance value (kOhm) and Insulation status displayed on the Maintenance Desk Insulation Monitoring screen.

1.12 At each alarm transition threshold:

Check the insulation status changes from: ‘Critical’ to ‘Warning’ at 100kOhm ‘Warning’ to ‘OK’ at 1000kOhm.

If the measured value deviates by more than ±5% from the designated alarm setting 100kOhm (105kOhm – 95kOhm) or 1000kOhm (1050kOhm – 950kOhm) the SM(S) shall be notified.

RK170 Output (mA)	**Total System Insulation Resistance (kOhm)**	**RCM ‘Insulation Monitoring’ Screen Status**
20.00	0	(Green) OK
13.600	80	
13.150	90	
12.950	95	
12.730	100	
12.550	105	(Amber) WARNING
12.350	110	
12.00	120	
6.087	800	
5.880	901	
5.795	950	
5.710	1003	(Red) CRITICAL
5.641	1050	
5.570	1103	
5.455	1200	
4.100	19080	

Table 2 - Resistance Value (2)

1.13 Remove the test equipment.

1.14 Reconnect the trend controller to the RK170. (Terminals 6 and 7).

1.15 Replace all fuses.

1.16 Check the ELD LCD is displaying the resistance value. (The value shall be greater than 1000kOhm).

1.17 Check the maintenance desk insulation monitoring screen is displaying resistance values greater than 1000kOhm and the Insulation status is (green) ‘OK’.

1.18 Record details and test results.

END

There is no provision for a maintenance control to prevent a release being given for the section under test. A safe system of work shall be implemented in liaison with the Signaller.

1. Test

1.1 Obtain the signaller's permission to test the apparatus.

1.2 Check that the TRAFFIC indicator is illuminated.

1.3 Check that the PATROL push button function is inoperative with the Normal/Operate keyswitch in the NORMAL position.

1.4 Check that the Normal/Operate keyswitch cannot be operated without its unique key.

1.5 Arrange a release with the signaller and insert the key and turn the Normal/Operate keyswitch to the OPERATE position.

1.6 Check that the key is retained in keyswitch.

1.7 Press the button marked PATROL and check that the TRAFFIC indicator extinguishes and the PATROL indicator illuminates.

1.8 Confirm with the Signaller that the delimited section is in PATROL mode. e.g. signal 203 to signal 204.

1.9 Turn the Normal/Operate keyswitch to the NORMAL position and check that the PATROL indicator remains illuminated.

1.10 Request the signaller to cancel the release and confirm that the section remains in PATROL mode The PATROL mode indicator remains illuminated.

1.11 Turn the Normal/Operate keyswitch to the OPERATE position and press the button marked TRAFFIC.

1.12 Check that the PATROL indicator extinguishes and the TRAFFIC indicator illuminates.

1.13 Confirm with the Signaller that the section has been returned to TRAFFIC mode.

1.14 Turn the Normal/Operate keyswitch to the NORMAL position and remove the key.

1.15 If applicable, repeat 1.1 to 1.15 for any adjacent section(s).

1.16 Repeat 1.1 to 1.16 at the other associated control position(s).

END

General

Treadles shall be set and checked using one of the following methods:

a) Line/bob-weights and associated plastic gauge.

b) Extendable bar treadle gauge.

The metal treadle arm gauge shall not be used for this task.

Record all results on the Record Card.

1. Treadle Gauging - Method One (Line and Bob)

Gauge Set-up

A line shall be attached to the plumb weights that allows for the weights to suspend the line over both running rails. See Figure 1.

Gauge Test

The plastic gauge can then be used with the notched end against the line and the stepped side against the treadle arm. The height below and from the rail can then be read from the scale. See Figure 2 and Table 1.

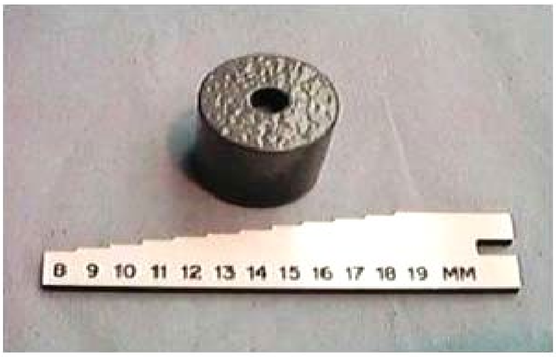


Figure 1 - Use of the Treadle Gauge

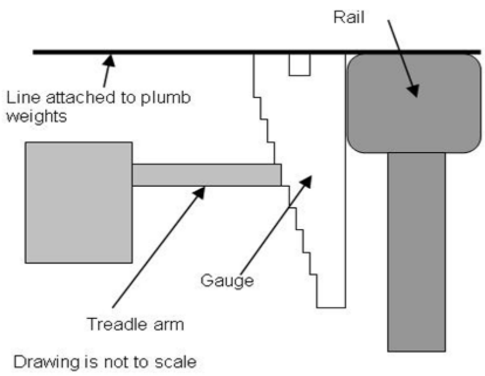


Figure 2 - Treadle Gauging Equipment

Treadle Type	Height Below Rail Level (H)	Distance From Running Edge of Rail (X)
69	16mm (±1mm)	10mm (+2mm or -5mm)

Table 1 - Treadle height and arm limits

2. Treadle Gauging - Method Two (Integrated Gauge)

Gauge Set-up

2.1 Place one end of the new treadle gauge on the rail and release the lock nut in the centre, extend the rod until the gauge reaches the opposite rail.

2.2 Check that both measuring ends are undamaged, in the correct position and correspond.

2.3 Hand tighten the centre release lock nut on the rod and check that both ends are positioned correctly on the rail. The gauge should be allowed to move freely without stalling or stuttering, see Figure 3.

Figure 3 – Using the Gauge

Gauging Test

<u>The 5mm Check - Inner running edge of the rail & the treadle arm.</u>

2.4 Place the gauge with the 5mm section in front of the arm and offer / move the gauge towards the treadle arm.

The 5mm section should pass through the gap.

2.5 Note if the gap is smaller, then the treadle arm needs to be adjusted, after treadle adjustment, repeat this check.

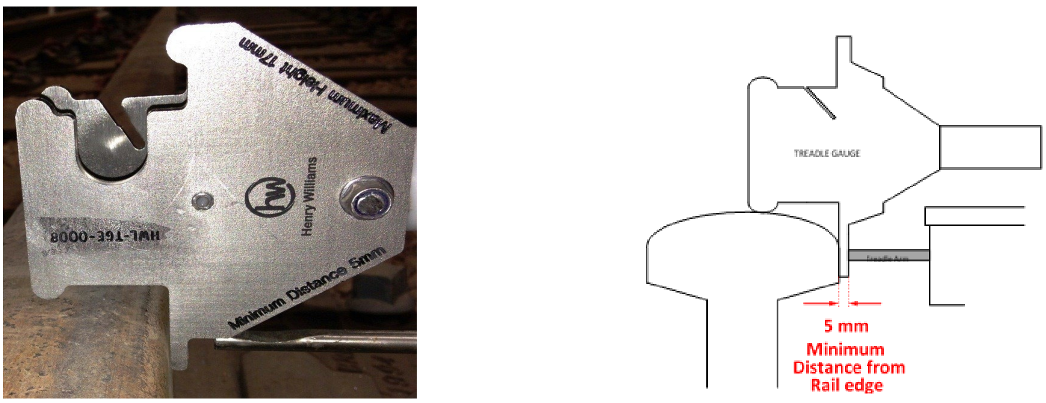


Figure 4 – 5mm Check

The 12mm Check - Inner running edge of the rail & the treadle arm.

2.6 Place the gauge with the 12mm section in front of the arm and offer / move the gauge towards the treadle arm.

The 12mm section of the gauge should only just pass through the gap touching the trip arm.

2.7 If the gap is greater than 12mm then the treadle arm, needs to be adjusted, after treadle adjustment, repeat this check.

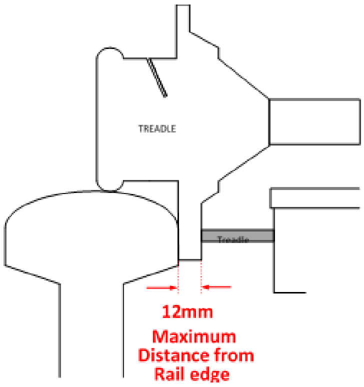


Figure 5 – 12mm Check

NOTE: *Caution should be taken to prevent an operation of the treadle arm when completing this check.*

The 15mm Check - Measuring the Height of the treadle.

2.8 Place the gauge with the 15mm section in front of the arm and offer / move the gauge towards the treadle arm.

The gauge should just pass over the treadle arm.

2.9 If the 15mm gauge fails to pass over the treadle arm, then the treadle height needs to be adjusted, after treadle adjustment, repeat this check

NOTE: *Caution should be taken to prevent an operation of the treadle arm when completing this check.*

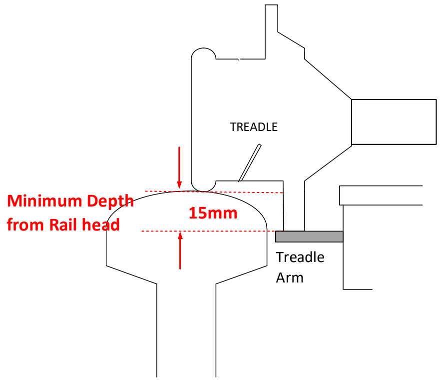


Figure 6 - 15mm Check

17mm Check - Measuring the Height of the treadle.

2.10 Place the gauge with the 17mm section of the gauge in front of the arm and offer / move the gauge towards the treadle arm.

The gauge should JUST TOUCH the top of the trip arm.

2.11 If the 17mm gauge fails, then the treadle height needs to be adjusted. After treadle adjustment, repeat this check.

This is the Optimum arm height setting for reliability and is important that this is achieved

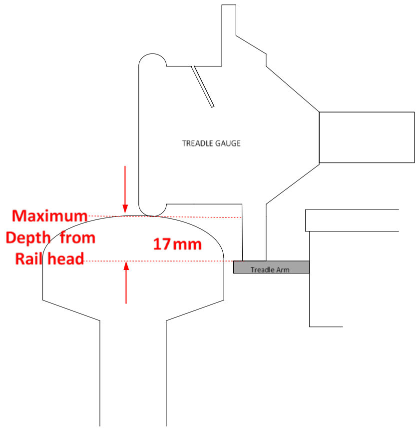


Figure 7 - 17mm Check

NOTE: *Caution should be taken to prevent an operation of the treadle arm when completing this check.*

Treadle Arm Wear Gauging Check.

The Integrated Treadle Gauge has two arm wear measurement slots within the gauge, these are uniquely identified and are used to indicate arm wear of over 75% (exceeding 2.6mm wear) and over 100% (exceeding 3.5mm wear).

This enables the Technician to report to SM(S) the arm wear condition at each maintenance visit and enables the timely planning of Treadle replacement.

Trip Arm Wear Check

2.12 Select the 75% wear gauge, align the gauge slot with the Treadle Trip Arm and slide the gauge across the worn area of the trip arm horizontally (approximately 10mm from end of trip arm).

If the wear exceeds the 75% wear gauge, repeat with the 100% wear gauge and record the reading.

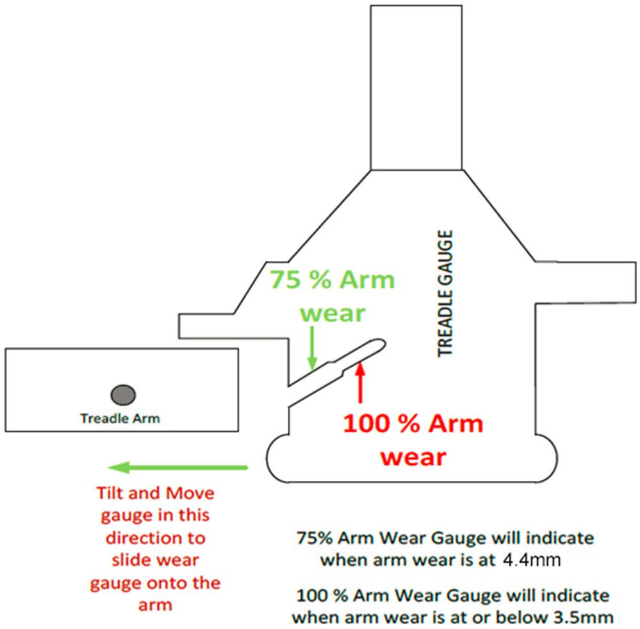


Figure 8 - Trip Arm Wear Check

2.13 Technicians shall inform SM(S) when arm wear has reached the 75% worn level, Treadles which are found to have 100% arm wear shall be reported immediately and replacement planned in as soon as possible.

2.14 Sites which have accelerated arm wear, shall have the arm heights re-checked for compliance with this guide.

END

Includes:	For EPOS Units - Hot Axle Box Detector (HABD)
Excludes:	All other types HABD systems

1. General

1.1 Manual post calibration is required in the following cases:

a) After cleaning the optical components.

b) After installing a new EPOS unit.

1.2 "Manual post calibration" creates a new "current characteristic", which immediately takes the current attenuation characteristics (e.g. changes due to cleaning) of the measuring system into consideration.

NOTE: *The passage of an actual train will interrupt the Manual Post Calibration Test.*

2. Manual Calibration

2.1 To carry out a "manual calibration" complete the following steps:

a) Launch the "Satellite Management UI" application.

b) Click on "Calibration" in the "Satellite Management UI" menu bar.

2.2 The following dropdown menu appears.

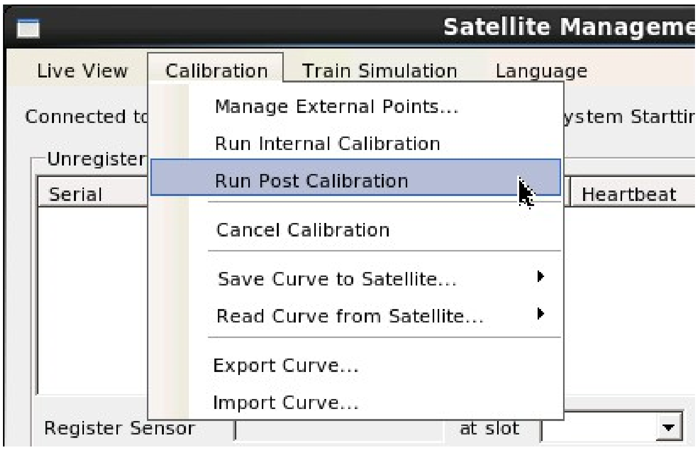


Figure 1 - Dropdown menu “Calibration" – item “Run Post Calibration”

2.3 Click the "Run Post Calibration" menu.

The FUES-EPOS system starts post calibration for all measuring points at the same time.

2.4 A log window opens, in which you can monitor the calibration process. See Figure 2.

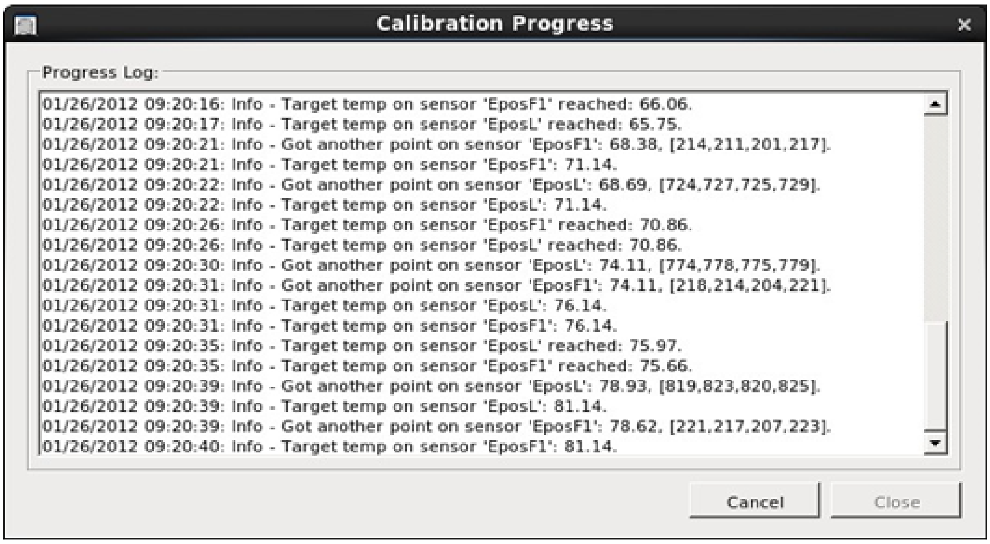


Figure 2 - Log window after starting post calibration

2.5 The internal calibration process has been successfully completed when event logging stops and the last line confirms successful calibration with the following message: New calibration curve ready. See Figure 3.

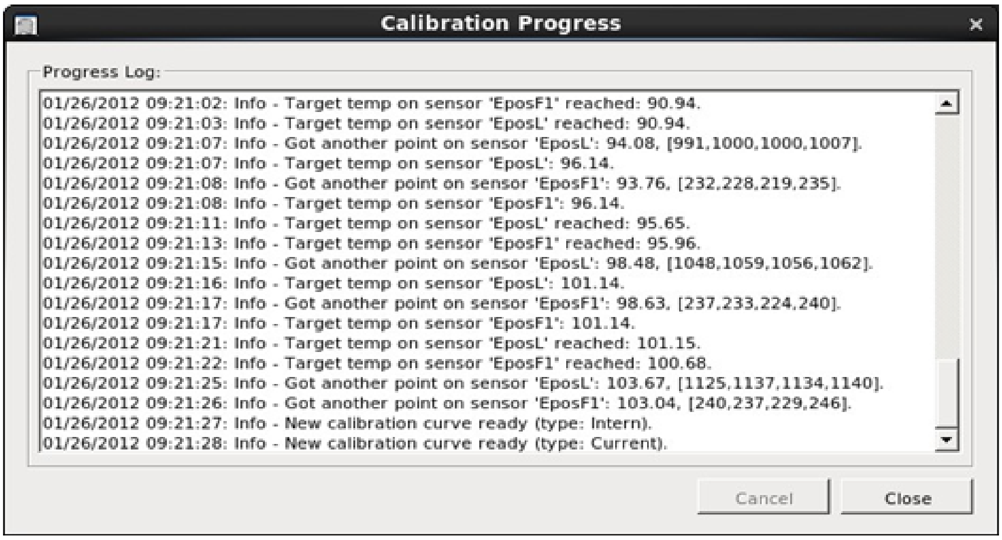


Figure 3 - Log window after completing post calibration

2.6 Close the log window by clicking the <Close> button. This completes "manual post calibration".

END

Includes:	For RSR123 Sensors fitted on Hot Axle Box Detector (HABD)
Excludes:	All other types of RSR123 Sensors fitted on other systems

1. Occupancy Detection Capability Test - Using PB200 Plate

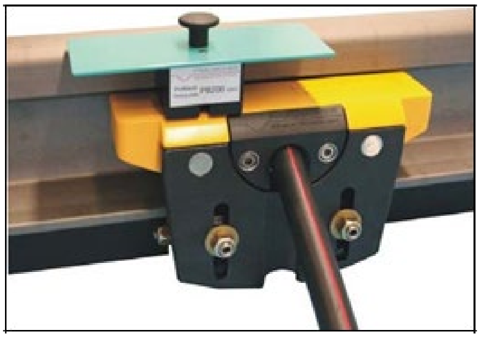


Figure 1 - PB200 above System 1

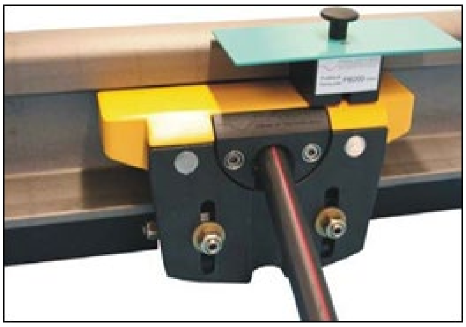


Figure 2 – PB200 above System 2

1.1 Carry out the following:

a) Place the PB200 testing plate above the system to be tested as shown in Figure 1 and check the SP board is indicating occupancy.

b) Move the PB200 to the position shown in Figure 2 and check the SP board is indicating occupancy.

c) Remove the PB200 testing plate.

1.2 If the SP board fails to indicate occupancy, carry out NR/SMS/PartB/Test/184 (EPOS – RSR123 Wheel Sensor Voltage Adjustment), followed by repeating this test.

END

Includes:	EPOS HABD
Excludes:	All other HABD Systems

1. Verifying the Measuring Precision

1.1 Run the train simulation (measurement) as follows:

a) Switch on the heat source.

b) Set the corresponding temperature value on the heat source control panel.

c) Position the heat source at the EPOS unit to be verified.

d) Launch the "Satellite Management UI" application.

e) Click the "Train Simulation" menu item.

f) The dropdown menu shown in Figure 1 appears.

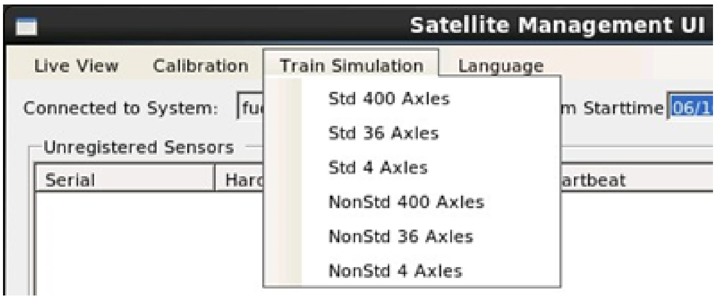


Figure 1 - Drop-down menu "Train Simulation"

g) You can run the train simulations shown in this menu, See Figure 2.

- The wheel sensor signals are simulated by the software.
- The shutters are opened.

Menu item	Function
Std 400 Axles	Train simulation in standard direction with 400 axles at 60 km/h
Std 36 Axles	Train simulation in standard direction with 36 axles at 360 km/h
Std 4 Axles	Train simulation in standard direction with 4 axles at 120 km/h
Non Std 400 Axles	Train simulation in non-standard direction with 400 axles at 60 km/h
Non Std 36 Axles	Train simulation in non-standard direction with 36 axles at 360 km/h
Non Std 4 Axles	Train simulation in non-standard direction with 4 axles at 120 km/h

Figure 2 – Simulation Options

NOTE: *These train simulations can also be run by pressing buttons on the control and evaluation unit's SP board.*

1.2 When the heat source has reached a steady target temperature, run any train simulation via the dropdown menu or the buttons on the IC board.

The FUES-EPOS system simulates a train passage. The shutters off the EPOS units open and the system records the temperature of the heat source.

1.3 We recommend verifying measuring accuracy at the following temperature values:

Measuring position	Temperature [°C]
HBD	85
HWD	300

Table 1 – Temperature Values

2. Checking the Measuring Results

2.1 Open the graphical user interface TIS GUI on the desktop of the FUES-EPOS system.

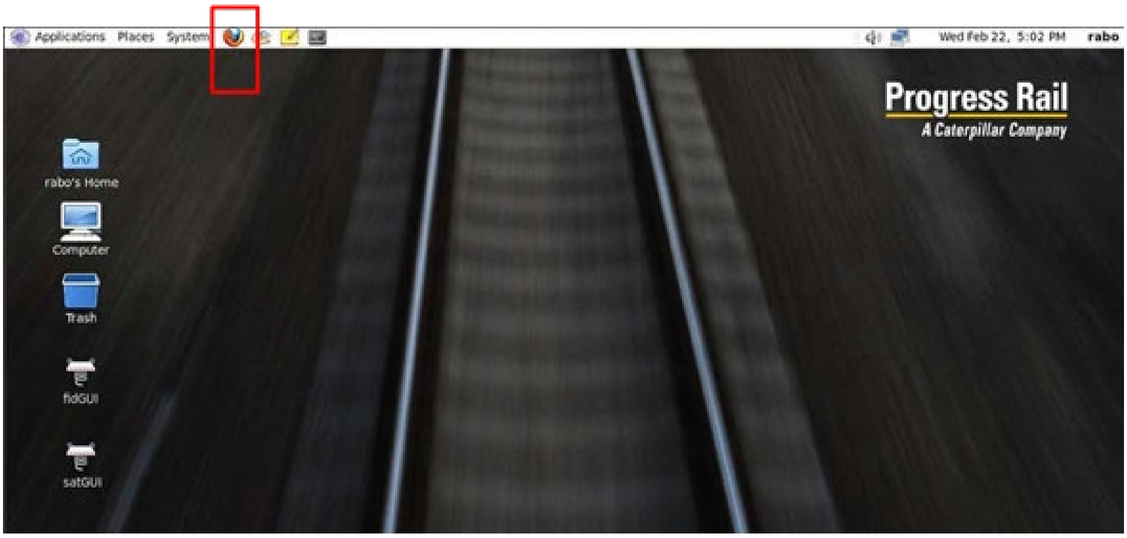


Figure 3 - FUES-EPOS system desktop (example)

NOTE: *Quick start icon for the web browser for opening the TIS GUI shown in the red box*

2.2 Click on the quick start icon for the web browser to open the TIS GUI The TIS GUI login window appears.

2.3 Enter the username and password.

The TIS GUI start window appears.

2.4 Click the Train ID button in the Last Train area below the navigation menu (see Figure 4, circled in red).

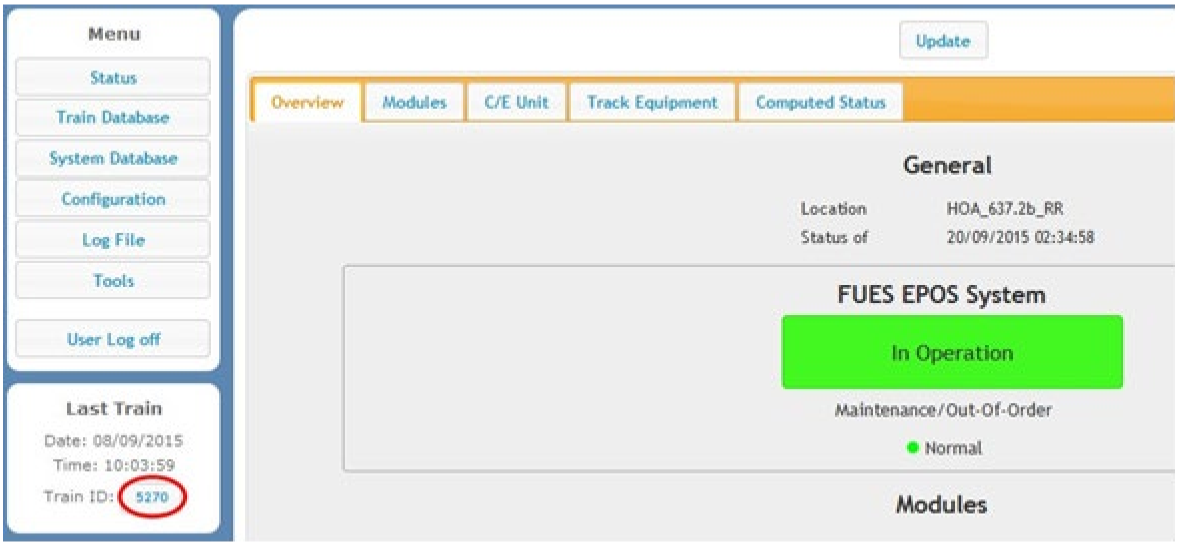


Figure 4 - Selecting the last train in the "Train selection" tab

2.5 This opens the tabs with the corresponding train data.

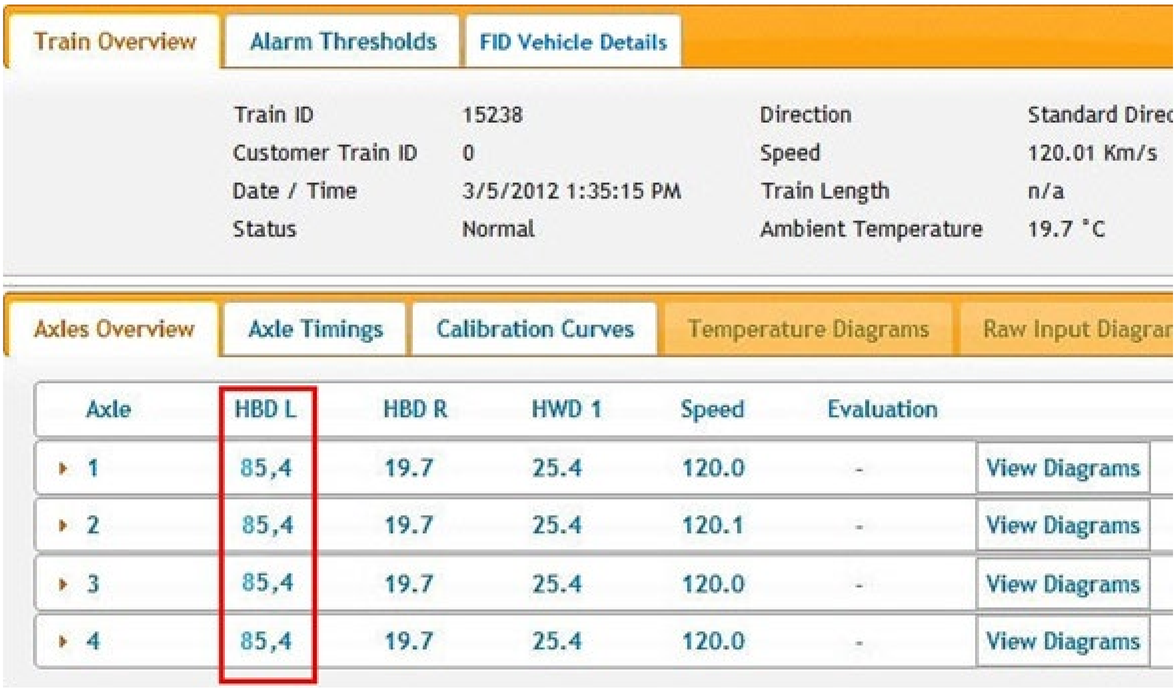


Figure 5 - Reading off the measured temperature values in the axle overview (HBD-L as an example)

2.6 Read off the temperatures measured for the selected measuring system in the axle data of the simulated train (see Figure 5).

2.7 Enter the average temperature value in the corresponding log.

You can use the following documents for this:

a) Document 5500219 "On-site testing (SAT)".

b) Document 5500220 "Factory testing (FAT)".

c) Document 5500222 "Maintenance Schedule/Record".

2.8 Check whether the defined tolerances are observed.

The following defaults apply:

Measuring position	Temperature
HBD	85 °C ± 3 C
HWD	300 °C ± 10 C

Table 2 – Temperature Tolerances

2.9 Repeat the measuring precision verification for all installed EPOS units.

2.10 If the measuring precision of an EPOS unit is outside of the defined tolerances carry out NR/SMS/PartB/Test/183 (EPOS – Basic Calibration).

END

Includes:	EPOS HABD
Excludes:	All other HABD Systems

1. General

1.1 If deviations outside of tolerance are determined while verifying measuring precision (e.g., during annual maintenance a “Basic Calibration” shall be performed.

Basic calibration gives you the ability to adjust the measuring system on the EPOS unit in question to changes that cannot be adequately compensated for by automatic post basic calibration (e.g. caused by irreversible soiling, scratches, or aging effects).

2. Performing "external calibration"

2.1 Click on "Calibration" in the "Satellite Management UI" menu bar.

The following dropdown menu appears, see Figure 1.

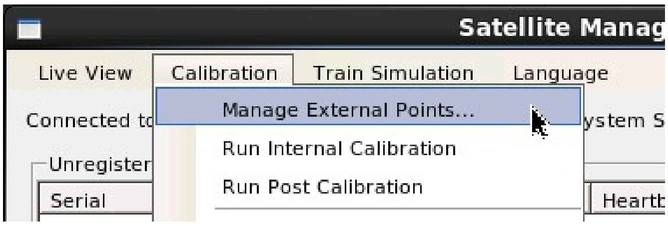


Figure 1 - Dropdown menu "Calibration" – item “Manage External Points”

2.2 Click the "Manage External Points" menu item.

This opens the "External Calibration Manager" dialogue window (see Figure 2)

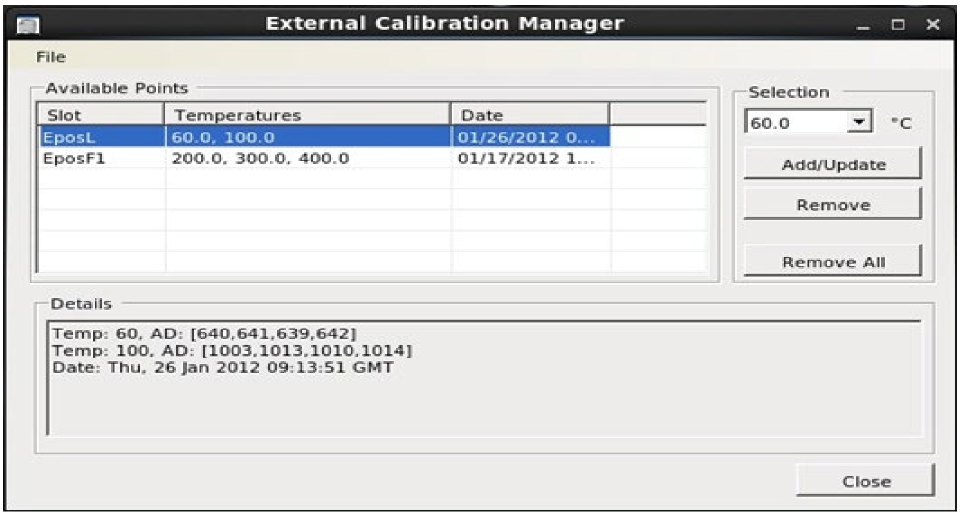


Figure 2 - "External Calibration Manager" dialogue window

2.3 In the list of "Available Points" select the measuring system (EPOS unit) for which you will be performing calibration. See Figure 2.

2.4 Select the temperature value in the dropdown list.

NOTE: *You only need to perform basic calibration of EPOS units whose measuring precision is outside of the tolerance.*

If multiple EPOS units are affected, we recommend a specific approach to choosing the calibration point order in line with Table 1.

NOTE: *that cooling and heating the calibration radiator takes a considerable amount of time, and that the suggested measuring points have proved useful in basic calibration.*

Measuring position	Temperature [°C]
HBD-L	60
HBD-R	60
HBD-L	100
HBD-R	100
HWD1	200
HWD2	200
HWD1	300
HWD2	300
HWD1	400
HWD2	400

Table 1 - Recommended order of measuring systems for external calibration

2.5 Switch on the calibration radiator(s).

2.6 Set the corresponding temperature value on the calibration radiator control panel.

2.7 Position the calibration radiator at the EPOS unit to be calibrated.

2.8 When the calibration radiator has reached a steady target temperature, click the "Add/Update" button to start the measuring process.

The shutter on the corresponding EPOS unit opens and the system records the digital values measured. The measuring process is complete when the shutter closes again.

2.9 Repeat this process for all required calibration points.

After completing the last required calibration point, the external calibration is complete.

3. Performing "internal calibration"

3.1 Click on "Internal Calibration" in the "Satellite Management UI" menu bar.

The dropdown menu shown in Figure 3 appears.

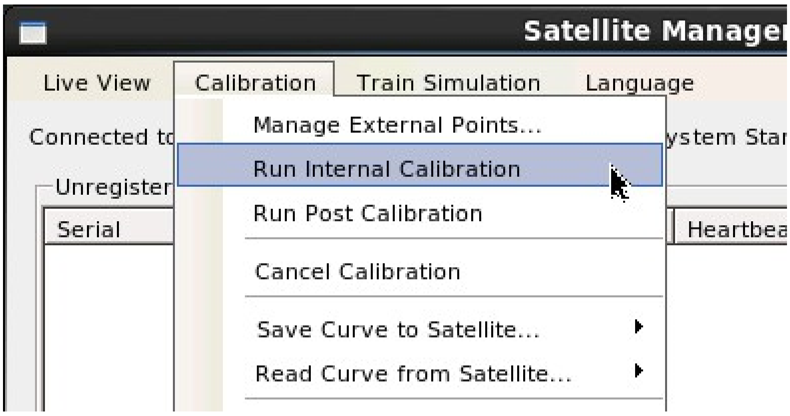


Figure 3 - Dropdown menu "Calibration" – item "Run Internal Calibration"

3.2 Click the "Run Internal Calibration" menu.

A selection window opens, see Figure 4.

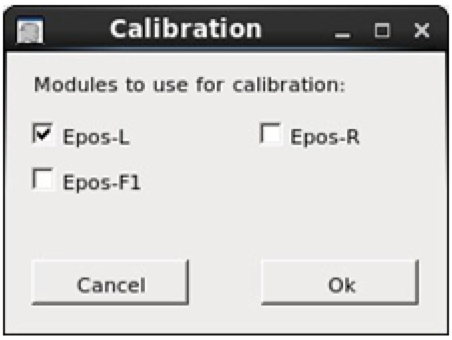


Figure 4 - Selection window

3.3 Select the measuring system(s) to be calibrated using ☑.

3.4 Click the <OK> button to start the internal calibration process.

The FUES-EPOS system starts internal calibration for the selected measuring system(s)

This opens a Log window (see Figure 5), in which you can monitor the calibration process.

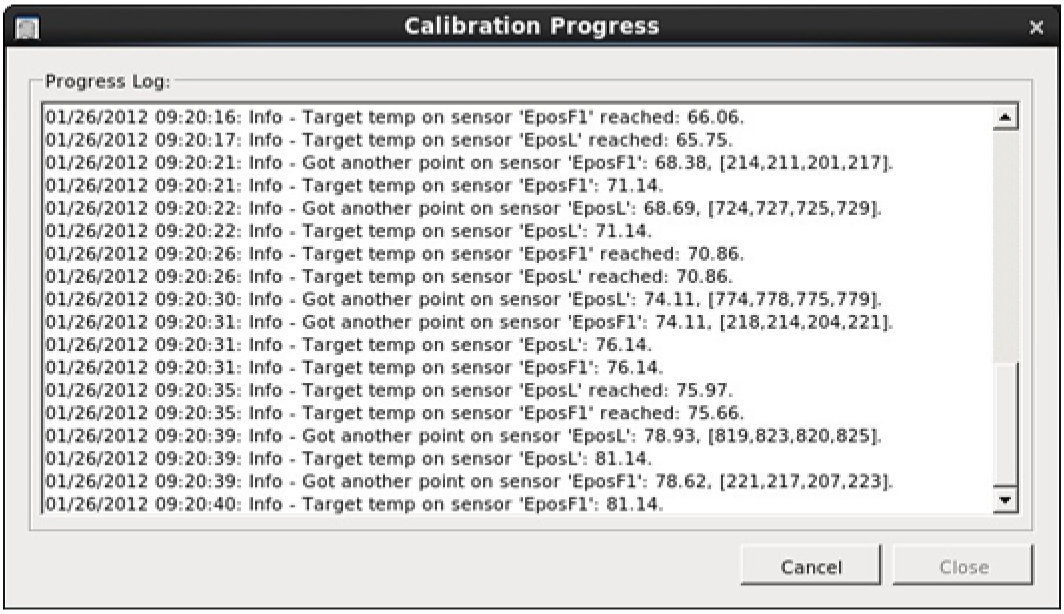


Figure 5 - Log window after starting internal calibration

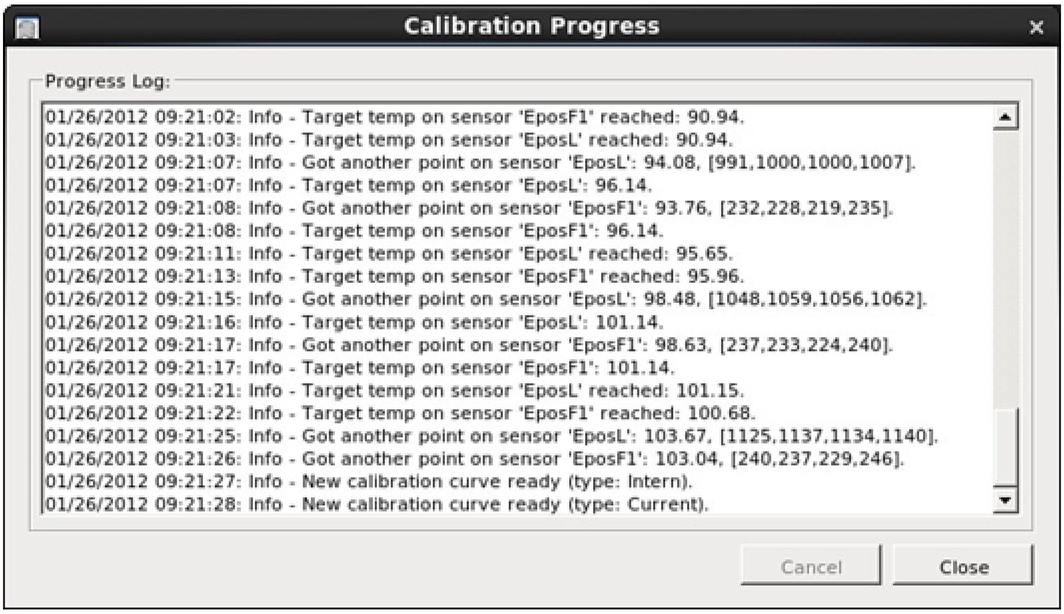


Figure 6 - Log window after completing internal calibration

The internal calibration process has been successfully completed when event logging stops and the last line confirms successful calibration with the following message: **New calibration curve ready,** see the last line of the screen shown in Figure 6.

3.5 Close the log window by clicking the <Close> button.

3.6 This completes the internal calibration.

4. Completing basic calibration

4.1 After completing internal calibration, the system computes the "basic characteristic" from the external and internal calibration data; this forms the basis for temperature measurements.

4.2 The basic calibration data are automatically stored in the FUES-EPOS system database where they are immediately available for the next train run.

Additionally, the basic calibration data in the newly calibrated EPOS unit shall be stored in the EPOS's Units memory. This means that the calibration data of this EPOS unit are available for use at other locations.

5. Storing the calibration data on an EPOS unit

5.1 Click on "Internal Calibration" in the "Satellite Management UI" menu bar.

The corresponding dropdown menu appears.

5.2 Move the cursor to the "Save Curve to Satellite" menu item, but do not press the mouse button.

Another dropdown menu appears where you can select the measuring system as shown in Figure 7.

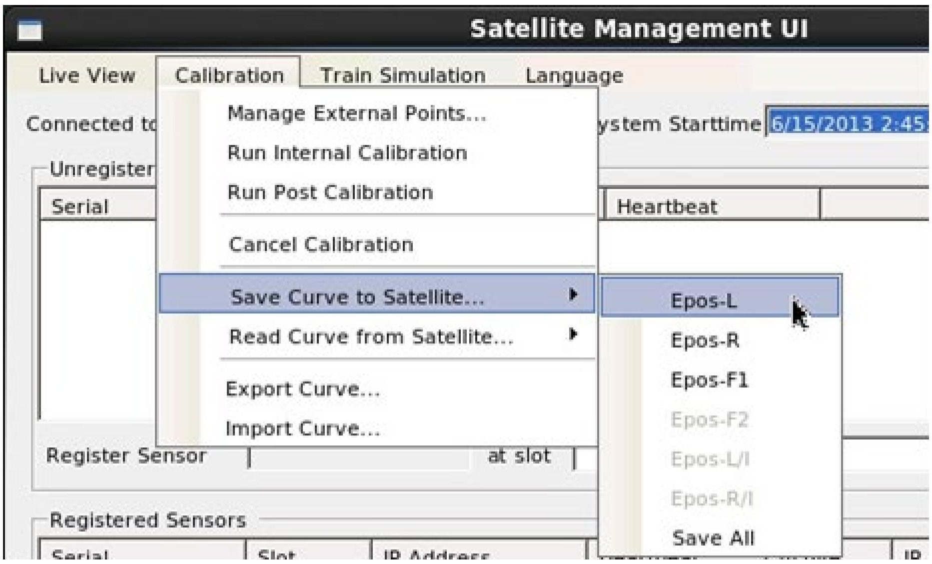


Figure 7 - Dropdown menu "Calibration" item "Save Curve to Satellite"

5.3 Move the cursor to the desired measuring system and left click.

The system starts to transfer the calibration data. This opens a log window where you can monitor the data transfer progress (see Figure 8 and Figure 9).

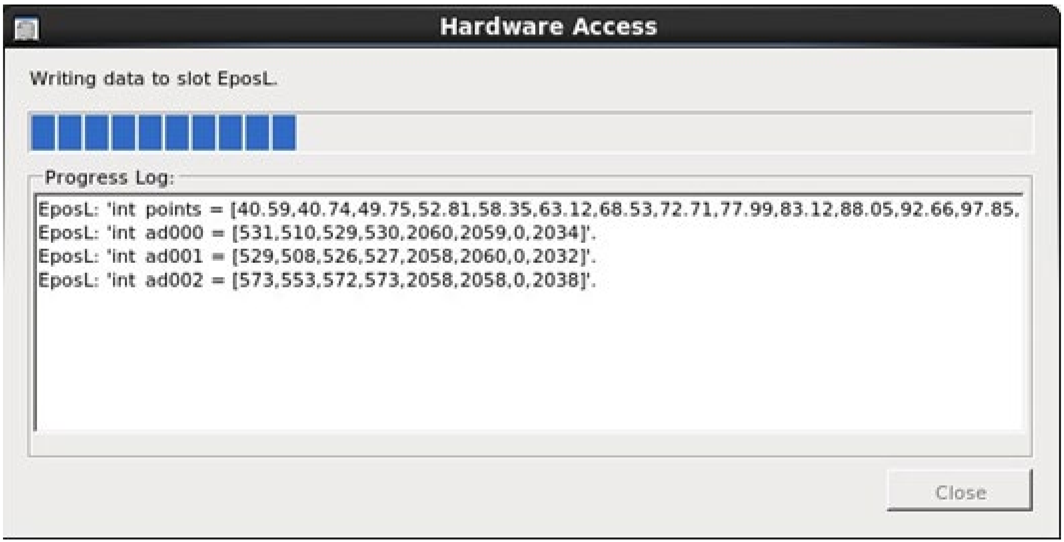


Figure 8 - Transferring the calibration data to an EPOS unit - start

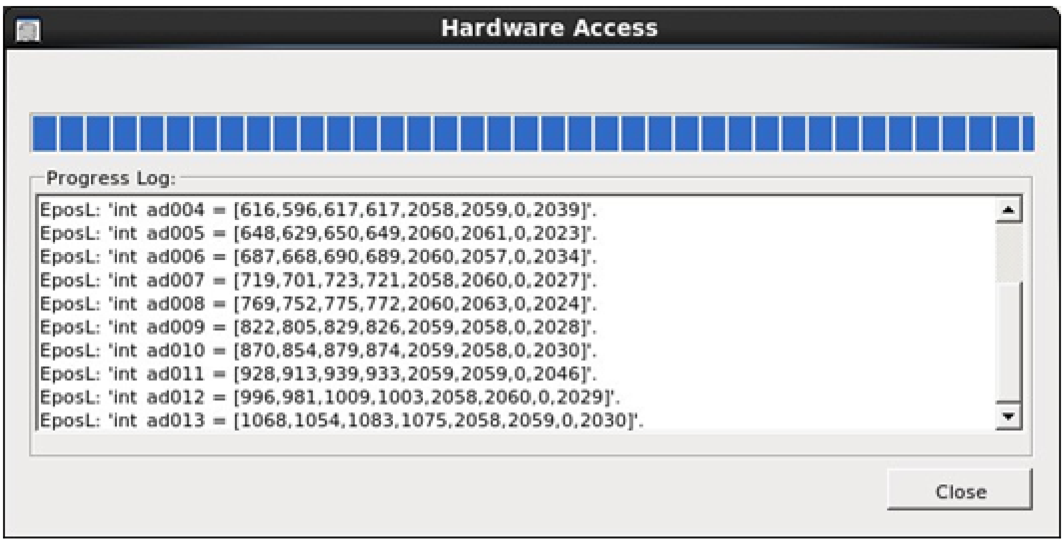


Figure 9 - Transferring the calibration data to an EPOS unit - end

5.4 Close the log window by clicking the <Close> button.

APPENDIX A - List fields "External Calibration Manager"

<table>
<tr><th>Designation / Column</th><th colspan="2">Description</th></tr>
<tr><td>Available points</td><td colspan="2"></td></tr>
<tr><td></td><td colspan="2">This list shows all the EPOS units (measuring systems) logged into and active on the EPOS system.
EPOS units with an error status are greyed.</td></tr>
<tr><td rowspan="5">Slot</td><td colspan="2">Designation of the measuring system; the following measuring systems are possible:</td></tr>
<tr><td>EPOS-L</td><td>EPOS HBD unit left</td></tr>
<tr><td>EPOS-R</td><td>EPOS HBD unit right</td></tr>
<tr><td>EPOS-F1</td><td>EPOS HWD1 unit</td></tr>
<tr><td>EPOS-F2</td><td>EPOS HWD2 unit</td></tr>
<tr><td>Temperatures</td><td colspan="2">Temperature values in °C at which the last external calibration was performed.</td></tr>
<tr><td>Date</td><td colspan="2">Date of the last external calibration.</td></tr>
<tr><td>Details</td><td colspan="2">This list displays the digital values of the last external calibration for the measuring system selected in "Available Points":</td></tr>
<tr><td rowspan="3"></td><td>Temp</td><td>Temperature value in °C for external calibration</td></tr>
<tr><td>AD</td><td>Corresponding digital values for the detector elements (E1, E2, …)</td></tr>
<tr><td>Date</td><td>Date and time of the last external calibration of the selected measuring systems</td></tr>
<tr><td>Select</td><td colspan="2">Dropdown list for selecting preselected temperature values in °C.

You can also define new temperature values. To do so, type a new temperature value in the numeric field and then perform external calibration with this value. The system stores this default value.</td></tr>
<tr><td>Add</td><td colspan="2">Clicking this button tells the system to start a measuring cycle and assign the digital values measured to the preselected measurement value in °C.
A calibration radiator with its temperature set to exactly this defined value must be located above the measuring system.</td></tr>
<tr><td>Remove</td><td colspan="2">Deletes the selected defined value</td></tr>
<tr><td>Remove all</td><td colspan="2">Deletes all defined values</td></tr>
</table>

END

Includes:	EPOS - RSR123 Wheel Sensor (HABD)
Excludes:	All other uses of the RSR123 Wheel Sensor

1. Voltage adjustment RSR123

1.1 The voltage adjustment via software is performed using the application "Satellite Management UI" Application.

1.2 Open the "Satellite Management UI" application by double clicking the corresponding "satGUI" icon on the desktop of the FUES-EPOS system.

1.3 Open the "Calibration" menu and click "Wheel sensor calibration" and a second drop-down menu showing "RR", "MK" or "GR" appears, click as required. See Figure 1.

If several wheel sensors need adjusting, use "All" to adjust all wheel sensors at the same time.

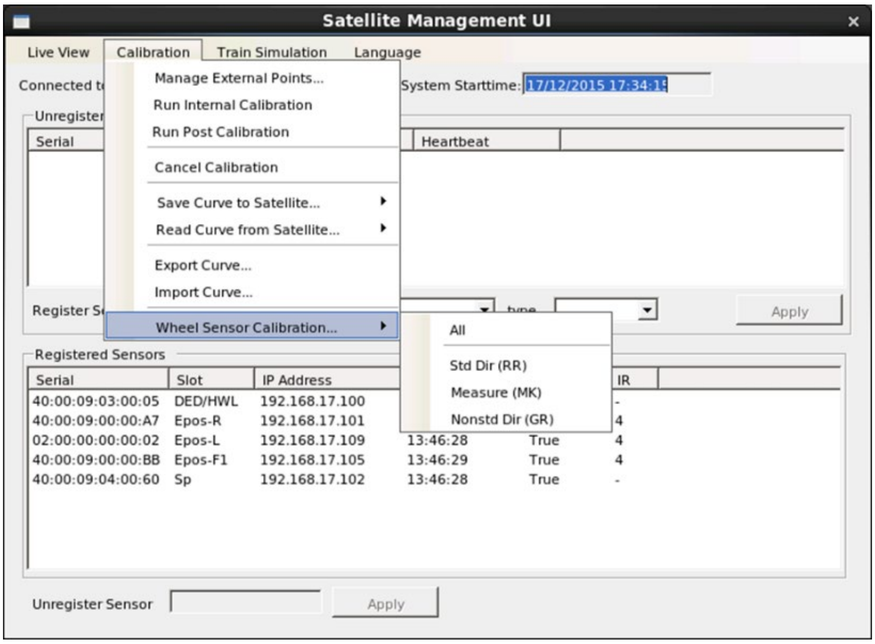


Figure 1 - Voltage adjustment of RSR123 – via software

1.4 Making a selection starts the process.

a) The status of the adjustment is displayed by a progress bar.

b) The completion of the adjustment is displayed by pop-up window.

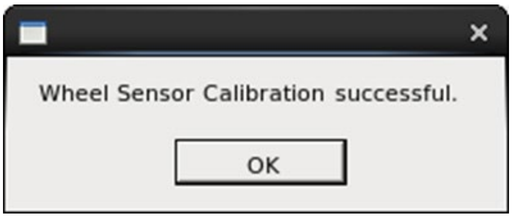


Figure 2 - Pop-up window after completion of the adjustment

END

SERVICE A TESTS

Details of the indications to be expected can be found in Appendix A

1. Test

1.1 Operate the points normal and reverse in turn and check that the Points Operating Module (POM) indications (Figure 1) and the Points Adaptor Module (PAM) detection relays (Figure 2) correspond with the lie of the points.

1.2 Check the position of the Signallers control device for the points and the Signallers indications correspond with the lie of the points.

APPENDIX A - Equipment Identification

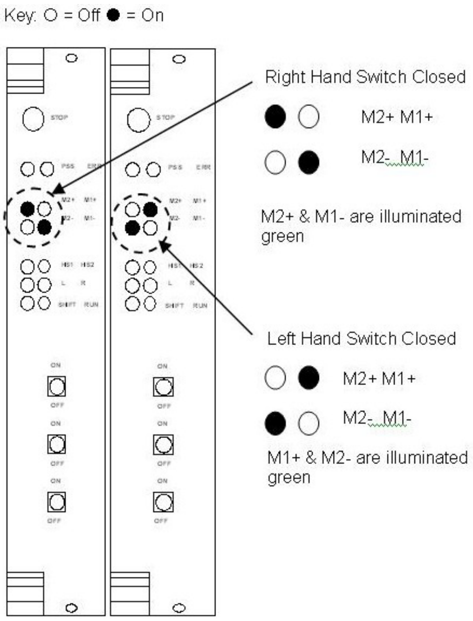


Figure 1 - Point Operating Module (POM)

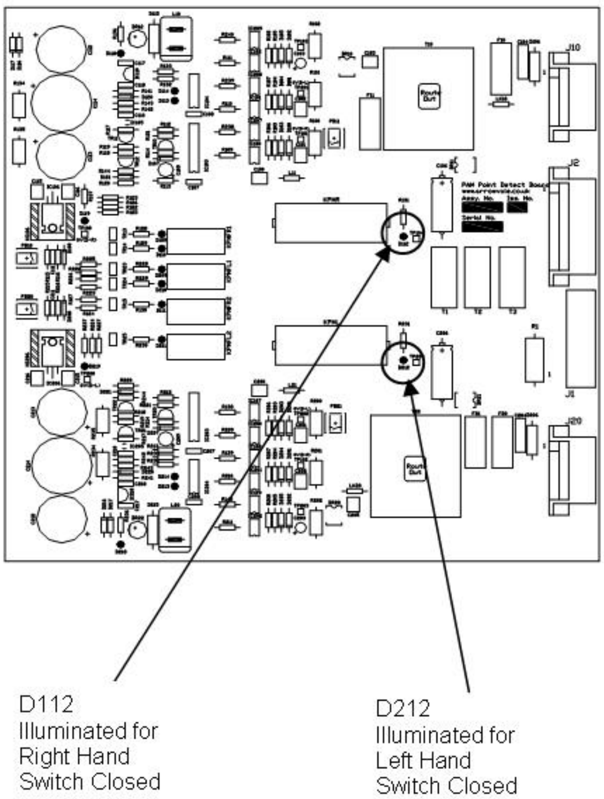


Figure 2 - Points Detect Module (PAM)

END

Details of the location of indications and push buttons can be found in Appendix A.

Abbreviations

LHSC: Left hand switch closed RHSC: Right hand switch closed

SERVICE B TESTS

1. Test

1.1 Check that the points operate correctly with no faults indicated or observed.

1.2 Move the points to the RHSC position. Check that D112 is illuminated and D212 extinguished.

1.3 Remove the lightning suppressors 4 & 5 to disconnect the PAM 4-wire interface.

1.4 Press PB21 and hold for approximately 1 second.

This will generate a simulated fault in the LHSC safety relay. D109/209 will illuminate and D111/211 will extinguish.

1.5 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 1):

a) Terminals 10, 12, & 15 connected together.

b) Terminal 13 not connected.

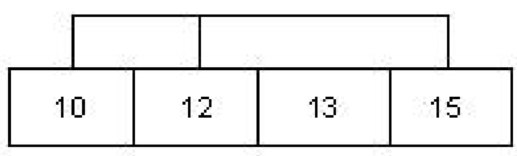


Figure 1 – Configuration 1

1.6 Remove and re-instate the auxiliary power to the Points Adaption Module (PAM) at terminals 54 &55. D109/209 will extinguish and D111/211 will illuminate, as for normal operation. The bi- stable fault relays shall both still be set.

1.7 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 2):

- Terminals 10, 12, 13 & 15 connected together.

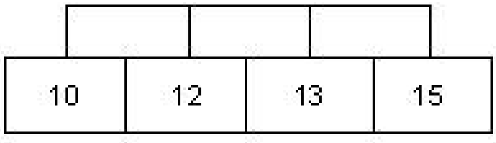


Figure 2 – Configuration 2

1.8 Press PB10. D110 should flash momentarily and the RHSC bi-stable fault relay should be reset.

1.9 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 3):

- Terminal 10,12,13,15 connected together

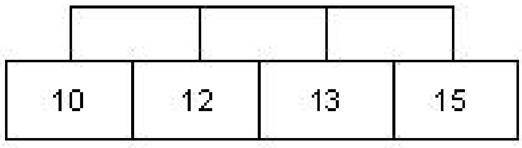


Figure 3 – Configuration 3

1.10 Press PB20. D210 should flash momentarily and the LHSC bi-stable fault relay should be reset.

1.11 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 4):

a) Terminal 10 connected to terminal 13

b) Terminal 12 connected to terminal 15

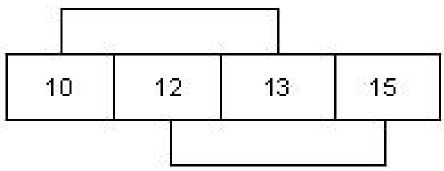


Figure 4 – Configuration 4

1.12 Replace lightning suppressors 4 & 5 to re-connect the PAM 4-wire interface.

1.13 Move the points to the LHSC position. D212 should be illuminated and D112 extinguished.

1.14 Remove lightning suppressors 4 & 5 to disconnect the PAM 4-wire interface.

1.15 Press PB 11 and hold for approximately 1 second.

This will generate a simulated fault in the RHSC safety relay. D109/209 will illuminate and D111/211 will extinguish.

1.16 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 5):

a) Terminal 10, 12, & 15 connected together.

b) Terminal 13 not connected.

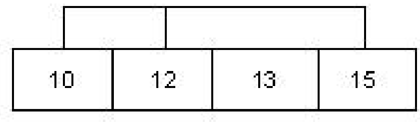


Figure 5 – Configuration 5

1.17 Remove and re instate the auxiliary power to the PAM at terminals 54 & 55. D109/209 will extinguish and D111/211 will illuminate, as for normal operation. However, the bi-stable fault relays shall still be set.

1.18 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 6):

- Terminals 10, 12, 13 & 15 connected together

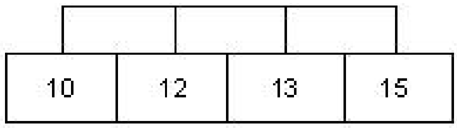


Figure 6 – Configuration 6

1.19 Press PB 20. D210 should flash momentarily and the LHSC bi-stable fault relay should be reset.

1.20 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 7):

- Terminals 10, 12, 13 & 15 connected together

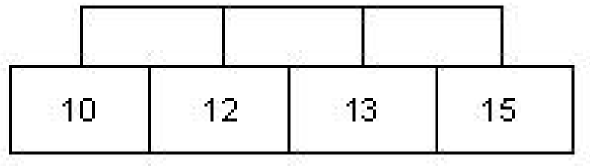


Figure 7 – Configuration 7

1.21 Press PB 10. D110 should flash momentarily and the RHSC bi-stable fault relay should be reset.

1.22 Perform a continuity check at the PAM side (top) of the terminal rail, to verify the following configuration (Figure 8):

a) Terminal 10 connected to terminal 12

b) Terminal 13 connected to terminal 15

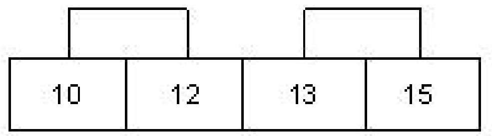


Figure 8 – Configuration 8

1.23 Replace lightning suppressors 4 & 5 to re- connect the PAM 4-wire interface.

NOTE: *It is important that all continuity testing is conducted at the top of the terminal rail. (i.e. the PAM side of the WAGO links).*

If the continuity testing is conducted on the wrong side of the WAGO links (incoming cable side), then the points detect module will not be tested correctly. This may also cause the POM to go in to error mode.

APPENDIX A - Point Detection Module

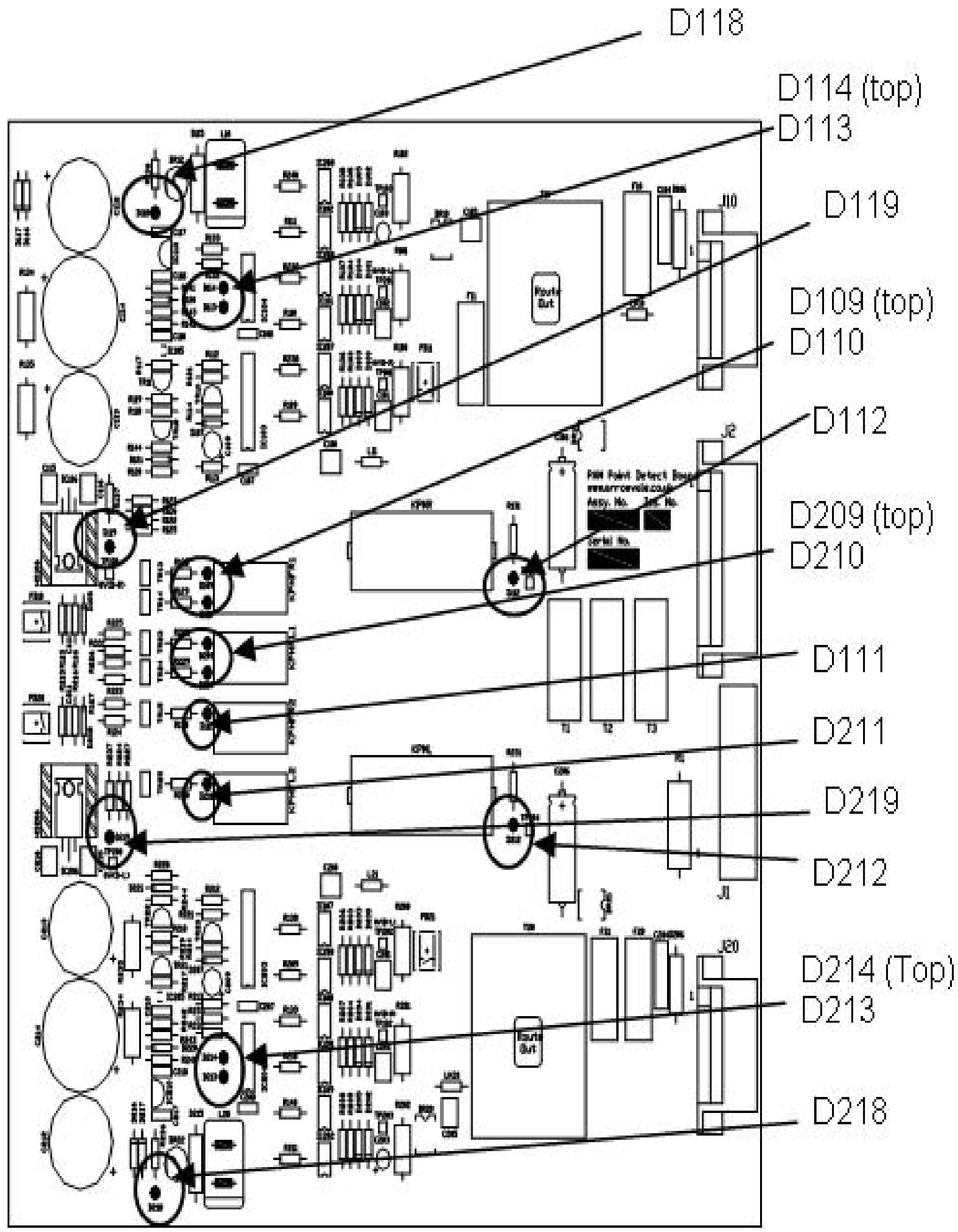


Figure 9 - The position of the LED indicators on the point detection module

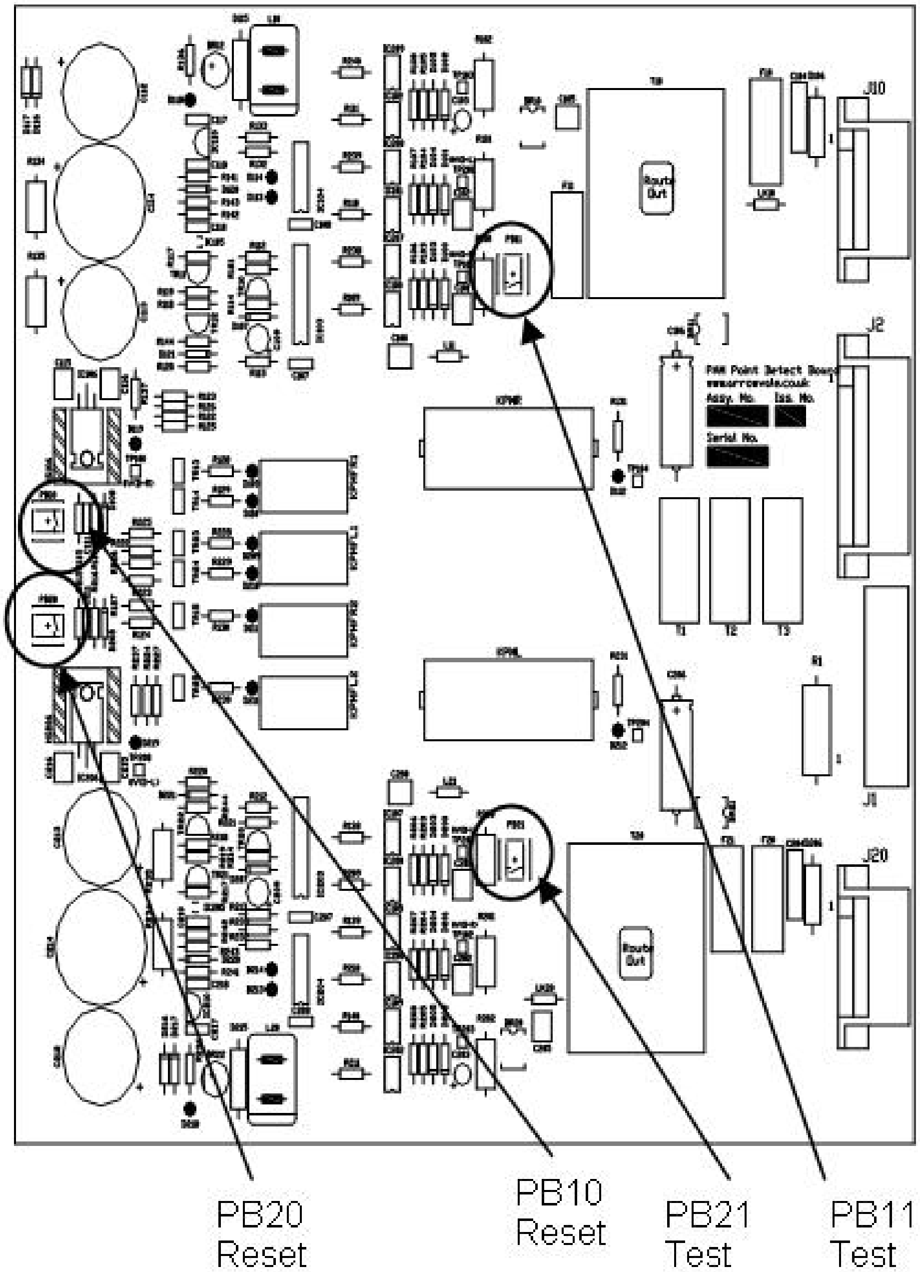


Figure 10 - The location of the push buttons on the point detector module

END

Details of the waveforms and connection of the dummy load resisters can be found in Appendix A.

Equipment Required Fluke 199 Scopemeter LEM PR 30 Current Probe.

1. Test

1.1 Connect the LEM current probe to Channel A of the Scopemeter and switch on both the Scopemeter and the probe.

1.2 Set up the equipment as follows:

a) Set channel A to be scaled in Amps.

b) Adjust the current probe offset to zero using the Scopemeter.

c) Set the Scopemeter to 500ms/div (with a 500ms pre-trigger) and a vertical scale of 1A/div.

d) Set the trigger to channel A (positive edge), 0.5A and single shot.

1.3 Connect the current probe to terminal 15 (connection L2 of the 4 wire interface).

1.4 Move the point machine in both directions and check that the envelope of the current waveform is always greater than 2.0A throughout the movement.

a) If this is the case (see Appendix A, Figure 1) then the dummy load resistors are not required.

b) If this is not the case (see Appendix A Figure 2) then the dummy resistors shall be connected in circuit.

1.5 If the dummy load resistors have been fitted, repeat 1.4 to check the current waveform is now correct.

1.6 Connect the current probe to terminal 12 (N connection of the 4 wire interface).

1.7 Move the points in both directions and check the envelope of the current waveform.

A distinct “blip” should be noticeable at the end of the waveform (see Appendix A Figure 3), this signifies that the point has reached its end position under power and the load resistors do not have to be fitted.

1.8 If this “blip” is not observed at the end of the waveform (see Appendix A, Figure 4 4), this would suggest that the points operating module has switched off power prematurely and the point machine is “freewheeling” into position.

This is not an acceptable condition and the dummy load resistors shall be connected in circuit.

1.9 If dummy load resistors have been fitted, repeat 1.7 to confirm the current waveform is now correct.

APPENDIX A - Scope Traces

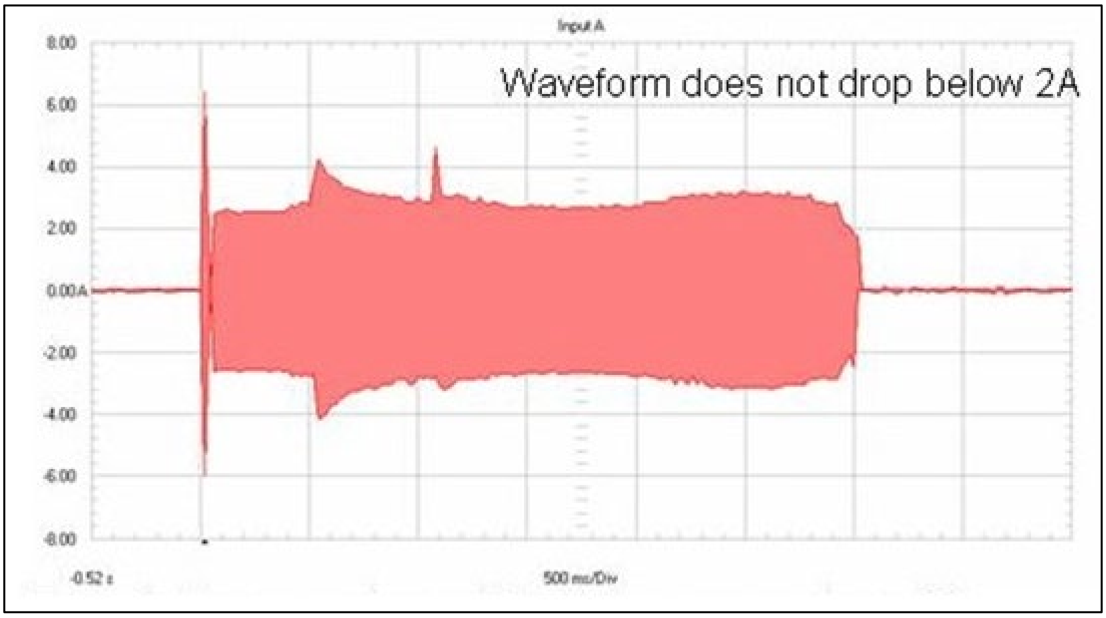


Figure 1 – Trace 1: Current probe on L2, running current above 2A
Dummy load resistors not necessary

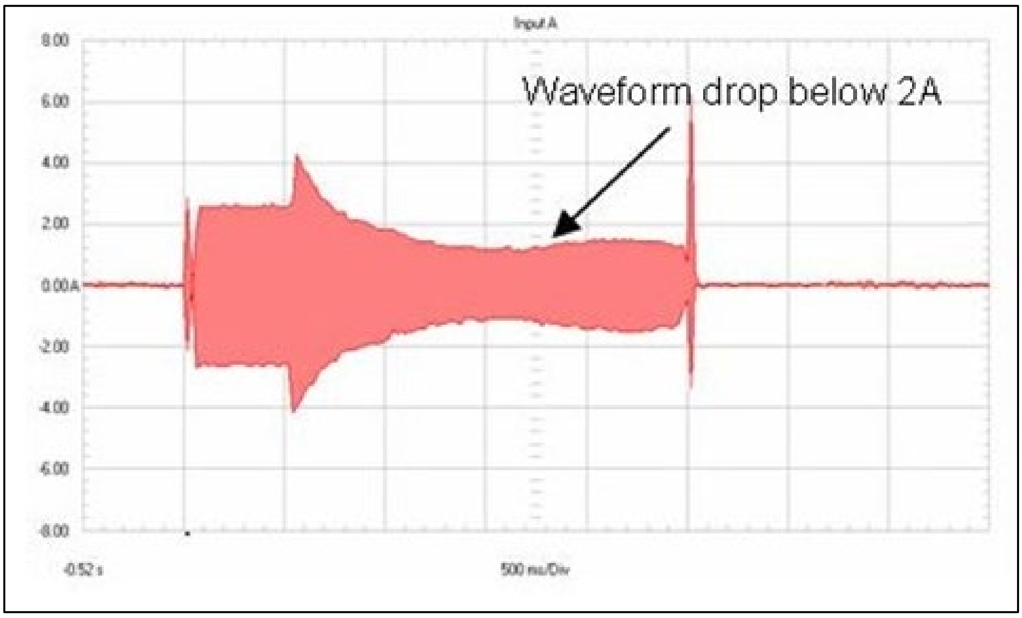


Figure 2 – Trace 2: Current probe L2, running current 2A
Dummy load resistors necessary

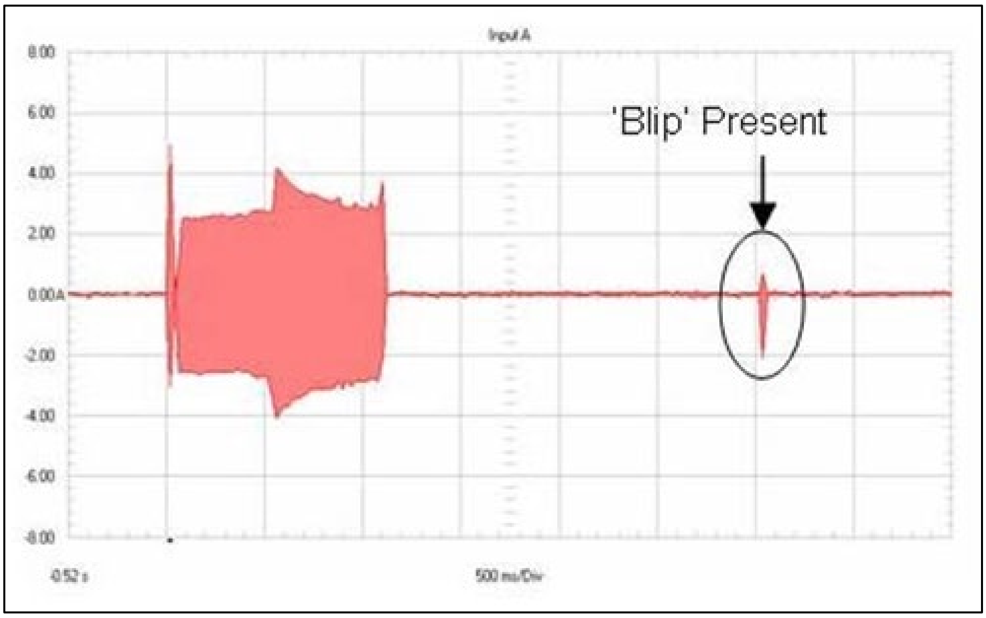


Figure 3 – Trace 3: Current probe on N, correct operation
Dummy load resistors not necessary

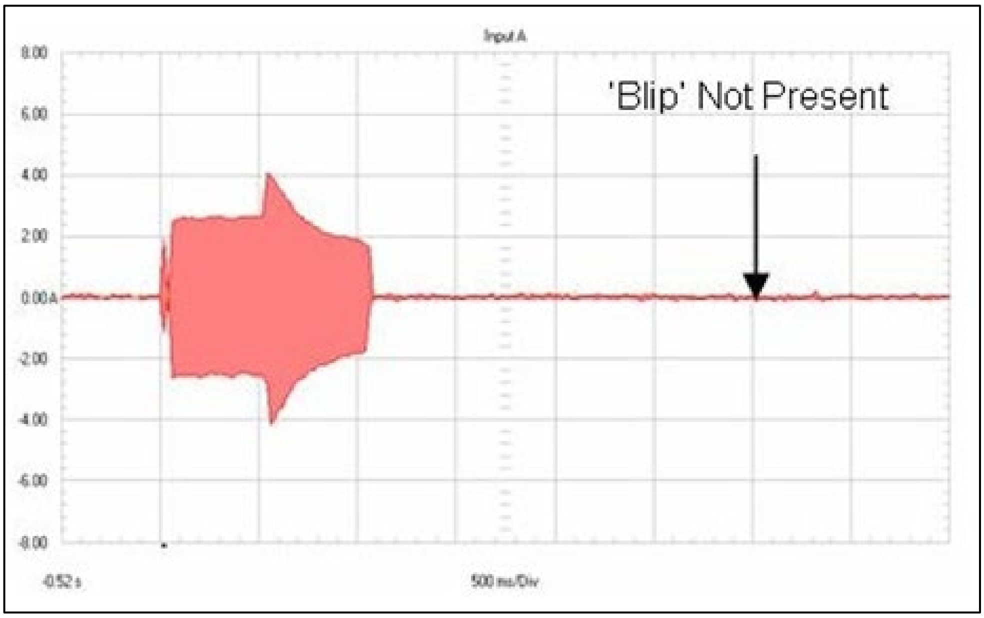


Figure 4 – Trace 4: Current probe N, Incorrect Operation
Dummy load resistors necessary

Connection of dummy load resistors.

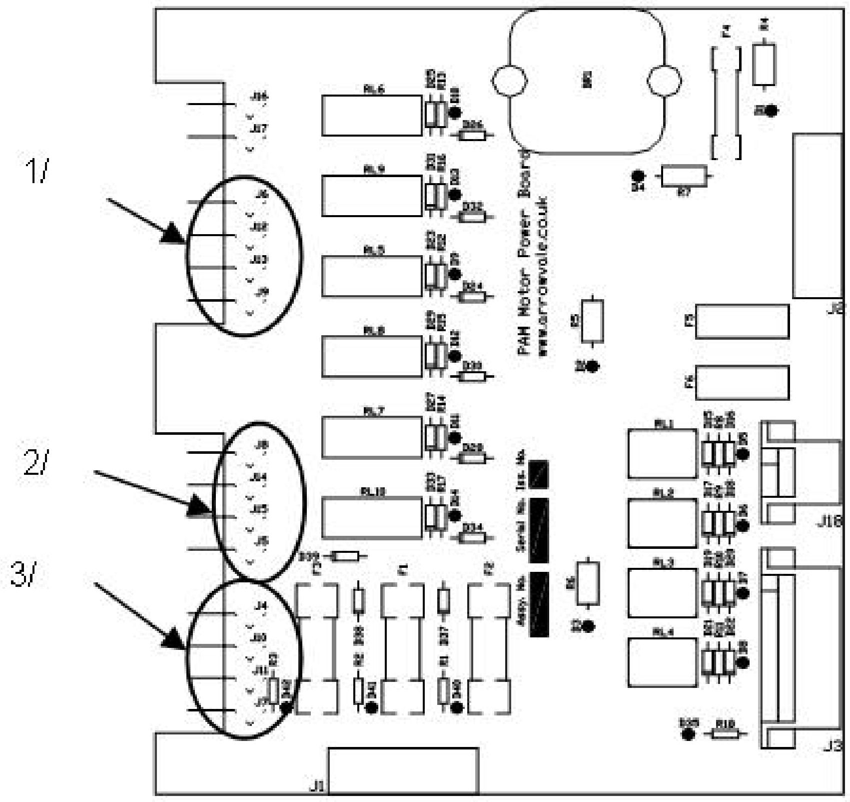
1. Isolate the Points Adaption Module.

2. Remove the protective plastic cover protecting the motor power module.

3. Move the connection from J11 to J10, J13 to J12 and J15 to J14.

4. Replace the protective plastic cover protecting the motor power module.

5. Reconnect the Points Adaption Module.



1/ Phase 1 load resistor connections
2/ Phase 2 load resistor connections
3/ Phase 3 load resistor connections

Figure 5 – Motor Power Module

END

Additional information on the KVB test set can be found in SMS Appendix 23

1 Balise Test

1.1 A balise test requires the test tool to be set flat on the balise along its longitudinal axis, after turning on the tester, the following message is displayed;

		A	P	P	U	Y	E	R		s	u	r		L	E	C	T		
			p	o	u	r		d	e	c	l	e	n	c	h	e	r		
							l	e		t	e	s	t						

1.2 Pressing the ‘LECT’ (read) key initiates the 27.115MHz signal towards the Balise to allow reception of a complete message.

<u>Marker Balise</u>

When the tester recognises a message from a Marker Balise, the display is as follows:

					M	A	R	Q	U	E	U	R							

<u>Fixed or Switchable Balise</u>

When the tester recognises a Fixed or Switchable Balise, with triplet data being transmitted, the display is as follows:

A	:	[	>	<	-	]													
X	:	5	M	E	9	4													
Y	:	C	M	2	1	D													
Z	:	7	M	4	0	1													

1.3 Observe the message being displayed on the KVB test set and confirm it is correct by comparing the DCO files and the signal aspect displayed.

1.4 To return to start, press ‘ECHAP’ (escape) Key.

2 “Presence train” Test, from the Balise

This test is intended to replicate the presence of a train. This is achieved by illuminating the yellow LED on the front face of the encoders UCS card when one of the balise’s driven by this encoder is energized by the test tool.

Due to the speed of the train, the energization time is too short for the LED to be seen lit by an observer.

2.1 A ‘presence train’ test requires the test tool to be set flat on the balise along its longitudinal axis, after turning on the tester, the following message is displayed;

```
  APPUYER sur LECT
   pour declencher
       le test
```

2.2 Press ‘1’ and the display will show the following message;

```
TEST PRESENCE TRAIN

maintenir LECT
    pendant le test
```

(Presence train test – Keep pressing LECT (read) during the test)

2.3 With one person at the balise, and one person at the encoder, Press and hold the ‘LECT’ (read) and check the yellow LED illuminates.

2.4 Return to main menu by releasing the ‘LECT’ (read) key and press ‘ECHAP’ (escape) Key.

3 Test of Encoder Output at Tail Cable

3.1 The tool must be connected to the end of the tail cable at the plug coupler of the balise, after turning on the tester, the following message is displayed:

```
  APPUYER sur LECT
   pour declencher
     le test
```

3.2 Press ‘LECT’ (read) to read the message coming from the encoder.

3.3 Compare message displayed to the DCO/Wiring Diagrams.

3.4 To return to start, press ‘ECHAP’ (escape) Key.

3.5 Repeat steps above for different aspects/messages if required.

4 Test from SBI Maintenance Card.

4.1 Connecting the tester to the SBI maintenance card, after turning on the tester, the following message is displayed:

	T	E	S	T		S	U	R		C	O	D	E	U	R		N			:
E	n	t	r	e	r		l	e		n	u	m	é	r	o		d	e		
l	a		s	o	r	t	i	e		a		t	e	s	t	e	r			
t	o	u	c	h	e	:		1	,		2	,		3		o	u			4

(Test on encoder N – Enter the output number to be tested – Key 1, 2, 3 or 4).

4.2 Choose the output that requires testing by pressing the relevant output key.

Pressing on any key ‘1’, ‘2’, ‘3’, or ‘4’ causes the tool to communicate towards the relevant output.

4.3 To return to start, press ‘ECHAP’ (escape) Key.

END

Includes:	Electromagnetic Lock when used at Level Crossing
Excludes:	All other Electromagnetic Lock Test

1. Indications Test

1.1 Check the crossing keeper/signallers crossing indication is illuminated when gate is closed and locked. Now check the following :

a) The alarm sounds within 3 seconds when gates are not locked.

b) The indication light does not illuminate when gate is closed and not locked.

c) The audible warning sounds and the fault light indications illuminate when gate is closed but not locked.

d) The audible warning can be cancelled by pressing the alarm acknowledge push button

e) Repeat 1.1 steps a) to d) for each crossing gate.

2. The Hall Effect Switch Test

2.1 Open the gate and place a single plastic blue .002mm disposable gauge between the lock and the armature (Figure 1) and carry out the following: -

Figure 1 - Magnetic lock mechanism

a) Energise the lock and observe that after approximately three seconds the audible warning sounds in the signal box and the fault light indications illuminates **do not** sound or illuminate.

b) Check that two people pushing each gate cannot force the gates open (Figure 2).

The gate should be pushed by applying pressure to the gate from a standing position, without jarring or shoving.

c) De-energise the lock and remove the gauge.

Figure 2 - Push Test

d) Repeat for all other gates.

2.2 After this test is complete recheck indications and audible alarms are functioning correctly for each gate before leaving site.

The plastic gauge shall only be used for one level crossing and disposed of. A new gauge shall be used for subsequent testing at other level crossings.

END

Includes:	Phoenix MD sensors only
Exclude:	All other types of HABD Sensor

The Variotherm works from a 230v supply.

The sensors shall have been in continuous operation for at least 1 hour before the test (2 hours if they have been switched off for more than half an hour).

Calibration Test

An on-site recalibration of the sensors can be undertaken to adjust any drift in measured values within reasonable limits.

Recalibration is only permitted in “Super” mode. The system / sensors are required to be stable before calibration is commenced.

Recalibration involves four steps:

1 Measured Values : Comparing measured values against a reference value

2 Determining the correction values

3 Transferring the correction values to the sensor.

4 Checking the results.

1 Measured Values

1.1 Select “Super” from the System Menu.

1.2 Select “DiMo” from the SCT Menu.

1.3 Maximise the DiMo window.

1.4 Enter the command “Testmode ON” to suppress data to the Signaller.

<u>HDB1 Low Value</u>

1.5 Enter the command “NKAL H1 ON” to suppress auto-calibration.

1.6 Enter the command “KASTFULL H1”

The SCT symbol will change from M to S whilst the standardisation is running, then to M again.

1.7 Enter the command “NACHKAL H1 ON” to commence calibration for the respective sensor under test.

1.8 Place the Heat Source on the sensor and check it is fitted correctly.

1.9 Set to the desired temperature of 60ºC.

1.10 Enter the command “MMS H1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS H1 OFF”.

1.11 Measure and record the value in the calibration section of the paper or digital record card.

HDB1 High Value

1.12 Adjust to the desired temperature of 110ºC.

1.13 Enter the command “MMS H1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS H1OFF”.

1.14 Measure and record the value in the calibration section of the paper or digital record card.

HDB2 Low Value

1.15 Allow the Heat Source time to cool below 60ºC.

1.16 Enter the command “NKAL H2 ON” to suppress auto-calibration.

1.17 Enter the command “KASTFULL H2”.

1.18 Enter the command “NACHKAL H2 ON” to commence calibration for the respective sensor under test.

1.19 Place the Heat Source on the sensor and check it is fitted correctly.

1.20 Adjust the Heat Source to 60ºC.

1.21 Enter the command “MMS H2 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS H2OFF”.

1.22 Measure and record the value in the calibration section of the paper or digital record card.

HDB2 High Value

1.23 Adjust the Heat Source to 110ºC.

1.24 Enter the command “MMS H2 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS H2 OFF”.

1.25 Measure and record the value in the calibration section of the paper or digital record card.

<u>HWD1 Low Value</u>

1.26 Enter the command “NKAL F1 ON” to suppress auto-calibration.

1.27 Enter the command “KASTFULL F1”.

1.28 Enter the command “NACHKAL F1 ON” to commence calibration for the respective sensor under test.

1.29 Place the Heat Source on the rail sensor and check it is fitted correctly.

1.30 Adjust the Heat source to 200ºC.

1.31 Enter the command “MMS F1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F1 OFF”.

1.32 Measure and record the value for channels 1 to 4 in the calibration section of the paper or digital record card.

1.33 Place the Heat Source on the centre sensor and check it is fitted correctly.

1.34 Enter the command “MMS F1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F1 OFF”.

1.35 Measure and Record the value for channels 5 to 8 in the calibration section of the paper or digital record card

<u>HWD1 High Value</u>

1.36 Adjust the Heat source to 350ºC.

1.37 Enter the command “MMS F1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F1 OFF”.

1.38 Measure and Record the value for channels 1 to 4 in the calibration section of the paper or digital record card.

1.39 Place the Heat Source on the centre sensor and check it is fitted correctly.

1.40 Enter the command “MMS F1 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F1 OFF”.

1.41 Measure and Record the value for channels 5 to 8 in the calibration section of the paper or digital record card.

HWD2 Low Value

1.42 Allow the Heat Source time to cool below 200ºC.

1.43 Enter the command “NKAL F2 ON” to suppress auto-calibration.

1.44 Enter the command “KASTFULL F2”.

1.45 Enter the command “NACHKAL F2 ON” to commence calibration for the respective sensor under test.

1.46 Place the Heat Source on the rail sensor and check it is fitted correctly.

1.47 Adjust the Heat source to 200ºC.

1.48 Enter the command “MMS F2 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F2 OFF”.

1.49 Measure and record the value for channels 1 to 4 in the calibration section of the paper or digital record card.

1.50 Place the Heat Source on the centre sensor and check it is fitted correctly.

1.51 Enter the command “MMS F2 ON” to commence reading the measured values of the sensor under test. Once the incoming values appear to be stable stop reading the measured values by entering the command “MMS F2 OFF”.

1.52 Measure and Record the value for channels 5 to 8 in the calibration section of the paper or digital record card.

2 Determining Correction Values

2.1 Double-click on the “Nachkal” icon on the Windows user interface. A screen titled “Phoenix MB Nachkalibrierung” will be displayed.

2.2 Select the sensor that you wish to enter values for by clicking on the respective target.

2.3 Enter the temperature values that you have noted down for each respective channel against the correct measured temperature.

2.4 After entering the values for both temperature settings click the “Calculate” button. The values for offset and gain for each channel will be calculated and displayed.

2.5 Click “OK” and the measured values are tested against offset and gain limits. These limits are listed as follows:

- HBD Limits = [-15< Offset < 15], [0.8 < Gain < 1.2]
- HWDSB = [-30< Offset < 30], [0.8 < Gain < 1.2]

2.6 If the measured values pass this test the correction values is written to the hard disk. Follow the on screen commands to terminate the program.

3 Transferring Correction Values to Sensor

Enter the command “NACHKAL H1 OFF” in the DiMo window.

This transfers the values stored on the hard disk drive to the appropriate sensor.

At this stage the process ends for one sensor and needs to be repeated for each of the other sensors.

4 Checking the Results

In the following sections If an “x” is shown in a command it should be substituted for the following alphanumeric code associated with the sensor being worked on:

a) For HBD1 = H1
b) For HBD2 = H2
c) For HWD1 = F1
d) For HWD2 = F2

4.1 Enter the command “PRE x" in the DiMo window.

This reads the sensor date from the flash memory.

4.2 Then enter the command “DPA x”. This displays the most recent data read from the sensor.

4.3 The lines beginning with Gain and Offset display the correction values for each of the 8 channels.

4.4 The offset is a number divided by 100 whilst the gain is indicated by a number divided by 1000 (e.g. an Offset 123 equals 1.23 whilst a Gain 985 corresponds to 0.985).

4.5 Record the results on the appropriate paper or digital record card.

5 System Closure

5.1 Enter the command “Testmode OFF” in the DiMo window.

5.2 Enter the command “NKAL x OFF” to enable auto-calibration.

5.3 Enter the command “E" in the DiMo window to close the DiMo application.

End

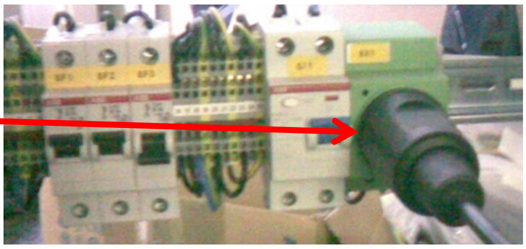
Includes:	Phoenix MD sensors only
Exclude:	All other types of HABD Sensor

The Variotherm works from a 230v supply.

The sensors shall have been in continuous operation for at least 1 hour before the test (2 hours if they have been switched off for more than half an hour).

1 Accuracy Test

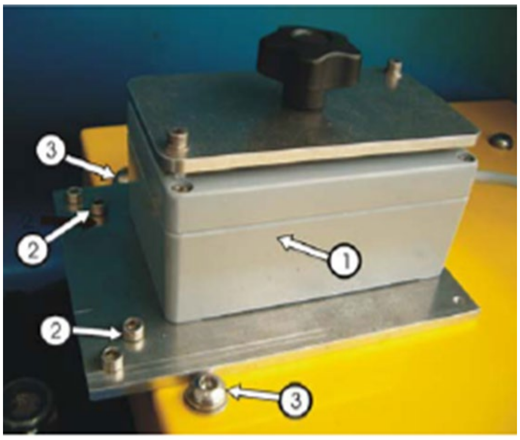
1.1 Connect the Variotherm power supply to the socket in the SCT.



1.2 Check the mirrors are clean before the accuracy test is started.

1.3 Switch the SCT to "test mode" to switch off error message reporting during the test.

Do not close the DiMo window.

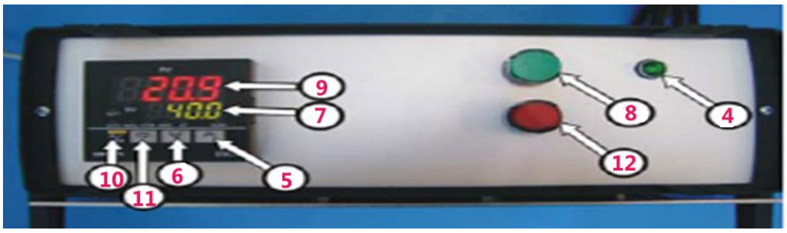


1.4 Position a Variotherm heat source (1) on top of sensor HBD1.

1.5 The screws (2) shall be touching the sensor hood.

1.6 The Variotherm heat source (1) shall be positioned between the sensor hood screws (3).

1.7 Check the Variotherm Unit's green power LED is Illuminated (4).



1.8 Using the up and down keys (5 & 6), set the target temperature to 70ºC (7).

1.9 Press green button (7) to activate the heater.

Actual temperature is shown (9).

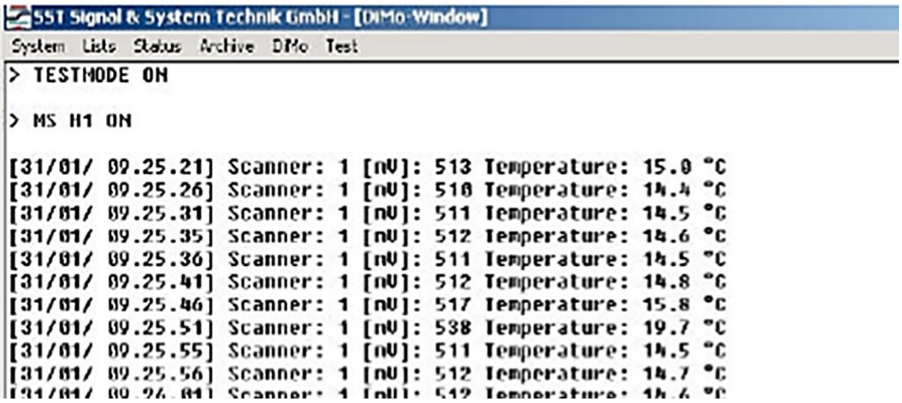
Do not press buttons 10 or 11, as they can affect the calibration.

The red button (12) switches the heater off

1.10 When the temperature shown by the Variotherm panel reaches 70ºC, move to the DiMo window and enter the command “MS H1 ON” and press enter.

H1 Addresses HBD1.

1.11 The HABD will report a temperature measurement every few seconds, and these measurements will be displayed in the DiMo window (Shown below).



1.12 When the readings have settled, stop the measuring process by entering the command “MS H1 OFF”.

1.13 Measure and record the temperature on the appropriate paper or digital record card.

If the temperature falls outside the nominal value of 70ºC +/- 3ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.14 Power down the Variotherm heat source using the red button before moving to the correct position on the top of the HBD2 sensor.

1.15 Press green button to activate the heater.

1.16 Using the up and down keys, check the target temperature is still set to 70ºC.

1.17 When the temperature shown by the Variotherm panel reaches 70ºC, move to the DiMo window and enter the command “MS H2 ON” and press enter.

H2 Addresses HBD2.

1.18 When the readings have settled, stop the measuring process by entering the command “MS H2 OFF”.

1.19 Measure and record the temperature on the appropriate paper or digital record card.

1.20 If the temperature falls outside the nominal value of 70ºC +/- 3ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.21 Leaving the Variotherm Heat source on HBD2 Use the up and down keys, move the target temperature to 120ºC.

1.22 When the temperature shown by the Variotherm panel reaches 120ºC, move to the DiMo window and enter the command “MS H2 ON” and press enter.

1.23 The HABD will report a temperature measurement every few seconds, and these measurements will be displayed in the DiMo window.

1.24 When the readings have settled, stop the measuring process by entering the command “MS H2 OFF”.

1.25 Measure and record the temperature on the appropriate paper or digital record card.

1.26 If the temperature falls outside the nominal value of 120ºC +/- 5ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.27 Power down the Variotherm heat source using the red button before moving to the correct position on the top of the HBD1 sensor.

1.28 Press green button to activate the heater.

1.29 Using the up and down keys, check the target temperature is still set to 120ºC.

1.30 When the temperature shown by the Variotherm panel reaches 120ºC, move to the DiMo window and enter the command “MS H1 ON” and press enter.

1.31 When the readings have settled, stop the measuring process by entering the command “MS H1 OFF”.

1.32 Measure and record the temperature on the appropriate paper or digital record card.

1.33 If the temperature falls outside the nominal value of 120ºC +/- 5ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.34 Power down the Variotherm heat source using the red button before moving to the correct position on the top of the HWD1 sensor.

1.35 Press green button to activate the heater.

1.36 Using the up and down keys, set the target temperature to 300ºC.

1.37 When the temperature shown by the Variotherm panel reaches 300ºC, move to the DiMo window and enter the command “MMS F1 ON” and press enter.

1.38 When the readings have settled, stop the measuring process by entering the command “MMS F1 OFF”.

1.39 Measure and record the temperature on the appropriate paper or digital record card.

1.40 If the temperature falls outside the nominal value of 300ºC +/- 10ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.41 Power down the Variotherm heat source using the red button before moving to the correct position on the top of the HWD1 sensor.

1.42 Press green button to activate the heater.

1.43 Using the up and down keys, check the target temperature is still set to 400ºC.

1.44 When the temperature shown by the Variotherm panel reaches 400ºC, move to the DiMo window and enter the command “MMS F2 ON” and press enter.

1.45 When the readings have settled, stop the measuring process by entering the command “MMS F2 OFF”.

1.46 Measure and record the temperature on the appropriate paper or digital record card.

1.47 If the temperature falls outside the nominal value of 400ºC +/- 5ºC then you shall stop this test and carry out a full Calibration Test as shown in NR/SMS/Test 211.

1.48 If all temperature values fall within their respective nominal values there is no need to carry out a full Calibration Test.

End

Includes:	TPWS Modules or Transmitters
Excludes:	TPWS Self Powered OSS Module (SPOSS)

GENERAL

All tests requiring TPWS Transmitter Loop field strength and frequency measurements shall use a test meter approved for use with TPWS equipment.

The multimeter shall be set to the correct range to accurately measure frequency with a minimum resolution of 1 Hz.

All test measurements shall be recorded on the TPWS Test record card.

When the power supply to TPWS is disconnected, a fault report will be indicated every time the signal displays a red aspect.

When using the test equipment in third/fourth rail electrified areas, avoid contact between the test aerial lead and the conductor rails.

An 'affected loop' is one that is fed by a Module which has been disturbed/replaced, in which case the pair of loops associated with the Module shall be tested.

An 'affected Module' includes any disturbed/replaced by the work and any associated Signalling Interface Module (and the Overspeed Sensor / Train Stop Modules fed by a disturbed/replaced Signalling Interface Module).

VCR:

Some TPWS installations in SSI areas do not have a VCR relay. Instead, the proving output from the SIM goes directly into an input on a TFM.

To establish if a TPWS failure exists for these installations check either the SSI Technicians' terminal or the failure indication on the Signaller's panel. Indications are shown either as a red lamp failure of the fitted signal or as a TPWS failure.

Where a TPWS Failure Indication Unit (F.I.U.) is provided, a check of the failure indication is a key part of the maintenance requirements for the F.I.U.

The tests are applicable at all TPWS installations.

Tests

1. Initial Fault Reporting Status

1.1 Check that the VCR relay is energised.

1.2 Check that no fault indication is received at the signal-box.

2. Tests at the TSS and OSS Modules and Loops

2.1 Technicians shall be positioned at the correct loop and at the other TPWS enclosure.

<u>Main Signal On (Red Aspect) Subsidiary Signal On (Not Illuminated)</u>

2.2 Arrange for the signal to display a stop aspect (red) and for any suppression function to be de-energised (i.e. no subsidiary signal input or points controls).

2.3 Check that the VCR relay is energised.

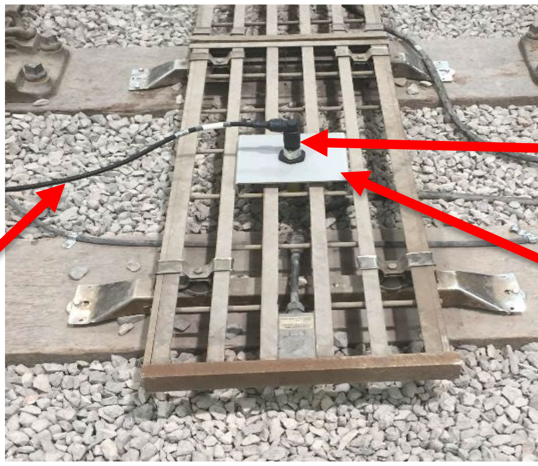
2.4 Check that the following LEDs are lit:

Module	Function	LED
TSM/OSM	Main I/P	Yellow
SIM	Loops Active	Yellow

2.5 Check that no other LEDs change state.

2.6 Measure and record the voltage and frequency at the arming loop and the trigger loop (TSS, OSS).

Test Aerial



Test

Maintenance

Figure 1: Measuring TPWS Field Strength - Maintenance Test

To measure the voltage and frequency, the TPWS test aerial shall be positioned centrally on the loop using the Maintenance Jig. The meter shall not be held over the loops, to avoid interference from the loop field. as shown in Figure 1.

Details of voltages and frequencies see NR/SMS/PartZ/Z08 (Train Protection - Reference Values).

2.7 The frequency shall within +/-0.01kHz of the stated frequency for each Transmitter Loop's function (f1 to f6 as specified on the location wiring diagrams).

3. Location and Signal-Box Indications

Main Signal On (Red Aspect) Subsidiary Signal On (Not Illuminated)

3.1 Measure the voltage on the outgoing links of each loop and check that:

a) The voltages are within +/- 20% from the first reading on the record card.

b) The difference between the TSS arming loop voltage and TSS trigger loop voltage is less than 0.3V AC.

c) The OSS arming loop voltage is greater than the OSS trigger loop voltage.

If any of the readings are out of tolerance this can indicate high resistance in the loop circuit.

To carry out the following tests, a Technician shall be positioned at the TPWS enclosure. Co-operation with the Signaller is required.

3.2 De-energise the OSS arming loop by slipping links to the loop output circuit and check that the following LED indications are shown:

Module	Function	LED
OSM/TSM	Fault	Red
SIM	Loop Active	Extinguished

3.3 Check that the VCR relay has de-energised.

3.4 Check that a fault indication is given to the Signaller.

3.5 Re-energise the OSS arming loop by remaking the links to the loop output circuit and check that the following LEDs are illuminated:

Module	Function	LED
OSM/TSM	Fault	Red
SIM	Loop Active	Yellow

3.6 Check that the VCR relay has energised.

3.7 Reset the system, check that the fault LED is extinguished.

3.8 Repeat tests 3.2 to 3.7 except step 3.4 for the OSS trigger loop.

3.9 Repeat tests 3.2 to 3.7 except step 3.3 for the TSS arming and trigger loops.

Main Signal On (Red Aspect) Subsidiary Signal Off (Illuminated) (If Applicable)

3.10 Arrange for the signal to display a stop aspect (red) and for any suppression function to be energised (i.e. subsidiary signal input).

3.11 Check that the following LEDs are lit:

Module	Function	LED
TSM	Main I/P	Yellow
TSM	Suppression Input	Yellow
TSM SIM	Loops Active	Extinguished

3.12 Check the LED indications on the OSS Modules:

Module	Function	LED
TSM	Main I/P	Yellow
TSM SIM	Loops Active	Yellow

4. Tests for PSR & Buffer Stops Only

For remote PSRs operated by the battery-powered OSS unit go to section 5.

4.1 Check that the green 'Power On' LEDs are illuminated on all modules for the PSR or buffer stop.

4.2 Check that the following LEDs are illuminated:

LED	Function	Colour
OSM	Mains I/P	Yellow
SIM	Loop Active	Yellow

4.3 Check that no other LEDs are illuminated (including fault LEDs).

Some PSR installations will have a suppression input with points controls and hence the yellow "Supp I/P" LED can be illuminated.

4.4 Measure and Record the voltage and frequency at the OSS arming loop and the OSS trigger loop.

a) The signal strength from each loop shall be no less than 29mV and no greater than 53mV measured with the meter set to the 50mV AC range.

b) The frequency shall be correct for the system (f1-f6) and within the tolerances listed in NR/SMS/PartZ/Z08 (Train Protection – Reference Values).

4.5 De-energise the OSS arming loop by slipping links to the loop output circuit and check that the following LED indications are shown:

LED	Function	State
OSM	Fault	Red
SIM	Loop Active	Extinguished

4.6 Check that the VCR relay has de-energised, (buffer stops only).

4.7 Re-energise the OSS arming loop by remaking the links to the loop output circuit and check that the following LED indications are shown:

LED	Function	State
OSM	Fault	Red
SIM	Loop Active	Yellow

4.8 Check that the VCR relay has energised.

4.9 Reset the system and check that the fault LED is extinguished.

4.10 Repeat tests 4.5 to 4.9 for the OSS trigger loop.

5. Final Checks

5.1 Check that the VCR relay is energised (buffer stops only).

5.2 Check that all green ‘Power’ LEDs are illuminated and that all ‘Fault’ LED’s are extinguished.

END

Includes:	TPWS Module or Transmitter
Excludes:	TPWS Self Powered OSS Module

This test is to check that the TPWS system is functioning correctly following plug-in Module replacement or a Transmitter Loop change following a failure

The test sequence checks the system logic and loop power of affected units in the plane of the loop.

An 'affected loop' is one that is fed by a Module which has been disturbed/replaced, in which case the pair of loops associated with the Module must be tested.

An 'affected Module' includes any disturbed/replaced by the work and any associated Signalling Interface Module (and the Overspeed Sensor / Train Stop Modules fed by a disturbed/replaced Signalling Interface Module).

All tests requiring TPWS Transmitter Loop field strength and frequency measurements shall use a test meter approved for use with TPWS equipment.

The multimeter shall be set to a range to accurately measure frequency with a minimum resolution of 1 Hz.

All test measurements shall be recorded on the record card.

1. Test - Following Equipment Failure

Prior to use, the TPWS Maintenance Jig and Test Aerial shall be visually inspected for damage.

1.1 Check the affected TPWS Module LEDs, by observing that only the green ‘power on’ LEDs are lit when the main signal is ‘off’ and any associated position light / semaphore subsidiary signal is unlit / on.

1.2 With the main signal ‘on’ check that the ’Main I/P’ LEDs are alight on the affected Train Stop and Overspeed Sensor Modules.

1.3 Use the TPWS test aerial to test the voltage received by the aerial and the frequency of the signal received at each affected Transmitter Loop in turn.

To measure the voltage and frequency, the TPWS test aerial shall be positioned centrally on the loop using the Maintenance Jig. The meter shall not be held over the loops, to avoid interference from the loop field. as shown in Figure 1.

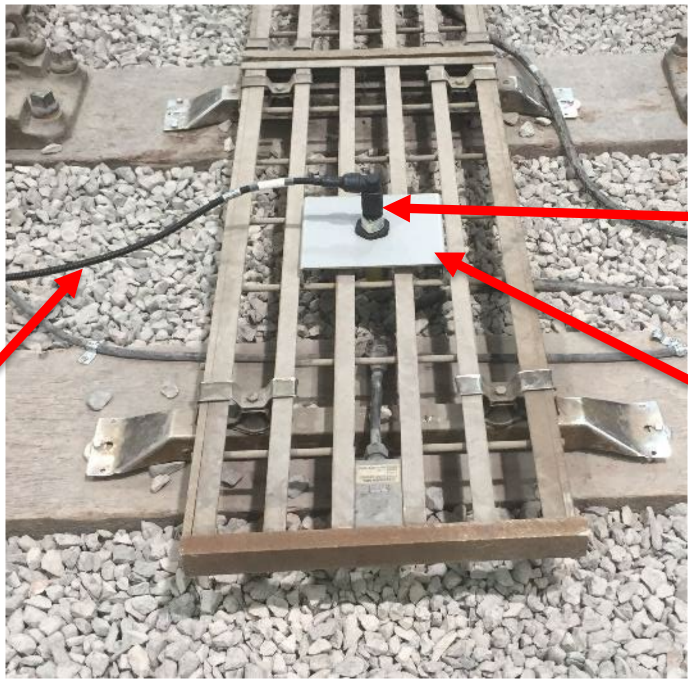


Figure 1: Measuring TPWS Field Strength - Maintenance Test

Details of voltages and frequencies see NR/SMS/PartZ/Z08 (Train Protection - Reference Values).

1.4 The frequency shall within +/-0.01kHz of the stated frequency for each Transmitter Loop's function (f1 to f6 as specified on the location wiring diagrams).

1.5 If a main signal has an associated position light / semaphore subsidiary signal arrange for it to be cleared to the 'off' position and check the 'Supp I/P' LED is illuminated on the affected Module and that no other LEDs change state.

Use the TPWS test aerial to test that the voltage received by the aerial at each affected Transmitter Loop is less than 2mV AC (at the TPWS tone frequency).

1.6 This test is only applicable where position light / semaphore subsidiary signal suppression is fitted)

With the main signal 'off' check that the 'Main I/P' and 'Supp I/P' LEDs are extinguished on the affected Train Stop and Overspeed Sensor Modules and that no other LEDs change state.

Use the TPWS calibrated test aerial to test that the voltage received by the aerial at each of the affected Transmitter Loops is less than 2mV AC (at the TPWS tone frequency).

1.7 If the Module or Transmitter Loop forms part of a Self-Powered OSS (SPOSS) then carry out NR/SMS/PartB/Test/233 - TPWS Self-Powered OSS (SPOSS) Trackside Equipment Test.

1.8 With the signal 'on', simulate a trackside equipment fault by slipping the links for the loop in the trackside apparatus case (OSS or TSS).

a) Check for correct fault indications on the affected module and in the Signal Box.

b) Remove the simulated fault.

c) Reset affected TPWS Modules.

This is done by undertaking a short (five second) isolation (disconnection of the BX110 supply fuse/link to the TPWS on the Baseplate or Trackside Enclosure).

1.9 Check that isolation fuses/links are in the correct position and that screw terminals are tight.

END

Includes:	TPWS Module or Transmitter Loop (following Pway Work)
Excludes:	Any TPWS Module or Transmitter Loop following a Failure

This test is to check that the TPWS system is functioning correctly following transmitter loop replacement associated with permanent way renewals work when the track bed has been laid.

The test sequence checks the transmitted power of the affected loops at 310mm above rail level.

An “affected loop” is one which has been disturbed or replaced by the “work”.

If the loops are to be disturbed as part of permanent way renewals work, then prior to any work commencing, the exact position of the loop shall be clearly marked.

If, because of the scope of the works, it was not possible to mark the original position of the loops prior to the works commencing, then re-measure the required distance (as shown on the location wiring diagram) from the associated signal to each loop.

This is likely to require re-measurement of the required distance (as shown on the location wiring diagram) from the associated signal.

All tests requiring TPWS Transmitter Loop field strength and frequency measurements shall use a test meter approved for use with TPWS equipment.

All test measurements shall be recorded on the TPWS Test record card.

1. Test - Following Equipment Removal and Refitting

Prior to use, the TPWS Commissioning Jig and Test Aerial shall be visually inspected for damage and to check correct alignment of the two mating halves.

1.1 Check that all loops are re-installed in the correct position.

1.2 Check the affected TPWS Module LEDs, by observing that only the green ‘power on’ LEDs are lit when the main signal is ‘off’ and any associated position light / semaphore subsidiary signal is unlit / on.

1.3 With the main signal ‘on’ check that the ’Main I/P’ LEDs are alight on the affected Train Stop and Overspeed Sensor Modules.

1.4 Use the TPWS test aerial to test the voltage received by the aerial and the frequency of the signal received at each affected Transmitter Loop in turn.

To measure the voltage and frequency, the TPWS test aerial shall be positioned centrally on the loop using the Commissioning & Maintenance Jigs.

The TPWS aerial should be placed into the top of the commissioning jig tube.

The meter shall not be held over the loops, to avoid interference from the loop field. as shown in Figure 1.

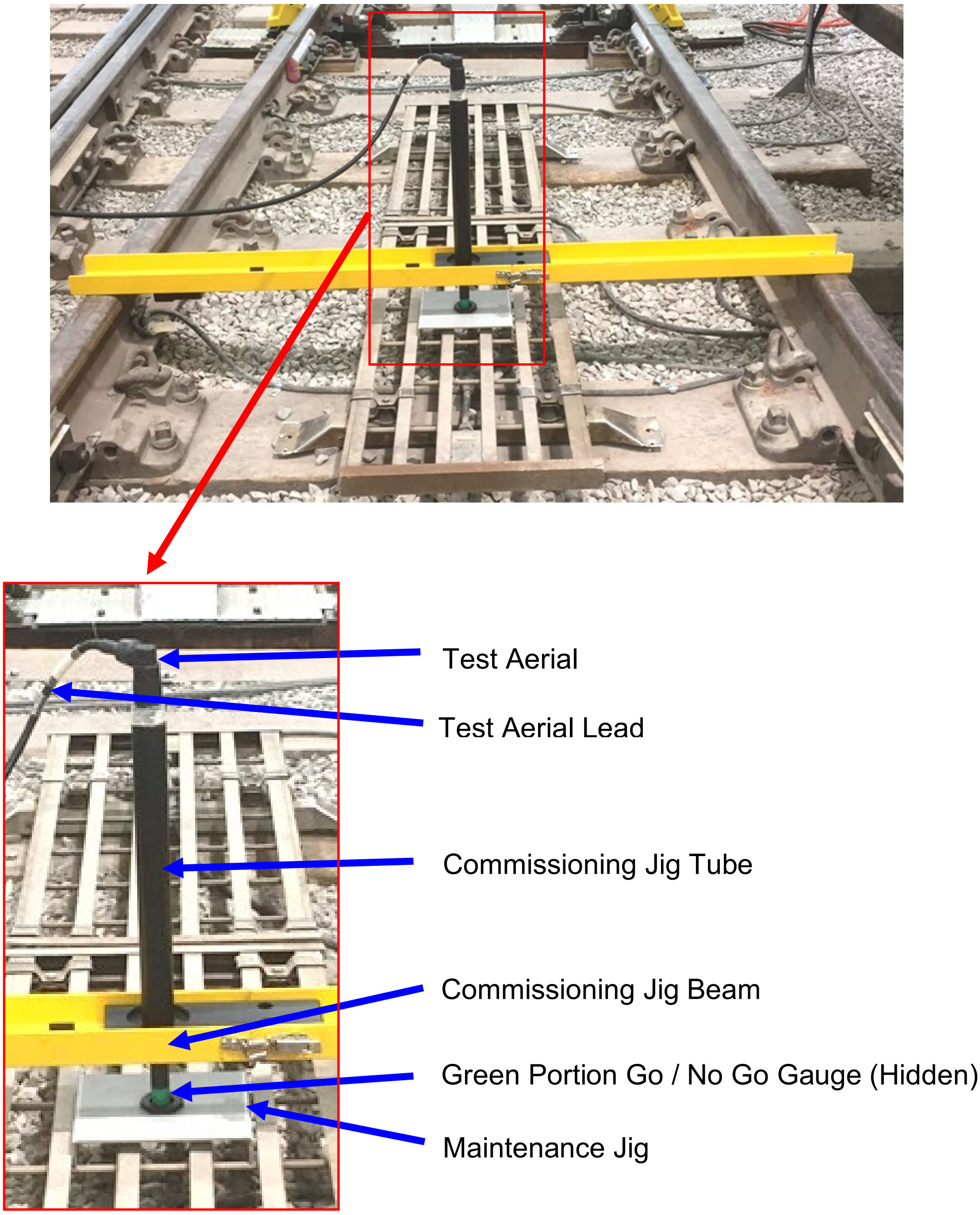


Figure 1: Measuring TPWS Field Strength - Commissioning Test

Details of voltages and frequencies see NR/SMS/PartZ/Z08 (Train Protection - Reference Values).

1.5 The frequency shall within +/-0.01kHz of the stated frequency for each Transmitter Loop's function (f1 to f6 as specified on the location wiring diagrams).

1.6 Measure the height of the top of the loop Below Rail Level (BRL) is within the "green" portion of the commissioning jig which reflects the tolerances specified in NR/SMS/PartZ/Z08 (Train Protection - Reference Values).

1.7 Check that the Transmitter Loop with is mounted in alignment with the track centreline.

1.8 If the Module or Transmitter Loop forms part of a Self-Powered OSS (SPOSS) then carry out NR/SMS/PartB/Test/233 (TPWS Self-Powered OSS (SPOSS) Trackside Equipment Test).

1.9 With the signal 'on', simulate a trackside equipment fault by slipping the links for the loop in the trackside apparatus case (OSS or TSS).

a) Check for correct fault indications on the affected module and in the Signal Box.

b) Remove the simulated fault.

c) Reset affected TPWS Modules.

This is done by undertaking a short (five second) isolation (disconnection of the BX110 supply fuse/link to the TPWS on the Baseplate or Trackside Enclosure).

2. Final Checks

2.1 Check that the VCR relay is energised (buffer stops only).

2.2 Check that all green 'Power' LEDs are illuminated and that all 'Fault' LED's are extinguished.

END

Includes:	TPWS Self-Powered OSS System (SPOSS)
Excludes:	All other TPWS Modules

When using the test equipment in third/fourth rail electrified areas, avoid contact between the test aerial lead and the conductor rails. Also, when using the equipment in wet conditions.

All tests requiring TPWS Transmitter Loop field strength and frequency measurements shall use a test meter approved for use with TPWS equipment.

The multimeter shall be set to a range appropriate to accurately measure frequency with a minimum resolution of 1 Hz.

All test measurements shall be recorded on the appropriate TPWS Test record card

When the power supply to TPWS is disconnected, a fault report will be indicated every time the signal displays a red aspect.

An 'affected loop' is one that is fed by a Module which has been disturbed/replaced, in which case the pair of loops associated with the Module should be tested.

An 'affected Module' includes any disturbed/replaced by the work and any associated Signalling Interface Module (and the Overspeed Sensor / Train Stop Modules fed by a disturbed/replaced Signalling Interface Module).

TEST

1. TPWS Self-Powered OSS System - Battery Test

1.1 To test battery 1, first isolate battery 2 by removing the fuse holder F2.

1.2 Press the ‘LOOP TEST’ button and Check that:

a) The green ‘TEST’ LED is illuminated for 6 seconds; and

b) The red ‘BATTERY LOW’ LED does not flash.

If the green ‘TEST’ LED does not illuminate this indicates that either Fuse 1 has ruptured or the battery is flat.

If the battery fuse has ruptured replace the fuse and re-test from step 1.1. If the battery fuse ruptures again change the SPOSM.

If the red ‘BATTERY LOW’ LED flashes during the test replace both batteries and re- test from step 1.1.

The reason for premature battery failure shall be investigated.

1.3 Re-insert the fuse holder F2.

1.4 To test battery 2 first isolate battery 1 by removing the fuse holder F1 and repeat steps 1.2 and 1.3.

2. TPWS Self-Powered OSS System – System Test.

2.1 Press the ‘SYSTEM TEST’ pushbutton on the SPOSM and Check that all LEDs illuminate (lamp test).

Illumination of all LED indicators confirms that the test sequence has started.

2.2 Depress the train detection treadle within 64 seconds and confirm that the ‘TRAIN DETECT’ green LED indicator remains illuminated while all the other indicators extinguish.

This confirms correct functionality of the train detection treadle input.

2.3 Once the ‘SYSTEM TEST’ pushbutton is pressed, the tester has 64 seconds to operate the train detection treadle and return to the SPOSM to view the indicators.

If the tester does not operate the treadle within 64 seconds the test sequence will abort and normal operation will be resumed.

Should the tester depress the treadle arm but not return to view the indicators within 64 seconds then the test sequence will have to be repeated.

2.4 64s after pressing the ‘SYSTEM TEST’ pushbutton, and provided the treadle input test is successful, the SPOSM will automatically energise the transmitter loops and complete a series of checks on the loop driver circuits and battery status.

This is identified by the green ‘TEST’ LED being illuminated for the duration of this test (6 seconds) confirming that the test is underway.

2.5 Check that none of the red ‘ARMING LOOP FAULT’, ‘TRIGGER LOOP FAULT’ or ‘BATTERY LOW’ LED indicators flash during the 6 seconds that the green ‘TEST’ indicator is illuminated.

If either of the loop fault LEDs flash then this indicates a fault in the respective loop circuit.

If the low battery LED flash this indicates the battery capacity is insufficient.

If the green ‘TEST’ LED not illuminate at all during this test then this also indicates a fault situation.

2.6 Test Mode will automatically end and normal operation will be resumed following completion of loop driver and battery tests.

2.7 To complete the transmitter loop output (voltage and frequency) tests, the SPOSM 'LOOP TEST' pushbutton shall be used to trigger the SPOSM to transmit.

Pressing the 'LOOP TEST' pushbutton will immediately start the SPOSM transmitting for 6 seconds during which time, loop measurements may be taken.

The loop test cycle will repeat continuously for as long as the 'LOOP TEST' pushbutton is held depressed.

This will provide almost continuous loop transmission with only a 375ms gap in transmission every 6 seconds.

2.8 The SPOSS Treadle shall follow standard treadle maintenance requirements as defined in NR/SMS/PartC/TQ01 (Mechanical Treadles).

3. Final Checks

3.1 Check that the VCR relay is energised (buffer stops only).

3.2 Check that all green 'Power' LEDs are illuminated and that all 'Fault' LED's are extinguished.

END

Includes:	TPWS Failure Indication Units
Excludes:	All other TPWS Modules or Units

This test is to check that the TPWS Failure Indication Unit (FIU) for use in mechanical signal boxes is functioning correctly following FIU replacement following a failure.

The test sequence checks the FIU system logic.

1. Test

Master Unit

1. With the 'NOR/ACK' switch in the NOR position, check that the Power On Lamp is illuminated and that the 'TPWS Failed' lamp is extinguished.
2. Press the indication 'Push to Test' pushbutton and check that the 'TPWS Failed' and 'Power On' lamps both flash and the audible alarm sounds.
3. Release the indication 'Push to Test' pushbutton and check that the 'TPWS Failed' lamp extinguishes and the 'Power On' lamp becomes illuminated steadily.
4. Remove the protective terminal cover from the rear of the master unit.
5. Using a digital multi meter, measure the voltage at the power supply input terminals, B12 - N12, check they lie within the range 9V DC to 15.6V DC.
6. Disconnect the wire on Terminal T1 (or T3 if 24V Fault Input is being used) and check that the 'TPWS Failed' lamp flashes and that the audible alarm sounds.
7. Turn the 'NOR/ACK' switch to ACK position and check that the 'TPWS Failed' lamp illuminates steadily and that the audible alarm silences.
8. Reconnect the wire to terminal T1 (or T3 as appropriate) and check that the 'TPWS Failed' lamp flashes but the audible alarm remains silent.
9. Turn the 'NOR/ACK' switch to NOR and check that the 'TPWS Failed' lamp extinguishes.
10. Disconnect the wire on Terminal T4 and check that the 'Power On' lamp flashes.
11. Reconnect the wire to Terminal T4 and check that the 'Power On' lamp becomes steadily illuminated.
12. Remove the termination plug from the top-most FIU and check that the audible alarm sounds.
13. Replace the termination plug and check that the audible alarm is silenced.

14. Check the security of the wiring and replace the protective terminal cover.

Slave Unit

15. With the ‘NOR/ACK’ switch in the NOR position, check that the slave unit ‘TPWS Failed’ lamp is extinguished.

16. Press the indication ‘Push to Test’ pushbutton on the associated master unit and check that the ‘TPWS Failed’ lamps flash on both the master and slave unit, the ‘Power On’ lamp on the master unit flashes and the audible alarm sounds.

17. Release the indication ‘Push to Test’ pushbutton and check that all ‘TPWS Failed’ lamps extinguish and the ‘Power On’ lamp on the master unit becomes illuminated steadily.

18. Remove the protective terminal cover from the rear of the slave unit.

19. Disconnect the wire on Terminal T1 (or T3 if 24V Fault Input is being used) and check that the slave unit ‘TPWS Failed’ lamp flashes and the audible alarm on the Master unit sounds.

20. Turn the ‘NOR/ACK’ switch to the ACK position and check that the ‘TPWS Failed’ lamp on the slave unit is steadily illuminated and that the audible alarm on the master unit is silenced.

21. Reconnect the wire to terminal T1 (or T3) and check that the ‘TPWS Failed’ lamp flashes but the audible alarm on the master unit remains silent.

22. Turn the ‘NOR/ACK’ switch to NOR and check that the ‘TPWS Failed’ lamp extinguishes.

23. Replace the protective terminal cover.

24. Repeat test on any other slave units.

END

Includes:	TPWS Buffer Stop Optimisation Project Equipment
Excludes:	All other TPWS equipment

This test is to check that the TPWS system is functioning correctly following arming loop repositioning associated with the TPWS Buffer Stop Optimisation Project.

The test sequence checks the system logic, loop power of affected units in the plane of the loop, and the transmitted power of the affected loops at 310mm above rail level. An 'affected loop' is one which has been disturbed/replaced by the work.

Prior to any work commencing, the exact position of the repositioned arming loop shall be clearly marked as detailed in the site specific method statement.

All tests requiring TPWS Transmitter Loop field strength and frequency measurements shall use a test meter approved for use with TPWS equipment. The TPWS Multimeter from Fluke is approved for such applications.

All test measurements shall be recorded on NR/SMS/PartR/TP11/RC01 (TPWS Test: Equipment Associated with Signals Record Card (Front)), together with the reason for the test “Arming Loop Re-positioned”.

A Signal Maintenance Testing Logbook entry and the TPWS Buffer Stop Optimisation Project Test Certificate shall be completed for each installation.

Prior to use, it is recommended that the TPWS Commissioning Jig is visually inspected for damage and to confirm correct alignment of the two mating halves. If a bend of more than 10mm when measured at the centre of the beam to with respect to the ends, the Commissioning Jig should not be used.

1. Test

1. Measure and record the leading edge separation distance between the arming and trigger loop on the Test Certificate.

2. Check that all loops are re-installed in the correct position to the schedule in the site specific method statement or work plan.

3. Check the affected TPWS Module LEDs by ensuring that the green ‘Power On’ LEDs and the ’Main I/P’ LEDs are alight on the affected Sensor Modules.

4. Use the TPWS calibrated test aerial to test the voltage received by the aerial and the frequency of the signal received at the arming transmitter loop.

   The voltage shall be greater than 4.26mV AC see NR/SMS/PartZ/Z08 (Train Protection - Reference Values) for values. To measure the voltage, the TPWS test aerial shall be positioned centrally above the plane of the loop using the Commissioning Jig and recorded to the 5 digit capability of the multimeter.

When taking measurements, the meter shall not be held over the loops, to avoid interference from the loop field. It shall instead be held as far outside of the rails as the test aerial lead allows, as shown in NR/SMS/PartB/Test/232 (TPWS Module or Transmitter Loop Test (following P Way Work).

Use the TPWS calibrated test aerial to test the voltage received by the aerial and the frequency of the signal received at the arming transmitter loop.

The voltage should be between 59mV and 107mV AC for Buffer Stop Mini-Loops, and the frequency within +/-0.01kHz of the stated frequency (as specified on the location wiring diagrams).

To measure the voltage and frequency, the TPWS test aerial shall be positioned centrally within the plane of the loop using the Maintenance Jig and recorded to the 5 digit capability of the multimeter.

When taking measurements, the meter shall not be held over the loops, to avoid interference from the loop field.

It shall instead be held as far outside of the rails as the test aerial lead allows, as shown in NR/SMS/Part03/Test/231 (TPWS Module or Transmitter Loop Test (following failure).

5. Measure the height of the top of the loop Below Rail Level (BRL) and check that it is within the tolerances specified in NR/SMS/PartZ/Z03 (Train Detection Reference Values).

6. Measure the height of the loop above the sleeper and check that it is within the following tolerances:

   For loops mounted on steel sleepers check the loop is a minimum of 70mm above the top surface of the sleeper.

   For loops mounted on concrete slab track check the loop is a minimum of 50mm above the top surface of the sleeper.

7. Check that the centre line of the Transmitter Loop is within 10mm of the centre line of the track.

8. Check that tamper-proof seals are intact of the Thales pre-wired equipment.

9. De-energise the affect loops by slipping links to the loop output circuit and check for correct fault indications on the affected module and in the signal box (if provided). Remove the simulated fault.

10. Reset affected TPWS Modules by undertaking a short term isolation (disconnection of the BX110 supply fuse/link to the TPWS on the Baseplate or Trackside Enclosure) for five seconds.

This shall be done with the main signal ‘off’ to clear any fault indication.

11. Check that isolation fuses/links are in the correct position and that screw terminals are tight.

12. Record the values on the maintenance record card, see NR/SMS/PartR/Index.

END

Includes:	Primary Cell Fed, TJ/Secondary Cell Fed, Feed set Fed, AC immune and non- immune
Excludes:	All other types of track circuit

GENERAL

DC track circuits fed from primary cells usually tend to have low feed voltages, feed resistance, rail voltage, relay resistance and operating values. This is a design trait to conserve the limited life of power available from a primary cell.

Track circuits fed indirectly from mains supplies will have higher values of those mentioned which improves reliability and detection under poorer conditions (rusty rails, low ballast resistance etc).

Design improvements have also led to systems that require no feed resistance adjustment and have immunity to AC interference.

A faulting guide and adjustment details for this type of track circuit can be found in NR/SMTH/Part10/FF02 (Faulting Guide: DC Track Circuits).

1. Maintenance Test

Feed End

1.1 Measure and record the DC voltage across the rails.

Feed End Relay (If fitted)

1.2 Connect a train shunt across the track links. Obtain a drop shunt and pick up shunt value. Disconnect the shunt box.

If the track links are not accessible, connect the train shunt across the rails.

If the drop shunt is lower than the minimum value NR/SMS/PartZ/Z03 (Train Detection - Reference Values) carry out the full test.

Relay End

1.3 Measure and record the DC voltage across the energised track relay coil.

1.4 Connect a train shunt across the track links. Obtain a drop shunt and pick up shunt value. Disconnect the train shunt.

If the track links are not accessible, connect the train shunt across the rails.

If the drop shunt is lower than the minimum value NR/SMS/PartZ/Z03 (Train Detection - Reference Values) carry out the Full Test.

Where a feed end relay is also provided, carry out this test by observing the relay end track relay.

1.5 Assess the condition of ballast/ground conditions.

1.6 Record the results on the record card.

1.7 Compare results with previous records for any significant variations. Where there is a significant variation in values, retest with the train shunt applied to the rails.

If any adjustments are carried out a Full Test shall be carried completed.

A variation in drop shunt value can be caused by variations in the equipment or environment.

In wet conditions, a higher value of drop shunt can be expected. In dry or icy conditions, a lower value can be obtained. Poor ballast conditions can also affect the value of the drop shunt.

2. Full Test

The full test should be carried out whenever alterations are made including relaying, lead/jumper renewal, equipment replacement, adjustment etc.

Feed End

2.1 Measure the feed voltages, currents and other parameters as required on the record card.

Feed End Relay (If fitted)

2.2 Connect a train shunt across the rails. Obtain a drop shunt and pick up shunt value. Disconnect the shunt box.

If the drop shunt is lower than the minimum value NR/SMS/PartZ/Z03 (Train Detection - Reference Values) the track circuit shall be regarded as failed and the cause shall be investigated.

Relay End

2.3 Measure the relay voltages, currents and other parameters as required on the record card.

2.4 Measure the DC voltage on the track relay coil.

2.5 Connect a shunt box across the rails. Obtain a drop shunt and pick up shunt value. Disconnect the shunt box.

If the drop shunt is lower than the minimum value (NR/SMS/Part/Z03 (Train Detection - Reference Values) the track circuit shall be regarded as failed and the cause shall be investigated.

Where a feed end relay is also provided, carry out this test by observing the relay end track relay.

2.6 With the train shunt set to 0.5Ω, apply the shunt across the rails at all the extremities of the track circuit. Check that the track relay drops sharply.

2.7 Assess the condition of ballast/ground conditions.

2.8 Record the results on the record card. Compare results with previous records for significant variation.

Where there is a significant variation in values the cause shall be investigated and rectified. The Full Test shall then be carried out again.

Remember to take into account weather and ballast conditions.

3. Residual Voltage Check

This check is not required if the track circuit is fitted with a feed end relay.

3.1 Measure the drop away and pick up voltages of the track circuit at the relay end.

A 150kΩ shunt should be used when testing with a fluke meter.

3.2 Disconnect the feed end track links.

3.3 After a period of 120 seconds, measure the voltage across the coils of the track relay. This voltage shall be compared to the voltages recorded in 3.1.

If the recorded voltage is:

a) Greater than 30% (but less than 70%) of the minimum drop away voltage, report immediately to the SM(S).

If the voltage does not exceed 70% of the minimum drop away voltage, the S&TME can authorise the track circuit to remain in service provided that any jumpers in the bonding, including fishplates and other types of bonding are duplicated, and all types of bonding are inspected at 4 weekly intervals.

Plain Line TCs with no jumpers can be inspected at 13 weekly intervals.

This is to allow time for corrective maintenance actions to be undertaken to identify and eliminate the source of the residual voltage or other measures such as replacement of rail pads and insulations on concrete sleepers and slab track to be undertaken.

Such actions shall normally be completed within 12 Months.

b) Greater than 70% of the minimum drop away, the track circuit shall not remain in service unless the S&TME can confirm that a Risk Assessment and Time Bound Action Plan has been submitted and authorised by the RAM(S).

The S&TME shall keep a register of all track circuits where residual voltages exceed 30% of the minimum drop away Voltage.

END

Includes:	EBI Track 200 Audio Frequency Track Circuit (formally known as TI21) and Aster21
Excludes:	All other Track Circuits

The Aster21 Application is detailed in NR Standard NR/L2/SIG/11766 which defines that the EBI Track 200 SMS covers Aster21 with the exception that the relay drive is 24VDC for Aster21.

1. Maintenance Test A1

Feed (Transmitter) End

1.1 Check all rail connections and bonding are tightened to the correct torque. (Appendix F of NR/SMS/Appendix/08).

Impedance Bonds (where fitted)

1.2 Check the impedance bond for the following:

a) Bond Covers correctly fitted and not damaged.

b) Drain holes clear (on Howells & WH3 bonds).

It might be necessary to drill drain holes if they are not present. (Pre installation check).

c) Tuning capacitor or tuning module connections.

1.3 Check all rail connections and bonding are tightened to the correct torque (Appendix F of NR/SMS/Appendix/08).

Relay (Receiver) End

1.4 Check all rail connections and bonding are tightened to the correct torque (Appendix F of NR/SMS/Appendix/08).

1.5 Measure the rail-to-rail voltage at the EBI Track 200 equipment rail connections (Pole) using a TTM/MTM (Vp, (Appendix F of NR/SMS/Appendix/08).

For consistency, this measurement shall always be carried out at the rails.

1.6 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.

For a Single Rail track circuit the measurement shall be made in the Signal rail.

1.7 Where a tuned zone is involved, Measure using a FSM/MTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 1.5 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against Appendix B of NR/SMS/Appendix/08. If the ratio is below specification, the low result usually relates to badly dressed cables and or poor connections, therefore, Check that the cables are dressed correctly and that all Tuning units' connection are correct, clean and tight.

1.8 If a digital receiver is in use, Check the display for a steady 'PICK' or 'drop' indication. If one of these indications cycles with the indication 'ERR' then refer to Appendix E4 of NR/SMS/Appendix/08 and investigate the reason for the error. An 'ERR' state shall not be left without authority from the SM(S).

A significant deviation is indicated if the change of track current is greater than:

a) ±20% OR
b) ±10mA.

On The Receiver

Press OK then 'NEXT' until 'INOW'

Press OK then Next Until 'USB'

Press OK and note the value

Press 'BACK' then 'NEXT' until 'LSB'

Press OK and note the value

Calculate and record sideband imbalance by dividing the larger value by the smaller value.

If the sideband imbalance exceeds the ratio values above, the track circuit shall be investigated to ascertain the cause of the imbalance. Carry out steps 2.4.7 to 2.4.11 of NR/SMS/Appendix/08.

1.9 For Analogue receivers Measure the voltage across the 1Ω resistor; compare this reading against the Record Card.

For Digital receivers Record the Inow AV current using the display on the receiver and compare this reading against the Record Card.

If the obtained reading is not within 10% of the Commissioning reading or last Set-up reading on the Record Card, the reason for the discrepancy shall be investigated.

If adjustment is required, the initial setting for an analogue RX shall be selected from Appendix D Table D1 of NR/SMS/Appendix/08 using the voltage across the

1Ω resistor, followed by a drop shunt test. For digital RX, an auto-set routine shall be performed. (See Appendix E of NR/SMS/Appendix/08)

The RX current is the best measure of the track circuits' stability. Significant deviations from previous readings shall be investigated.

For track circuits which continually give problems, the frequency of checking the receiver current might need to be increased to help in diagnosing the cause of any issues.

A significant change shall be determined by which is the greater of :

a) ±20% OR
b) ±10mA.

1.10 Record the ballast and weather conditions on the track circuit Record Card.

1.11 Using a shunt applied to the rails between the RX tuning unit rail connections obtain a drop shunt value and a pick up shunt value.

Shunt Box and Connection Verification Check
Connect a shunt box across the rails at the receiver TU or ETU track connections.
Set the drop shunt to 0.0Ω.
Check that clear track current (INOW) has fallen to less than 5mA.

If the readings are equal to or higher then 5mA then the Shunt Box, meter leads and connections should be checked to confirm it is giving a 0.0Ω shunt.

Shunt values are detailed in NR/SMS/Part/Z03.

On the pick-up shunt, allow 2 seconds between each value to allow the slow to pick relay drive from the RX to operate.

The pick-up value should normally be 0.1Ω higher than the drop shunt.

Compare the results with previous records (if available) obtained under similar conditions. If the results are not within ±10% the cause shall be investigated and rectified as appropriate. A FULL TEST shall then be carried out.

2. Full Test

2.1 Examine the track circuit in accordance with NR/SMS/TC16 service A.

Feed (Transmitter) End (Digital TX and Analogue TX)

2.2 Examine the TX unit case, connector and terminations and check the plug coupler is pushed fully home. Also check the plug coupler on any PSUs, TCUs or LMUs used are also pushed fully home.

2.3 Regardless of the supply voltage Check/Set the PSU input tappings to P5 and P115.

For Analogue Transmitters:

Measure the input and output voltages of the power supply.

These should be in the range of:

a) Input: 99V to 121V AC
b) Output: 22.5V to 30.5V DC

For Digital Transmitters:

Measure the input voltage of the power supply.

If the supply is over 115VAC, adjust the PSU output tappings to give between 25V DC and 27V DC. Otherwise, adjust the PSU output tappings to give ideally 24V – 26V DC.

Digital TX of MOD strike 2 may show a red POWER LED indication if the power supply voltage is over 27V DC. This can be ignored provided that the TX has been set up as stated above.

Digital TX of MOD strike 2 to 4 will shut down at 30.5V DC therefore it is important to check the voltage is kept below this threshold.

Record the PSU Output Voltage

2.4 Measure the DC current drawn by the equipment.

a) Normal Power 1.3A to 2.2A.
b) Low Power/TCU 0.2A to 0.5A
c) Low Power Plus 0.2A to 0.55A

2.5 Measure the total AC+DC current drawn by the equipment. If the measured value is 20% above the expected maximum value (i.e. 2.6A for Normal Power TX, 0.6A for Low Power TX, 0.65A for Low Power Plus TX) then investigate from where this additional current is being generated.

2.6 Measure the TX output voltage across terminals OP/1 and OP/2 using a TTM.

For Analogue Transmitters the voltages should be:

a) Frequencies A, C, E, G: 10V – 11V RMS
b) Frequencies B, D, F, H: 15V – 16V RMS

For Digital Transmitters

c) 8.5V to 12.5V RMS regardless of frequency.

For either type of transmitter, when connected in low power mode or low power plus mode, the output voltage may be up to 5V RMS higher than in normal power.

2.7 Measure the rail-to-rail voltage at the TU (Pole) or ETU rail connections using a FSM/TTM (Vp, Appendix A of NR/SMS/Appendix/08).

For a TCU system refer to the low power figures.

For consistency this measurement shall always be carried out at the rails.

2.8 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.

For a Single Rail track circuit the measurement shall be made in the Signal rail.

2.9 Where a tuned zone is involved, Measure using a FSM/TTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 3.7 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against Appendix B of NR/SMS/Appendix/08. If the ratio is below specification, Check that the cables are routed correctly and that all Tuning Unit connections are correct, clean and tight.

Impedance Bond and Track Capacitors (Where fitted)

The impedance of an impedance bond can be checked by measuring the EBI Track 200 voltage across the bond and the current through it. To take the current measurements use a Rocoil connected to a TTM.

2.10 Check all rail connections and bonding are tightened to the correct torque (Appendix F of NR/SMS/Appendix/08).

2.11 Check the security and the fixing of the Track capacitor.

2.12 Measure using a FSM/TTM the rail-to-rail voltage.

Clauses 2.13 and 2.14 are not applicable to B3 3000 and B3 500 bonds.

2.13 Measure the voltage across the auxiliary coil or tuning module, Check it is in the correct ratio with the rail-to-rail voltage (Appendix C of NR/SMS/Appendix/08). If it is not the impedance bond shall be investigated for a fault.

2.14 Apply a short circuit across the tuning capacitor/module, Check that the rail voltage falls then remove the short circuit and Check the voltage rises.

Clauses 2.15 to 2.19 are applicable to Intermediate bonds only.

2.15 Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the TTM (= amps, I1).

2.16 Repeat the measurement 1 metre from the bond on the RX side (I2)

2.17 Subtract I2 from I1 obtaining the current through the bond at the EBI Track 200 frequency.

2.18 Measure the rail to rail voltage (V) across the impedance bond.

2.19 Divide the voltage (V) by the current calculated from 2.17 giving the impedance (Z), Z= V / (I1-I2).

This value should be greater than 8Ω. If less than 8Ω, Check for traction imbalance before remedial action is taken with the impedance bond.

Relay (Receiver) End

2.20 Examine the RX unit case, connectors and terminations and check the plug coupler is pushed fully home. Also check the plug coupler on any PSUs, TCUs or LMUs used are also pushed fully home.

2.21 Measure the input and output voltages of the power supply

a) Input: 99V to 121V AC
b) Output: 22.5V to 30.5V DC

The output voltage should be close to 24V unless there is reason to believe that the I/P conditions are unusual, in which case the input tapping should be adjusted to 120 volts

2.22 Measure the DC current drawn by the equipment.

a) 0.2A to 0.5A.

2.23 Measure the total AC+DC current drawn by the equipment. If the measured value is 20% above the expected maximum value (i.e. 0.6A for RX) then investigate from where this additional current is being generated.

2.24 If a digital receiver is in use, Check the display for a steady ‘PICK’ or ‘drop’ indication. If one of these indications cycles with the indication ‘ERR’ then refer to Appendix E4 of NR/SMS/Appendix/08 and investigate the reason for the error. An ‘ERR’ state shall not be left without authority from the SM(S).

2.25 If a digital receiver is in use, confirm the track circuit has a Sideband imbalance ratio less than:

a) 1.6:1 for TU/ETU/SPETU
b) 1.8:1 for TCU

On The Receiver

Press OK then 'NEXT' until 'INOW'

Press OK then Next Until 'USB'

Press OK and note the value.

Press 'BACK' then 'NEXT' until 'LSB'

Press OK and note the value.

Calculate and record sideband imbalance by dividing the larger value by the smaller value.

If the sideband imbalance exceeds the ratio values above, the track circuit should be investigated to ascertain the cause of the imbalance. Carry out steps 2.4.7 to 2.4.11 of NR/SMS/Appendix/08.

2.26 Measure the rail-to-rail voltage at the TU (Pole) or ETU rail connections using a FSM/TTM (Vp Appendix A of NR/SMS/Appendix/08).

For a TCU system refer to the low power figures.

For consistency this measurement shall always be carried out at the rails.

2.27 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.

For a Single Rail track circuit the measurement shall be made in the Signal rail.

Low rail volts or rail current could be due to ballast or other track equipment, as well as a fault at the TX end of the track.

2.28 Where a tuned zone is involved, Measure using a FSM/TTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 2.26 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against Appendix B of NR/SMS/Appendix/08. If the ratio is below specification, the low result usually relates to badly dressed cables and or poor connections, therefore, Check that the cables are dressed correctly and that all Tuning units' connection are correct, clean and tight.

2.29 For Analogue receivers Measure the voltage across the 1Ω resistor; compare this reading against the Record Card.

For Digital receivers Record the Inow AV current using the display on the receiver and compare this reading against the Record Card.

If the obtained reading is not within 10% of the Commissioning reading or last Set-up reading on the Record Card, the reason for the discrepancy shall be investigated.

If adjustment is required, the initial setting for an analogue RX shall be selected from Appendix D Table D1 of NR/SMS/Appendix/08 using the voltage across the 1Ω resistor, followed by a drop shunt test. For digital RX, an auto-set routine shall be performed.

The RX current is the best measure of the track circuits' stability. Significant deviations from previous readings shall be investigated.

A significant deviation is indicated if the change of track current is greater than:

a) ±20% OR
b) ±10mA.

2.30 Measure the voltage across the energised track relay coils.

a) 40V to 75V DC for the analogue RX
b) 40V to 44V DC for the digital RX MOD 1 & 2
c) 48V to 52V DC for the digital RX MOD 3 or later

Aster21 Receivers are configured for 24VDC relay drive therefore the voltage across the energised track relay coils will be 20V to 26V DC.

2.31 Using a train shunt applied to the rails between the RX tuning unit rail connections obtain a drop shunt value and a pick up shunt value.

Shunt Box and Connection Verification Check
Connect a shunt box across the rails at the receiver TU or ETU track connections.
Set the drop shunt to 0.0Ω.
Check that clear track current (INOW) has fallen to less than 5mA.

If the readings are equal to or higher then 5mA then the Shunt Box, meter leads and connections should be checked to confirm it is giving a 0.0Ω shunt.

Shunt values are detailed in NR/SMS/Part/Z03.

On the pick-up shunt allow 2 seconds between each value to allow the slow to pick receiver relay drive to operate.

2.32 Compare the results with previous records (if available) obtained under similar conditions. If the results are not similar the cause shall be investigated and rectified as appropriate. The FULL TEST shall then be repeated.

2.33 Record the ballast and weather conditions on the track circuit Record Card.

Interference Test

Check that all tracks in vicinity of track to be tested are energised and working

This test checks the levels of in band and traction interference present at the RX, and requires temporary disconnection of the TX.

Check the fusing arrangements before this test as more than one track circuit might be affected.

2.34 Remove the B24 fuse to the TX and Check that the correct track relay drops. Set the TTM to the 20mV range (30mV range for FSM) and the frequency to that of the track circuit under test. Measure the voltage across the 1Ω resistor at the RX.

Readings greater than 8mV for double rail tracks and greater than 3mV for single rail tracks are un-acceptable, the track circuit shall be signed out of use and your SM(S) informed.

Where a digital RX is in use, these readings as currents, can be read directly from the RX display where they are displayed in mA. Since the Voltage reading above is taken across a 1Ω resistor the mA reading directly equates to the mV reading.

Extremity Tests

2.35 Apply a shunt at the extremities of the track circuit, in accordance with the track plan, and Check the track relay drops for each application.

Minimum Shunt values are detailed in NR/SMS/Part/Z03.

End

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartB/Test/254		
Track Circuit: SF15 / U Type Aster		
Issue No: 04	Issue Date: 05/12/2020	Compliance Date: 05/06/2021

Includes:	SF15 / U Type Aster track circuits
Excludes:	Aster 21, EBI Track 200 (formally known as TI21) and EBI Track 400. All other types of track

General

The TX and RX shall not be disconnected at the same time.

As this could result in an adjacent track circuit feeding through and causing a possible wrong side failure.

Centre Fed Track Circuits

Each half of a centre fed track circuit operates as an independent track circuit and should be tested as such. Record cards should be kept for each part.

Cut Section Track Circuits

Each cut section should be treated as an individual track circuit and record cards kept accordingly.

Disconnection of Units

The Tx and Rx should not be disconnected at the same time as this could results in an adjacent track circuit feeding through and causing a possible wrong side failure.

Test Equipment

A frequency selective meter (FSM), or TI21 Test Meter (TTM), set to the frequency of the track circuit under test.

Gain Settings

The gain setting shall not be increased without consulting your SM(S).

Tuned Zones

These shall be kept clear of all metallic objects including new or scrap lengths of rail for a distance of at least 1.25m (4ft).

The tail cables from the TU/ACT to the rails form part of the tuned circuit, because of this they should be bound together wherever possible, not allowed to form loops and not be run in parallel with the running rails.

Failure to observe these items can result in the effectiveness of the tuned area being altered.

Bonded Rail Joints

Bonds across rail joints should be of a low resistance as this can influence the characteristics of the track circuit.

1. Maintenance Test

Relay (Receiver) End

1.1 Measure and record at the power supply (T/J or Charger) the AC input voltage and the DC output voltage (between 22.5V and 29.5V).

1.2 Measure and record at the receiver unit the AC input voltage between T1 and T2.

1.3 Where a tuned zone is involved.

a) Measure the rail-to-rail voltage at the TU rail connections using a FSM/TTM

b) Measure the rail-to-rail voltage at the adjacent TU rail connection at the frequency of the track circuit under test.

The ratio between these two measurements should be compared to the table in Appendix C.

1.4 Apply a train shunt across the rails at the tuning unit and obtain a drop shunt and a pick-up shunt.

The test results where the receiver is adjacent to a pair of insulated rail joints shall be compared to the table in Appendix B.

For shunt values refer to NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

1.5 With the track circuit not shunted by trains or a train shunt, measure the DC voltage across the track relay coil terminals R1(+) and R2(-).

2. Full Test

The full test should be carried out whenever alterations are made including; relaying, lead/ jumper renewal, equipment replacement, adjustment etc). The full test should also follow the clearing of a fault.

All measurements taken at track circuit frequency are to be taken using a frequency selective meter.

The minimum drop shunt value with the train shunt applied across the rails at the transmitter-tuning unit is 0.3Ω.

2.1 Examine the track circuit in accordance with NR/SMS/PartC/TC10 (Track Circuits: Aster SF15 / U Type) - Service A.

Feed (Transmitter) End

2.2 Measure and record at the power supply (T/J or Charger) the AC input voltage and the DC output voltage (between 22.5V and 29.5V).

2.3 Measure and record at the transmitter unit the AC output voltage between terminals 1&2 or 1&3 and measure the AC feedback voltage between T1&T2.

2.4 Measure and record at the tuning unit the AC voltage between T1&T2. Check they are as follows:

TU Voltage (T1/T2)		
TC Length	Min	Max
50m	1.6V	2.7V
1000m	2.5V	5.3V

Table 1 – TU Voltages

2.5 Measure the rail-to-rail voltage at the TU rail connections using a FSM/TTM. For consistency this measurement shall always be carried out at the rails.

2.6 Where a tuned zone is involved.

a) Measure the rail-to-rail voltage at the TU rail connections using a FSM/TTM,

b) then measure the rail-to-rail voltage at the adjacent TU rail connection at the frequency of the track circuit under test.

The ratio between these two measurements shall be compared to the table in Appendix C.

Relay (Receiver) End

2.7 Measure and record at the power supply (T/J or Charger) the AC input voltage and the DC output voltage (between 22.5V and 29.5V).

2.8 Check the tappings REC1, REC2 and straps A/-/H on the receiver unit for the track circuit length (Appendix A).

NOTE: *The tappings are only a guide and adjustment to obtain satisfactory shunts should always take priority.*

2.9 Measure and record at the receiver unit the AC input voltage between T1 and T2.

2.10 Measure and record at the tuning unit the AC voltage between T1 and T2. Check they are as follows:

TU Voltage (T1/T2)		
TC Length	Min	Max
50m	1.7V	2.8V
1000m	0.25V	0.8V

Table 2 - AC Voltages

2.11 Measure and record the rail-to-rail voltage at the TU rail connections using a FSM/TTM. For consistency this measurement shall always be carried out at the rails.

2.12 Where a tuned zone is involved.

a) Measure the rail-to-rail voltage at the TU rail connections using a FSM/TTM.

b) Measure the rail-to-rail voltage at the adjacent TU rail connection at the frequency of the track circuit under test.

The ratio between these two measurements should be compared to the table in Appendix C.

2.13 Apply a train shunt across the rails at the tuning unit and obtain a drop shunt and a pick-up shunt.

2.14 The test results where the receiver is adjacent to a pair of insulated rail joints should be compared to the table in Appendix B.

For shunt values refer to NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

2.15 Train Shunt Test all extremities of the track circuit. This test should also obtain simultaneous track circuit occupation where an overlapping section exists.

2.16 With the track circuit not shunted by trains or a train shunt, measure the DC voltage across the track relay coil terminals R1(+) and R2(-) and the tuning unit input voltage between T1 and T2.

2.17 Apply a train shunt to the tuning unit terminalsT1 & T2 and obtain a drop shunt and pick up.

2.18 Record the obtained results and other details along with the latest setting numbers on the paper or digital record card.

Where the Receiver Is Adjacent to A Pair of Insulated Rail Joints

2.19 Report situations where track circuit track tail cables are not terminated within 1m of an IRJ.

2.20 Drop shunt test at three positions approximately 15m apart, within 50m of transmitter and its terminations. For a feed end the test should be outside the tuned zone. Results are listed in Appendix B.

Interference Test

2.21 Remove the B24 fuse to the Tx and check the track relay drops. Set a frequency selective meter to the frequency of the track circuit under test and measure the AC input voltage at the Rx unit between T1 and T2.

2.22 Compare this voltage with the one obtained in 2.9, if it is greater than 25% of this voltage, the track circuit shall be signed out of use and your supervisor informed immediately.

APPENDIX A - Receiver Gain Connections

Length (m)	REC1	REC2	Strap
Min	A	B	-
50	C	D	-
	A	D	BC
100	D	E	-
	A	E	BD
	C	E	-
	A	E	BC
200	E	G	CF
	E	G	AF BD
	E	G	DF
	D	G	AF BC
300	D	G	CF
	B	G	AF
	F	G	-
	A	G	BF
400	C	G	DF
	A	G	BC DF
	D	G	EF
	A	G	BD EF
500	C	G	EF
	A	G	BC EF
	E	H	CG
	E	H	AG BD
600	E	H	DG
	D	H	AG BC
	D	H	CG
	B	H	AG

Length (m)	REC1	REC2	Strap
700	G	H	-
	A	H	BG
	C	H	DG
	A	H	BC DG
800	D	H	EG
	C	H	EG
	A	H	BC EG
900	E	H	CF
	E	H	AF BD
	E	H	DF
	D	H	AF BC
1000	D	H	CF
	B	H	AF
	F	H	-
	A	H	BF
	C	H	DF
	A	H	BC DF
	D	H	EF
	A	H	BD EF
	C	H	EF
	A	H	BC EF
MAX	-	-	-

Table 3 - Receiver Gain Connections

The receiver gain connections listed above are to be used as a guide.

Adjustment can be required to suit local conditions.

APPENDIX B - Test Results Where the Receiver Is Adjacent to A Pair of Insulated Rail Joints

Where the drop shunt values below 0.5W (0.7W when wet):

- Inform your SM(S).
- Reduce the gain on the receiver and retest. If unsatisfactory, arrange for the receiver and tuning units to be replaced.

Track circuits that cannot be properly adjusted should be advised to the Signaller.

APPENDIX C - Tuned Zone Ratios

Ratio	Action
2:1 or less	The relevant tuning unit shall be replaced within 48 hours
Between 3:1 & 2:1	IF the other end of the TC not under test is formed of a tuned zone, test the Tuned Zone Ratio at the far end and if that is less than 5:1, replace the tuning unit with the lower Tuned Zone Ratio value
Above 3:1	No action

Table 4 - Tuned Zone Ratios

END

Includes:	HVI Track Circuit equipment
Excludes:	All other Track Circuit types

GENERAL

Red bonds are very dangerous if they become disconnected. Never touch them as there could be a dangerous voltage. Report to E.C.O any found.

In 3rd rail DC traction areas and in dual electrified areas (3rd rail DC and AC overhead line) HVI track circuit transformer/terminal boxes (known as 'bread bins') can experience a catastrophic arcing across the terminals when the 3rd rail DC traction supply is short circuited to the 'signalling' rail.

As these traction short circuits can be unpredictable (they can be caused by trains, conductive rubbish etc) no preventative or corrective maintenance shall be undertaken inside the 'bread bin' with the 3rd rail DC traction current energised.

If preventative or corrective maintenance requires access inside the 'bread bin' the 3rd rail DC traction current shall be isolated for the entire length of the track circuit(s) concerned. Alternatively remove all track leads, including any adjacent leads that are housed in the same bread bin. Measurements shall be taken on the rails.

In 3rd rail DC traction supply areas where track access can be restricted, there can be permanent 'test leads' installed from the rails to a special test box in a position of safety. In this situation the terminations in the test box may be used to obtain measurements where the test asks for readings 'on the rails'.

The resistance of the test leads (stated on the test box) shall be taken into account when obtaining measurements by this method.

This does not apply in non-electrified areas or if the traction supply is by AC overhead line only.

The tests are marked with a # symbol, only the tests applicable to the traction current supply in the area of the track circuit shall be carried out. If you are unsure, ask your SM(S).

# Symbol	Meaning
#1	Non-electrified areas and overhead line (AC & DC) areas only
#2	3rd rail DC traction areas and dual supply traction areas (3rd rail and overhead line) only
#3	All areas

NOTE: *A faulting guide and adjustment details for this type of track circuit can be found in NR/SMTH/Part10/FF06 Faulting Guide: High Voltage Impulse (HVI) Track Circuits*

1. Maintenance test

1.1 #1 Drop Shunt Test (T1): Using a shunt box, carry out a drop shunt test at the relay end track transformer track terminals.

The drop shunt values can be found in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

1.2 #2 Drop Shunt Test (T2): Using a shunt box, carry out a drop shunt test at the relay end on the rails.

1.3 #3 Track Relay Voltage Test (T3): Using a digital voltmeter set on DC manual range, measure the voltage at the track relay plug board contacts.

There will be a fluctuation in the reading.

Electrified and Non-Electrified Lines	
V1+ to V1-	**V2+ to V2-**
Min 20V	Min 30V
Max 50V	Max100V

1.4 #1 Relay End Track Transformer Voltage (T4): Measure the relay voltage at track relay end track transformer track terminals, using adapter integrator with a digital voltmeter on auto range.

1.5 #2 Relay End Track Transformer Voltage (T4): Measure the relay voltage at track relay end on the rails, using adapter integrator with a digital voltmeter on auto range.

Polarity Ratio +ve : -ve	**Electrified Lines**	**Non- Electrified Lines**
	V+ to V-	**VA to VB**
	Min 50V Max 150V	Min 20V Max 120V
Min 5:1 Max 10:1	Min 8V Max 22V	Min 2V Max 12V

1.6 #1 Relay End Load Test (T5): Load test at relay end track transformer track terminals with a 0.5Ω shunt across the rails, using adaptor integrator.

1.7 #2 Relay End Load Test (T5): Load test at relay end with a 0.5Ω shunt across the rails, using adaptor integrator.

Electrified Lines	**Non-Electrified Lines**
V+ to V-	**VA to VB**
Min 10V	Min 6V

2. Full Test

2.1 #1 Drop Shunt Tests (T1 & T2): Using a shunt box, carry out a drop shunt test at the relay end track transformer terminals and on the rails.

The drop shunt values can be found in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

2.2 #2 Drop Shunt Tests (T2): Using a shunt box, carry out a drop shunt test at the relay end rails.

2.3 #3 Track Relay Voltage Test (T3): Using a digital voltmeter set on dc manual range, measure the voltage at the track relay plugboard contacts.

There will be a fluctuation in the reading.

Electrified and Non-Electrified Lines	
V1+ to V1-	**V2+ to V2-**
Min 20V	Min 30V
Max 50V	Max100V

2.4 #1 Relay End Track Transformer Voltage (T4): Measure the relay voltage at track relay end track transformer track terminals, using adapter integrator with a digital voltmeter on auto range.

2.5 #2 Relay End Track Transformer Voltage (T4): Measure the relay voltage at track relay end on the rails, using adapter integrator with a digital voltmeter on auto range.

Polarity Ratio +ve : -ve	**Electrified Lines**	**Non- Electrified Lines**
	V+ to V-	**VA to VB**
	Min 50V Max 150V	Min 20V Max 120V
Min 5:1	Min 8V Max 22V	Min 2V Max 12V

2.6 #1 Relay End Load Test (T5): Load test at the relay end track transformer track terminals with a 0.5Ω shunt across the track terminals, using adaptor integrator.

2.7 #2 Relay End Load Test (T5): Load test at relay end track transformer track terminals with 0.5Ω shunt across the rails, using adaptor integrator.

Electrified Lines	**Non-Electrified Lines**
V+ to V-	**VA to VB**
Min 10V	Min 6V

2.8 #3 Power Supply Test (T6): Measure the power supply voltage and current, under full working load using a digital meter.

Electrified and Non-Electrified Lines	
Voltage Parameters	**Current Parameters**
Min 95V Max 121V	Min 0.3A Max 0.5A

2.9 #3 Transmitter Power Test (T7): (To be completed within 2 minutes)

a) Connect a short circuit between transmitter terminals C- and t6. Disconnect any strapping between t1 and t6.

If any terminal other than t6 is connected to outgoing links, remove the links.

b) Using the Adapter Integrator and a digital meter measure the transmitter power between terminals 1 (+ve) & 3 (-ve) of the transmitter.

c) Reconnect terminals and links.

Electrified and Non-Electrified Lines
Minimum 120V

2.10 #1 Feed End Voltage Test (T8): Measure feed voltage at feed end track transformer track terminals, using adapter integrator with a digital voltmeter on auto range.

2.11 #2 Feed End Voltage Test (T8): Measure feed voltage at feed end, on the rails, using adapter integrator with a digital voltmeter on auto range.

Polarity Ratio +ve : -ve	**Electrified Lines**	**Non- Electrified Lines**
	V+ to V-	**VA to VC**
	Min 50V Max 150V	Min 20V Max 120V
Min 5:1 Max 10:1	Min 8V Max 22V	Min 2V Max 12V

2.12 #3 Pulse Rate Test (T9): Touch the rear casing of the feed end track transformer and count the number of pulses.

Electrified and Non-Electrified Lines
Number of Pulses in 7 Seconds
Min 15 Max 30

2.13 #3 Un-shunted External Interference Test (T10): Disconnect the PSU fuses and using a digital voltmeter set to DC manual range. Measure the voltage at track relay terminals. Reconnect the PSU fuses.

Electrified Lines	Non-Electrified Lines
V2+ to V2-	
Max 10V	Max 6V

2.14 #3 Shunted External Interference Test (T11): Disconnect the PSU fuses and Connect a short circuit across the feed end transformer V+V-. Using a digital voltmeter set to DC manual range; Measure the voltage at track relay terminals. Reconnect the PSU fuses and remove the short circuit.

Electrified and Non-Electrified Lines
V2+ to V2-
Max 7V

END

Includes:	BR-WR Quick Release Track Circuit equipment
Excludes:	All other Track Circuit types

There is no simple relationship between the drop shunt value across the rails and the drop shunt value across the relay (the track relay being remote from the rails and associated transformer-rectifier).

If the voltage across the relay at drop away does not vary on subsequent maintenance tests by more than the percentage permitted, this can be considered a valid drop shunt test for this type of track circuit.

1 Maintenance test

1.1 Carry out a drop shunt test.

Where this is not practicable because the TR is remote from the rails, the following test can be used as an alternative.

a) At the relay end of the track circuit with the train shunt applied across the relay end links, obtain the drop away voltage value across the relay coils.

Details of drop shunt values are in NR/SMS/Part/Z03.

The variation of the drop away voltage should not exceed +/ 10% of the voltage recorded at the last FULL TEST of the track circuit. If the variation exceeds these limits the shunt value shall be determined by a FULL TEST.

1.2 Measure the voltage across the track relay coil with the track circuit clear of trains and train shunt.

1.3 Assess the condition of the ballast.

1.4 Record all test results on the paper or digital record card.

2 Full Test.

A FULL TEST shall be carried out following installation and after alterations (e.g. relaying, ballast cleaning or insulation changing, renewed/ repaired apparatus, leads or jumpers) or changed settings.

2.1 Examine the track circuit (NR/SMS/TC14 Service A.)

Feed End

2.2 Measure the voltages and note the feed unit output strapping, as required on the paper or digital record card. Adjust as necessary.

Relay End

2.3 Measure the rail volts at the relay end rail terminations.

2.4 Measure the track relay coil voltage with the track circuit clear of trains and train shunt.

Final Check

2.5 Train Shunt test all extremities of the track circuit.

2.6 Drop Shunt test the track circuit.

The value of the drop shunt shall be noted, either as the track relay just makes its back contacts, or where only front contacts exist when they are fully open.

2.7 Check, by visual observation, that relay operation is sharp and positive.

Details of drop shunt values are in NR/SMS/Part/Z03

2.8 Record all test results on the paper or digital record card.

2.9 With the shunt box applied across the rails at the relay end, obtain the pickup shunt value.

2.10 Carry out a Maintenance Test.

Appendix A - Feed and Relay Units

1. **Colour Coding of Feed and Relay Units Feed End:**

Westinghouse original units - grey. Other - red.

Relay End:

- Yellow - BR938
- Blue - Shelf Type, 2.25Ω Red - NT1
- White - BR938, DC immune – for DC point heating

2. **Setting up a Quick Release Track Circuit for Testing**

At the track feed unit, adjust the input strapping to suit the 110Vac busbar voltage. Adjust the output strapping to match the length of the track circuit as given in the following table:

Length of Track (Approx) metres	Output Voltage	Strapping
1000	20	2 and 18
900	19	1 and 18
800	18	0 and 18

700	17	2 and 15
600	16	1 and 15
500	15	0 and 15
400	14	2 and 12
300	13	1 and 12
Below 300	12	0 and 12

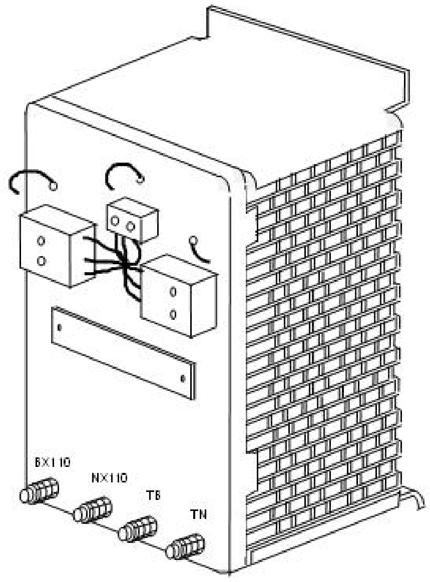


Figure 1: Input strapping and connections

End

Includes:	Reed Type RT Track Circuit equipment (Jointed and Jointless versions)
Excludes:	All other Track Circuit types

High voltages can be present on impedance bonds and other track circuit terminations. Switch off mobile phones if you are working in the proximity (3 meters) of the TX or RX equipment.

A double rail jointed reed track circuit shall never be re-configured as a single rail track circuit.

Due to operating problems, only the jointed configuration can be used in electrified areas. It may be configured as a single rail or a double rail track circuit.

Double rail track circuits require the use of impedance bonds.

More information on Reed Type RT track circuits can be found in NR/L2/SIG/11763

Layout Configurations

The Reed type RT track circuit is an audio frequency track circuit capable of operating in jointless and jointed modes. Both types use the same TX & RX but differ in the way the audio frequency signal is taken from the rails at the TX & RX.

The jointed configuration uses direct connections to the rails as in other TC types; the jointless version uses compound loops between the rails which inductively couple the audio frequency signal between the rails and TX/RX.

The Jointless version is always center fed (except where it adjoins a jointed section) the jointed version can be center fed or end fed.

Additional intermediate RXs can be positioned within both types (Jointed and Jointless) of a Reed TC, with a simple loop of cable mounted in the four foot.

The audio signal in the rails is detected by the simple loop and fed via an attenuator and the RX amplifier/filter to the TR which functions as at a jointed RX.

Track Circuits with Intermediate Receivers

Each of the two overlapping sections where a simple loop is fitted operates as an independent track circuit and shall be tested as such with record cards kept accordingly. Note that the TR will only be shunted by a train directly over the loop.

Centre Fed Track Circuits

Each half of a centre fed track circuit operates as an independent track circuit and shall be tested as such and record cards kept for each part.

Cut Section Track Circuits

Each cut section shall be treated as an individual track circuit and record cards kept accordingly.

Impedance Bond Tuning

Any impedance bond within the track circuit shall be tuned with the correct resonating capacitor across the auxiliary coil. Each tuning capacitor or module identifies the style of bond to which it should be fitted.

'Beating' Receiver Readings

If the receiver filter or dummy amplifier output or track relay voltage readings are seen to 'beat' (the measured voltage will rise and fall at a slow regular rate) interference between two track circuits of the same frequency is occurring. This shall be reported to your SM(S) immediately.

1. Maintenance Test Relay (Receiver) End

1.1 Connect a train shunt to the incoming track circuit terminations in the apparatus case and obtain a drop shunt value.

Where there is a variation in the shunt value from the last recorded (after making allowance for differing weather conditions) the drop shunt test shall be verified by a test carried out with the shunt applied to the rails.

Drop shunt values are in NR/SMS/PartZ/Z03 – Train Detection Reference Values.

1.2 Measure using a digital meter the AC voltage on the receiver track filter (RT7202, RT7212) between terminals 11 and 12.

- 150mV to 300mV

If an attenuator filter is fitted (RT7302) replace this with a dummy amplifier and Measure the output voltage.

- 75mV approx.

If the voltages are incorrect investigate the cause. If the resistor tapings are adjusted the FULL TEST shall be carried out.

1.3 With the track circuit clear of trains and train shunts, Measure the voltage across the track relay coils R1(+) and R4(-).

- Between 11.5V and 13.5V.

This indicates the correct functioning of the receiver.

1.4 Check that the surge arrestor is not hot to the touch. If it is hot check the track circuit adjustments and connections.

1.5 Assess the condition of ballast/ ground conditions.

1.6 Compare results with previous records for significant variation.

A variation in drop shunt value may be caused by variations in the equipment or environment. In wet conditions, a low value of drop shunt can be expected. In dry or icy conditions, a higher value will be obtained.

If the drop shunt exceeds the highest value for the track circuit, look for degraded ballast or debris.

If the drop shunt is lower than the minimum value, the track circuit shall be regarded as failed.

2. Full Test

The full test shall be carried out whenever alterations are made including; relaying, lead/ jumper renewal, equipment replacement, adjustment etc).

2.1 Examine the track circuit in accordance with NRSMS/PartC/TC06 – Track Circuits: Reed - Service A.

2.2 Check the impedance bond (where fitted and where accessible and without removing) for the following:

a) • Correct glands fitted.

b) • Drain holes clear (on Howells & WH3 bonds).

c) • Terminal box connections.

d) • Tuning capacitor.

2.3 Check that the impedance bonds are tuned with the correct resonating circuit across the auxiliary coil.

2.4 With a suitable meter connected across the rails, check that when the resonating circuit is disconnected the rail voltage falls, and when it is re- connected the rail voltage rises.

2.5 Measure the voltage across the resonating circuit; Check that it is in the correct ratio with the rail-to-rail voltage (Appendix A). If not, the impedance bond shall be investigated for a fault.

2.6 Check that all the rail connections and bonding are secure.

If tightened is required, it shall be to the torque detailed in NR/SMS/PartZ/Z03 – Train Detection Reference Values.

Feed (Transmitter) End

2.7 Measure the primary AC voltage of the constant voltage transformer (NT1202) between terminals BX110 and NX110.

- 99V to 121V.

2.8 Measure the supply to the power amplifier between terminals T5 and T6.

- 14V to 16V.

2.9 Measure the DC input voltage of the oscillator amplifier (RT5001) between terminals A1(+) and A2(-):

- 15V to 17V.

2.10 Disconnect a track feed link and connect a suitable meter (capable of measuring AC current to at least 2A) on the AC current range across the link.

a) Apply a short circuit across the rails at the feed end connections and Measure the current (Appendix B).

b) Remove the short circuit and observe that the current reading falls.

c) The current fall should be less than 150mA.

d) Remove the meter and restore the link.

e) Be aware that high back E.M.F. may develop across the link terminals when the link is disconnected.

f) The link terminals shall not be shorted together to discharge the E.M.F. this shall be done using a resistor of approximately 250kΩ or a meter with an equivalent internal resistance.

g) Do not short circuit the output of the power amplifier as this could result in serious damage to the equipment.

Relay (Receiver) End

2.11 Measure the input AC voltage of the power supply unit (RR9121).

- 99V to 121V.

2.12 Measure the DC supply voltage at the receiver amplifier (RR2002) between terminals D2(+) & A3(-)

- 12V to 13.8V.

2.13 Measure using a digital meter the AC voltage on the receiver track filter (RT7202, RT7212) between terminals 11 and 12.

- 150mV to 300mV.

2.14 If any of the values obtained in 2.13 are out of range, the receiver track filter (RT7202, RT7212) shall be adjusted by changing the tapings on terminals 21, 22, and 23.

Before any adjustments are made consideration should be given to the condition of the track causing low ballast resistance or any factors.

2.15 If after adjustments have been made in 2.14 and voltages in 2.13 are still out of range, the feed end track filter (RT7202, RT7212) shall be adjusted on terminals 21, 22 and 23.

When adjustments have been made in 2.13 and 2.14 it is necessary to re-start the FULL TEST at 2.9.

2.16 With the track circuit clear of trains and train shunts Measure the voltage across the track relay coils R1(+) and R4(-)

- Between 11.5V and 13.5V.

Compound Loops (Jointless configurations only)

2.17 Check that the loop is undamaged and securely fitted in the four foot. Check that the connections between the loop and the track filter / surge divider are undamaged and secure.

Intermediate Receivers with Simple Loops (Jointed/Jointless configurations where provided)

2.18 Check that the loop is undamaged and securely fitted in the four foot. Check that the connections between the loop and the attenuator filter are undamaged and secure.

2.19 Measure the input AC voltage of the power supply unit (RR9121).

- 99V to 121V.

2.20 Measure the DC supply voltage at the receiver amplifier (RR2002) between terminals D2(+) & A3(-)

- 12V to 13.8V.

2.21 Replace the attenuator filter (RT7302) with a dummy amplifier and Measure the AC output voltage with a suitable digital meter:

- 75mV approx.

2.22 If any of the values obtained in 2.21 are out of range, the attenuator filter (RT7302) it shall be adjusted by using its variable resistor settings.

Before any adjustments are made consideration should be given to the condition of the track causing low ballast resistance.

2.23 If after adjustments have been made in 2.22 and voltages in 2.21 are still out of range, the feed end track filter (RT7202, RT7212) shall be adjusted on terminals 21, 22 and 23.

When adjustments have been made in 2.21 and 2.22 it is necessary to re-start the FULL TEST at 2.9.

2.24 With the track circuit clear of trains and train shunts Measure the voltage across the track relay coils R1(+) and R4(-)

- Between 11.5V and 13.5V.

Final Checks

2.25 With the train shunt set to 0.5Ω, (0.3Ω if impedance bonds are fitted) drop shunt all extremities of the track circuit.

2.26 With the train shunt applied across the rails, obtain a drop shunt and a pick-up shunt value.

Drop shunt values are in NR/SMS/PartZ/Z03 – Train Detection Reference Values.

2.27 Assess the condition of ballast/ ground conditions and Record all details along with any new settings on the paper or digital record card.

Interference Test

2.28 Remove the BX110 fuse to the TX and Check that the track relay drops. Measure the AC voltage on the TX track filter.

If a reading greater than 8mV is obtained, replace the RX amplifier with a dummy amplifier and Measure the output of this. If a reading greater than 8mV is still found, inform your SM(S) immediately.

Fault Finding Guidelines

Full fault-finding guidelines can be found in NR/L2/SIG/11763.

APPENDIX A - Impedance Bond Voltage Ratios

Impedance Bond Style	Voltage Ratio
DE	40:1
MR	56:1
P3	45:1
S	56:1
WH3	56:1

APPENDIX B - Transmitter Power Amplifier Currents

TC Type	Amplifier Type	Terminals	AC Current	
			Min	Max
Double Rail	RT7101	1 and 2	1.2A	1.8A
	RT7112	10 and 12		
Single Rail	RT7111	1 and 2	1.1A	1.4A
	RT7112	11 and 12		

APPENDIX C - Transmitter Power Amplifier Voltages

TC Type	Amplifier Type	Terminals	AC Voltage (Approx.)
Double Rail	RT7101	1 and 2	17V
	RT7112	10 and 12	
Single Rail	RT7111	1 and 2	13V
	RT7112	11 and 12	

END

Includes:	AC Rectified (Diode) Track Circuit equipment
Excludes:	All other Track Circuit types

Carry out the following tests and record the results on the paper or digital record card.

1. Maintenance Test – Feed / Relay (Near) End

1.1 Note and record the strapping of the feed resistor.

1.2 Measure and record the AC voltage across the feed resistor.

1.3 Measure and record the AC and DC voltage at the relay coils and across the rails.

1.4 Connect a shunt box across the track circuit links and measure the drop away and pick up shunt.

Drop shunt values are in NR/SMS/Part/Z03.

1.5 Compare the results with previous records for significant variation.

1.6 If any adjustment is required then the FULL TEST shall be carried out.

2. Full Test

The full test shall be carried out whenever alterations are made including; relaying, lead/ jumper renewal, equipment replacement, adjustment etc).

Feed/Relay End (Near)

2.1 Note and record the strapping of the feed resistor.

2.2 Measure and record the AC voltage across the feed resistor.

2.3 Measure and record the AC and DC voltage at the relay coils and across the rails.

2.4 Connect a shunt box across the track circuit links and measure the drop away and pick up shunt.

Diode End (Remote)

2.5 Measure and record the AC and DC voltage across the rails.

2.6 Disconnect one side of the diode and Measure the AC and DC current between the disconnected side of the diode and its termination, reconnect the diode.

2.7 Connect a shunt box across the rails and measure the drop away and pick up shunt.

If adjustments are required to the track circuit to bring the drop shunt to a satisfactory level, the full test shall be carried out again.

Appendix A - Strapping Matrix for Feed Resistor Adjustment

The drop shunt can be varied by adjusting the resistor strapping. Increasing the resistance will lower the voltage and increase the drop shunt, conversely decreasing the resistance will increase the voltage and decrease the drop shunt.

Feed Resistance	Input to	Output to	Strap 1	Strap 2	Strap 3	Strap 4
33Ω	T11	T12	T13 to T15	T15 to T17		
22Ω	T11	T12	T13 to T15	T14 to T16		
13.2Ω	T11	T12	T13 to T15	T15 to T14	T11 to T16	
11Ω	T11	T13	T13 to T14			
8.8Ω	T11	T12	T13 to T15	T14 to T02	T16 to T01	
7.3Ω	T11	T13	T01 to T02	T14 to T15	T15 to T13	
5.5Ω	T11	T13	T01 to T02	T13 to T16	T16 to T15	T15 to T14

End

Includes:	FS 2600 Type Track Circuit equipment
Excludes:	All other Track Circuit types

GENERAL

The FS2600 shall never be configured as a single rail track circuit.

High voltages can be present on impedance bonds and other track circuit terminations.

Test Equipment

Only a high impedance digital voltmeter (DVM) like the Fluke 23, Megger M2006 (or equivalent) shall be used for all readings.

A special test lead is required to connect the meter to the receiver unit monitor point socket.

A manufacturer's set up box is required for the receiver sensitivity set up.

A universal track circuit shunt box shall be used for all drop shunt tests.

Impedance Bonds

Howells or Westinghouse Mk3 type bonds require a 5mm drain hole in the bottom of the termination box to prevent water accumulation.

Impedance Bond Tuning Capacitors

Check the tuning capacitor is mounted as close as possible to the terminal block to reduce failures caused by vibration induced flexing.

Alternatively, the capacitor can be mounted on the wall of the terminal box and connected to the terminals by means of a fly lead made of fine multi-stranded wire soldered to the capacitor and connected to the terminal block by crimp connectors.

Equipment Disconnection

Check that the TX end fuse is removed before making any alterations or connections to the TX end impedance bond. Before removing the TX or RX remove the power supply and track fuses.

After changing an RX unit, the receiver sensitivity procedure shall be carried out. It is however permissible to delay this for up to 24 hours by re-using the configuration plug from the old unit providing a satisfactory drop shunt test has been carried out.

Configuration Plug

It has been found that in some instances internal wires in the configuration plug can become trapped by the cover leading to internal shorting and incorrect operation of the track circuit. When changing the plug always check that no wires have become trapped by the cover.

Carry out the following tests and record the results on the paper / digital record card

1. Maintenance Test Feed

Transmitter End

1.1 Check the security and the fixing of the TX equipment.

Transmitter and Intermediate Impedance Bond (Where Fitted)

1.2 Check the impedance bond for the following:

a) Correct glands fitted.

b) Drain holes clear (on Howells & WH3 bonds).

c) Terminal box connections.

d) Tuning capacitor connecting leads for cracks or fractures.

1.3 Check that all the rail connections and bonding are secure.

If tightened is required, it shall be to the torque detailed in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

Relay (Receiver) End

1.4 Check the security and the fixing of the RX equipment.

1.5 Observe the RX unit LEDs are giving the correct ‘track clear’ indications (Appendix A).

1.6 Remove the RX unit monitor point socket protective cover and connect the DVM to the socket using the special test lead. Measure the track clear monitor point voltage.

1.7 Connect the track shunt box across the rails at the intermediate impedance bond or if at the end of track circuit section connect it at the RX unit.

1.8 Set the shunt box to 0.6Ω and depress the button.

1.9 Observe the LEDs are giving the correct track shunted indications (Appendix A).

LEDs Input-A Valid and Input-B Valid might not change states simultaneously when the track is shunted, a momentary delay might be observed.

1.10 Measure the track shunted monitor point voltage then release the shunt button.

1.11 Compare the results with previous records obtained under similar conditions. If the results are not similar the cause shall be investigated and rectified. A FULL TEST shall then be carried out.

1.12 Disconnect the track shunt box and the DVM from the RX monitor point socket.

1.13 Check that the protective cover is refitted to the RX monitor point socket.

1.14 Check the impedance bond for the following:

a) Correct glands fitted.

b) Drain holes clear (on Howells & WH3 bonds).

c) Terminal box connections.

d) Tuning capacitor connecting leads for cracks or fractures.

1.15 Check that all the rail connections and bonding are secure.

If tightened is required, it shall be to the torque detailed in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

1.16 Record the ballast and weather conditions on the paper / digital record card.

2. Full Test

The full test shall be carried out whenever alterations are made including relaying, lead/jumper renewal, equipment replacement, adjustments etc.

2.1 Examine the track circuit in accordance with NR/SMS/PartC/TC09 (Track Circuits:FS2600) - Service A.

Feed (Transmitter) End

2.2 Examine the TX unit case, connectors, terminations and plug couplers.

2.3 Check the connections, wiring and terminations (as applicable) and ventilation grills. Check that they are not blocked.

2.4 Measure the supply voltage between terminals 14 and 15:

a) 99V to 121V AC.

2.5 Check that the TX voltage adjustment tap is set to 115V (terminal 11 linked to terminal 8).

2.6 Measure using a DVM the voltage on the TX output terminals and the voltage across the rails. Check they are within the limits shown in the Table 1:

TC Type	TX O/P Terminal	O/P Voltage	Rail Voltage
Without Intermediate	3 and 4	80V to 120V AC	5V to 11V AC
With Intermediate Bond	5 and 6	160V to 240V AC	6V to 15V AC

Table 1

Transmitter End Impedance Bond (Where Fitted)

2.7 Remove the TX end track fuse and apply a short circuit across the tuning capacitor then refit the TX end track fuse.

2.8 Measure the voltage across the auxiliary coil. Check that this is less than the voltage across the cables from the TX, if it is not, reverse the phasing of the impedance bond.

2.9 Measure the TX rail voltage, then remove the TX end track fuse, and remove the short circuit across the tuning capacitor. Refit the TX end track fuse.

2.10 Measure the rail voltage, check it has increased with the short removed from the tuning capacitor and is within the limits as follows:

a) No Intermediate Bond 5V to 11V AC.

b) Intermediate Bond Fitted 6V to 15V AC.

Intermediate Impedance Bond (Where Fitted)

2.11 Measure the rail voltage:

a) Minimum of 3V.

2.12 Measure the voltage across the auxiliary coil; Check this voltage when the bond is resonated is in the ratio of 1:56 to the rail voltage.

If it is not the impedance bond shall be investigated for a fault.

2.13 Measure the rail voltage then apply a short circuit across the tuning capacitor, check the voltage falls then remove the short circuit.

2.14 Disconnect the tuning capacitor, check the rail voltage falls. Reconnect the tuning capacitor.

Relay (Receiver) End

2.15 Examine the RX unit case, check the connections, wiring and terminations (as applicable).

2.16 Check the ventilation grilles are not blocked.

2.17 Observe the RX unit LED's are giving the correct 'track clear' indications (Appendix A).

2.18 Measure the supply voltage:

a) 99V to 121V AC.

2.19 Remove the RX unit monitor point socket protective cover and connect the DVM to the socket using the special test lead. Measure the track clear monitor point voltage.

2.20 Connect the track shunt box across the rails at the intermediate impedance bond or if at the end of track circuit section connect it at the RX unit.

2.21 Drop shunt the track circuit, measure the shunt when both RX relays are de-energised.

Drop shunt values are in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

2.22 Observe the operation or the relays through the RX window. Check both relays drop when both Valid LEDs are extinguished.

2.23 Observe the LEDs are giving the correct track shunted indications (Appendix A).

2.24 LEDs Input-A Valid and Input-B Valid might not change states simultaneously when the track is shunted, a momentary delay might be observed.

2.25 Measure the track shunted monitor point voltage.

The Input-A Valid and Input-B Valid LEDs might not extinguish at the same monitor point voltage. However, the higher reading must not exceed the lower reading by 10%.

2.26 If a satisfactory drop shunt cannot be obtained the cause shall be investigated and rectified, a FULL TEST shall be carried out again.

Receiver End Impedance Bond (Where Fitted)

2.27 Measure the rail voltage:

a) Minimum of 3V.

2.28 Remove the RX end track fuse and apply a short circuit across the rails, apply a short circuit across the tuning capacitor then remove the short circuit from across the rails.

2.29 Measure the rail voltage and check it has fallen from the value obtained in 2.27. Remove the short circuit across the tuning capacitor.

3. Final Checks

3.1 Train shunt all extremities of the track circuit.

3.2 Check that the protective cover is refitted to the RX monitor point socket after the DVM is removed.

3.3 Record the ballast and weather conditions on the track circuit record card.

4. Receiver Sensitivity Set Up Procedure

These tests shall be carried out if a receiver unit has been replaced. The set-up box is to be used.

4.1 Connect a shunt box across the rails at the intermediate bond (if fitted) otherwise at the RX end. Check by use of a DVM the rail voltage disappears when 0Ω is applied via the shunt box button.

4.2 Remove the RX track fuse.

This is to check that the RX unit is not damaged when the set-up plug or configuration plug are removed.

4.3 Connect a DVM switched to AC to SK1 and SK2 on the set-up box, set the MIN/MAX control to ‘MAX’, set the COARSE and MEDIUM switches to position 4, set the FINE switch to position 1 and set the ‘LINK’ switch to ‘SET UP’.

4.4 Fit a blank configuration plug shell to the 15-way D type connecter on the set-up box.

4.5 Check for correct alignment and fit.

4.6 Connect the 25-way connector loom to the set-up box and the other ends to the 9-way and 15-way connectors on the RX unit. Re-fit the track fuse.

4.7 Look up the Channel Specific Value for the channel number in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

Check that account is taken of any intermediate bond.

4.8 Press the set-up button and adjust the MIN/MAX control until the reading on the DVM matches the Channel Specific Value. Lock the MIN/MAX control and release the set-up button.

4.9 Set the shunt box to 4Ω. Press the button on the shunt box and the set-up button on the set-up box. Measure the voltage on the DVM and record it as 'ratio'. Release the buttons on both boxes.

4.10 Look up the MPV set up 'step increase' in Appendix B for the channel number and locate the 'ratio' in Appendix C. Move up the table the number of rows of the 'step increase' value and record the target MPV set up value.

4.11 Adjust the 'COARSE', 'MEDIUM' and 'FINE' switches in turn to get the reading on the DVM as close as possible to the target value and within the upper and lower limits.

4.12 Set the 'LINK' switch from 'SET UP' to 'LINK A', if the 'NO LINK' LED is lit go to 4.14. If it is not lit go to 4.13.

Note which LEDs on the set-up box are lit and connect one of the wire links provided with the configuration plug between the pins on the configuration plug corresponding to the lit LEDs on the set-up box.

4.13 If the lit LEDs do not extinguish or if other LEDs light check the link for correct fitment.

4.14 Set the 'LINK' switch in turn to 'LINK B, LINK C' and 'LINK D' Repeat 4.13 if any of the LED's (except the 'NO LINK' LED) light.

4.15 Turn the switch back from 'LINK D' to 'LINK A' ensuring that the LEDs around the configuration plug remain extinguished (except the 'NO LINK' LED).

4.16 If any light, remove all the links using the provided extractor tool and start again at 4.12.

4.17 Remove the configuration plug from the set-up box and check each pin and wire for the links are pushed firmly home into the connector hole. Check each is fully home by gently pulling on the wire.

4.18 Fit the hood to the configuration plug and write the link settings and name of the track circuit on the labels provided affixing these to the hood.

4.19 Remove the RX track fuse. Remove the 15-way D type plug from the RX leaving the 9-way connector in place. Fit the configuration plug to the RX 'SET UP' socket.

Do not over tighten the securing screws.

4.20 Re-fit the RX track fuse and check that the DVM is still indicating a value between the upper and lower limits of the MPV set up. If not start the Receiver Sensitivity Procedure again from 4.1.

4.21 With the shunt box still connected, set it to 0.6Ω and press the button. Measure the monitor point voltage.

4.22 Record the target and actual MPV set up link settings, weather and ballast conditions on the front of the track record card. Compare the new reading with the previous readings reporting any differences to your SM(S).

4.23 Observe that the LEDs in the RX unit are indicating that the track is shunted (Appendix A).

4.24 If the LEDs do not indicate that the track circuit that is shunted with the 0.6Ω drop shunt look for a fault with the track circuit or an error in the set-up process and then repeat the FULL TEST.

4.25 If this does not remedy the low drop shunt it can be improved by adjusting the 'COASE', 'MEDIUM' and 'FINE' switches to lower the MPV (to a minimum of 2.2v). You shall inform your SM(S).

Never increase the gain.

4.26 Remove the 9-way D type connector from the RX 'MONITOR POINT' and check that the protective cover is correctly fitted.

4.27 Drop shunt the track circuit, measure the shunt when both RX relays are de-energised.

Drop shunt details are in NR/SMS/PartZ/Z03 (Train Detection – Reference Values).

4.28 Observe the operation or the relays through the RX window. Check that both relays drop when both Valid LEDs are extinguished.

4.29 With the train shunt still applied obtain a pickup shunt value.

4.30 Repeat 4.28 and 4.29 with the train shunt applied to the incoming track circuit cable terminations in the apparatus case/equipment room.

4.31 Record all the obtained values and details with the latest setting number from the front of the record card and the reverse of the card.

Appendix A - Receiver Unit LED Indications

LED	Track Clear	Track Shunted
Supply	On	On
µP A Running	Flashing	Flashing
Input-A Valid	On	Off
µP B Running	Flashing	Flashing
Input-B Valid	On	Off
Output	On	Off

Table 2

Appendix B - MPV Set Up

	Channel Specific Value		
Channel Number	**WITH With Intermediate Bond**	**WITHOUT Without Intermediate Bond**	**MPV set- up Step Increase**
CH 1	0.957	0.961	6
CH 2	0.963	0.967	5
CH 3	0.968	0.972	3
CH 4	0.974	0.977	1
CH 5	0.978	0.980	2
CH 6	0.982	0.984	3
CH 7	0.987	0.989	4
CH 8	0.992	0.993	4
CH 9	0.995	0.996	3
CH 10	1.000	1.000	0

Table 3

Appendix C - MPV Ratio and Limits

Ratio WITH Intermediate Bond	Ratio WITHOUT Intermediate Bond	MPV set- up Target	MPV Upper Limit	MPV Lower Limit
0.523 – 0.531	0.418 - 0.425	7.40	7.49	7.31
0.531 – 0.538	0.425 – 0.432	7.22	7.31	7.13
0.538 – 0.545	0.432 – 0.438	7.04	7.13	6.95
0.545 – 0.550	0.438 – 0.444	6.87	6.95	6.78
0.550 – 0.556	0.444 – 0.449	6.70	6.78	6.62
0.556 – 0.561	0.449 – 0.454	6.54	6.62	6.46
0.561 – 0.566	0.454 – 0.460	6.38	6.46	6.30
0.566 – 0.572	0.460 – 0.465	6.22	6.30	6.15
0.572 – 0.577	0.465 – 0.470	6.07	6.15	6.00
0.577 – 0.582	0.470 – 0.476	5.92	6.00	5.85
0.582 – 0.587	0.476 – 0.481	5.78	5.85	5.71
0.587 – 0.592	0.481 – 0.486	5.64	5.71	5.57
0.592 – 0.597	0.486 – 0.491	5.50	5.57	5.43
0.597 – 0.602	0.491 – 0.496	5.37	5.43	5.30
0.602 – 0.607	0.496 – 0.501	5.23	5.30	5.17
0.607 – 0.612	0.501 – 0.507	5.11	5.17	5.04
0.612 – 0.616	0.507 – 0.512	4.98	5.04	4.92
0.616 – 0.621	0.512 – 0.517	4.86	4.92	4.80
0.621 – 0.626	0.517 – 0.522	4.74	4.80	4.68

Ratio WITH Intermediate Bond	Ratio WITHOUT Intermediate Bond	MPV set- up Target	MPV Upper Limit	MPV Lower Limit
0.626 – 0.630	0.522 – 0.527	4.63	4.68	4.57
0.630 – 0.635	0.527 – 0.531	4.51	4.57	4.46
0.635 – 0.640	0.531 – 0.536	4.40	4.46	4.35
0.640 – 0.644	0.536 – 0.541	4.30	4.35	4.24
0.644 – 0.648	0.541 – 0.546	4.19	4.24	4.14
0.648 – 0.653	0.546 – 0.551	4.09	4.14	4.04
0.653 – 0.657	0.551 – 0.555	3.99	4.04	3.94
0.657 – 0.661	0.555 – 0.560	3.89	3.94	3.84
0.661 – 0.666	0.560 – 0.565	3.80	3.84	3.75
0.666 – 0.670	0.565 – 0.569	3.70	3.75	3.66
0.670 – 0.674	0.569 – 0.574	3.61	3.66	3.57
0.674 – 0.678	0.574 – 0.578	3.53	3.57	3.48
0.678 – 0.682	0.578 – 0.583	3.44	3.48	3.40
0.682 – 0.686	0.583 – 0.587	3.36	3.40	3.32
0.686 – 0.690	0.587 – 0.592	3.27	3.32	3.23
0.690 – 0.694	0.592 – 0.596	3.19	3.23	3.16
0.694 – 0.698	0.596 – 0.600	3.12	3.16	3.08
0.698 – 0.701	0.600 – 0.604	3.04	3.08	3.00
0.701 – 0.705	0.604 – 0.608	2.97	3.00	2.93
0.705 – 0.709	0.608 – 0.613	2.89	2.93	2.86
0.709 – 0.712	0.613 – 0.617	2.82	2.86	2.79
0.712 – 0.716	0.617 – 0.621	2.75	2.79	2.72
0.716 – 0.719	0.621 – 0.625	2.69	2.72	2.65
0.719 – 0.723	0.625 – 0.628	2.62	2.65	2.59
0.723 – 0.726	0.628 – 0.632	2.56	2.59	2.53
0.726 – 0.730	0.632 – 0.636	2.50	2.53	2.47
0.730 – 0.733	0.636 – 0.640	2.43	2.47	2.40
0.733 – 0.736	0.640 – 0.643	2.38	2.40	2.35
0.736 – 0.739	0.643 – 0.647	2.32	2.35	2.29
0.739 – 0.742	0.647 – 0.650	2.26	2.29	2.23
0.742 – 0.746	0.650 – 0.654	2.21	2.23	2.18
0.746 – 0.749	0.654 – 0.657	2.15	2.18	2.13
0.749 – 0.752	0.657 – 0.661	2.10	2.13	2.07
0.752 – 0.755	0.661 – 0.664	2.05	2.07	2.02
0.755 – 0.757	0.664 – 0.667	2.00	2.02	1.97
0.757 – 0.760	0.667 – 0.670	1.95	1.97	1.93
0.760 – 0.763	0.670 – 0.674	1.90	1.93	1.88

Ratio WITH Intermediate Bond	Ratio WITHOUT Intermediate Bond	MPV set- up Target	MPV Upper Limit	MPV Lower Limit
0.763 – 0.766	0.674 – 0.677	1.86	1.88	1.83
0.766 – 0.769	0.677 – 0.680	1.81	1.83	1.79
0.769 – 0.771	0.680 – 0.683	1.77	1.79	1.74
0.771 – 0.774	0.683 – 0.686	1.72	1.74	1.70
0.774 – 0.776	0.686 – 0.689	1.68	1.70	1.66
0.776 – 0.779	0.689 – 0.691	1.64	1.66	1.62
0.779 – 0.781	0.691 – 0.694	1.60	1.62	1.58
0.781 – 0.784	0.694 – 0.697	1.56	1.58	1.54
0.784 – 0.786	0.697 – 0.700	1.52	1.54	1.50
0.786 – 0.789	0.700 – 0.702	1.49	1.50	1.47

Table 4

END

Includes:	All single and double rail 50Hz track circuits, VT1(SP) types
Excludes:	All other Track Circuit types

High voltages might be present on the terminals of capacitors in circuit at the feed or relay end of a track circuit, on impedance bonds and other track circuit terminals.

Always use an insulated spanner to turn the nuts of links connecting fixed or adjustable capacitors.

Links shall be held by their insulated knobs.

Capacitors disconnected from a circuit shall be discharged for safety by temporarily applying a short circuit to them (NR/SMS/PartC/TC00 (Track Circuits General) contains details of how to discharge a capacitor).

Damaged or disconnected red bonds, shall be reported to E.C.O. and the required actions taken.

A faulting guide and adjustment details for this type of track circuit can be found in NR/SMTH/Part10/FF07 (Faulting Guide: 50Hz AC Track Circuits).

Cut Section Track Circuits:

Each cut section shall be treated as an individual track circuit and record cards kept accordingly.

Bonding:

Damaged or disconnected bonds (other than red bonds, see ‘warning’), shall be investigated and actioned.

Before bonding is connected, all contact surfaces shall be wire brushed and a thin film of electrolytic paste applied.

Bonds across rail joints shall be of a low resistance as this can influence the characteristics of the track circuit.

Over Resonance (See Also Special Stagger Test)

Over resonance of impedance bond track circuits, or ‘Spanish Condition’, occurs when setting the relay end capacitor to over resonate combines with the inductance of the track to create a circuit that can resonate with applied 50Hz interference even when the track feed is shunted.

The usual cause is a high relay end capacitance (associated with an incorrectly phased relay end bond) and a failed IRJ. To prevent this, relay end capacitor settings above 9μF shall be avoided where possible or the Special Stagger Test carried out.

Layout Configurations

Where a short double rail track circuit (100m or less) with impedance bonds is required, the design normally employs a single rail feed transformer in reverse mode, with its low voltage winding feeding the track.

VT1(SP) Track Circuits:

The VT1(SP) track circuit has been designed to replace standard single rail 50Hz AC track circuits in limited situations where certain electric traction units have been authorised to run (e.g. class 373 trains).

The VT1(SP) track circuit uses the same principle of operation as the standard 50Hz type but has a delay unit attached to its adapted VT1 type relay by an interconnecting cable.

In this configuration, the clearing of the track circuit after removal of the train shunt is delayed by at least 2 seconds.

The VT1(SP) unit is also distinguished from the standard VT1 by having a revised small label at the bottom of its plug board and a large label at the top of its plug board.

The feed transformer is wired such that the primary and secondary windings are interchanged so as to achieve an output of 85V - 90V. A label shall be attached to the transformer to inform personnel that the primary and secondary connections have been wired in this way.

A 30μF - 60μF variable capacitor is used instead of the standard 20μF type at the feed end to increase current flow and rail voltage.

A 21Ω 15W variable resistor is added at the relay end to de-sensitise the relay end circuit and reduce the relay voltage to 1.5V +/- 0.5V.

A label should be attached to the resistor warning personnel not to change it or its adjustment setting.

Traction Spikes at Relay End

<u>Double Rail Track Circuits:</u>

This can be prevented by fitment of a transient suppressor unit with the permission of the Route Asset Manager (S&T).

<u>Single Rail Track Circuits:</u>

This can be prevented by fitment of an isolating transformer with the permission of the Route Asset Manager (Signals).

Installing Insulated Rail Joints: (IRJs)

When an IRJ is renewed, it shall be cleaned of any swarf and fully tested at the time of installation.

Check good electrical contact by scraping off rust down to bright metal before attaching test probes.

Glued IRJ's shall be tested with a 500V insulation tester before they are welded into place.

SGE AB711 Style Relay

There is a known failure mode with this type of track circuit, where the vane cuts a groove into the stop allowing it to become jammed. This can lead to a Wrong Side Failure, where the track circuit shows clear whilst occupied.

A workshop Instruction was issued to resolve the failure mode in 1962, but some of the unmodified relays are still in operational use.

When carrying out maintenance and an unmodified AB711 relay is found, report it to your SM(S).

1. Maintenance Test

Control Voltage, Phase Angle, and Stagger Tests

1.1 Measure the voltage across the control coil with the track circuit clear of trains and train shunt. Compare the results with the previous results.

The phase and stagger tests assume the use of the MK 4 direct reading phase angle meter (cat. no. 40/56014), if other test instruments are to be used for these, consult the relevant documentation since complex calculations can be required.

1.2 Connect the 'Local' and 'Control' as shown in Table 1 .

	Local BX		**Control BX**	
Relay	**Red Lead**	**Black Lead**	**Red Lead**	**Black Lead**
VT1 &VT1(SP)	7 or 1	8 or 2	5	6
G2/G4	Q1	Q2	R1	R2
CE391	Q1 or 7	Q2 or 8	R1 or 5	R2 or 6
AB401/AB402	Q1	Q2	R1	R2
L4	Q1	Q2	R1	R2
AB711	Q1	Q2	R1	R2

Table 1 - Phase Angle Measurement

1.3 Measure the phase angle with the switch in the “Phase Angle” position (Appendix A).

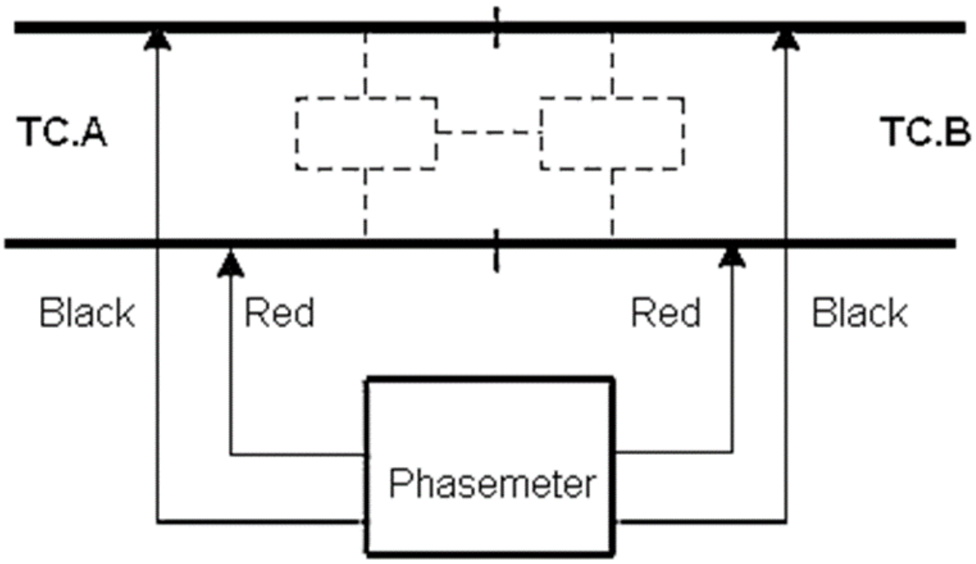
The ideal readings are, with the phase angle between 55º and 85º and the phase voltage 25% above the normal operating voltage given on the relay label.

1.4 Connect the meter as shown below and set the switch to “stagger”.

For the correct stagger the Mk4 meter needle shall be in the green sector with both green lights alight.

The needle just reaches the green sector (100º - 110º) for stagger between a double and single rail track circuit.

The needle should be well into the green sector (160º - 180º) for the stagger between two double rail track circuits.



To conserve the internal batteries, switch to PHASE (OFF) when readings are not being taken.

Drop Shunt Test

1.5 At the relay end of the track circuit, connect the train shunt box across the rails and drop shunt the track circuit.

Drop shunt values can be found in NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

If a satisfactory drop shunt value is not obtained, fully check and re-test the track circuit according to the Full Test procedure (entering comment in the “Remarks” section of the record card).

Single Rail Track Circuits Only:

1.6 With the train shunt set to 0.5Ω apply the shunt across the rails at all 'stub end' extremities of the track circuit.

If the train shunt does not drop the relay, the bonding shall be investigated.

1.7 Assess the condition of the ballast.

Record all test results on the paper or digital record card. Compare the results with the previous results.

Significant changes in the drop away shunt value shall be investigated. (Any changed weather conditions that could affect the ballast resistance shall be taken into account).

2. Full Test

On installation and after alterations, e.g. relaying, ballast cleaning or insulation changing has taken place, apparatus has been changed, leads or jumpers have been renewed/repaired or settings have been changed, a Full Test shall be carried out. These tests assume the track circuit is not occupied by a train unless otherwise stated.

2.1 Examine in accordance with NR/SMS/PartC/TC08 (Track Circuits: AC 50Hz) Service A.

2.2 With the train shunt set to 0.5Ω, apply the shunt across the rails at all the extremities of the track circuit. Check that the track relay drops sharply.

3. Feed End

3.1 Measure the following voltages, adjusting as necessary.

a) Power supply - Acceptable value is 99V - 121V.

b) Across the feed links. Single Rail TCs.

c) Across Surge Arrester. Double Rail TCs.

d) Across the rails.

e) The capacitor and note the capacitor setting.

3.2 Measure the current to the track. Between 0.4A and 0.8A for standard type and between 0.4A and 1.4A for VT1(SP).

3.3 If applicable, carry out Feed End Impedance Bonds steps.

4. Relay End

4.1 Measure the following voltages, adjusting as necessary.

a) Across the rails.

b) Across the feed links. Single Rail TCs.

c) Across Surge Arrester. Double Rail TCs.

d) The track relay coil.

4.2 Measure the current from the track. Between 0.3A and 0.5A.

4.3 Record the approximate control resistor setting.

4.4 Measure the Control Voltage (Steps 1.1 and 1.2).

4.5 Measure the Phase Angle and carry out the Stagger Tests (Appendix A).

4.6 If applicable, carry out Relay End Impedance Bonds steps.

5. Local Policy Requirement

5.1 If applicable and only during a B service, Check the section of the NR/SMS/PartL/Index (Local Policies) for your area and carry out NR/SMS/PartB/Test/041 (Insulated Rail Joint Test) as directed.

6. Feed End and Relay End Impedance Bonds

6.1 Check that terminal B of the capacitor is connected via terminal E of the surge arrestor to the rail, and not to the bond coil.

6.2 Measure the voltage across the rails and the capacitor. Note the capacitor setting.

Calculate the voltage ratio and compare with the values given in the Impedance Bond Voltage Ratio Table, (Appendix C).

If necessary, carry out remedial action in accordance with the notes in Appendix C.

6.3 Measure the voltage across auxiliary coil and check that the bonds are phased correctly.

The voltage from/to the track shall be equal to or greater than the auxiliary coil voltage plus the voltage across the rails. If not, the auxiliary coil connections shall be reversed and the track retested.

If the feed end bond auxiliary coil is reversed, then the feed end transformer secondary connection shall also be reversed to maintain the correct stagger.

If the relay end bond auxiliary coil is reversed, then the track relay control coil connection shall also be reversed to maintain the correct operation of the track circuit.

6.4 If applicable, with trains running, check the traction imbalance in each section between bonds.

Take readings with peak hold current clamp meters on each side lead and observe the balance is within 5%.

6.5 Check that all the rail connections and bonding are secure. If tightening is required, it shall be to the torque detailed in NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

7. Relay End Impedance Bonds

In addition to the steps 2.13 to 2.17 above carry out the following steps.

7.1 If the relay end capacitor is set at more than 9μF, check that an intermediate bond nearer to feed end (if fitted) is not set above 9.3μF.

7.2 Check the relay stability by increasing and decreasing the setting of the relay end capacitor by 1μF (or 0.323μF if provided), in turn.

Withdraw and replace the relay fuse at each alteration and check that the relay re-energises each time.

If it does not, then fully check and re-test the track circuit.

7.3 If a relay end bond capacitor is set at more than 10μF carry out the Special Stagger Test (Appendix A).

For settings above 12μF, inform your SM(S) before proceeding.

8. Intermediate Bonds

8.1 Measure the voltage across the rails and the capacitor. Note the capacitor setting.

Calculate the voltage ratio and compare with the values given in the Impedance Bond Voltage Ratio Table, (Appendix C).

If necessary, carry out remedial action as directed by the notes in Appendix C.

8.2 If applicable, with trains running, check the traction imbalance in each section between bonds.

Take readings with peak hold current clamp meters on each side lead and observe the balance is within 5%.

8.3 Check that all the rail connections and bonding are secure. If tightened is required, it shall be to the torque detailed in NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

8.4 Check that the voltage between the apparatus housing metalwork and the following terminals is less than 10V AC.

a) Relay capacitor terminal B.

b) Relay control resistor.

c) Surge arrestor terminal E.

This check is to determine that the relay capacitor terminal B is connected to the surge arrestor terminal E and NOT to the impedance bond coil.

If the result is greater than 10V AC then the wiring to the rails shall be reversed as follows:

If the tail cable core numbering on the surge arrestor conforms to the wiring diagram, then reverse the tail cable cores at the impedance bond.

If the tail cable core numbering on the surge arrestor does not conform to the wiring diagram, then alter the cable cores at the surge arrestor to correspond with the diagrams.

Where two single cores are used, reverse them at the surge arrestor as this avoids going onto the track and opening up the bond terminal.

9. Final Checks

These tests shall be undertaken when satisfactory setting values have been obtained:

Drop shunt values are in NR/SMS/PartZ/Z03 (Train Detection - Reference Values).

9.1 With the shunt box connected across the rails at the relay end, obtain the Pick-Up shunt value.

It should be approximately 25% above the drop shunt figure.

9.2 Check the voltages across the track relay control and local coils are still satisfactory.

9.3 Re-secure any capacitor switch locking bars provided.

9.4 Record the values and other details on the paper or digital record card.

APPENDIX A - Stagger Test

To prevent the feed of one track circuit incorrectly energising the relay of an adjacent track circuit when an IRJ fails, it is essential that the rails of these adjacent track circuits are of opposite polarities.

This is called the ‘stagger’ of the track circuits.

For 50Hz AC track circuits, correct stagger is maintained by verifying that adjacent track circuits are ‘out of phase’ with each other.

Important Notes

a) Phase angle is directly related to the phase angle of the supply derived from the grid feeder point.

b) Where substation switching causes the supply to be fed from a different grid point, the phase angle of each track circuit supplied from that point can change phase by 180º. This might lead to un-staggered tracks, particularly at the boundaries of the affected supply area.

c) To prevent this, it is essential that the stagger of all affected track circuits is checked where the supply has changed its grid feeder point – advanced warning should be provided by the Electrical Control Room for that area.

d) At some boundary sites, a special supply is fed from the adjacent substation area to supply one or more track circuits with a supply of the same phase as their opposite ends.

e) This supply busbar should carry an identifying label, and in no circumstances shall track circuits supplied by one supply be switched to the other supply.

Phase Test

Connect the MK 4 direct reading phase meter at the relay terminals or plug board to avoid case wiring errors and any traction suppressors.

The meter gives a phase angle of between 0ºand 180º. The phase lead or lag is indicated by red lights.

APPENDIX B - Special Stagger Test

Carry out this test whenever a relay end bond capacitor needs to exceed 10μF so as to obtain satisfactory operation of the track circuit.

Do not adjust the relay end capacitor above 12μF without the permission of the Route Asset Manager (Signals).

Use a MK 4 direct reading phase angle meter.

1. Connect the ‘local’ and ‘control’ as shown in Maintenance Test step 1.1.

2. Short out one relay end IRJ and observe the behaviour of the track relay during passage of an electric powered train over the track circuit under test.

   ***NOTE:** Any phase change or voltage rise on the direct reading meter.*

   If there is a tendency of the relay vane to lift off its backstop during the passage of a train, accompanied by a large swing in phase angle and a rise in control voltage, proceed to step 4.

3. Remove the short circuit from across the IRJ.

Track Circuit Fails Special Stagger Test

4. Check that tests in the FULL TEST up to 2.21 are satisfactorily completed.

5. Check there is no residual voltage across relay coil with feed fuse removed.

6. Check that relay phase angle inverts by about 180º from its ‘TC clear’ position when shunted by a train.

7. Check the voltage across the feed capacitor equals voltage across surge arrestor plus voltage across transformer secondary winding.

8. Check the voltage across the relay capacitor equals voltage across surge arrestor plus the voltage across relay control coil.

9. Check the feed current falls when track circuit is occupied.

10. Check the feed capacitor is not set to a higher value than relay capacitor.

11. If, after any defects have been rectified and all checks satisfactory, relay end capacitor still set at over 10μF consult your SM(S).

APPENDIX C - Impedance Bond Voltage Ratio Table

Impedance Bond Style	Voltage Ratio	Approx. DC Auxiliary Coil Resistance
WH3 (Howells)	56:1	3.3Ω
WH3 (WRSL)	56:1	3.0Ω
MR	56:1	3.4Ω
S	56:1	3.0Ω
P3	45:1	2.5Ω
DE	40:1	5.5Ω
M	42:1	4.0Ω (T0/T3)
M2/5	42:1	3.48Ω (T0/T3)
DD	42:1	5.5Ω
B	45:1	5.0Ω
B (Kent Coast only)	66:1	5.0Ω

Table 2 - Impedance Bond Voltage Ratio Table

The combination of G4 track relay and type 2 or type 3 impedance bonds shall be avoided.

If the ratio is more than 10% lower than the value stated above, the bond is faulty. If the bond is type WH3, MR or S the entire bond shall be replaced.

For other bonds the fault might be further isolated by checking the auxiliary coil resistance.

If this is correct the traction coil is defective, and the bond shall be replaced. The auxiliary coil might be replaced as an interim measure and re-tested.

On site replacement of the auxiliary coil cannot guarantee the precise tuning of the air gap, which requires workshop test equipment.

Arrangements shall be made to replace the bond at the earliest opportunity.

END

Includes:	Overlay Rail Circuit equipment
Excludes:	All other Rail/Track Circuit types

1. Maintenance test

1.1 Check that the rail circuit relay is de-energised.

Run In End

1.2 Apply a 0.5Ω shunt across the rails at the remote end of the rail circuit and check that the rail circuit relay energises.

1.3 Measure and record the relay voltage. The voltage should be less than the saturation voltage level of the relay, if not readjust as a corrective maintenance item.

1.4 Measure and record, using two train shunt boxes in series increase the resistance until the rail circuit relay de- energises.

1.5 Measure and record the relay voltage.

The voltage should be equal to or less than the relay drop away voltage.

Run Off End

1.6 Apply a 0.5Ω shunt across the rails at the remote end of the rail circuit and check that the rail circuit relay energises.

1.7 Measure and record the relay voltage. The voltage should be less than the saturation voltage level of the relay, if not readjust as a corrective maintenance item.

1.8 Measure and record, using two train shunt boxes in series increase the resistance until the rail circuit relay de- energises.

1.9 Measure and record the relay voltage.

1.10 Check that the rail circuit relay is de-energised at the end of the tests.

1.11 Record all test results on the paper or digital record card. (SMS Part R Test 261-Overlay Track)

End

Includes:	Single Frequency DC Coded Tracks (Used on the Western Route)
Excludes:	All other DC Coded Tracks

For information on this type of Track see SMS Appendix 12

1. Maintenance Test

Feed End

1.1 Using a digital volt meter with a Min/Max facility. Set the DVM to DC Min/Max and measure the DC voltage across the rails, allowing a few cycles to capture the positive and negative impulses.

1.2 Note the (+/-) values and record the results on the record card.

Relay End

1.3 Using a digital volt meter with a Min/Max facility. Set the DVM to DC Min/Max and measure the DC voltage across the rails, allowing a few cycles to capture the positive and negative impulses.

1.4 Note the (+/-) values and record the results on the record card.

1.5 Connect a train shunt across the track links. Obtain a drop shunt value.

It can be difficult to ascertain exactly at which point a CFR is de energised and energised.

As the train shunt value is reduced, the CFR “beat” will slow as the incoming 75 cycles per minute are interrupted/ distorted, and the voltage across the CFR R1/R2 connection diminishes.

The CFR will eventually slow to a point where its front contacts will fully open. The CFR may still be observed to still “pulse” slightly whilst resting on its back contacts, but as long as the front contacts remain broken, this can be accepted as a successful shunt.

1.6 Record the values on the paper / digital record card.

1.7 With the train shunt still connected across the track links, obtain the pick-up value.

The pick-up is achieved by increasing the shunt value until the back contacts break, the front contacts make and the CFR starts to beat. At first the pulse will seem irregular. Continue to increase the shunt until the distinctive and regular “beat” can be observed and heard. The front and back contacts should now be open for an equal amount of time.

1.8 Record the value on the record card and disconnect the shunt box.

1.9 If the drop shunt is lower than the minimum value shown in NR/SMS/Part Z/03, assess the ballast/ground conditions. Compare the results with previous records for any significant variations. Where there is a significant variation in values, retest the track. If there are still variations then a full test should be carried out.

A variation in drop shunt value may be caused by variations in the equipment or the environment. In wet conditions a higher drop shunt value can be expected. In dry or icy conditions, a lower value may be obtained. Poor ballast conditions can also affect the value of the drop shunt (see NR/SMS/TC00).

2. Full Test

A full test should be carried out whenever alterations are made including relaying, lead/jumper renewal, equipment replacement / adjustment etc.

2.1 Examine the track in accordance with NR/SMS/TC05 service A.

Feed End

2.2 Measure and record the feed end voltages, resistor settings, and other parameters as shown on the full test paper or digital record card

Relay End

2.3 Measure and record the feed end voltages, resistor settings, and other parameters as shown on the full test paper or digital record card (NR/SMS/T262/DC Coded)

2.4 Measure and record the Min/Max +/- DC voltage on the CFR coil.

2.5 Connect a train shunt across the track links. Obtain a drop shunt value and pick-up values.

2.6 If the drop shunt lower than the minimum value shown in NR/SMS/Part Z the track should be regarded as “failed” and the cause investigated.

2.7 With the track shunt set at 0.5 ohms, apply the shunt across the rails at the extremities of the track circuit. Check the CFR ceases oscillating.

2.8 Assess the condition of the ballast/ground.

2.9 Compare the results with previous records for any significant variations. Where there is a significant variation in values these should be investigated.

Due to the design of this DC Coded Track Circuit no residual voltage testing is required

End

Includes:	EBI Track 400 Audio Frequency Track Circuit
Excludes:	All other Track Circuits

1. Maintenance Test A1

Feed (Transmitter) End

1.1 Check all rail connections and bonding are tightened to the correct torque (Appendix K of NR/SMS/Appendix/10).

1.2 Check the display for a steady 'RUN' indication. If one of these indications cycles with the indication 'ERR' then refer to NR/SMS/Appendix/10 and investigate the reason for the error. An 'ERR' state shall not be left without authority from the SM (S).

Impedance Bonds (where fitted)

1.3 Check the impedance bond for the following:

a) Bond Covers correctly fitted and not damaged.

b) Drain holes clear (on Howells & WH3 bonds).

It is necessary to drill drain holes if they are not present. (Pre installation check).

c) Tuning capacitor or tuning module connections.

1.4 Check all rail connections and bonding are tightened to the correct torque (Appendix K of NR/SMS/Appendix/10).

Relay (Receiver) End

1.5 Check all rail connections and bonding are tightened to the correct torque (Appendix K of NR/SMS/Appendix/10).

1.6 Measure the rail-to-rail voltage at the EBI Track 400 equipment rail connections (Pole) using a TTM/MTM Vp, (See NR/SMS/Appendix/10 for additional information). For consistency this measurement shall always be carried out at the rails.

1.7 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.
For a Single Rail track circuit the measurement shall be made in the Signal rail.

1.8 Where a tuned circuit is involved, Measure using a TTM/MTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 1.6 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against the detail found in NR/SMS/Appendix/10. If the ratio is below specification, the low result usually relates to badly dressed cables and or poor connections, therefore, Check that the cables are dressed correctly and that all Tuning units' connection are correct, clean and tight.

1.9 Where a tuned circuit is involved, Repeat steps 1.6 to 1.8 for the adjacent/abutting track at this tuned zone – This track is 'under test' for the purposes of these steps.

1.10 Check the display for a steady 'PICK' or 'drop' indication. If one of these indications cycles with the indication 'ERR' then refer to NR/SMS/Appendix/10 and investigate the reason for the error. An 'ERR' state shall not be left without authority from the SM(S).

1.11 Record the Ith Threshold using the display on the receiver and compare this reading against the Record Card.
The Threshold value should be identical to previous recorded values. If it is not, the track has been set up without being noted on the record card and a Full Test shall be carried out.

1.12 Record the Inow AV current using the display on the receiver and compare this reading against the Record Card.
If the obtained reading is not within 10% of the Record Card, the reason for the discrepancy shall be investigated.

The RX current is the best measure of the track circuits' stability. Significant deviations from previous readings shall be investigated.

A significant deviation is indicated if the change of track current is greater than:

- ±20% OR
- ±10mA.

1.13 Record the ballast and weather conditions on the track circuit Record Card.

1.14 Using a shunt applied to the rails between the RX tuning unit rail connections obtain a drop shunt value and a pick up shunt value.

Shunt values are detailed in NR/SMS/Part/Z03.

On the pick-up shunt, allow 2 seconds between each value to allow the slow to pick relay drive from the RX to operate.

A Station Area frequency track will pick up in 1 second.

The pick-up value should normally be 0.1Ω higher than the drop shunt.

1.15 Compare the results with previous records (if available) obtained under similar conditions. If the results are not within ±10% the cause shall be investigated and rectified as appropriate. A FULL TEST shall then be carried out.

2. Full Test

2.1 Examine the track circuit in accordance with NR/SMS/TC17 service A.

Feed (Transmitter/OM) End

2.2 Examine the TX unit case, connector and terminations and check the plug coupler is pushed fully home.

2.3 Examine the TX unit frequency key and check it is fully turned to the right and latched into the key holder.

NOTE: Unlatching the key or removing it will cause the Relay to be de-energised and the track show occupied.

2.4 Examine the OM unit case, connector and terminations and check the plug coupler is pushed fully home.

2.5 Measure the voltage on the 110V signalling supply to the PSU.

2.6 Measure the voltage from the PSU to the Transmitter/OM (Vpsu). It should be in the range of 46VDC to 50VDC.

2.7 Measure the DC current drawn by the equipment.

- Open Line Frequencies, >250m long : 1.5A to 5A
- Open Line Frequencies, <250m long : 0.2A to 1.5A
- Station Area Frequencies, 1.5A to 5A

2.8 Measure the TX output voltage across terminals TM1 and TM2 using a TTM/MTM.

It should be in the range of 32V RMS to 34V RMS.

2.9 Record the OM Step Setting and Resistor Setting.

- OM Step setting is in the range from 1 to 27
- OM Resistor setting for Open Line frequencies –set at 0R
- OM Resistor setting for Station Area frequencies set at
  - 48R for TC feed<750m
  - 0R for TC feed>750m to 2km

2.10 Record the OM output voltage (Vout).

2.11 For Open Line frequency tracks - Measure the LMU(TU) I/P Voltage.

It should be in the range of 50V to 148V RMS.

2.12 For Open Line frequency tracks - Measure the TX TU/ETU I/P voltage on terminals 4 & 5 (Meter).

It should be in the range of:

0.6V to 2.0V RMS for track lengths 20m to 250m
0.5V to 15.0V RMS for track lengths 250m to 1100m

For Station Area frequency tracks - Measure the TX SATU/CU I/P voltage on terminals LINE 1 & 2 (Meter).
A value of 95V RMS shall not be exceeded.

2.13 Measure the rail-to-rail voltage at the EBI Track 400 equipment rail connections (Pole) using a TTM/MTM (Vp, See NR/SMS/Appendix/10).
For consistency this measurement shall always be carried out at the rails.

2.14 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.
For a Single Rail track circuit the measurement shall be made in the Signal rail.

2.15 Where a tuned circuit is involved, Measure using a TTM/MTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 2.13 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against the details found in NR/SMS/Appendix/10. If the ratio is below specification, Check that the cables are routed correctly and that all Tuning Unit connections are correct, clean and tight.

Impedance Bond and Track Capacitors (Where fitted)

The impedance of an impedance bond can be checked by measuring the EBI Track 400 voltage across the bond and the current through it. To take the current measurements use a Rocoil connected to a TTM.

2.16 Check all rail connections and bonding are tightened to the correct torque (See Appendix K of NR/SMS/Appendix/10)

2.17 Check the security and the fixing of the Track capacitor.

2.18 Measure using a TTM/MTM the rail-to-rail voltage.

Clauses 2.19 and 2.20 are not applicable to B3 3000 and B3 500 bonds

2.19 Measure the voltage across the auxiliary coil or tuning module, Check it is in the correct ratio with the rail-to-rail voltage (See NR/SMS/Appendix/10). If it is not the impedance bond shall be investigated for a fault.

2.20 Apply a short circuit across the tuning capacitor/module, Check that the rail voltage falls then remove the short circuit and Check the voltage rises.

Clauses 2.21 to 2.25 are applicable to Intermediate bonds only.

2.21 Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the TTM (= amps, I1).

2.22 Repeat the measurement 1 metre from the bond on the RX side (I2)

2.23 Subtract I2 from I1 thus obtaining the current through the bond at the EBI Track 400 frequency.

2.24 Measure the rail to rail voltage (V) across the impedance bond.

2.25 Divide the voltage (V) by the current calculated from 2.23 thus giving the impedance (Z), Z= V / (I1-I2).

This value should be greater than 8Ω. If less than 8Ω, Check for traction imbalance before remedial action is taken with the impedance bond.

Relay (Receiver) End

2.26 Examine the RX unit case, connector and terminations and check the plug coupler is pushed fully home.

2.27 Examine the RX unit frequency key and check it is fully turned to the right and latched into the key holder.

Unlatching the key or removing it will cause the Relay to be de-energised and the track show occupied.

2.28 Measure the voltage on the 110V signalling supply to the PSU.

2.29 Measure the voltage from the PSU to the Receiver.

It should be in the range of 46VDC to 50VDC.

2.30 Measure the DC current drawn by the equipment.

- Relay Up : 100mA to 150mA DC

2.31 Check the display for a steady 'PICK' or 'drop' indication. If one of these indications cycles with the indication 'ERR' then refer to NR/SMS/Appendix/10 and investigate the reason for the error. An 'ERR' state shall not be left without authority from the SM (S).

2.32 For Open Line frequency tracks - Measure the RX TU/ETU O/P voltage on terminals 1 & 2 (Meter).

It should be in the range of 0.3V to 1.7V RMS.

For Station Area frequency tracks - Measure the RX SATU/CU O/P voltage on terminals LINE 1 & 2 (Meter).

2.33 Measure the rail-to-rail voltage at the EBI Track 400 equipment rail connections (Pole) using a TTM/MTM (Vp, See NR/SMS/Appendix/10).
For consistency this measurement shall always be carried out at the rails.

2.34 Measure the rail current in the rail within 1 metre and on the track circuit side of the rail connections with a Rocoil.
For a Single Rail track circuit the measurement shall be made in the Signal rail.

Low rail volts or rail current could be due to ballast or other track equipment, as well as a fault at the TX end of the track.

2.35 Where a tuned circuit is involved, Measure using a TTM/MTM the rail-to-rail voltage at the companion TU rail connection (Zero) at the frequency of the track circuit under test. (Vz).

The voltage measured in 2.33 (Vp Pole) divided by the voltage at the companion TU (Vz Zero) gives the Tuned Zone ratio (Tzr) where Tzr = Vp/Vz.

Check the ratio against the details found in NR/SMS/Appendix/10. If the ratio is below specification, the low result usually relates to badly dressed cables and or poor connections, therefore, Check that the cables are dressed correctly and that all Tuning units' connection are correct, clean and tight.

2.36 Record the Inow AV current using the display on the receiver and compare this reading against the Record Card.

If the obtained reading is not within 10% of the Record Card, the reason for the discrepancy shall be investigated.

If adjustment is required an auto-set routine shall be performed.

The RX current is the best measure of the track circuits' stability. Significant deviations from previous readings shall be investigated.

A significant deviation is indicated if the change of track current is greater than:

- ±20% OR
- ±10mA.

2.37 Record the Ith current value using the display on the receiver and compare this reading against the Record Card.

The reading should be identical to the Record Card.

If the readings are not identical, the track has been adjusted without recording the event. A new auto-set routine shall be performed.

2.38 Record the Inow ITOT current using the display on the receiver and compare this reading against the Record Card.

If the obtained reading is not within 10% of the Record Card, the reason for the discrepancy shall be investigated.

This is usually because there is an external noise sources creating undesired wideband interference.

2.39 Record the Inow QUAL value using the display on the receiver and compare this reading against the Record Card.

Anything less than 100% shall be investigated for poor signal transmission along the track circuit.

2.40 Measure the voltage across the energised track relay coils.

- 48V to 52V DC for the RX MOD 2 or later.

2.41 Using a train shunt applied to the rails between the RX tuning unit rail connections obtain a drop shunt value and a pick up shunt value.

Shunt values are detailed in NR/SMS/Part/Z03.

On the pick-up shunt allow 2 seconds between each value to allow the slow to pick receiver relay drive to operate.

A Station Area frequency track will pick up in 1 second.
The pick-up value should normally be 0.1Ω higher than the drop shunt.

2.42 Compare the results with previous records (if available) obtained under similar conditions. If the results are not similar the cause shall be investigated and rectified as appropriate. The FULL TEST shall then be repeated.

2.43 Record the ballast and weather conditions on the track circuit Record Card.

Interference Test (Crosstalk and Feedthrough)

This test checks the levels of in band and traction interference present at the RX, and requires temporary disconnection of the TX.

Check the fusing arrangements before this test as more than one track circuit can be affected.

2.44 Remove the B48 fuse or switch off the MCB to the TX and Check that the correct track relay drops. Record the Inow AV value from the receiver.

Open Line Double Rail tracks: The Inow AV reading shall be less than 8mA.

Open Line Single Rail tracks with 30m bonding: The Inow AV reading shall be less than 3mA.

Readings greater than these values shall be investigated.

Station Area tracks : The Inow AV reading shall be:

- less than 10% of 'Ith' OR
- less than 20mA

whichever is the lower.

A higher level shall be investigated (look for disconnected cable screens, TU failure, etc.) The track circuit shall be signed out of use and your SM (S) informed.

Extremity Tests

2.45 For Open Line frequency tracks - Apply a shunt, using the minimum shunt values, at the extremities of the track circuit, in accordance with the track plan, and Check the track relay drops for each application.

Minimum Shunt values are detailed in NR/SMS/Part/Z03.

For Station Area frequency tracks – Set a shunt box to 0.2Ω and carry out a shunt test at the following points in the track circuit:

- TX Pole, Mid Point, RX Pole
- At any other ends in Points tracks.

The track circuit should drop and record the RX current for each location with the Shunt in place.

Station Area Frequency Tuned Zone Impedance

2.46 For Station Area frequency tracks with Tuned Zones – Measure and Calculate the Tuned Zone Impedance at the TX and RX ends.

At the TX end calculate TZimp: $\mathrm{TZimp} = \left(\frac{\mathrm{CT}}{\mathrm{Ish}} - 1\right)$

Where: CT = Receiver input current (Inow AV) Measured when track is clear
Ish = Receiver input current (Inow AV) measured when a 1Ω shunt has been applied at the Tx end rail connections.

At the RX end calculate TZimp: $\mathrm{TZimp} = \left(\frac{\mathrm{CT}}{\mathrm{Ish}} - 1\right)$

Where: CT = Receiver input current (Inow AV) Measured when track is clear
Ish = Receiver input current (Inow AV) measured when a 1Ω shunt has been applied at the Rx end rail connections.

Repeat the RX end calculation for any other RX Tuned Zones in the track circuit.

TZimp shall be > 0.4Ω in all cases.

End

Includes:	Unistar HR
Excludes:	IBCL, RCPL and All Powered Point Machines and Mechanical points

GENERAL

Before the FPL test is carried out, a safe system of work shall be established so that a Signaller cannot set a route over or control the points being tested. See NR/SMS/PartA/A04 (Method Statement Summary).

To avoid injury whilst placing and removing gauges, it is recommended that you use the hands-free gauges (ask your SM(S)) or hold the gauges with pliers or mole grips.

Observe the Lock Prism indicators through the windows on the DLD (Drive, Locking, Detection) unit lid, only remove the lid of the DLD unit if the detection requires to be adjusted, or the windows are obscured (e.g. by dirt/moisture).

All adjustments shall be recorded as corrective maintenance.

Confirm detection by connecting a meter to the outgoing KR circuit with a final check in liaison with the Signaller that indications are visible at the signalling control centre.

Confirm that detection is made and broken by referring to the meter only.

1. FPL Test

These steps shall be undertaken for both normal and reverse positions of the points.

Use the 3.5mm point checking gauge and a 1.5mm gauge for this test.

1.1 Place the points on manual.

For the TOE Drive Lock and Detect Unit (DLD):

1.2 Place the 3.5mm gauge between the switch and stock rail at a point midway between the Drive and Detection Rods (this is where the two switch rail connection brackets meet).

1.3 Manually operate the points to the closed position and check that Lock Prism Indicators fail to align.

a) Check that detection is broken.

b) If the lock prism fails to complete its travel and engage, then this is a pass. Record the result on the record card and proceed to Step 1.4.

c) If the lock prism completes its travel, then this is a failure, and the drive rod end requires adjustment.

Additional gauges shall be added in 0.5mm increments until the lock prism fails to complete its travel. If the lock is still made at 5mm, this shall be recorded, reported to Integrated Control Centre (ICC), and investigated.

Carry out remedial action, the drive rod end shall now be adjusted to bring the points back to a position where they fail the 3.5mm test.

When the lock fails at 3.5mm proceed to step 1.4.

1.4 Place the 1.5mm gauge between the switch and stock rail at a point midway between the Drive and Detection Rods (this is where the two switch rail connection brackets meet).

a) Manually operate the points to the closed position and check that the Lock Prism Indicators align.

b) Check that detection is made.

c) If the Lock Prism Indicators align but detection is not made, then the test shall be treated as a fail.

Carry out remedial action, the detector rod end shall now be adjusted to bring them back to a position where they pass the 1.5mm test.

This action will require the main lid of the DLD to be removed to verify the detector bar markings – refer to Figure 1.

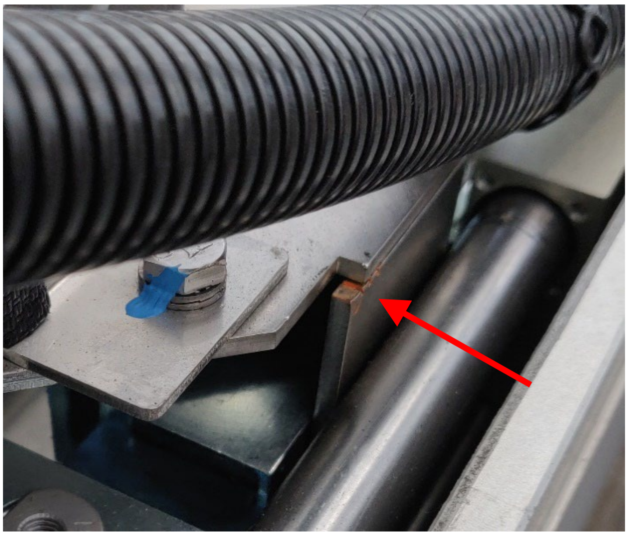


Figure 1 – Detector Bar Markings (indicated by arrow)

In wet or inclement weather the drying bags shall be removed and stored safely and the DLD body left open for the shortest possible time.

On completion of the work, any moisture shall be carefully removed, and the drying bags replaced before the lid is replaced.

When detection is made at 1.5mm you can proceed to step 1.5.

1.5 Repeat steps 1.2 to 1.4 for the opposite switch.

1.6 If it has been necessary to adjust either Drive or Detector rod ends, carry out NR/SMS/PartB/271 (Detector Test (Unistar)).

1.7 Restore the points to power.

1.8 Record the results of the FPL test on the record card.

1.9 Carry out a final check before completion of the work by asking the Signaller to operate the points to normal and reverse (twice if possible). Observe correct operation.

END

Includes:	Unistar HR
Excludes:	IBCL, RCPL and All Powered Point Machines and Mechanical points

GENERAL

Isolate the point machine by opening / turning the access lever on the hydraulic power pack. Select Normal or Reverse direction for manual operation. Disconnect the outgoing point detection from the DLD (Drive, Locking, Detection) unit or apply an alternative safe system of work (See NR/SMS/PartA/A04).

Gauges

a) 1.5mm & 3.5mm gauges for Toe drive positions.

b) 2mm & 4mm gauges for Supplementary drive positions.

1. DLD at Toe Position

1.1 Place the points on manual, and manually operate points to the normal position.

1.2 Check the correct voltage is present on the outgoing circuit (KR lines) for the closed switch on the links in the disconnection box.

1.3 Check the correct voltage is present on the outgoing circuit (KR lines) for the open switch on the links in the disconnection box.

1.4 Open the switch blade and insert the 3.5mm gauge between the stock and switch rail, aligned centrally to the detector rod at the normal position.

1.5 Manually operate the points and test that detection is broken, check that the witness marks on the detector plate are not visible.

1.6 Repeat using the 1.5mm gauge and test that detection is made, and the correct voltage is present.

1.7 Check that the witness marks on the Detector Plate are protruding such that the cover plate sits between the first and second witness mark. This equates to a detection position between 0mm and 2.5mm from switch closed position.

Where the witness marks (See Figure 1) indicate detection is being made between 2.5mm and 5mm (cover plate sits between second and third mark), adjust the detector bar to return the visible detection marks to sit between the first and second mark, equating to the 0mm to 2.5mm range.

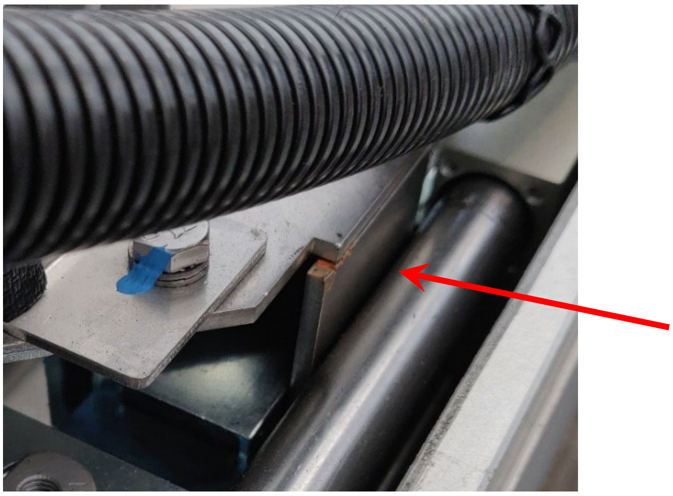


Figure 1 - Detector Plate witness marks indicating optimal set up between marks for 0mm and 2.5mm

1.8 Repeat Tests 1.2 to 1.7 for reverse side.

1.9 If supplementary Drive DLDs are fitted, proceed to Step 2. Otherwise complete Step 3.

2. Supplementary Drive DLDs (if fitted)

2.1. Place the points on manual, and manually operate the points to the normal position.

2.2. Check that the correct voltage is present on the outgoing circuit for the closed switch.

2.3. Check that the correct voltage is present on the outgoing circuit for the open switch.

2.4. Open the switch blade and insert the 4mm gauge between the stock and switch rail, aligned centrally to the detector rod at the normal position.

2.5. Manually operate the points and check that detection is broken. Check that the witness marks on the Detector Plate are not visible.

2.6. Insert the 2mm gauge between the stock and switch rail, aligned centrally to the detector rod.

2.7. Check that the witness marks on the Detector Plate are protruding such that the cover plate sits between the first and second witness mark. This equates to a detection position between 0mm and 2.5mm from switch closed position.

Where the witness marks indicate detection is being made between 2.5mm and 5mm (cover plate sits between second and third mark), adjust the detector bar to return the visible detection marks to sit between the first and second mark, equating to the 0mm to 2.5mm range.

2.8. Repeat Tests 2.2 – 2.7 for the reverse position.

2.9. Repeat tests 2.1 to 2.8 for each supplementary drive DLD.

3. Final Checks

3.1 Replace all covers / lids and latch securely.

3.2 The final check before completion of the work is to restore the points to power and ask the Signaller to operate the points to normal and reverse positions (twice if possible). Observe correct operation.

END

GENERAL

The tasks and tests stated in this section are to be carried out on equipment after incidents of flooding. If a piece of equipment is not covered below, inform your SM(S).

Equipment types

1. Train Operated Points (Hydro-Pneumatic).
2. Machine Operated Points.
3. Pneumatic Point Machines & Train Stops.
4. HPSS Point Systems.
5. Rail Clamp Point Lock.
6. Electrical Detectors.
7. Mechanical Fittings and Points.
8. Trackside Apparatus Cases & Equipment Rooms.
9. Electronic Equipment.
10. Rail / Sleeper Attached / Mounted Equipment.
11. Electrically Lit Signals.
12. Semaphore Signal Machines.
13. Operational Telephones.
14. Lever Frames, Lever Locks & Circuit Controllers.
15. Hydraulic Trainstops.
16. Automatic/Manually Controlled Level Crossing Equipment.
17. Mechanical Gated Level Crossings.

1. Equipment & Associated Action Required

Train Operated Points (Hydro-Pneumatic).

These use a closed hydraulic system.

1.1 Check the integrity of seals.

1.2 Check electrical connections for corrosion, contamination, and damage. Rectify or renew as necessary.

1.3 Carry out NR/SMS/PartB/Test/018 (Train Operated Points Detection Test).

1.4 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

1.5 Test for correct operation and indication for normal & reverse positions.

2. Machine Operated Points

Includes:	HW, ML, MV- GRS Model 5, SGE HA, SGE HB, WBS 63, WBS M3 & M3A
Excludes:	All other Machine Operated Points

2.1 Clean and wipe contacts & terminal blocks.

2.2 Check electrical connections and terminal blocks for corrosion, contamination, and damage. Rectify or renew as necessary.

2.3 Clean and wipe parts that have a moving metal-to-metal contact surface (gear wheels etc) and apply new lubricant (oil or grease as approved).

2.4 Clean and wipe motor bushes and commutator operate point motors and check for any excessive noise/sparking/smell.

2.5 The electromagnetic clutch of HW2000s could have become blocked by silt. Attempting to operate the points might reveal any problems, renew as required.

2.6 Carry out NR/SMS/PartB/Test/001 (FPL Test Machine).

2.7 Carry out NR/SMS/PartB/Test/011 (Electrical Detection Test - Machine).

2.8 Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

2.9 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

2.10 Test for correct operation and indication for normal & reverse positions.

3. Pneumatic Point Machines & Train Stops

Includes:	Point machine types WBS EP&D, SGE VB
Excludes:	All other Pneumatic Point Machines & Train Stops

The air main pump is the responsibility of the Plant Engineer who should confirm that this part of the system is working correctly.

3.1 Clean and wipe contacts & terminal blocks.

3.2 Check seals/gaiters for damage.

3.3 Clean air filters & exhausts.

3.4 Renew damaged/corroded items as required.

3.5 Wash and wipe parts that have a moving metal-to-metal contact surface (gear wheels, lock bars etc) and apply new lubricant (oil or grease as approved).

3.6 Remove accumulated water from the air supply (including supply main valves).

3.7 Bleed points might be provided. High-pressure air systems are prone to rapid corrosion due to the high concentration of oxygen.

3.8 Clean the oil filter and renew the lubricant.

Point Machines Only:

3.9 Carry out NR/SMS/PartB/Test/001 (FPL Test - Machine).

3.10 Carry out NR/SMS/PartB/Test/011 (Electrical Detection Test - Machine).

3.11 Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

3.12 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

3.13 Test for correct operation and (point machines) indication for normal & reverse positions.

4. HPSS Point Systems

Includes:	ECU, LVDT, Motor & Brake
Excludes:	All other HPSS Point Systems

HPSS systems are designed to withstand submersion in up to one meter of water.

4.1 Check cable insulation, cable entry points, plug couplers and all electrical equipment for insulation damage and secure fitment.

4.2 Renew components as required.

4.3 Remove any obstructions on the torsion back drive.

4.4 Wash and wipe the nuts & thread on the lost motion drive if contaminated.

4.5 Carry out NR/SMS/PartB/Test/004 (FPL Test - HPSS).

4.6 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

4.7 Test for correct operation and indication for normal & reverse positions.

5. Rail Clamp Point Lock

These use a vented hydraulic system.

5.1 If it is suspected the water level has risen above reservoir fill-hole level renew the pump unit, drain the hydraulic system, and compress the actuators to expel any fluid.

5.2 Renew the hydraulic fluid NR/SMS/PartB/Test/015 (Clamp Lock: Test for air in the system).

5.3 Check the pump unit electrical connections, terminal blocks, and mechanical components for corrosion, contamination, and damage. Rectify or renew as necessary.

5.4 Check the microswitch assembles, if they are of the ITW type, no further action is required.

5.5 If they are of any other type (e.g. Dowty), renew the microswitch assembles.

5.6 If you are in doubt about the type of microswitches, ask your SM(S).

5.7 Clean and apply new lubricants to the following on the open switch:

a) Fixed & adjustable cams.

b) Lock arm.

c) Locking piece.

d) Lock arm pivot.

5.8 Manually pump across and repeat on the other switch.

5.9 Carry out NR/SMS/PartB/Test/003 (Facing Point Lock Tests - Clamp Lock).

5.10 Carry out NR/SMS/PartB/Test/013 (Detection Test – Clamp Lock).

5.11 Carry out NR/SMS/PartB/Test/019 (Detection Loop Test).

5.12 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

5.13 Test for correct operation and indication for normal & reverse positions.

6. Electrical Detectors

Includes:	BR998 type, Crewe type, LMS type, SGE type.
Excludes:	All other Electrical Detectors

6.1 Clean and wipe contacts & terminal blocks.

6.2 Check electrical connections and terminal blocks for corrosion, contamination, and damage. Rectify or renew as necessary.

6.3 BR998 detectors: Check the microswitch assembles; if they are of the ITW type, no further action is required.

6.4 If they are of any other type (e.g. Dowty), renew the complete detector.

6.5 If you are in doubt about the type of microswitches, ask your SM(S).

6.6 Wash and wipe parts that have a moving metal-to- metal contact surface and apply new lubricant (oil or grease).

6.7 As required, carry out :

a) NR/SMS/PartB/Test/010 (BR998 Detector Electrical Tests).

b) NR/SMS/PartB/Test/011 (Electrical Detection Test - Machine).

c) NR/SMS/PartB/Test/016 (Supplementary Detection Test).

d) NR/SMS/PartB/Test/019 (Detection Loop Test).

6.8 If not undertaken as part of the point actuator tasks.

6.9 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test).

6.10 Test for correct operation and indication for normal & reverse positions.

7. Mechanical Fittings and Points

Includes:	Wire/Rodding runs, Cranks, Semaphore, Signal fittings, Mechanical detectors, Mechanical back drives, Point fittings.
Excludes:	All other Mechanical Fittings and Points

7.1 Check wire/rodding runs are free from any obstructions. Check all foundations are stable. Check all pulley wheels/roller wheels are free to move.

7.2 Pulley wheels & roller wheels shall not be lubricated, unless using a dry film lubricate.

7.3 Clean, wash and wipe all cranks/semaphore signal fittings. Fill the bearings with new lubricant. Check the crank/fitting for security and freedom of movement.

7.4 New grease shall be pumped in to expel the existing grease in the bearing.

7.5 Clean the bearing surfaces on oil lubricated cranks and flood the bearing with new oil. Check any bearing covers (e.g. 'Top Hats') are replaced or renewed if missing.

7.6 Excess grease and oil shall be wiped away.

7.7 Clean, wash and wipe all mechanical detectors.

7.8 Apply new lubricant to the detector slide and rollers.

7.9 Carry out NR/SMS/PartB/Test/012 (Detection Test – Mechanical).

7.10 Brush and wash all exposed screw threads, then wipe clean.

Mechanical points as required:

7.11 Carry out a NR/SMS/PartB/Test/002 (FPL Test Mechanical).

7.12 Test by operation all signals and points that are mechanically operated. Check correct indications / detection are given for each operating position of the equipment.

8. Trackside Apparatus Cases & Equipment Rooms

Includes:	Disconnection boxes, Lineside & Tail Cables, Multicore, Twin & single core Cables, terminal blocks & links, Internal single core wires, Power supplies, Fuses and holders, Relays, Contactors.
Excludes:	All other Trackside Apparatus Cases & Equipment Rooms

8.1 Clean and wipe all racking, shelving, casings/walls.

All cables, Wires, and Terminals:

8.2 Examine insulation, terminations, terminal blocks, and links. clean and wipe terminal blocks and links, renew if necessary. Renew crimps or re-terminate as necessary.

Internal Wires:

8.3 Examine length of wire, renew if insulation has been damaged / degraded or if all the wire has been totally submerged.

Lineside and Tail Cables:

8.4 Carry out NR/SMS/PartB/Test/054 (Cable Insulation Test).

8.5 Fuses and Fuse Holders: Remove each fuse in turn and check to see if it has blown. Clean and wipe the fuse holder. Replace with new fuses only after the equipment it feeds has been checked.

Power Supplies:

8.6 Examine transformers & transformer/rectifiers (TJ) for evidence of water penetration. Clean and wipe terminals and terminal blocks.

If the TJ contains electronics replace unit. Renew primary and secondary cells if it is suspected that water has risen above the vent/filling caps.

Busbars fitted with ELDs:

8.7 Carry out NR/SMS/PartB/Test/053 (ELD Test & Calibration).

Busbars without ELDs:

8.8 Carry out NR/SMS/PartB/Test/051 (Bus Bar Earth Test).

Relays and Relay Bases:

8.9 Remove relay and spade connectors. Clean and wipe relay base and spade connectors, renew if necessary. Renew relay and test for correct operation.

Timer relays:

8.10 Check each relay using NR/SMS/PartB/Test/061 (Relay Timer Test).

Contactors:

8.11 Clean and wipe terminals and contact faces. Examine components for corrosion, contamination and damage. Rectify or renew as necessary.

9. Electronic Equipment

Includes:	TPWS modules, HABD scanners, Inverters, UPS, SSI modules, Axle counter evaluators & lineside junction boxes (EAK).
Excludes:	All other types of Electronic Equipment.

TPWS Modules:

9.1 Clean and wipe terminations.

9.2 Examine each module by tilting forwards and inspecting the front 'window'. If no water is seen, the module is OK for continued use.

If water is seen, the module shall be replaced.

Other Electronic/Computer Scanners/Modules/Units:

9.3 Examine equipment. If water is known or suspected of entering the equipment, it shall be replaced.

10. Rail / Sleeper Attached / Mounted Equipment

Includes:	Treadles, TC equipment, AWS, ATP, TPWS OSS & TSS, TASS Balise, Axle counter rail contacts, HABD Transducers.
Excludes:	All other Rail / Sleeper Attached / Mounted Equipment.

Mechanical Treadles:

10.1 Renew treadle.

Freddy Treadle:

10.2 Clean and wipe terminations, test by operation.

Track Circuit Tuning Units:

10.3 Renew equipment.

Track Circuit Connections and Bonds:

10.4 Clean and wipe the connections as necessary. Check the security of the connections and any clips or orange pipe used, renew if necessary.

Check if orange pipe is used that any accumulated water has drained off, rectify if necessary. Check the security of any fishplate bonds, renew if necessary. Check where any TC passes through a level crossing with Bomacs or other crossing surfaces.

Remove or flush out any trapped debris or other contaminates.

Older types of Bomacs have a metal band around them. Trapped metallic objects can easily short out the TC.

Insulated Rail Joints:

10.5 Carry out NR/SMS/PartB/Test/041 (Insulated Rail Joint (IRJ) Tests).

Impedance Bonds:

10.6 Check rail terminations, termination box and/or connection points. Clean and wipe as necessary. Test the bond as per Track Circuit Test (250 to 263) at NR/SMS/PartB/Index.

All Track Circuits:

10.7 Carry out a full Track Circuit Test (250 to 263) NR/SMS/PartB/Index.

AWS Equipment:

10.8 Clean and wipe as necessary.

10.9 Check the security of the magnets and ramp.

Check the termination box on the electro / suppressed permanent magnet, clean and wipe terminations and links.

Renew crimps and connections if necessary.

10.10 Carry out NR/SMS/PartB/Test 024 (AWS Tests).

ATP (GWML) Equipment:

10.11 Check the Beacon, infill loop and termination boxes for damage and security, clean and wipe terminations and links.

Renew crimps and connections if necessary.

Test the loop resistance, renew if necessary.

ATP (Chilterns) Equipment:

10.12 Renew the loop electronics unit. Check the loop and termination boxes for damage and security. Clean and wipe terminations and links.

Renew crimps and connections if necessary.

10.13 Carry out NR/SMS/PartB/Test/029 (ATP Equipment (Chilterns) Loop Test).

TPWS OSS & TSS:

10.14 Check the OSS and/or TSS loops and associated disconnection boxes for damage and security, renew if necessary.

Clean and wipe terminations and links.

Renew crimps and connections if necessary.

10.15 Carry out NR/SMS/PartB/Test/230 (Train Protection and Warning system (TPWS) Tests).

Balise (All types):

10.16 Check for damage and security.

10.17 Replace if necessary.

HABD Transducers:

10.18 Check for damage, security and alignment. Replace if necessary.

Axle Counter Rail Contacts (Count Heads):

10.19 Check for damage and security, carry out NR/SMS/PartB/Test/045 (Thales Axle Counters Dummy Wheel Test – AxLM & AzLE) or NR/SMS/PartB/Test/042 (Axle Counters Dummy Wheel Test - AzL 70, 70/30, 70/30S). Replace as necessary.

11. Electrically Lit Signals

Includes:	Ground mounted repeaters, Position light signals, Signal post replacement switches, Mechanical disc signals, Stencil indicators, Theatre indicators, Internally lit LOS signals.
Excludes:	All other Electrically Lit Signals

11.1 Clean and wipe interior of signal head, lamp holders, transformers, terminals, terminal bocks and links. Examine crimps and terminations, renew if necessary.

11.2 Remove lens(es)/stencil(s) (internal and external as applicable), Clean and wipe or renew as required.

11.3 Wash and wipe lamps, renew as required.

Signal post replacement switch (SPRS):

11.4 Clean and wipe interior, terminations and terminal bocks.

Examine crimps and terminations, renew if necessary.

11.5 Carry out NR/SMS/PartB/Test/023 (Other Signal Tests).

11.6 Renew EKR relay (if applicable).

11.7 Test as required:

a) NR/SMS/PartB/Test/021 (Filament Signal Lamp Tests).

b) NR/SMS/PartB/Test/022 (Signal Lamp and Light Module Proving Tests).

12. Semaphore Signal Machines

Includes:	BP, GRS, SGE, WBS
Excludes:	All other Semaphore Signal Machines

12.1 Clean and wipe interior, circuit controller (if applicable) terminations and terminal blocks. Examine crimps and terminations, renew if necessary.

12.2 Wash and wipe surfaces that have a moving metal-to-metal contact surface (gear wheels, bearings etc) and apply new lubricant.

12.3 Clean and wipe motor bushes and commutator operate motor and check for any excessive noise/sparking/smell. Renew if necessary.

12.4 Check, if fitted, leather brake pads for condition. Renew if necessary.

12.5 Test for correct operation and indication for On, Off and Wrong positions.

13. Operational Telephones

Includes:	SPTs, Point zone telephones, Level crossing telephones, Lineside direct line telephones
Excludes:	All dial telephones and plug points connected to exchanges.

13.1 Replace telephone using the correct TMTH Test Plan.

13.2 Carry out NR/L3/TEL/30181/011 - Maintenance of Operational Telephones.

14. Lever Frames, Lever Locks & Circuit Controllers

Includes:	All types of mechanical locking signal box, ground frames, Electrical locks and combined locks, Circuit controllers.
Excludes:	All other Lever Frames, Lever Locks & Circuit Controllers.

14.1 If water has entered any locking boxes, report it to your SM(S).

The lids of any locking boxes are not to be removed unless you are requested to do so by your SM(S).

14.2 Wash and wipe frame structure, levers, catch handles, catch rods, and locking connections. Check all components are undamaged and secure.

14.3 Report any damage to your SM(S).

14.4 Wash and wipe exteriors of lever locks and circuit controllers.

14.5 Clean and wipe interior, terminations, and terminal blocks.

14.6 Examine crimps and terminations, renew if necessary.

14.7 Clean contact faces or bands/fingers in circuit controllers.

14.8 Wash and wipe surfaces that have a moving metal-to-metal contact surface and apply new lubricant.

14.9 Test by operation the electrical release(s) and mechanical interlocking of the lever frame.

Simple ground frames (i.e. 1 releases 2, 2 reverse locks 1) can be tested using the layout diagram or plate legends. Complex signal box frames require an experienced tester.

15. Hydraulic Trainstops

These use a vented hydraulic system.

15.1 If it is suspected the water level has risen above reservoir fill-hole level renew the pump unit, drain the hydraulic system and expel any fluid. Renew the hydraulic fluid.

15.2 Check the mechanical components for corrosion, contamination and damage. Rectify or renew as necessary.

16. Automatic/Manually Controlled Level Crossing Equipment

Includes:	AHBC, ABCL, AFBCL, AOCL, AOCL+B, AOCR, MSL, MCB, OCB, Rural Barriers, Boom gates, Hydraulic and mechanical barrier units.
Excludes:	All other Automatic/Manually Controlled Level Crossing Equipment

Hydraulic Barrier Units:

16.1 Clean and wipe interior of unit. If it is suspected the water level has risen above reservoir fill-hole level renew the pump unit.

16.2 Drain the hydraulic system and expel any fluid.

16.3 Check the condition of seals and gaiters on the rams.

16.4 Remove then wash and wipe ram pins.

16.5 Lubricate the ram pins and main bearings with new grease/oil.

16.6 Check the ram and boom for security and freedom of movement. Clean and wipe motor bushes and commutator.

16.7 Clean and wipe terminal blocks, renew if necessary. Renew crimps or re-terminate as necessary.

16.8 New grease shall be pumped in to the grease nipples to expel any existing grease.

BR 843 units are fully self-contained; renewing the unit by default, renews all the hydraulic and internal electrical components.

Mechanical Barrier Units:

16.9 Clean and wipe interior of unit.

16.10 Check electrical connections and terminal blocks for corrosion, contamination and damage. Rectify or renew as necessary.

16.11 Clean and wipe parts that have a moving metal-to-metal contact surface (gear wheels etc) and apply new lubricant.

16.12 Clean and wipe motor bushes and commutator. Renew crimps or re- terminate as necessary.

Boom Gates:

16.13 If it is suspected that the boom gate motor or gearbox has been partially or totally submerged, then the complete unit shall be changed.

16.14 Check electrical wiring and plugs for corrosion, contamination and damage. Rectify or renew as necessary.

16.15 Check clutch operates correctly, repack universal joints and wheel bearing with new grease.

16.16 If it is suspected that any limit switches in the hinge assembly might have been submerged, then change the limit switches.

16.17 Clean and wipe contacts & terminal blocks in hinge assembly. Re-grease hinge bearings.

16.18 If it is suspected that the control cubicle has been totally or partially submerged, then change the control plate.

16.19 Carry out NR/SMS/PartB/Test/052 (Dynamic Earth Test). Not NER mechanical barrier units.

16.20 Test the sequence of crossing operation hand, local and automatic operation as applicable for automatic crossings.

16.21 Check hand, local and signal box operation as applicable for manual crossings.

17. Mechanical Gated Level Crossings

Includes:	Wheel operated, Hand operated, Gate locks, Wicket gates.
Excludes:	All other Mechanical Gated Leve Crossings.

17.1 Check rodding runs are free from any obstructions.

17.2 Check all foundations are stable. Check all roller wheels are free to move.

17.3 Clean, wash and wipe all cranks. Fill the bearings with new lubricant. Check the crank for security and freedom of movement.

17.4 New grease shall be pumped in to expel the existing grease in the bearing.

17.5 Excess grease shall be wiped away.

17.6 Clean and wipe gate locks interiors.

17.7 Care shall be taken when removing the covers of gate locks, components and springs might fly out.

17.8 Clean, wash and wipe wicket gate mechanisms.

17.9 Apply new lubricant to sides.

17.10 Clean, wash and wipe gate stops housings and internal mechanism. Lubricate with oil.

17.11 Check that all debris and contaminates are cleaned from around the top slots of the stops. Any small obstruction could cause the stops not to rise and fall correctly.

17.12 Test gate and locking operation to the Signaller’s satisfaction.

17.13 The final action for all equipment is to test for correct operation.

END

This test is solely part of a maintenance service and shall not be used in place of the token tests mandated under the provisions of NR/SMTH.

This test is to prove the integrity of an individual token system as a whole, whereas Services A&B are specific services on individual instruments.

In order to carry out this test it will be necessary to take possession of the system.

A token shall NOT be withdrawn for the purposes of any possession.

If the work is to be carried out on a line open for traffic, and working by Pilotman has been arranged, the Pilotman SHALL NOT BE GIVEN A TOKEN.

Access will not be available to sidings worked by a ground frame released by the token during the period of the test.

Staff will need to be positioned at each terminal instrument throughout the duration of the system test, and at each other instrument whilst that specific instrument is under test.

During testing of Intermediate/Auxiliary instruments, both galvanometers/indicators shall operate before when attempting to electrically withdraw a token. Failure to check this will invalidate the test.

One person on site shall take overall direction of the system test.

Steps 1.9 to 1.26 do NOT apply to systems which either (a) wholly use BR 930 series relays for polar functions, or (b) where the transmission between sites is by means of Reed Vital FDM equipment.

1. Test

1.1 Prove that the system is in phase by electrically releasing one token from the system.

1.2 Replace the token into the instrument.

1.3 Check that the correct number of tokens is present in the system.

1.4 Unlock each instrument and manually withdraw all tokens.

1.5 Check each token for correct colour and labelling.

1.6 Check the bearing faces and keyways of each token for excessive wear.

1.7 Replace all the tokens into the instruments from which they were withdrawn.

1.8 Prove that the system is in phase by electrically releasing one token from the system.

1.9 If the token system is NSKT with a diode is provided in series with the AZR at the remote end, arrange to have the diode strapped out for the duration of the testing.

From the signal box end controlling instrument Check that the strap is effective by electrically releasing a token, and then pressing and releasing the plunger, verifying that the galvanometer/indicator re-operates for a few seconds after the plunger has been released.

Replace the token into the instrument.

1.10 Designate one instrument as the instrument under test.

1.11 Arrange for an electrical release to be made to the instrument under test for steps 1.12 to 1.16.

If the system is NSKT, several successive releases might be needed to carry out the various tests

1.12 Check that the voltage on the lock relay coil (R1/R2) is between 12 – 16 volts. For Intermediate/Auxiliary instruments repeat for the other relay.

1.13 If a voltage in step 1.12 is in excess of 16 volts, inform your SM(S) to arrange for the insertion of suitable resistors in series with the relay coil. If the voltage is in excess of 24 volts, the relay must also be changed within 3 months.

1.14 Check that the voltage on the lock coil is between 12-15 volts.

1.15 Electrically withdraw a token from the instrument under test.

1.16 Check that another token cannot be electrically withdrawn from the instrument under test.

1.17 Replace the token into the instrument from which it was withdrawn.

1.18 Withdraw a token from another token instrument.

1.19 Check that another token cannot be electrically withdrawn from the instrument under test.

1.20 Replace the token into the instrument from which it was withdrawn. If the instrument under test is a terminal instrument go to step 1.24

1.21 Withdraw a token from a different instrument from that used in step 7.18, and which is in the towards the other end of the section beyond the instrument under test.

1.22 Check that another token cannot be electrically withdrawn from the instrument under test.

1.23 Replace the token into the instrument from which it was withdrawn.

1.24 Repeat steps 1.10 to 1.23 in turn for all other token instruments in the system.

1.25 Close and re-lock all instruments.

1.26 If a diode was strapped out as set out in step 9, remove the strap.

1.27 Check that a token can be released from an instrument.

1.28 Replace the token.

END

This check is not a full “Signal Sighting Inspection”, full signal sighting shall only be carried out by a person holding the appropriate competency.

If a visibility issue is recorded during a check that you are unable to rectify then your SM(S) shall be advised

The Formula for Speed & Distance Measurements can also be found in NR/SMS/PartZ/Z01 – Signal Reference Values.

The Signal Visibility Check is split into 4 Section’s use the flow chart in figure 1 to determine which test is required.

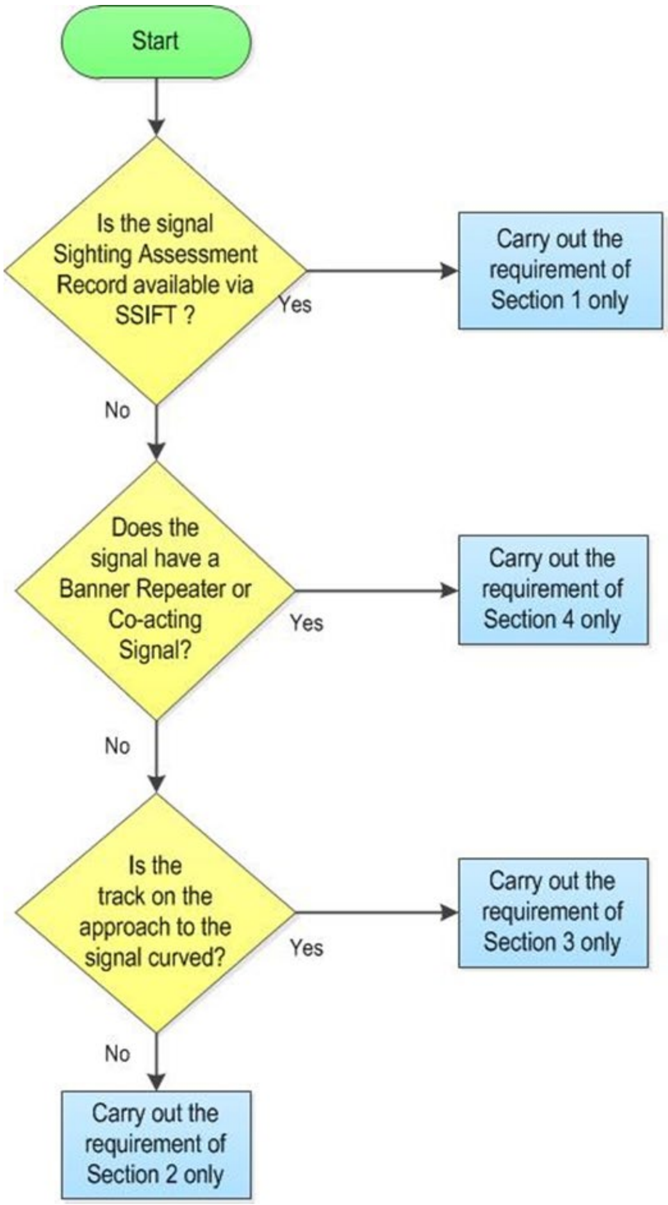


Figure 1 - Decision Flowchart

1. Signal Sighting Assessment Record (preferred option)

The contents of the latest "Signal Sighting Assessment Records" are now available to all via the SSIFT App.

1.1 Access the Signal Sighting details of the relevant signal via the SSIFT App.

1.2 Check the signal from the required reading distance detailed on the signal sighting assessment record and record the visibility on the record card.

1.3 The removal of small areas of vegetation, that are affecting the signal visibility of the signal aspects, are the responsibility of the signalling technician.

If the area to be cleared is more extensive, then the SM(S) shall be informed.

2. Signal Sighting Assessment Record Unavailable – Track approaching the signal is not curved

2.1 Identify the maximum line speed at which the signal can be approached.

2.2 Using Signal Visibility Chart (10 seconds) in NR/SMS/PartZ/Z01 – Signal Reference Values, work out the distance on the approach side of the signal at which the Viewing Point is located.

2.3 From a position in line with the right-hand edge of the signal head, observe there is no obscuration between your location and the Viewing Point.

If there are no obstructions between the signal and viewing distance, there is no requirement to walk out to the Viewing Point.

2.4 If there are any obstructions, the signal shall be viewed from the Viewing Point and the degree of those obstructions recorded on the record card. The SM(S) shall be advised.

2.5 The removal of small areas of vegetation, that are affecting the signal visibility of the signal aspects, are the responsibility of the signalling technician. If the area to be cleared is extensive, then the SM(S) shall be informed.

3. Signal Sighting Assessment Record Unavailable – Track approaching the signal is curved

3.1 Identify the maximum line speed at which the signal can be approached.

3.2 Using Signal Visibility Chart (10 seconds) in NR/SMS/PartZ/Z01 – Signal Reference Values, work out the distance on the approach side of the signal at which the Viewing Point is located.

3.3 Walk to the Viewing Point and observe there is no obscuration between your location and the signal.

3.4 The removal of small areas of vegetation, that are affecting the signal visibility of the signal aspects, are the responsibility of the signalling technician. If the area to be cleared is more extensive, then the SM(S) shall be informed.

4. Signal Sighting Assessment Record Unavailable – The Signal fitted with a banner repeater or co-acting signal. And at a banner repeater or co-acting signal

4.1 Identify the maximum line speed at which the signal can be approached.

4.2 Using Signal Visibility Chart (5 seconds) in NR/SMS/PartZ/Z01 – Signal Reference Values, work out the distance on the approach side of the signal at which the Viewing Point is located.

4.3 From a position in line with the right-hand edge of the signal head, observe there is no obscuration between your location and the Viewing Point.

If there are no obstructions between the signal and the Viewing Point, there is no requirement to walk out to the Viewing Point.

4.4 If there are any obstructions, the signal shall be viewed from the Viewing Point and the degree of those obstructions recorded on the record card. The SM(S) shall be advised.

4.5 The removal of small areas of vegetation, that are affecting the signal visibility of the signal aspects, are the responsibility of the signalling technician. If the area to be cleared is more extensive, then the SM(S) shall be informed.

END