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NR/L3/SIG/11231

NR/SMTH/Part/10

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END

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 the above items that 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.

This guide assumes that the track relay is not energised and testing is started at the relay end. If testing is started at any other point the order of the steps will have to be altered.

FAULT FINDING GUIDE

1.1 Check the record card for voltages when the TC is working.

1.2 Measure the voltage across the rails at the relay end. If the voltage is low, or there is no voltage go to 1.4. If it is within the specified limits, continue.

1.3 Check tail cables, disconnection boxes, wiring, connections, relay coil, links and (if provided) the relay end adjustable resistor for loose or open circuit connections.

1.4 Measure the voltage at the feed end. If it is within the specified limits go to 1.5. If it is low, go to 1.6. If there is no voltage, go to 1.7.

1.5 Check throughout the length of the track circuit for the following:

a) Broken or high resistance bonding.

b) Broken rails.

1.6 Check throughout the length of the track circuit for partial or full short circuits. These could be caused by faulty IRJs, especially in S&C, insulations on points and rail fastenings and poor ballast conditions.

1.7 Check (as provided) tail cables, disconnection boxes, wiring, connections, links, fuses, feed sets, TJs, batteries and adjustable resistors for loose/open circuit connections or short circuits.

APPENDIX A - Track Circuit Adjustments

Systems fitted with feed sets are set up on commissioning and shall not be altered during maintenance.

If a satisfactory drop shunt cannot be obtained on a track circuit using these feed sets, report immediately as corrective maintenance.

Some systems with feed sets have adjustable resistors at the relay end. These shall not be adjusted.

Systems that do not use a feed set (primary cell and TJ/secondary cell fed) are usually fitted with a separate adjustable resistor block at the feed end that can be adjusted by using the input/output leads and straps to obtain the resistance necessary to obtain a satisfactory drop shunt.

Increasing the resistance will decrease the voltage and increase the drop shunt; conversely decreasing the resistance will increase the voltage and decrease the drop shunt.

Drop shunt values are detailed in NR/SMS/PartZ/Z03.

END

GENERAL

For the Fault Finding Guide please use Section 2 of NRSMS/Appendix08.

END

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 shall be tested as such. Record cards shall be kept for each part.

Cut Section Track Circuits: Each cut section shall be treated as an individual track circuit and record cards kept accordingly.

Where the Receiver Is Adjacent to a Pair of Insulated Rail Joints:

Report situations where track circuit track tail cables are not terminated within 1m of an IRJ.

Drop shunt test at three positions approximately 15m apart, within 50m of transmitter and its terminations.

For end fed TC, the test shall be outside the tuned zone. Results are listed in Appendix B.

These guidelines start at the feed (Tx) end but fault finding can start at either end.

To quickly localise a fault:

a) Check cables and connections.

b) Compare voltage readings with values with record card.

c) Always check correct frequency apparatus is fitted.

NOTE: *applying a shunt to an adjoining track circuit causes it to show occupied.*

FAULT FINDING GUIDE

1. Feed (Transmitter) End

1.1 Check the transmitter is emitting its characteristic ‘singing’ note (that is, loud and steady). If this is correct move to step 1.5, if not continue.

1.2 Measure the DC input voltage to the transmitter unit between terminals + and – (between 22.5V and 29.5V).

1.3 If this is correct change the transmitter unit check that the correct frequency unit is selected by observing the colour coding on the units.

1.4 If it is incorrect investigate the power supply and restore. When the power supply feeds other units, it might be necessary to disconnect them one at a time to find the faulty one.

1.5 Measure the AC feedback voltage to the tuning unit between terminals T1 and T2. If this voltage is within approximately 33% of its previously recorded value proceed to step 1.8. If it has fallen by more than 33% of its previously recorded value continue.

1.6 Connect a train shunt set at 10Ω across the transmitter side of the track circuit feed links, then connect a meter set to read AC across the train shunt. If terminals 3 and C are connected, disconnect at terminal C.

Open the track feed links and measure the voltage. The voltage should not be less than given in Table 1.

Close the track feed links and reconnect the link to terminal C before disconnecting the meter and train shunt. If the voltage is lower than given in Table 1 change the transmitter unit. If the voltage is above the minimum go to step 1.8.

Track Circuit Frequency (Hz)	Minimum Voltage
1700	3.5V
2000	3.8V
2300	4.9V
2600	5.3V

Table 1 – Minimum Voltages

1.7 If a train shunt is not available measure the current from the power supply. Typical values for the transmitter end are given Table 2. If the current is lower than 33% of the value given change the transmitter unit. If the current is correct move to step 1.8.

Track Circuit Frequency (Hz)	Maximum Current
1700	1.6A
2000	1.7A
2300	1.8A
2600	1.9A

Table 2 – Maximum Currents

1.8 Check the tuning unit and change if necessary. Check the wires are connected to the correct terminals.

1.9 Examine the surge diverter and change if necessary.

1.10 Examine the track circuit connections to the tuning unit and track transformer.

1.11 Where two Aster tracks adjoin, measure the AC voltage on the tuning unit between terminals T1 and T2 with a short circuit across the adjoining track circuit tuning units between terminals T1 and T2. If there is an increase in the voltage reading when the short circuit is applied replace the adjoining track circuits tuning unit.

1.12 Apply a short circuit across the rails at the adjacent TTU (this causes the adjacent track circuit to fail). If the short circuit causes the failed track circuit to clear, replace the adjacent TTU.

1.13 If after changing the transmitter, track transformer or tuning unit and the measurements are correct the feed end apparatus is operating normally.

2. Track Circuit: General

2.1 Examine the track circuit NR/SMS/PartC/TC10 (Track Circuits: Aster SF15 / U Type) - Service A.

3. Relay (Receiver) End

3.1 Check the track relay, if energised check the line circuits.

3.2 If the relay is de-energised measure the AC input voltage on the tuning unit between terminals T1 and T2.

3.3 If the voltage has fallen by less than 33% of its last recorded value go to step 3.4 If it fallen by more than 33% of its last recorded value go to step 3.5.

3.4 Attention shall be given to a track circuit examination NR/SMS/PartC/TC10 (Track Circuits: Aster SF15 / U Type) - Service A, and testing at the transmitter end of the track circuit.

3.5 Check the tuning unit, track transformer and receiver unit connections. Re-terminate any poor connections.

3.6 If the voltage in measured in 16 is still low and two Aster tracks adjoin, measure the AC voltage on the tuning unit between terminals T1 and T2 with a short circuit across the adjoining track circuit tuning units between terminals T1 and T2. If the voltage is now correct replace the adjoining track circuits tuning unit.

3.7 Measure the DC input voltage to the receiver unit between terminals + and – (between 22.5V and 29.5V).

3.8 If it is incorrect investigate the power supply and restore. When the power supply feeds other units, it might be necessary to disconnect them one at a time to find the faulty one.

3.9 Examine the surge diverter and change if necessary.

3.10 Check the relay voltage on the terminals R1 and R2 of the receiver. If this is greater than 19V with the relay de-energised, then relay or the wiring to it is faulty.

3.11 Measure the AC voltage on the receiver unit between terminals T1 and T2. If the voltage is more than 66% of its last recorded value change the receiver unit. If the voltage is less than 66% of its last recorded value examine the track transformer, tuning units and receiver unit. Replace if necessary.

3.12 Apply a short circuit across the rails at the adjacent TTU (this causes the adjacent track circuit to fail). If the short circuit causes the failed track circuit to clear, replace the adjacent TTU.

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
	A	H	BD 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	-	-	-

The receiver gain connections listed above are to be used as a guide. Adjustment might be required to suit local conditions.

END

1. HVI Track Circuit Faulting Check List

The questions can be answered in any order.

1.1 Contact Fault Control and review whether this is a repeat failure; has the TC shown a similar fault characteristic prior to this fault?

TX End

1.2 Test the supply voltage 95V-121V and current load test 0.3A-0.5A. Are the measurements within expected values? (Record results).

1.3 Carry out TX power test (T7) (Connect a short circuit between terminals C- and t6).

Disconnect any strapping between t1 and t6 and measure the TX power between t1(+ve) and t3(-ve).

The minimum expected value is 120V.

1.4 Are the TX Voltages higher or lower than expected?

1.5 Relay end voltages/tests measure and record.

Compare to previous results on record card.

a) Min 20V - Max 50V

b) V1+toV1- =

RX End

1.6 Relay end load test (T5) (Apply 0.5Ω shunt on rails @ RX end).

Compare to previous results on record card.

a) Min 30V - Max 100V

b) V2+toV2- =

1.7 Are the RX Voltages higher or lower than expected?

1.8 Carry out drop shunt test.

a) Min 0.5Ω - Max 2.5Ω.

TC voltages near min & low drop shunt value will indicate a developing fault in the receiver that should be replaced.

TC voltages near max and high drop shunt value will indicate the transmitter is not providing the required waveform and should be changed.

1.9 Check security of tail cable entry points and terminations within TX and RX.

1.10 Check all rail terminations.

1.11 Examine the length of all tail cables at both the TX and RX end. Check for no joints or cuts. If any damage found. Replace immediately.

1.12 Hand trace to verify cables are free from mechanical trapping and they are cleated down. If any damage found. Replace immediately.

1.13 Check and test the TC bonding, including any jumper cables, and TC interrupters (use the current clamp meter for jumpers).

1.14 Is the track circuit bonding correct, intact and free from short circuit causing objects? (Rectify any defects) Including any Pin Brazing.

2. Examining the P-way

2.1 Check the following:

a) All rails are intact?

b) Rails, insulations and IRJ's are free from contamination?

c) Remove any metallic debris from around IBJ's and point insulations.

d) Is the track free of wet beds and contamination?

e) Test the IRJs, do they pass all tests? Carry out NR/SMS/PartB/Test/041 (Insulated Rail Joint (IRJ) Tests).

NOTE: *Disconnection of track circuits will be required for this test.*

3. Additional Fault-Finding Notes

A full description is contained within NR/L2/SIG/11756 HVI Track Circuits.

No adjustment can be made to the HVI track circuit during maintenance visits. Service B is therefore restricted to testing those components whose performance can be expected to change.

Transmitters and power supply units shall not be plugged in or unplugged, or straps changed whilst they are powered up.

In 3rd Rail DC traction areas, and in dual electrified areas, HVI track circuit transformer/terminal boxes (known as 'bread bins') can experience a catastrophic arcing across the terminals when the traction supply is short circuited to the "Signalling" rail.

As such traction short circuits are unpredictable (and can be caused by trains, rubbish falling across the rails or other reasons) it is undesirable to work inside the 'bread bin' with the traction current energised. The main reasons for opening the 'bread bin' are maintenance to carry out NR/SMS/PartB/Test/255 (HVI TC Test) and fault finding.

Work shall not be attempted inside the 'bread bin' on 3rd rail DC and dual electrified areas unless the DC traction current is isolated for the entire length of the track circuit(s) concerned. Non-electrified and AC or DC overhead electrified areas are not affected.

Fault finding shall use test points other than inside the box. If the fault finding requires entry to the 'bread bin', the traction current shall be isolated first. NR/SMS/PartB/Test/255 (HVI TC Test) shall be undertaken on the rails as described in Appendix A.

Access to the track in some areas is very restricted. It is permissible for the local Area Signal Engineer to authorise installation of permanent test 'leads', wired from the rails to a special test box positioned in a place of safety.

This box shall have the leads terminated in the box as far apart as physically possible.

It is recommended such a test box is non-metallic.

An ideal termination arrangement for each test lead would be one terminated at the top and the other at the bottom of a 6-way 2BA terminal block. (After installation, the loop resistance of the leads should be measured, and the value recorded in the box so that allowances can be made when applying shunts at the test box.)

4. Track Relay Voltage

The track relay voltages V1 and V2 will indicate the correct functioning of the receiver and will vary inversely proportional to the drop shunt value (i.e. as the track voltage rises, the drop shunt will fall).

Track relay voltages that are near the minimum, while the drop shunt remains low, indicates a developing fault in the receiver, which should be changed.

Track voltages which are near the maximum, while the drop shunt remains high, indicates that the transmitter is not providing the required waveform and should be changed.

5. Relay End Voltage

The rail voltage is a measure of the energisation level of the track circuit. It will change inversely proportional to the drop shunt value and will be affected by the same factors.

Values of relay voltage towards the maximum should be accompanied by higher limit values of track relay voltage and a lower limit of drop shunt.

Values of relay voltage towards the minimum should be accompanied by lower limit values of track relay voltage and a higher limit of drop shunt.

If the rail voltage is high and the drop shunt is high, it indicates that the transmitter is providing an unsatisfactory waveform and should be changed.

6. Current Provided by Equipment

The ability of the transmitter to provide power can be checked by measuring the current at the relay end. As the instrument for measuring the waveform will only measure voltages, it is necessary to pass current through a 0.5□ resistor to measure a representative voltage.

The value of this voltage is individual to each track circuit, being affected by length, length of tail cables and complexity of S&C. The measurement is important as a basis for comparison rather than an absolute value. The voltage measured should not differ by more than +/- 3V from the commissioning result.

If the test voltage is satisfactory but the rail and track relay voltages are low, then it is likely that the track circuit is being shunted by poor ballast or debris.

If the test voltage is low but the rail voltage is satisfactory, it is likely that the track circuit bonding or tail cables are becoming defective.

END

FAULTING GUIDE

SR = Single Rail Installations Only.

DR = Double Rail Installations Only.

Relay End

1. Check the position of the relay vane.

   If the vane is up (delay unit for VT1(SP) also up) check the status of the track with the Signaller.

   If it is showing occupied at the signal box end investigate for an indication fault.

   If the vane is down, proceed to Step 2.

   For VT1(SP) only, if the vane is up and the delay unit is down, go to the Delay Unit Tests(15).

2. Measure the voltage on the relay local coil.

   If the voltage is within spec (99V to 121V) go to Step 3.

   If the voltage is below spec or at zero check the BX110 supply and fuse.

3. Measure the voltage on the relay control coil.

   If the voltage is within spec (approximately 25% above the relay nominal value) visually inspect the relay for signs of damage.

   Check for a tendency to drive in the opposite direction, if found a Full Test shall be required.

   Check the control coil resistor (DR). If the voltage is low, check the stabiliser (SR). If a transient suppressor (GDT or Spark Gap) is fitted, remove it from its base then recheck the voltage. If the voltage increases, check the rating of the suppressor noting that long track circuits with Type 3 bonds might require a 1000V type at the feed and first intermediate bonds.

4. If there is no voltage check the track fuse. Check the control coil resistance is at least 3Ω. Check the control coil resistor (DR).

5. Check for any DC voltage across the relay control coil with a multimeter whilst trains are in vicinity (SR).

   If none found proceed to Step 6.

   If more than 0.5V DC is found at any instant and the relay chatters, check all negative bonding in area.

   If all present and functioning correctly, refer to the Route Engineer [Signalling], Principal Route Engineer [Signalling] or equivalent for possible fitment of interference suppressor unit.

6. Measure phase angle and voltage and compare with the NR/SMS record card (DR).

   If the phase angle is higher and the control voltage lower, check the relay capacitor,

   Check for impedance bond faults.

   If the phase angle is the same and the control voltage is lower, check for a high resistance connection, rail to rail fault etc.

7. Measure the AC voltage across the rails at the relay end and compare with the record card.

8. If the voltage is approximately 45V AC (SR), check for high resistance at the relay end.

   If the voltage is within the specified limits or higher, check track leads to relay.

   Check the phase angle of control and local voltages (DR). Check the relay end impedance bond (DR).

   If the voltage is low, check the relay end and intermediate impedance bonds (DR).

   If there is no voltage, check for voltage across rails proceeding towards the feed end.

9. Measure the rail end current to the rails (SR). If it is over 0.5A AC replace the stabilising rectifier.

   Measure the AC voltage across the rails and compare with the NR/SMS record card.

   If the voltage is higher than the specified limits, check for a high resistance fault in the bonding and relay end circuitry, also check for a possible increase in the ballast resistance.

   Check feed end and intermediate impedance bonds (DR).

If the voltage is within the specified limits, check again the rails at relay end. Check for high resistance bonding fault. Check feed end and intermediate impedance bonds (DR).

If the voltage is low, check the track feed transformer outputs, step 10. Check bonding and cables for possible short circuit. Check IRJ's and other insulations for possible breakdown.

If there is no voltage check the 10A fuse.

If OK proceed to Step 11.

10. Measure the voltage across the 110v supply fuse (SR).

If the voltage is between 150V & 180V AC check for high resistance at the feed end.

Feed End

11. Measure the output voltage of the track feed transformer.

If the voltage is within the specified limits, go to Step 12.

99V to 121V for the standard type, 85V to 90V or 90V to 99V if the former is not achievable for the VT1(SP) type.

If the voltage is outside the specified limits, check the feed end supply. (Step12), check the 110V feed fuse. Replace or adjust feed transformer.

12. Measure the output voltage at the feed end with the track feed fuse removed.

If the voltage is within the specified limits, replace the fuse and re-check.

If the voltage is low or at zero, check the 110V supply and fuse. Test the capacitor by setting a value using alternative switch settings or replace, and then re-check the voltage.

13. Remove the surge arrestor and re-check, if it is now correct replace surge arrestor and carry out a Full Test (DR).

14. Measure the current to rails at the feed end and compare against the NR/SMS record card.

If the current has increased, check the stabilising rectifier (SR), check for a short circuit bonding fault, check for impedance bond short circuit (DR).

If the current has decreased, check for a high resistance in feed cable connections or track circuit bonding, or a fault in feed or relay equipment.

If the feed end current is significantly greater than the relay end current (SR), check for a rail-to-rail fault.

VT1 (SP) Delay Unit Tests

15. Check the delay unit after the VT1(SP) relay has been energised for more than 2 seconds.

If the unit is not completely energised, (e.g. one or more relays in the unit not energised) go to step 16.

If the unit is completely energised, go to step 17.

16. With the VT1(SP) relay energised, remove the interconnecting cable between the relay and the delay unit. At the fixed connector on the delay unit connect a multimeter (set to 100V DC.) between pin A (+ve) and pin B (-ve).

If the voltage is not between 55V to 60V DC, replace the VT1(SP) relay

If the voltage is between 55V to 60V DC, go to step 17.

17. Reconnect the cable at the relay end and check for a voltage of 55V to 60V DC. on pins A and B at free end of cable.

If the voltage is not present, replace the connecting cable.

If the voltage is present, replace the delay unit.

18. Check the sequence of operation of delay unit as follows:

Observe that relay R1 (on right hand side of delay unit when viewed from front) energises, de-energises and re-energises and that relay R2a energises followed by relay R2b.

If the delay unit does not operate in this manner, replace the delay unit.

If the delay unit does operate in this manner, check for possible high resistance output contacts between pins 23 & 24 and 13 & 14 of the VT1(SP) relay.

END

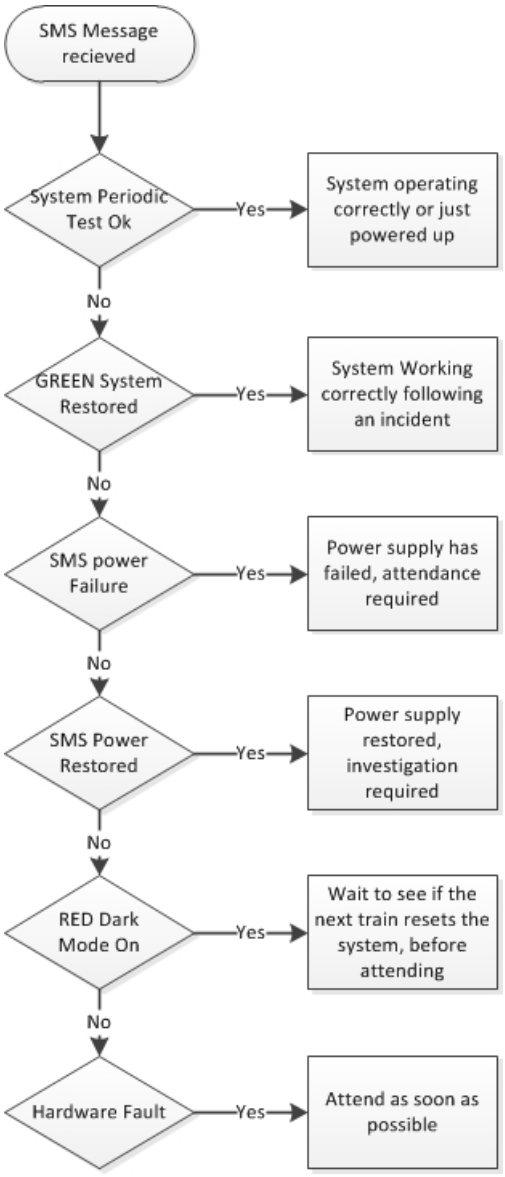
NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF08		
Faulting Guide: EBI Gate 200 Level Crossing System		
Issue No. 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	EBI Gate 200
Excludes:	All other Overlay MSL crossings

SMS Text Notifications

Message received	Meaning
"System Periodic Test Ok"	Sent on Power up and Mid-day
"GREEN System Restored"	System has been restored
"RED Dark Mode On"	Dark Mode On. This could be caused by engineering works, irregular train movements or a fault with the system.
"SMS Power Failure"	Input power failure to the system.
"SMS Power Restored"	Power restored.
"Hardware Fault"	Irrecoverable Fault

SMS Message Sequence :



Site Arrival Checklist

Note the following:

1. Is the “On Demand” button (Where fitted) illuminated?

2. Push button (where fitted) on the crossing to check status on the master and slave post.

3. Inspect Master Post.

    a) Is there a power supply to the post?

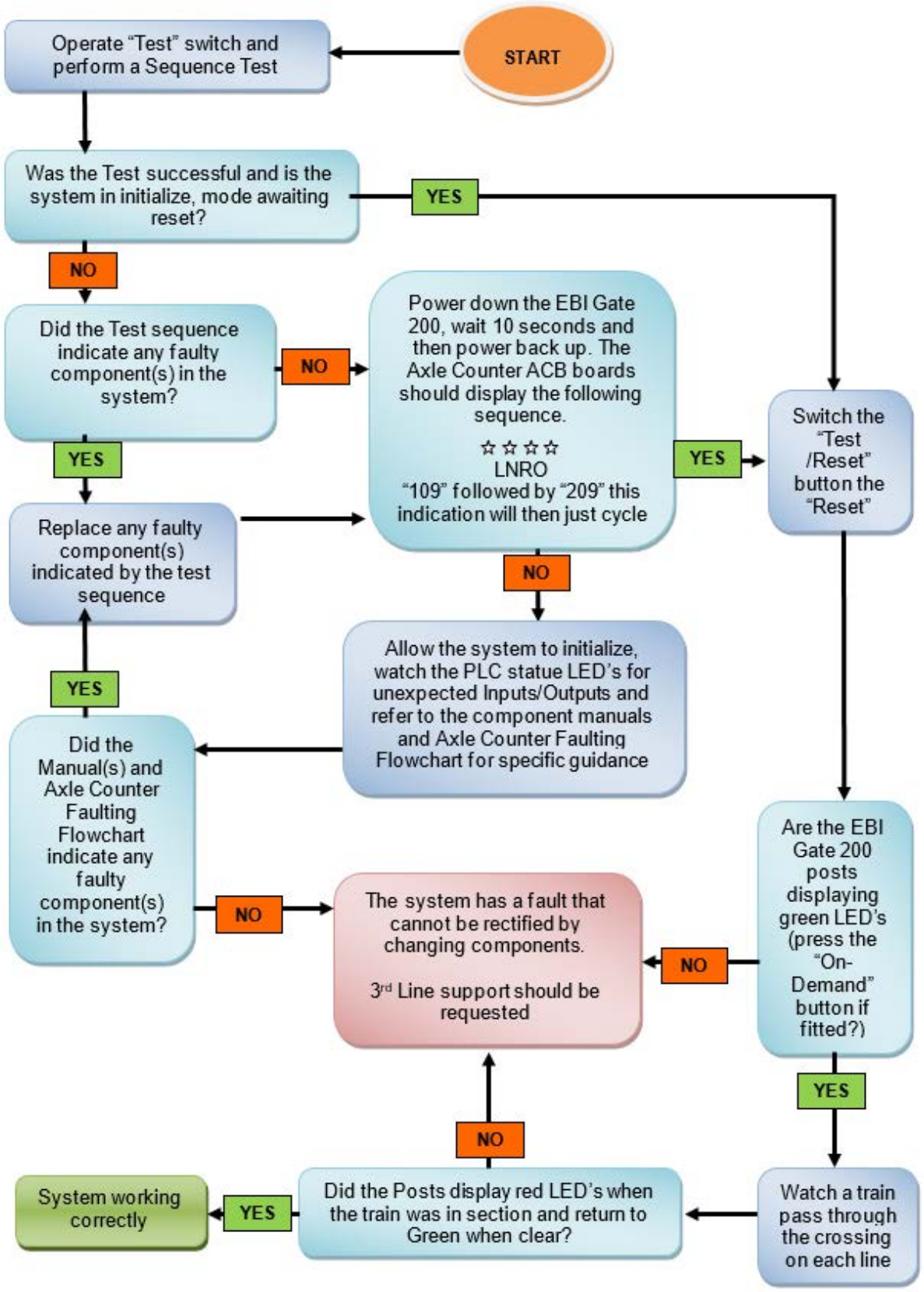
    b) Are error codes present on the axle counter system?

    c) Are the Programmable Logic Controller (PLC’s) active?

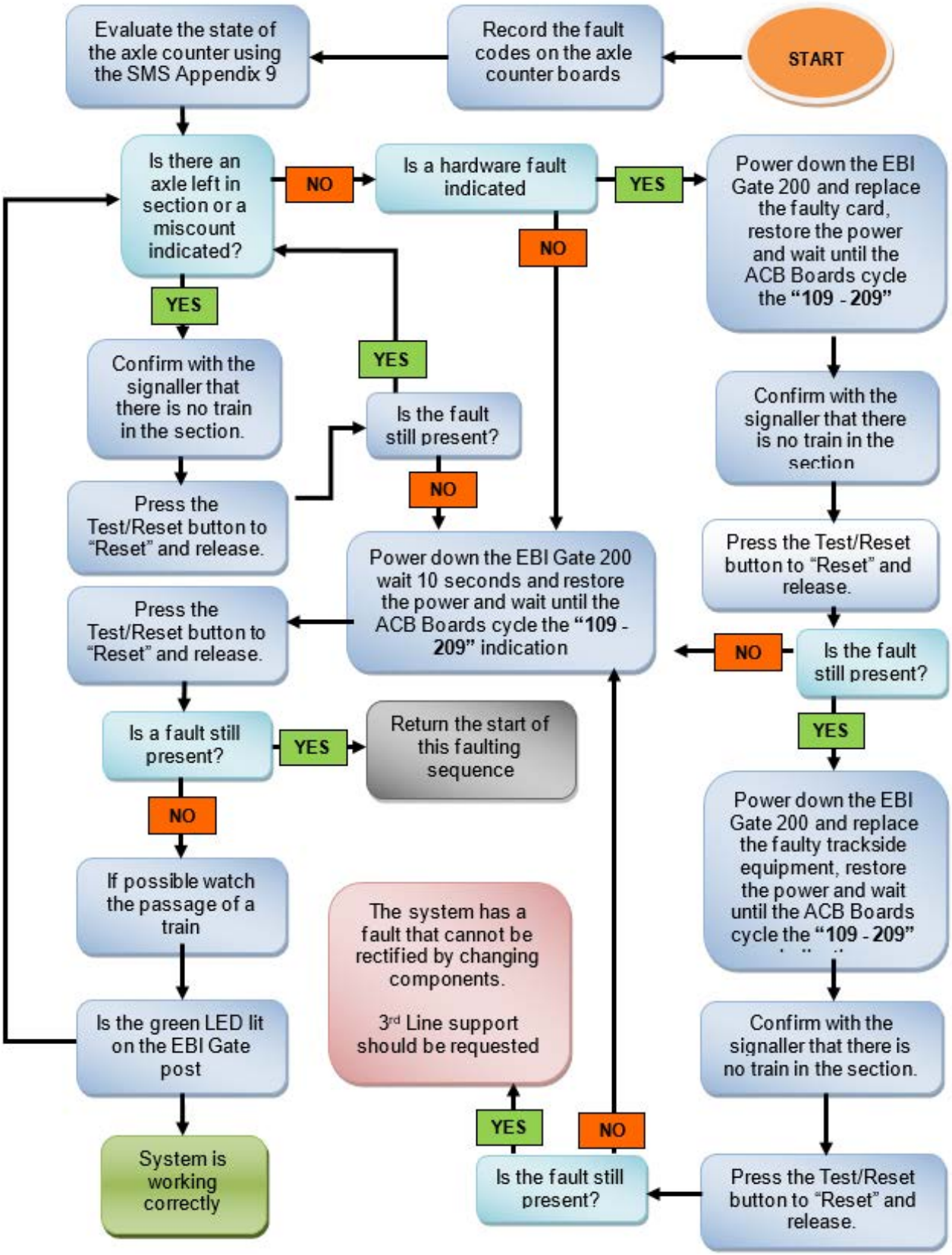
    d) Is the Auto dialler flashing?

4. Inspect Slave Post

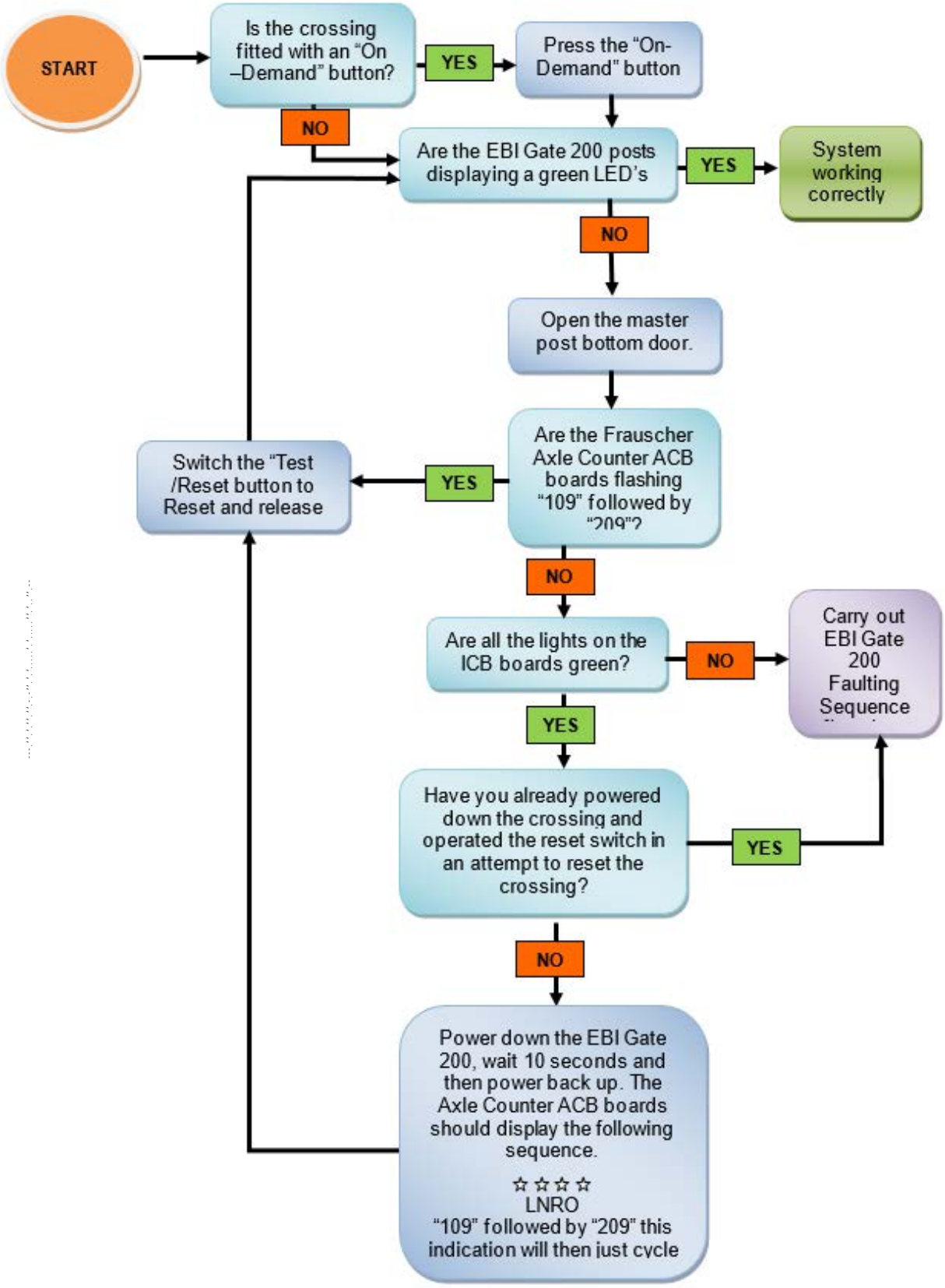
Faulting Sequence



Axle Counter Faulting Sequence



Reset Sequence



EBI Gate 200 Power Supply

5. Go to the **Master Post** and check the following.

   a) Is the Blue collar around the "On Demand" Button illuminated? (where fitted).

   b) Is there power to the axle counter system? i.e. Are the ACB displays lit? Are the LED's on IMC boards lit or flashing?

   c) Is there power to the Auto-Dialer? i.e. Are any of the LED's on the front of the Auto-Dialer illuminated or flashing?

   d) Is there power to the PLC? ie. Are any of the LED's on the front of the PLC illuminated or flashing?

   e) Are any of the PSU Controller LEDs Illuminated?

   f) Is there power to the DC power supply? ie. Are any of the LED's on the front of the PSU/UPS illuminated or flashing?

6. Go to the Slave Post and check the following.

   g) Is the Blue "On Demand" Button illuminated? (where fitted).

7. If the answers to questions A to G are all YES then the fault is not related to the power supply and you should re-evaluate the symptoms.

8. If the answers to questions A to G are all NO then the fault is in the AC power supply and the EBI Gate system should be disconnected while this is investigated.

9. If some of the questions have been answered NO, then the power is failing to reach that particular component. Using the test points in Table 1 you can trace the voltage supply through the system. Comparison of actual readings with the limits indicated allows the faulty component to be traced.

Test Point	Expected voltage	Fault
AC Input : Bottom of fuse 1(L) – Neutral (N)	110 or 230v AC	Supply Issue
AC Input : Top of fuse 1(L) – Neutral (N)	110 or 230v AC	Fuse 1 Faulty
AC side of the PSU : Live (L) – Neutral (N)	110 or 230v AC	Wiring fault between F1 and PSU
DC side of the PSU : +ve (+) to negative (-)	24v DC +/- *	Faulty PSU
Fuse 2 bottom – negative (-) TB1 Terminal 10	24v DC +/- *	Wiring fault between PSU and F2
Fuse 2 top – negative (-) TB1 Terminal 10	24v DC +/- *	Fuse 2 Faulty
Fuse 3 bottom – negative (-) TB1 Terminal 10	24v DC +/- *	Wiring fault between PSU and F3
Fuse 3 top – negative (-) TB1 Terminal 10	24v DC +/- *	Fuse 3 Faulty
UPS Battery FuseTB2 Fuse 4 top – negative (-) TB2 Terminal 22	24v DC +/- *	TB2 Fuse 4 Faulty

Table 1

* The expected DC voltage is a non-adjustable value: if it is not achieved the backplane should be replaced.

If a replaced fuse blows again during power up, then the relevant backplane should be replaced.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF09		
Faulting Guide: Power Operated Gate Opener (POGO)		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	GateCare Power Operated Gate Opener (POGO)
Excludes:	All other types of Power Operated Gates

Figure 1 - NR2 - Power Operated Gate Opener (POGO)

Do not enter 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.

FAULT FINDING GUIDE

The NR control board is equipped with three unique features to assist in troubleshooting a gate system.

1. LED indications.
2. Current sensor beeper.
3. The “Open / Close” command push button.

1. LED Indications

1.1 A series of LED indicators lights are located on the main control board which is mounted inside the crossing control box.

These LED’s help to identify problems with the actuator limit switches and all control circuits.

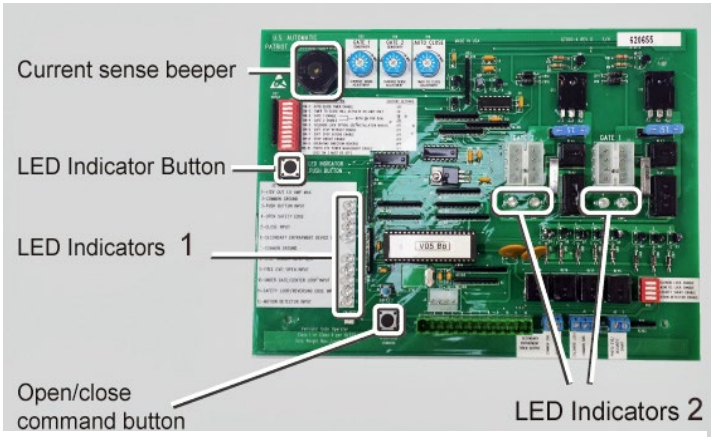


Figure 2 – Control Board

1.2 These LEDs are normally unlit; to illuminate them you should press the LED Indicator Push Button on the left-hand side of the board as shown in Figure 2.

1.3 The tables below assist in identifying which equipment is active:

No	Function	Indication "lit" means
1	+12vdc output 1.5amps max	No LED fitted
2	Common Ground	No LED fitted
3	Push button Input	A green push button is depressed
4	Not used	Not used in NR 2 If lit replace control board
5	Close input	Not used in NR 2 If lit replace control board
6	Not used	Not used in NR 2 If lit replace control board
7	Common Ground	No LED fitted
8	Green Signal Light input	POGO Only (N/C input) - Always lit *POGO/MSL Link (Lit when MSL is Green /Unlit when MSL is Red) If this LED is "out" confirm the green 12 way terminal block connector is full pressed home. If it is, check the cables in terminals 7 & 8, 13 & 14, and MSL connections (where linked) are intact.
9	Not used	Not used in NR 2 If lit replace control board
10	Under Gate / Centre Loop	Not used in NR 2 If lit replace control board
11	Safety Input (Photo eye N/O)	Not used in NR 2 If lit replace control board
12	Emergency Open Button Input	A red emergency push button is depressed

Table 1 – LED Indicators

LED Position	Function	Indication "lit" means
Left	Retract Limit	Limit switch depressed (Gate Open)
Right	Extend Limit	Limit switch depressed (Gate Closed)

Table 2 – LED Indicators Gate 2 (Left Side)

LED Position	Function	Indication "lit" means
Left	Retract Limit	Limit switch depressed (Gate Open)
Right	Extend Limit	Limit switch depressed (Gate Closed)

Table 3 – LED Indicators Gate 1 (Right Side)

For more details related to the LED Indicators refer to section 7.

2. Current Sensing Beeper

2.1 The second feature to assist in troubleshooting is the current sense beeper. The beeper sounds anytime the current sense circuit is activated. This is useful in detecting a false reverse due to an improper or too sensitive current reverse setting, or a gate that needs excessive force to move it.

3. The “Open / Close” command push button

3.1 The third feature to assist in troubleshooting is the control board “Open / Close Command” push button. This button makes it possible to operate the gates with the twelve terminal wiring plug removed. The removal of this plug disables the red / green buttons, solenoids and N/C contact from a green aspect.

Before disconnecting the green 12-way terminal plug on the control board you shall remove the latch pins for both gates in both open and closed positions, because the removal of the terminal block disables the solenoids and push buttons, however the actuators still try to drive the gates, damaging the equipment.

4. On arrival at the site

4.1 Before your testing commences check that the gate actuators are not unpinned.

4.2 If the actuators are unpinned, you should assume that during the time they have been disconnected someone has pressed one of the gates operating buttons.

4.3 The pushing of a button with an actuator unpinned causes the limit switches to move out of adjustment. Therefore, before starting to diagnose / investigate any fault you should check / reset the limit switches.

5. A Gate or Gates do not open

5.1 Remove the main control box cover, press and hold the “LED Indicator” push button and observe all the red LED’s (see the table in clause 1.3).

5.2 Identify the blue internal “Reset” push button located above the “Open / Close Command” button (Figure 3) or external reset button mounted on the control box exterior. (Figure 4).

Figure 4 – External reset

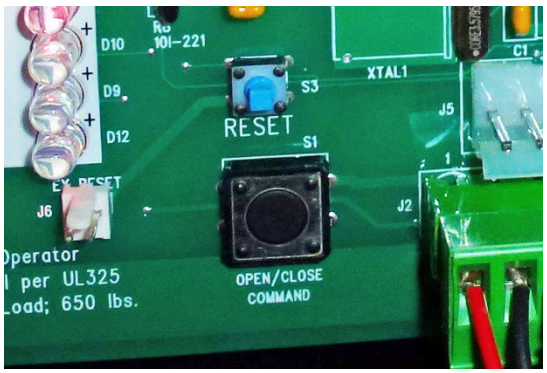


Figure 3 – Internal reset

5.3 Press the reset button.

5.4 Locate and press the LED indicator button.

5.5 Check LED 8 (Green Signal Light input (N/C input)) is lit, if the LED is “out” check the green 12-way terminal plug is full pressed home.

5.6 If the terminal block is correctly pressed home, check the jumper between terminals 7 and 8 on the block is intact.

5.7 Pressing the “Open / Close Command” push button, and listen for a clicking sound, if click is heard and the gates do not open then check that dipswitches SW-3 and SW-4 are set to the on position (Gate enabled) Figure 3.

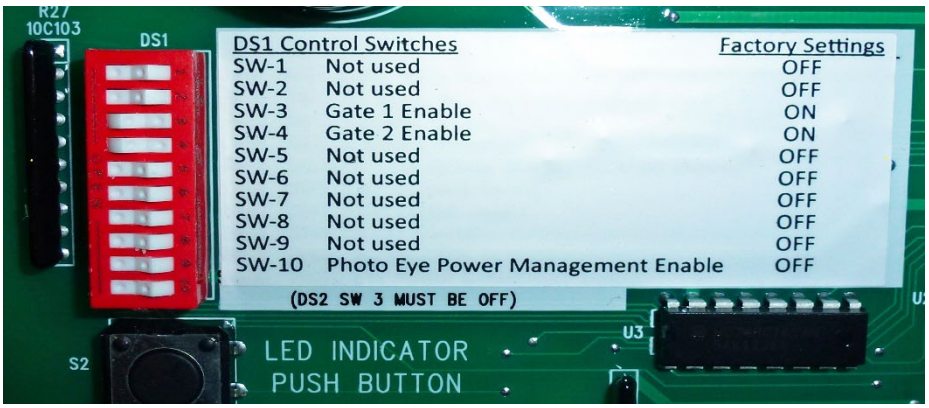


Figure 5 – DS1 Control switches

5.8 If the clicking is not heard examine and test the two 15-amp fuses mounted above 8-way X1 and X2 actuator plug sockets (Figure 6).

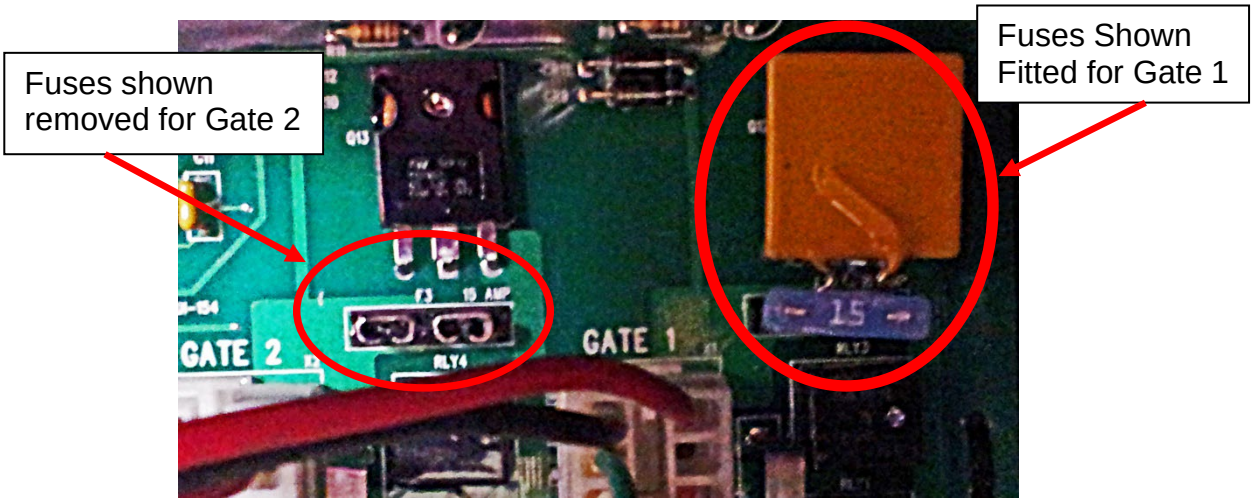


Figure 6 - Location of the Actuator Fuses

Each gate has two fuses fitted in series, the first is a 15-amp spade style fuse (Figure 7, left side) and the second is an automatically resetting thermal fuse (Figure7, right side).

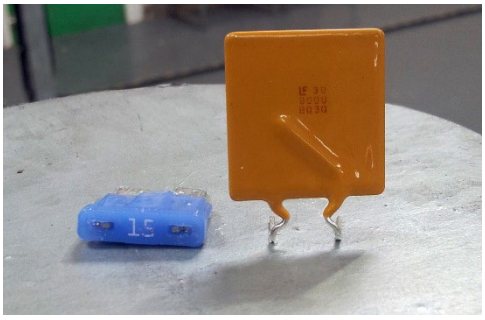


Figure 7 - Actuator Fuses

To fit these fuses, insert the thermal fuse legs into the two female spade holders mounted on the board and then push the 15-amp spade fuse gently into position. The thermal fuse is held in place by the tight fit of the spade fuse.

5.9 If a clicking sound is heard the battery needs to be load tested to determine its condition. Check the battery voltage with the solar panel disconnected is above 12.7 volts.

Battery condition	Voltage range
100%	12.7 (or greater)
75%	12.5
50%	12.2
25%	12.0

Table 4 – Battery Condition

5.10 If the voltage is less than 11.5V it should be replaced.

NOTE: *This type of battery, if allowed to completely discharge, never regains its full capacity. This type of damage is cumulative. This loss of capacity shows up as a quicker than expected discharge rate. (ie the gates shall start to slow after fewer moves).*

Locate and press the LED indicator button.

5.11 Both the retract limit and extend limit LEDs beneath the same Actuator plug should never be on simultaneously.

a) If they are with the gate in the open position and the actuator connected the actuator shall not operate. You should adjust the closed limit switch until its LED goes off.

By adjusting this switch, you are setting the point at which the gate shall stop, so from time to time you should operate the gate towards the closed position and adjust the limit switch to stop the gate at the desired point. As shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test).

b) If they are with the gate in the closed position and the actuator connected the actuator shall not operate. You should adjust the closed limit switch until its LED goes off.

By adjusting this switch, you are setting the point at which the gate stops, so from time to time you should operate the gate towards the open position and adjust the limit switch to stop the gate at the desired point. As shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test).

Gate 2 fails to operate

5.12 Press the “Open / Close Command” button and verify that the Gate 1 operates to the open position.

5.13 Gate 1 operates correctly, and Gate 2 fails to respond, remove the plug in X1 and mark it for identification then remove plug X2 and plug it into the vacant X1 socket (Figure 8).

5.14 If the Gate 2 operates as soon as the X2 plug is fitted into socket X1 this proves that the actuator and tail cables are working for Gate 2 and the NR Control Board is faulty

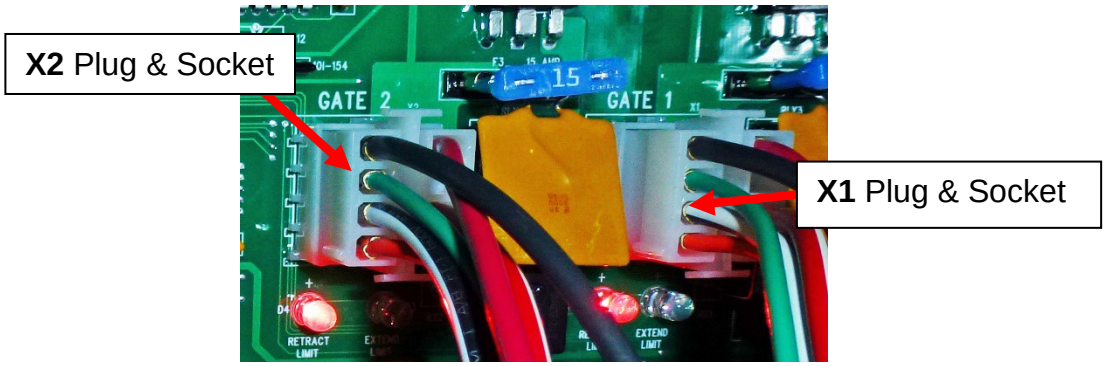


Figure 8 - Location of the X1 and X2 Plugs and Sockets

5.15 Should Gate 2 still fail to operate then the tail cable and disconnection box should be investigated. The DC supply to the actuators should be checked on the terminal blocks inside the disconnection box close to the actuator, and voltage of 13vDC should be expected when a call is placed on the actuator to move the gate (Figure 9).

The polarity of this voltage depends on the direction of movement.

Figure 9 – Actuator Voltage Readings

5.16 Remember to reinstate both X1 and X2 plugs to their respective sockets when testing is completed.

Gate 1 fails to operate.

5.17 Gate 2 operates correctly, and Gate 1 fails to respond, remove the plug in X2 and mark it for identification then remove plug X1 and plug it into the vacant X2 socket (Figure 9).

5.18 If the Gate 1 operates as soon as the X1 plug is fitted into socket X2 this proves that the actuator and tail cables are working for Gate 1 and the NR Control Board is faulty.

5.19 Should Gate 1 still fail to operate then the tail cable and disconnection box should be investigated. The DC supply to the actuators should be checked on the terminal blocks inside the disconnection box close the actuator, and voltage of 13vDC should be expected when a call is placed on the actuator to move the gate (Figure 9).

The polarity of this voltage depends on the direction of movement.

5.20 Remember to reinstate both X1 and X2 plugs to their respective sockets when testing is completed.

6. The Gates open / close slowly

6.1 The usual cause of slow running is low battery voltage. Two things need to be considered.

a) Battery condition (replace or charge)

b) What caused the battery to become discharged?

NOTE: *The battery is charged only from the solar panel.*

6.2 Check the panel is facing in a southerly direction and is not located in a completely shaded area.

6.3 Inspect solar panel surface for contamination and cable for damage.

Should it be necessary for the Solar panel to be disconnected you shall disconnect and insulate the exposed conductors one at a time as the short circuit caused by the cable cores touching damages or destroy the power generation capabilities of the solar panel.

6.4 To test the solar panel for correct voltage, disconnect the incoming supply links from the Solar panel in the disconnection box mounted with the Main Control Box.

6.5 Using a DC voltmeter, measure the dc voltage. It should measure between 17 & 22vDC volts on a sunny day. If this reading is incorrect the panel might be defective.

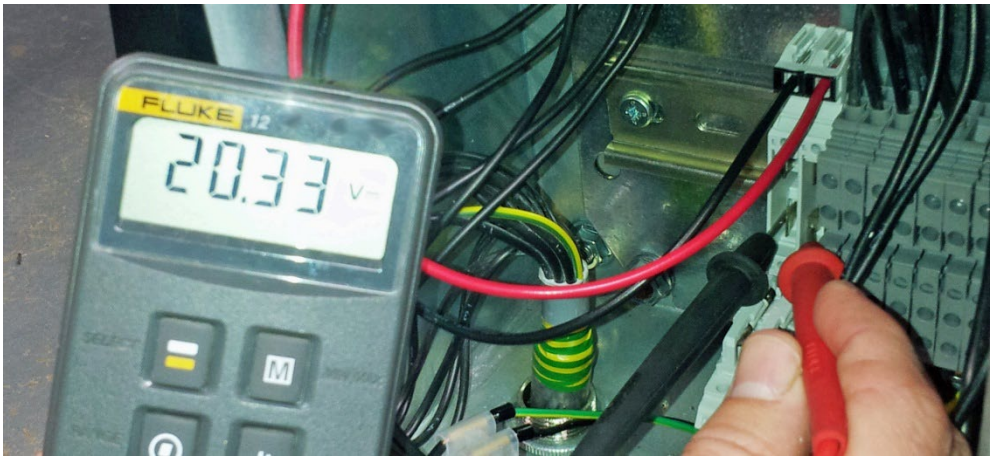


Figure 10 - Solar Panel Voltage measurement

Weather conditions	Input voltage range
Bright and sunny	17 to 22 volts
Grey and cloudy	12.7 to 17 volts
Stormy and dark	Less than 12.7

Table 5 – Expected voltages

6.6 If the reading is lower than 12.7vDC and the weather is not stormy and or dark this should be reported to the SM(S) who should consider replacing the panel.

6.7 Do not reconnect the solar panel at this point.

Do not take any readings using the current setting of your meter on this type of battery

6.8 Check the battery voltage with the solar panel disconnected is above 12.7vDC.

Battery condition	Voltage range
100%	12.7 (or greater)
75%	12.5
50%	12.2
25%	12.0

Table 6 – Battery Condition

6.9 Check the correct deep cycle battery is installed.

6.10 If the voltage is less than 11.5V it should be replaced.

NOTE: *This type of battery, if allowed to completely discharge, shall never regain its full capacity. This type of damage is cumulative. This loss of capacity shows up as a quicker than expected discharge rate. (I.e. the gates shall start to slow after fewer moves).*

6.11 Check that solar panel leads are connected to the battery correctly.

6.12 Reinstate the disconnected links for the Solar Panel.

7. The gate begins to open or close but stops and reverses after a couple of seconds.

7.1 Remove the main control box cover and locate the NR control board.

7.2 Locate the sensitivity adjustment potentiometer located on the control board (Figure 11).

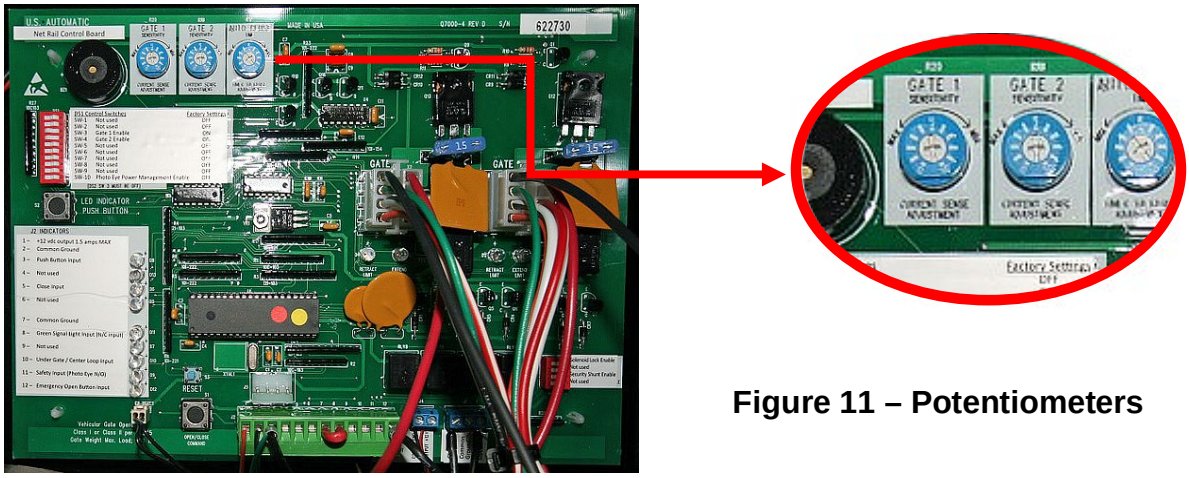


Figure 11 – Potentiometers

The white centre potentiometer is adjustable, and normally a setting of 5 operates most gates.

If the gate requires a setting above 8 to open and close the gate there is a good chance the gate has a problem that should be corrected.

Possible causes are incorrect hinges / lubrication; gate touching the ground, gate not level or the actuator arm connected to the gate is bent or incorrectly installed.

8. Gate opens correctly, then immediately reverses direction.

8.1 The most likely cause is an incorrectly adjusted retract limit switch. Firstly, determine which gate needs adjustment.

8.2 Operate the gates to the open position, while the gate is in motion press the LED Indications button and observe the retract LED indications for the limit switches that are directly below the X1 and X2 sockets.

8.3 When the Gates reach the fully open position the overload bleep sounds, the gates both move away from the latch posts and stop.

8.4 With the gate's closed neither of the retract limit switch LED's should be lit. A lit LED indicates that the gate is incorrectly adjusted.

8.5 Once the gate, or gates, that need adjustment are identified you should carry out the adjustment as shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test). And retest.

9. Gate closes correctly, then immediately reverses direction and fully opens.

9.1 The most likely cause is an incorrectly adjusted extend limit switch. Firstly, determine which gate is in need of adjustment.

9.2 Operate the gates to the closed position, while the gate is in motion press the LED Indications button and observe the extend LED indications for the limit switches that are directly below the X1 and X2 sockets.

9.3 When the Gates reach the fully closed position the overload bleep sounds, the gates return to the fully open position.

9.4 At the point the gate was closed and one or both of the extend limit switch LED shall not have been lit. The unlit LED indicates that the gate is incorrectly adjusted.

9.5 Once the gate, or gates, that need adjustment are identified you should carry out the adjustment as shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test) and retest.

10. The Gates or Gate fails to complete it travel before stopping.

10.1 The most likely cause is an incorrect limit switch adjustment.

10.2 Carry out the adjustment on the limit switch of the gate which is not closing fully as shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test). And retest.

11. Control board 15-amp fuse blows when Open/Close command is given.

11.1 A blown fuse means the gates shall not operate in power mode. Possible causes are an obstruction that prevents the gate from moving, the gate is attempting to 'over close' or 'over open' due to incorrect limit switch setting or there might be a wiring problem because of a faulty connection.

11.2 Before commencing any testing, you should remove the latch pins and manually operate both gates to check they are not binding or catching at any point across their full range of movement.

11.3 Open the main control box cover and locate the NR control board. Locate the 2 LED's under the X1 and X2 actuator connectors on the control board.

11.4 Press the "LED Indicator" push button and hold it in, observe the LED's and determine if the retract limit or extend limit LED is on.

11.5 Check if the correct LED is on for the gate position. For example, if the left LED is on that is the retract limit and the gate should be in the open position. The right LED represents the extend position.

11.6 If the retract limit LED is on and the gate is closed, a command to operate the gate shall try to force the gate beyond the closed position which could blow a fuse.

11.7 If the extend limit LED is on and the gate is open a command to operate the gate shall try to force the gate beyond the open position.

Again, this could blow a fuse. In either case, the actuator limit switches need to be adjusted as shown in NR/SMS/PartB/Test/084 (Power Operated Gate Opener Adjustment / Test) and then the cause for them becoming misadjusted needs to be determined.

The cause is likely to be incorrect wiring, a poor actuator plug connection at the NR control board or excessive sensitivity adjustment applied during installation.

11.8 Check all wiring and verify actuator connector is connected at the control board.

12. The Gate only operates when the "LED INDICATOR" is pressed.

12.1 Advise you SM(S) or on call Supervisor immediately.

13. Solenoid Lock Issues

13.1 Before commencing any testing, you should check that the solenoids are not binding or catching. If the solenoids are binding the current sensing bleeper sounds.

The solenoid lock is a 12vDC device with a nominal current consumption of 350mA when energized. The solenoid lock consists of a spring-loaded latch pin and a strike pin.

13.2 The control board is designed to energize the lock (releasing it) whenever the gate is in the fully open or fully closed position and then receives a command to operate.

13.3 The control shall output 12 vdc ½ second before gate begins to move (allowing time for lock to release) for duration of about 3 seconds.

13.4 The 12 vdc is protected by an auto-resettable fuse that shuts off the output voltage if a short or bind is detected in the lock or its wiring.

13.5 The Solenoid's are connected to the NR Control Board at the bottom right corner of the board. For illustration purposes the cables have been removed from Figure 12.

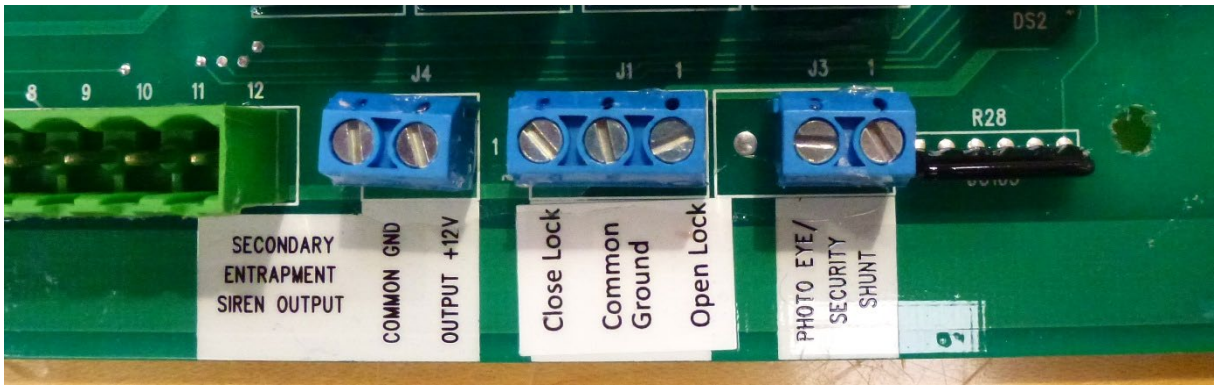


Figure 12 – The J1, J3 and J4 terminations

14. The lock does not pull the latching pin or shall not unlock the gate in the open or closed position

14.1 Remove the strike pin from the lock.

14.2 Using a voltmeter, connect the meter leads to J1 pin 1 (Open Lock) and the Common Ground J1 pin 2.

14.3 Operate the gate to the fully open or closed position.

14.4 Observe the voltmeter press the open / close command button. The meter should read 12vDC – for about 3 seconds on start up.

14.5 If 12vDC is present then the problem is in the wiring, lock or binding of the lock.

Verify wiring.

14.6 Open or close the gate fully.

14.7 Disconnect the green and blue wire from the lock (at the gate lock).

14.8 Using voltmeter connect to the red and black wire which are now disconnected from the lock.

14.9 Operate the gate, the meter should read 12vDC (for about 3 seconds) on start up.

Verify the lock

14.10 Reconnect the green and blue wires to the lock (at the gate lock).

14.11 Verify the strike pin is removed (eliminates the possibility of binding).

14.12 Open or close the gate fully.

14.13 Operate the gate and verify the latch pin is pulled (for about 3 seconds) on start-up.

Verify binding of the latch pin

14.14 Open or close the gate fully.

14.15 Install the strike into the lock (gate should be In the locked position once strike pin is installed).

14.16 Operate the gate to see if gate lock releases.

14.17 If not, then the latch pin is binding up because of too much pressure on the strike pin.

14.18 This is a mechanical issue, caused by incorrect gate stop position or the lock is not aligned correctly.

14.19 Identify which is causing the bind and correct.

The lock does not pull the latch pin (unlock) from the open gate position.

14.20 Verify gate is on the retract limit. Lock pin shall only pull if the retract limit is activated.

14.21 Adjust retract if limit is not activated.

The lock does not pull the latch pin (unlock) from the closed gate position

14.22 Verify the gate is on the closed limit. Lock only activates if the closed limit is activated.

14.23 Adjust closed limit if limit is not activated.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF10		
Faulting Guide: Frauscher Advanced Axle Counter		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Frauscher Advanced Axle Counter equipment
Excludes:	All other types of axle counters and equipment

1. Wheel Sensor RSR123

1.1 Examine the wheel sensor mounting plates and bolts for heavy soiling, security and external damage. If necessary, remove heavy soiling or replace wheel sensor as described in NR/SMTH/Part04/AX40 (Replace a Frauscher Wheel Sensor RSR123).

1.2 Check the area around the rail contacts (within 2 m); should be free of the following items:

a) Visible P/way defects.

b) Metallic debris.

c) New / scrap rails in the four / six foot or cess.

d) Traction bonds.

e) Excessive ballast.

2. Voltage Measurements

2.1 Measure voltage at test sockets for Sys1 and/or Sys2 the reference value should be = 500 mV DC ± 5 %.

2.2 The measured voltage complies with the wheel sensor system current via a 100 Ohm shunt (100 mV therefore complies with 1 mA wheel sensor system current).

The voltage shall be measured in the unoccupied status of the RSR123.

If the voltage is < 475 mV and > 525 mV, then:

a) Do not adjust the RSR123.

b) Check wheel sensor mounting.

c) Check if the RSR123 is occupied (traversed).

If the voltage is alternating < 375 mV and > 550 mV, then:

d) RSR123 fallen off the rail (results in error code output from RSR123).

If the voltage is > 600 mV then:

e) Check for a short-circuit of wire 1 with 2 or wire 3 with 4.

f) RSR123 incorrectly connected.

If the voltage is 0 mV, then:

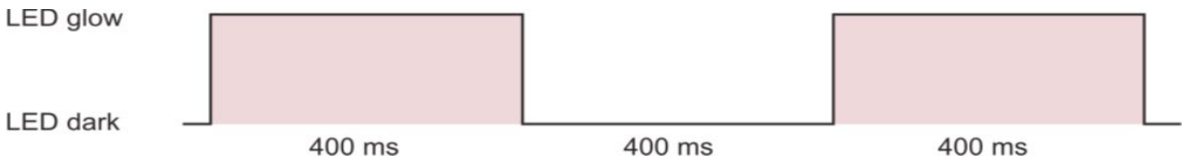
g) Check for a wire break wire 1, 2, 3 or 4.

h) Is the RSR123 connected.

3. AEB

3.1 LED indicators on the AEB

Slow flashing of the Sys1 or Sys2 LED.



Possible causes:

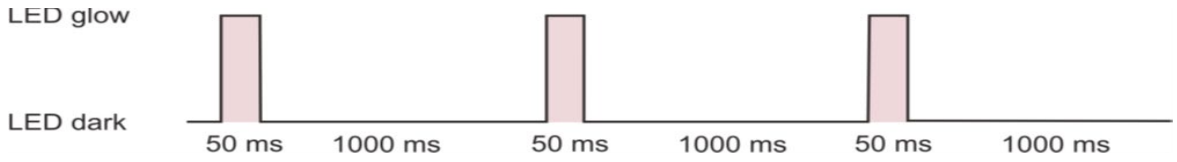
a) RSR123/AEB not adjusted.

b) Wire break or wire short circuit in wheel sensor cable.

c) An overcurrent.

d) Wheel sensor current level overlaid with harmonics.

Short flashing of the Sys1 or Sys2 LED

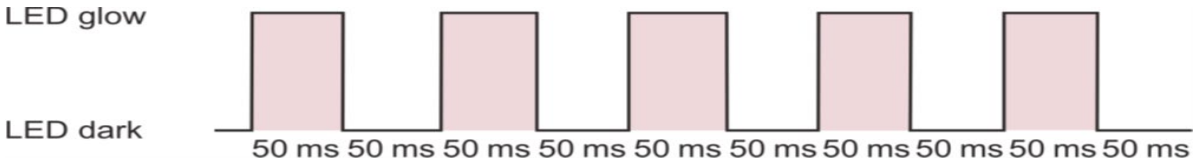


Possible causes:

e) No Life-signal from RSR123 (displayed after 1 minute).

f) Wheel sensor current drift of the RSR180/RSR123 (displayed after 1 minute)

Fast flashing of the Sys1 and Sys2 LED



Possible causes:

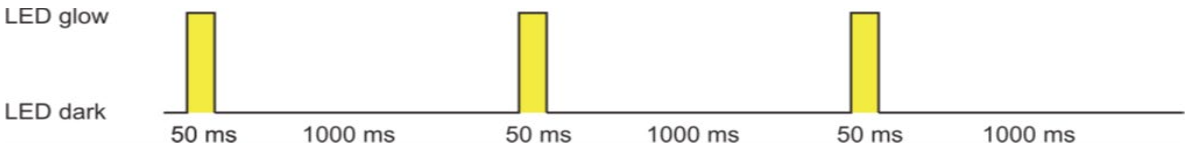
g) Adjustment process terminated (flash duration 2 seconds).

h) Invalid activation sequence instigated for adjustment (flash duration 2 seconds).

i) Internal AEB fault. In this case the power supply must be briefly disconnected.

If the problem continues, the AEB has to be replaced and/or the configuration of the AEB has to be checked.

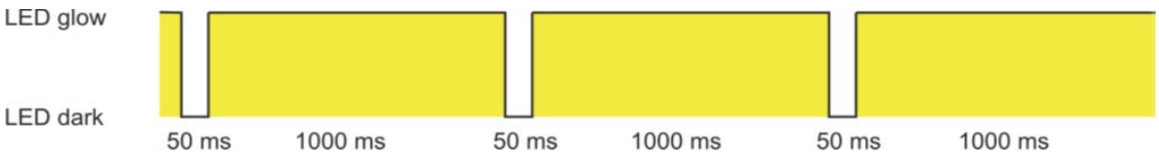
Short flashing of A1 and A2 LED



Possible cause:

j) The AEB is desensitised and the track section (FMA) is clear (in the case of counting head control).

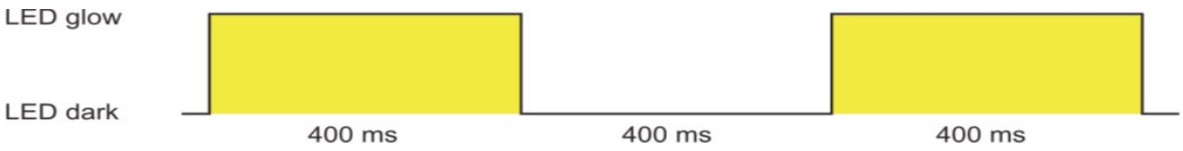
LED A1 and A2 shortly out



Possible cause:

k) The AEB is desensitised and the track section (FMA) is occupied (in the case of counting head control).

Slow flashing of A1 or A2 LED



Possible cause:

l) Track section FMA1 or FMA2 faulty.

B1 and/or B2 LED illuminated

Possible cause:

m) Not yet received a valid configuration file or data transfer interfered.

4. Error codes of the AEB

In the event of a fault and/or of an invalid configuration the AEB issues error codes. The output of the error codes can take place via an IO-EXB which is connected to the respective AEB.

The error codes can also be readout via the ASD or via diagnostic system.

If these error codes occur the configuration should be corrected by the person who designed the configuration.

If an error code occurs which is not described in the table below, please consult Frauscher and if necessary, send the AEB back to Frauscher.

Error code	Possible cause(s) / description
10	DIP-switches counting head outputs on the AEB are set different for channel 1 and channel 2.
12	Adjacent channel is faulty (only one channel of the AEB is faulty).
23	Automatic positioning was selected but bit-position is not configured with “0” (configuration word “data transmission output”).
24	Configuration word “assignment” is not set on each CO-EXB.
25	Configuration word “assignment” is configured several times per CO-EXB.
109	In case of hardware configuration IO-EXB boards are located in the system but no CO-EXB.
112	With the DIP-switches ID on the AEB “0” is set as ID of the AEB (for one channel ore for both channels).
115	Too many CO-EXB boards are located in the system.

Error code	Possible cause(s) / description
116	In case of software configuration CO-EXB boards are located in the system.
120	The maximum number of permitted counting heads per track section (FMA) is exceeded.
121	The maximum number of permitted counting head control sections is exceeded (configuration word “counting head control ID”).
122	The maximum number of permitted synchronisation or supervisor sections is exceeded (configuration word “synchronisation ID”).
123	Multiple configuration of track section FMA (e.g. 2 x FMA 1 or 2 x FMA 2).
124	Multiple configuration of reset.
125	Multiple configuration of counting head.
127	Configuration word “data transmission input” does not directly follow “data transmission output”.
128	No configuration of track section FMA (mandatory) for FMA 1.
129	No configuration of track section FMA (mandatory) for FMA 2.
130	Track section FMA 2 configured without FMA 1.
131	Track section FMA 1 is configured with supervisor section FMA 2 but FMA 2 is not configured.
132	Bits with indicator “AUX1_OUT”, “AUX2_OUT” and/or “MAIN_OUT“ were set to a ”not defined“ value (configuration word “track section (FMA)”).
133	Error if track section FMA 1 is to be output to a half, but track section FMA 2 is not output to a half IO-EXB (configuration word “track section (FMA)”)
134	Error if track section FMA 2 is to be output to a half, but track section FMA 1 is not output to a half IO-EXB (configuration word “track section (FMA)”)
135	No IDs configured for track section FMA 1 but own counting head is not counted.
136	No IDs configured for track section FMA 2 but own counting head is not counted.
137	Direction inversion is set for track section FMA 1, but own counting head is not counted.
138	Direction inversion is set for track section FMA 2, but own counting head is not counted.
139	Configuration of an auxiliary output for track section FMA 1, output however only via software.
140	Configuration of an auxiliary output for track section FMA 2, output however only via software.
141	Configuration of auxiliary output 2 for track section FMA 1, output however only to a half IO-EXB.

Error code	Possible cause(s) / description
142	Configuration of auxiliary output 2 for track section FMA 2, output however only to a half IO-EXB.
143	Configuration of the counting head control input for track section FMA 1, output however only via software.
144	Configuration of the counting head control input for track section FMA 2 (per AEB only one counting head control input is possible).
145	Wrong number of IO-EXB boards (e.g. one IO-EXB was configured and de facto there are two IO-EXB boards).
146	The maximum number of communication partners per AEB is exceeded.
147	Invalid ID (configured ID complies with the own ID.
148	Invalid ID (configured ID is zero).
149	Track section FMA 1 reset type configured with an invalid value (bits with indicator “RESET_IN” and/or “RESET_OUT” were set to a “not defined” value).
150	Track section FMA 2 reset type configured with an invalid value (bits with indicator “RESET_IN” and/or “RESET_OUT” were set to a “not defined” value).
151	The maximum number of permitted IO-EXB boards is exceeded.
152	In case of deactivated outputs, the automatic positioning was activated, a position was set, not the ID of the own ID is entered (configuration word “data transmission output”) or the configuration word “data transmission input” was not configured immediately.
153	Safety level of the data transmission input invalid (bits with indicator “SAFETY_LEVEL” were set to a “not defined” value).
154	Counting head ID configured several times.
155	Counting head control ID configured several times.
156	Synchronisation ID configured several times.
157	Invalid position of the output information (outside of 24 bit).
158	Data transmission configuration before the track section (FMA) configuration.
159	Automatic and manual positioning is combined for the data transmission.
172	Project number configured several times.
173	Project number configured with zero.
174	Configuration word “assignment” is used with software configuration.
175	Incorrect configuration of configuration word “assignment” (ID of AEB is wrong).

Error code	Possible cause(s) / description
176	No configuration of the configuration word “assignment” in the case of the hardware configuration.
177	Incompatible protocol-version-number between several AEB boards (old and new AEB boards were mixed).
178	No correspondence of the project numbers between the communication partners.
179 180	DIP-switches ID of AEB were set different for channel 1 and channel 2.
181 182	Different number of configuration words.
183 184 185	Different configuration.
186	All configuration requests unsuccessful (No CF-Card for configuration of AEB, wrong ID in the configuration file or wrong ID set on the AEB).
187	Invalid position of the input information (outside of 24 bit).

Table 1 – AEB Error Codes

5. Power Supply

5.1 LED Indications

Check the green PWR LED on the front panel of the PSC.

If the green LED is not illuminated, the possible causes are:

a) No voltage input .

b) SMD-fuse is blown (in this case replace the PSC and send the defective PSC back to Frauscher).

6. Communication Boards

6.1 LED Indications

Description of Error	Possible Cause(s)
LED ”PWR" not lit	No supply voltage
LED “CAN“ lit after Power-up	Board not yet ready for operation
LED ”CAN“ flashing or lit during operation	Error on CAN bus
LED “Ethernet 1” and/or “Ethernet 2”, top not lit	No connection to network 1 and/or 2
LED “Ethernet 1” and/or. “Ethernet 2”, bottom not lit	No data transfer
LED “Card” not lit	No CF-Card, no configuration on CF-Card or faulty CF-Card

Table 2 - Communication Board Error Codes

7. Fast flashing of Status LED

Possible cause:

a) Internal COM-AdC / COM-xxx fault

8. Error codes of the COM-AdC / COM-xxx

In the event of a fault and / or of an invalid configuration the COM-AdC / COM-xxx issues error codes (see Table 3). The error codes can be readout via the ASD or via diagnostic system.

If these error codes occur the configuration shall be corrected by the person who designed the configuration.

The error codes 18-48 (own channel) or 146-176 (other channel) affect the configuration with configuration words. If an error code occurs which is not described in Table 3, please consult Frauscher and if necessary, send the COM-AdC / COM-xxx back to Frauscher.

Error Codes		Possible Cause(S) / Description
Own Channel	**Other Channel**	
0	128	no error
15	143	error protocol-version does not correspond with AEB
16	144	error project-number does not correspond with AEB
17	145	DIP-switch setting of channel 1 and channel 2 not identical
18	146	number of possible configuration requests obtained, no answer
19	147	number of possible configuration requests obtained, faulty answers COMPONENT, CRC,...) received
20	148	comparison VERSION/VERIFY with the other channel failed
21	149	CFG_MY_IP_ADDR may only be configured once
22	150	CFG_MY_MASK may only be configured once
23	151	CFG_UDP_PORT_INT may only be configured once
24	152	CFG_ARP_TIMING may only be configured once
25	153	CFG_GTWY_IP, Gateway 1 (GTWY) may only be configured once
2	154	CFG_GTWY_IP, Gateway 2 (GTWY) may only be configured once
627	155	CFG_GTWY_DEST, Gateway 1 (GTWY) may only be configured once
28	156	CFG_GTWY_DEST, Gateway 2 (GTWY) may only be configured once
29	157	CFG_GTWY_MASK may only be configured once
30	158	CFG_DFLT_GTWY_IP may only be configured once
31	159	CFG_DEST_IP_ADDR with the same ID configured several times
32	160	CFG_UDP_PORT_DEST may only be configured once
33	161	CFG_FWRD_ACD, the same CAN sender-ID (CAN_TX_ID) appears in the configuration words CFG_FWRD_ACD and CFG_FWRD_TS
34	162	CFG_FWRD_TS configured too often
35	163	CFG_FWRD_ACD configured too often
36	164	CFG_FWRD_TS, the same CAN sender-ID (CAN_TX_ID) appears in the configuration words CFG_FWRD_ACD and CFG_FWRD_TS
37	165	CFG_FWRD_DIAG configured too often
38	166	CFG_FILTER_DIAG may only be configured once
39	167	CFG_MY_IP_ADDR or CFG_MY_MASK configured without the other configuration word
40	168	CFG_GTWY_IP, gateway 1 (GTWY) without CFG_GTWY_DEST, gateway 1 (GTWY) configured
41	169	CFG_GTWY_DEST, gateway 1 (GTWY) without CFG_GTWY_IP, gateway 1(GTWY) configured
42	170	CFG_GTWY_IP, gateway 2 (GTWY) without CFG_GTWY_DEST, gateway 2 (GTWY) configured

Error Codes		Possible Cause(S) / Description
Own Channel	Other Channel	
43	171	CFG_GTWY_DEST, gateway 2 (GTWY) without CFG_GTWY_IP, gateway 2 (GTWY) configured
44	172	CFG_DEST_IP_ADDR without CFG_MY_IP_ADDR and CFG_MY_MASK configured
45	173	CFG_UDP_PORT_DEST without CFG_DEST_IP_ADDR configured
46	174	external CFG_DEST_IP_ADDR without CFG_DFLT_GTWY_IP configured or CFG_GTWY_DEST gateway 1 and 2 (GTWY) not configured
47	175	external CFG_DEST_IP_ADDR without CFG_DFLT_GTWY_IP configured, CFG_GTWY_DEST gateway 1 (GTWY) wrong or CFG_GTWY_DEST gateway 2 (GTWY) not configured
48	176	external CFG_DEST_IP_ADDR without CFG_DFLT_GTWY_IP configured or CFG_GTWY_DEST gateway 1 and 2 (GTWY) configured wrong

Table 3 - COM-AdC / COM-xxx Error Codes

9. Error codes of CF-card

9.1 The error codes of the CF-card can be readout e.g. via the ASD.

Error Code	Possible Cause(S) / Description
0	no error
1	CF-card not formatted
2	boot record is bad / partition damaged
3	file system type unsupported
8	could not find the file on the device (error relates only to the respective request)
9	could not find the directory (CONFIG),
16	unsupported sector size / wrong formatting
17	access to CF-card not finished yet (no error, only information)

Table 4 - CF- Card Error Codes

10. Input / Output Extension Board IO-EXB

10.1 Troubleshooting Operating Status.

Operating Status	Display		
	1st Position	2nd Position	3rd Position
Partial traversing (Selection of the track section (FMA) with display-button on the front panel)	**P.**	**Code for determining the RSR causing the issue (see table 6)**	
Waiting for clearing of track (Selection of the track section (FMA) with display-button on the front panel)	**F.**	**Axle number, display to maximum 99 axles**	
Error (Selection of the track section (FMA) with display-button on the front panel)	**E**	**Dezimaler Fehlercode (01 to 99) (see table 6)**	
Communication error during axle counting (Selection of the track section (FMA) with display-button on the front panel)	**C.**	**Decimal error code (01 to 99) (see table 6)**	
Communication error during synchronisation (Selection of the track section (FMA) with display-button on the front panel)	**S.**	**Code for determining the AEB causing the issue (see table 6)**	

Table 5 – IO-EXB Operating Status

Error Code	Possible Cause(S)
0	Error number in case of problem on the own RSR
1 to 15	Error number in case of fault on the 1st to 15th external RSR of the track section (FMA)
16	Error number in case of negative counting
17	Error number in case of communication failure > 30 days
18	Error number during failed channel comparison
21-35	Unusable transfer quality of the counting head (for 1st to 15th external RSR of the track section (FMA))
41-43	Unusable transfer quality of the synchronisation (for 1st to 3rd track section (FMA))
- - -	Display during power up (during power-up the ASD shows the error code 99 (until Reset))

Table 6 - IO-EXB Error Codes

11. Data Transmission

11.1 Troubleshooting Operating Status.

Operating Status	Display		
	1st Position	2nd Position	3rd Position
Communication error	**C.**		**1**
Transfer quality for actuation of the outputs is unusable	**E.**	**2**	**1**
Different signals at own input (relevant to QUAD- and DUAL-inputs)	**E.**		**0**
Different signals at the other input (relevant to QUAD and DUAL-inputs)	**E.**		**1**

Table 7 – Data Transmission Operating Status

12. Error codes of AEB (displayed on the IO-EXB)

The error codes of AEB are described in Table 1.

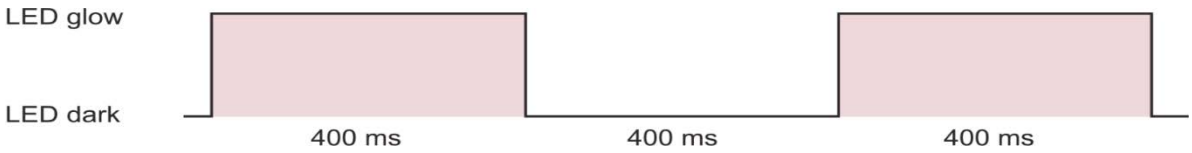
If using an AEB in combination with an IO-EXB, the IO-EXB can output error codes of the AEB.

If several IO-EXB boards have been connected to an AEB, the AEB error codes are displayed on the first IO-EXB.

The display of the IO-EXB shows alternately “Er1” – error code of AEB channel 1 – “Er2” – error code of AEB channel 2. The indication of AEB error codes takes precedence over the indication of axle counting error codes and data transmission error codes.

13. LED indicator on the IO-EXB

Slow flashing of the left Status LED on the IO-EXB



Possible causes:

a) Error during data transmission.

b) Track section (FMA) faulty.

14. Overvoltage Protection Board BSI005

Consider that the clamps of the BSI005 may be subject to transient over voltages.

In case of replacement of an AEB (by reason of an unknown failure) the BSI005 shall also be replaced.

14.1 Measure the voltage between clamps E1 and E2 it should be 28 to 31 V DC.

14.2 Measure the voltage between clamps E3 and E4 it should be 28 to 31 V DC.

If either of the voltages between clamps are not in the range stated, the overvoltage protection board shall be replaced as described in NR/SMTH/Part04/AX44 (Replace an Overvoltage Protection Unit BSI00).

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF11		
Faulting Guide: Platform Identification Beacon		
Issue No. 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	Platform Identification Beacons (PIBS)
Excludes:	All other track mounted Beacons

GENERAL

On being notified that there may be a fault with the trackside equipment, there are two distinct areas of activity, locating or diagnosing a fault within the trackside equipment and then rectifying the fault.

Diagnosing a Fault

The PIBS trackside equipment monitors for a variety of faults at start-up (power on) and then during operation it continuously monitors pre-selected conditions.

All malfunctions of the trackside equipment result in the transmission to trains being stopped; at the same time the healthy blue LED on the outside of the control panel is extinguished, i.e. upon pressing the LED button the lamp will not illuminate.

In addition, In the event of a fault with the PIBS trackside equipment, the 7-Segment display on the transmitter control unit within the control panel will display a code. This code will help to locate the cause of the problem by reference to Table 1.

Fault codes which display the decimal point are associated with IC1 and coding plug CP01; fault codes which do not display the decimal point are associated with lC2 and coding plug CP02.

Once the failed component has been replaced and the unit powered up again, PIBS will perform a system self-check and, assuming the fault has been cleared, the system will automatically reset itself into an active state. In the case of a hardware fault and the transmitter unit (LRU) needs replacing, it is essential that the coding plugs are left in the transmitter pane and returned with the unit for repair.

After any repair and before placing the system back into operation, use the Tracklink 2 Beacon Test Unit to check the output from the beacon to confirm for correct station and platform length.

There are no repairable components or adjustments which can be made within the transmitter control unit (LRU No.9). This unit has been sealed at manufacture and has to be replaced as a whole. Breakage of the seals on this unit will invalidate any warranty or guarantee.

Rectifying a Fault

PIBS is a modular system; all components are Line Replaceable Units, (LRUs). This means that there are no user serviceable parts contained within the PIBS system.

In the event of a failure of any module, reference should be made to Table 2. The item in question shall be replaced with a spare and the faulty item returned to the manufacturer for repair. You shall also notify IFC and your SM (S).

Tracklink 2 Beacon Test Unit (Track Loop Tester)

It is possible for maintenance personnel to confirm the correct operation and identification of the location of the station and platform length, etc., by use of the Test Unit. The top panel is shown in Figure 1.

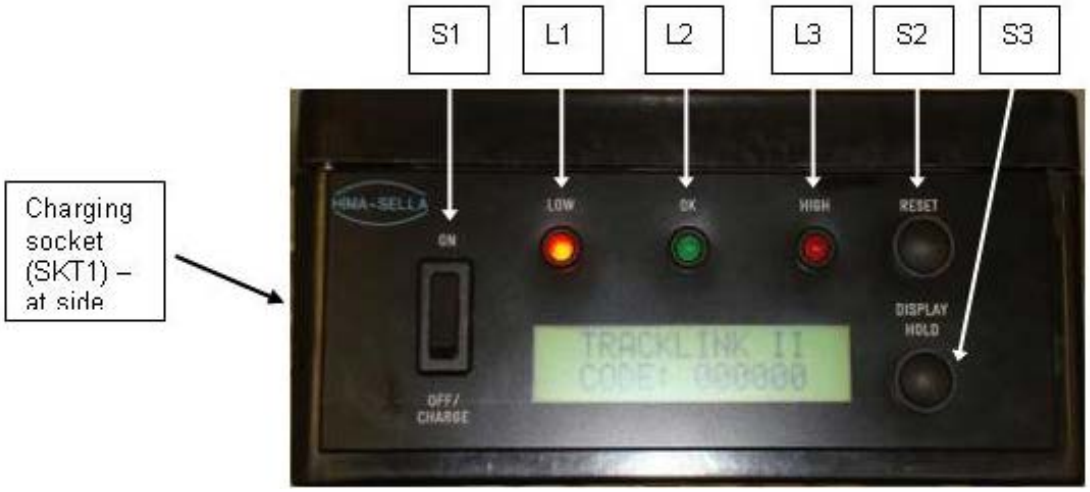


Figure 1 – Tracklink 2 Beacon Test Unit Panel

IC1/CP01	IC2/CP02	Status Description	Suggested Action
	0	Healthy	None
	1	Transmitter Output Signal Level High	1) Check All Track Loop Connections (short-circuit) 2) Hardware Fault — Replace Transmitter Unit (LRU)
	2	Transmitter Output Signal Level Error	Hardware Fault — Replace Transmitter Unit (LRU)
	3	No Track Data after 2 Seconds	Hardware Fault — Replace Transmitter Unit (LRU)
	4	Transmitter Output Signal Level Low	1) Check All Track Loop Connections (disconnected) 2) Hardware Fault — Replace Transmitter Unit
5.	5	RAM Data Register Fault	Hardware Fault — Replace Transmitter Unit (LRU)
6.	6	Initialisation Fault (at Power On)	Hardware Fault — Replace Transmitter Unit (LRU)
7.	7	Brown-out Reset Fault	1) Check Power Supply to Transmitter Unit 2) Hardware Fault — Replace Transmitter Unit (LRU)
8.	8	CPU Data Transfer Fault	1) Check Feeder cable is not near sources of interference 2) Hardware Fault — Replace Transmitter Unit (LRU)
9.	9	Watchdog Reset Fault	Hardware Fault — Replace Transmitter Unit (LRU)
	A	5V Logic Supply High	Hardware Fault — Replace Transmitter Unit (LRU)
b.	b	Coding Plug Parity Fault	1) Check Coding Plug installed correctly 2) Faulty Coding Plug 3) Hardware Fault — Replace Transmitter Unit (LRU)
C.	C	Coding Plug Not Present	1) Check Coding Plug installed correctly 2) Faulty Coding Plug. 3) Hardware Fault — Replace Transmitter Unit (LRU)
	d	Track Data Check Fault	1) Check Coding Plugs installed Correctly 2) Check Coding Plug Numbers Match
	E	Feedback Coil Connection Fault	Hardware Fault — Replace Transmitter Unit (LRU)
	F	Track Data Receive Fault	1) Check All Track Loop Connections 2) Check Feeder cable is not near sources of interference
-.		Operation Stopped	Hardware Fault — Replace Transmitter Unit (LRU)

Table 1 – Transmitter Control Unit Fault Code Table

LRI Item No.	HSD 2000 Part No.	Description	Quantity per System	PADS Cat. No.
1	2000/066/00	Tracklink 2 Beacon (complete)	1 off	3492/098996
2	2000/066/01	Tracklink 2 Support Beams (specify fixings)	5 off	
3	2000/066/02	5m Track Cable Type C3, 2 core, 2.5mm2 c/w 3 pin moulded socket	1 off	006/160086
4	2000/066/03	10m Track Cable Type C3, 2 core, 2.5mm2 c/w 3 pin moulded socket		
5	2000/066/04	60m Tail Cable Type C3, 2 core, 2.5mm2	1 off	006/160086
6	2000/016/00	3 way Disconnection Box (complete)	1 off	3492/098997
7	2000/016/01	Dis. Box Support Stake	1 off	
8	2000/046/00	Tracklink 2 Transmitter S/S Enclosure	1 off	3492/098995
9	2000/046/01	Transmitter Control Unit	1 off	
10	2000/046/02	Transmitter Control Unit Power Supply Unit	1 off	
11	2000/046/03	Matched Coding Plug Set	2 off	
12	2000/046/04	Replacement LED Switch Indicator Complete (White)	1 off	
13	2000/046/05	Replacement LED Switch Indicator Complete (Blue)	1 off	
14	2000/046/06	Panel Condensation Heater	1 off	
15	2000/046/07	Condensation Heater Thermostat	1 off	
16	2000/046/08	Complete Termination Rail	1 off	
17	2000/046/09	Complete Set of Panel Identification Labels	1 set	
	Alter. to type C3 cable	5m Track Cable, ZHLS Type E3, 2 core, 2.5mm2 c/w 3 pin moulded socket	1 off	006/160090
		10m Track Cable, ZHLS Type E3, 2 core, 2.5mm2 c/w 3 pin moulded socket		
		60m Tail Cable, ZHLS Type E3, 2 core, 2.5mm2	1 off	006/160090

Table 2 – Line Replaceable Units (LRUs)

To operate the test unit, place it centrally onto the Tracklink 2 beacon so it is in a stable position, as shown in Figure 2.

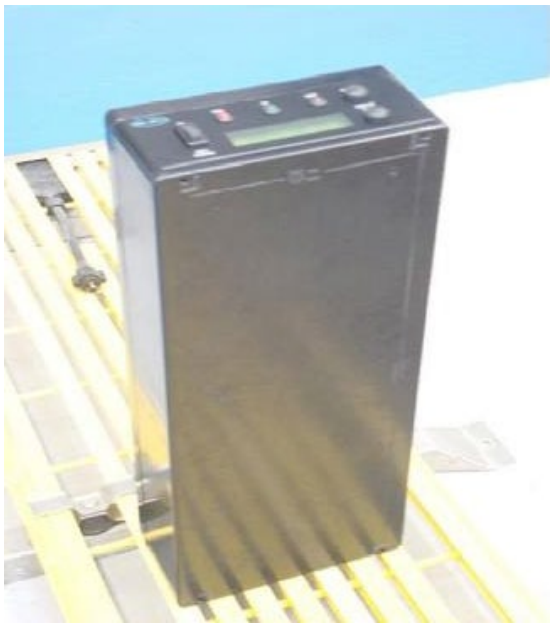


Figure 2 Test Unit Position on Beacon

With the test unit centrally positioned and stable on the beacon switch S1 to “ON” position. The test unit will automatically perform a self-checking procedure during its initialisation process, the sequence of which is as follows:

1. Indicators, L1- L3 externally mounted on the tester will illuminate for 2 seconds to show the LEDs are operational.

2. The 2 x 16-character display will display the following sequence:

TRACKLINK II TRACKLOOP TESTER

TRACKLINK II BATTERY LEVEL: 1-5	(1 = LOW, 5 = FULLY CHARGED)

TRACKLINK II CODE: 000000

In addition, the display backlight will be illuminated.

3. Providing the initialisation process is successful the test unit will go into normal operation. In addition, the Tracklink 2 beacon has to be active for the following to occur.

4. One of the 3 indicators L1 – L3 will illuminate to indicate field strength of the beacon.

   a) L1 “LOW” illuminated means field strength is below the acceptable transmission level.

   b) L2 “OK” illuminated means field strength is within acceptable transmission levels.

   c) L3 “HIGH” illuminated means field strength is greater than acceptable transmission level.

5. Only when L2 is illuminated a new code will be shown on the display as follows:

TRACKLINK II CODE: A1B2C3

The exact code will be determined by the coding plug in the trackside Tracklink 2 transmitter panel which is driving the beacon. The code represents the Location (station) and the Platform (length) data being transmitted from the beacon. This code can be cross referenced with the master listing to confirm it relates to the correct station and platform data.

6. Once the code is displayed press the “display hold” button (S3) which locks the current display. The test unit can be removed from beacon to view/read the data and should match that of the Tracklink 2 Transmitter panel driving the beacon.

7. To reset display and remove the locked data press the “reset” button (S2) which resets the code to 000000 and the LOW RED LED (L1) will illuminate if away from a beacon.

8. To deactivate test unit switch “S1” to the off/charge position.

With a fully charged battery the test unit should last approximately 8 hours in continuous use.

In the event that battery level reaches BATT LEVEL 1 on the display, the test unit will fail to operate. Place the test unit on charge via the charging socket (Figure 1) until a green light is shown on the charger unit which indicates test unit fully charged. While test unit is charging the charger unit shows a red light.

Maintenance of the Tracklink 2 Test Unit

Visual Checks:

a) Check external charging connector for damage.

b) Check external of tester for physical damage.

c) Check main label for secure fixing.

d) Yearly: Return to Hima-Sella Limited for calibration.

END

1. TPWS Failure Indications

The TPWS trackside equipment has two methods of detecting and indicating faults; an internal proving relay, which is generally connected to a signalling indication circuit (signal lamp proving relay circuit, SSI proving input or dedicated FIU circuit); and a 'Fault' LED.

The internal proving relay is energised whenever TPWS is transmitting and the internal circuits of the TPWS modules are not detecting a fault. It is de-energised whenever TPWS is not transmitting, even if it is not required to be transmitting. The status of the relay is indicated by the 'Loops Active' LED on the SIM.

The 'Fault' LED on the TPWS OSM/TSM module is a latched indication. Once a fault occurs the LED continues to be illuminated until reset (achieved by removing the power to the SIM) even if the signal is at a proceed aspect or the fault has cleared. However, this indicator is purely a visual indication to the maintainer and does not cause a TPWS failure to be reported to the Signaller.

Further information on 'Fault' LED indications is given in sections 2 and 4.

For signals, failure of TPWS to transmit when required, is generally reported in the lamp lit indication of the signal fitted. For buffer stops TPWS failure is reported in the platform starter signal's first filament failure proving circuit.

TPWS at PSRs do not normally have any remote fault reporting.

In relay areas and some SSI areas (non-data change TPWS installation), the VCR relay is incorporated into the lamp proving circuit of the fitted signal, and hence needs to be conditioned with contacts of signal operation relays in order that no TPWS fault is reported when the signal is off and TPWS is de-energised.

In other SSI areas (data change TPWS installations), the TPWS internal proving relay contact is used to operate an input to an SSI TFM, and any conditioning of fault reporting is done within the SSI data.

In mechanically signalled areas and the most recent re-signalling schemes using new NX panels or VDUs, TPWS failures are reported using a dedicated proving circuit and indication (an FIU indication in mechanically signalled areas and dedicated TPWS indications on new panels / VDU operated signalling systems).

TPWS failure in these areas might still result in the signal in rear being automatically replaced to danger.

As a result of the above circuit arrangements, the TPWS internal proving relay contact is included in the lamp proving circuit only when the signal is at danger, and failures of TPWS have no effect on the signalling system when a proceed aspect is being displayed.

When the signal is at danger TPWS failures have the same effect as a red lamp failure, causing the signal in rear to be held at or replaced to danger, and the Signaller's panel to display a lamp out indication (or a TPWS failed indication if a dedicated indication is provided).

2. Actions to be Taken if TPWS Fault LED is Illuminated

The 'Fault' LED on the TPWS OSMs / TSMs is a latched indication to help the maintainer identify and rectify faults. However, as explained in sections 14 and 16, it might register a fault due to external causes, such as Class 314/315 trains running over energised loops or short duration power supply outages.

This means that a lit 'Fault' LED does not necessarily indicate the ongoing presence of a TPWS fault.

Where a TPWS installation has fault reporting to the Signaller, and latched fault indications are frequently found in an area where such power supply outages or Class 314/315 problems are known, these fault indications may be ignored providing there is no other evidence of ongoing TPWS failure (e.g. 'blank on panel' or 'Loops Active' LEDs not lit with signal at danger).

In this case there is neither a requirement to report a latched fault indication to the Signaller, nor to enter it into FRAME.

Where there is no remote fault reporting, if a 'Fault' LED is found lit during three monthly and annual maintenance visits, the TPWS fault indication shall be reset and, as a minimum, voltages checked at the output terminals (see Section 19).

To re-set a latched 'Fault' LED indication, the associated BX 110 250mA fuse holder shall be pulled out or MCB switched off for 5 seconds and then replaced (see Section 20).

This reset procedure is intrusive, so set up a safe system of work with the Signaller. When the power supply to TPWS is disconnected, a fault alarm is generated every time the signal displays a red aspect, this can cause replacement of the signal in rear to danger.

3. Failure Identification

Once a failure has been isolated to the TPWS trackside equipment, carry out the fault-finding process outlined in the flowcharts in NR/SMTH/Part10/FF13.

Isolate the TPWS trackside equipment using the BX110 250mA fuse on the terminal rail of the baseplate, the MCB on the racking or trackside enclosure backplane, before any modules are removed or replaced. Remember that the main and subsidiary 110V AC. Inputs to the SIM might still be live.

Record all the test results on NR/SMTH/Part02/Form/12 (Train Protection Warning System (TPWS) Failure Report Form). All equipment that is removed from site and returned to the manufacturer shall be accompanied by a completed TPWS Fault Report Form to aid further failure diagnosis of any returned equipment.

This form can also be used to aid the process of escalating the fault to a second or third-line faulting team.

If any item of equipment is changed then testing shall be carried out using the relevant maintenance test plans, as detailed in NR/SMTH/Part04

All faults, whether rectified or cleared with no fault found (tested OK), shall be recorded in the Fault Management System (FMS).

NOTE: *Cases of 'Fault' LEDs being lit with no other evidence of failure (e.g. blank on panel, or change of aspect), do not count as faults to be recorded in FMS.*

Any failure within the internal wiring of a baseplate or trackside enclosure plugboard panel (including the module plugboard and/or spade connections) shall require the entire unit to be changed. The units are not to be repaired on site.

Where baseplates have not been provided then plugboard wiring shall be checked or replaced.

4. 'No Cause Found' (NCF) or 'No Fault Found' (NFF) - Failure Procedure

There are a number of possible failure modes of TPWS trackside equipment that lead to intermittent faults that are difficult to identify other than the presence of a latched 'Fault' LED.

The method of fault finding in the flowcharts identifies many, but not necessarily all, of these failures.

With the exception of failures in areas known to be susceptible to Class 315 and Power Supply faults, if having completed all procedures outlined in the fault-finding flowcharts in NR/SMTH/Part10/FF13, there is still no cause found for an intermittent fault, proceed as follows:

a) On first failure, replace any phosphor bronze contact modules with gold contact modules, and test as per the fault-finding flowchart.

b) On second failure repeat all tests, if still NCF, replace all TPWS modules.

c) On third failure repeat all tests, if still NCF, replace the baseplate or backplane or plugboard and wiring where no baseplate is provided.

d) On fourth failure repeat all tests, if still NCF, replace the tail cables and loops.

Repeat failures will be kept to a minimum by following this procedure.

It may be advisable to perform items b), c) and d) on the second failure in certain high-risk locations.

5. Loose Terminals

The TPWS transmitter loop output circuit is particularly prone to high resistances, as would be caused by loose connections on terminals and links.

It is hence important that all connections to the loops (i.e. the terminals at the trackside enclosure or baseplate terminal rails or plugboards where baseplates are not provided and outgoing links in apparatus cases and disconnection boxes) are thoroughly checked for tightness.

6. Contamination of Spring Contacts

High resistance contacts between the TPWS modules and the BR829 relay base are a known cause of failures with TPWS equipment with un-plated phosphor bronze contacts.

Although the action of removal and replacement of the TPWS modules can sometimes, in itself, clean the contacts and remove the source of the failure, it is recommended that all such modules are replaced with the equivalent modules with gold plated contacts.

7. Coil Resistance Check

Before performing this test, undertake a continuity check of your meter and leads, by shorting the meter leads together and making a note of the resistance of the leads. This value should be deducted from the results obtained in the following tests.

From the rear of the module, preferably held by a colleague on a solid surface, take the reading in Ohms with a Fluke 187 / 287 using only light pressure at the base of terminals D3/D4 as shown in Figure 1.

Apply light pressure so as not to deform the contact tension. Take care not to press the contacts together otherwise you will simply read a short across the pair.

The coil resistance should be between 320Ω - 400Ω (with an ambient temperature range of - 20°C to +30°C).

If the reading is outside this range, then the module shall be deemed defective and suitably quarantined.

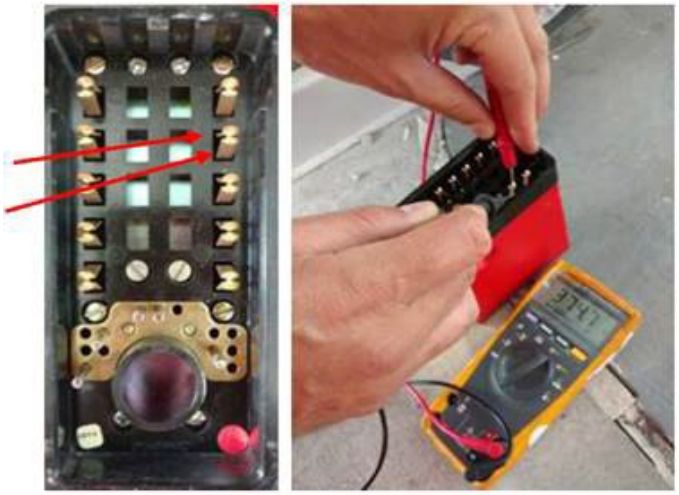


Figure 1 - Coil Resistance Check

8. Contact Resistance Check

Before performing this test, undertake a continuity check of your meter and leads, by shorting the meter leads together and making a note of the resistance of the leads. This value should be deducted from the results obtained in the following tests.

This test checks the proving contacts in the PS & SI (Red Module).

With the signal displaying a Red Aspect, (energising the proving relay coil of the TPWS module) take possession of the signal from the Signaller and slip links 7 and 8 on the TPWS baseplate, measure the resistance across the terminals 7 and 8 as shown in Figure 2.

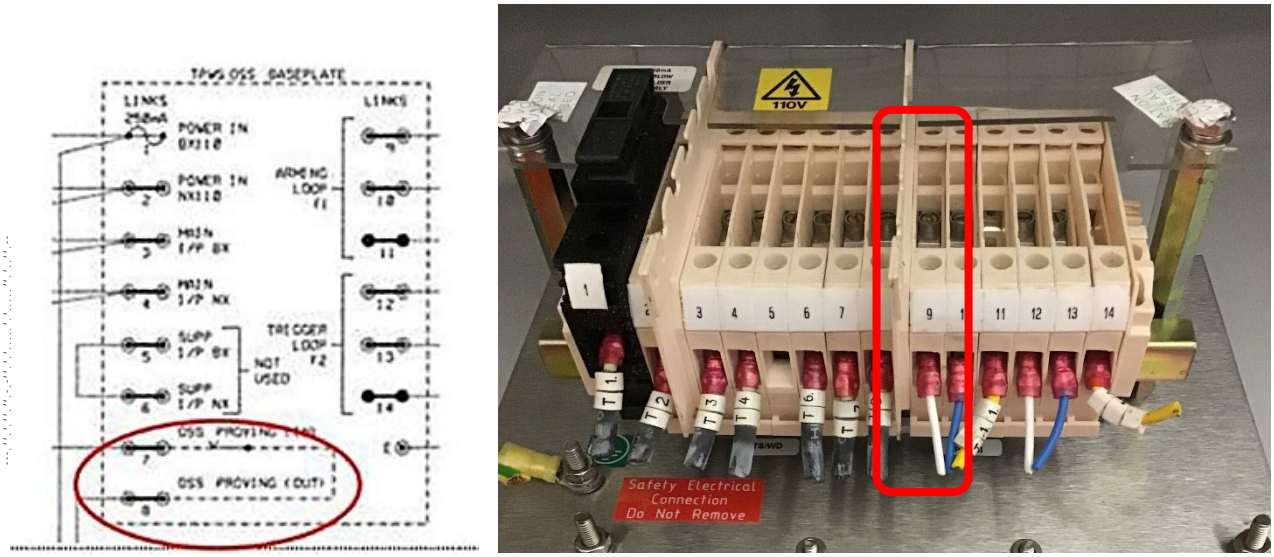


Figure 2 - Contact Resistance Check

Check that the contact resistance is ≤0.50Ω.

If the contact resistance is greater than 0.5Ω, then the module shall be deemed defective and suitably quarantined.

9. Thales Trackside Enclosures Door Seals

Some isolated cases of trackside enclosures have been found with moisture inside. Two causes have been established by Thales; the first due to the rubber door seal having been damaged during installation.

This damage is normally visible, and if found, the entire door shall be changed as individual seals are not available.

The second cause established is failure to correctly install the sealing washer for the cabinet support fixing holes as shown in NR/L3/SIG/11303 (Signalling Installation Handbook).

10. Ceramic capacitors in OSM/TSM

Ceramic capacitors in OSM and TSM modules can fail due to cracking, resulting in SIM failure due to excessive current draw.

In this case a failure within the OSM/TSM would only be identified by either the corresponding SIM overheating or by the SIM 250mA fuse blowing or MCB tripping.

When a TPWS failure occurs and the SIM is found to be overheated, indicating a capacitor failure, replacing only the SIM does not resolve this fault because the cause of the fault is in the OSM or TSM.

In this case, both the SIM and the OSM/TSM shall be changed.

11. Transmitter Loop Related Failures

A fault in TPWS transmitter loop windings can be identified by testing the DC resistance of the transmitter loop across the tail cable connections, using the Fluke 187/TPWS digital multi-meter, with the loop isolated.

A healthy loop should give an indicated DC resistance reading in the area of 0.5 to 1.5 Ohms, when measured across the two smaller pins of the loop plug coupler.

A faulty loop would give a much greater reading.

The meter shall be used in the ‘ΔRel’ mode for this test to compensate for the resistance of the test leads (i.e. normalise the reading first by shorting the two leads, then repeat the test with the Transmitter loop plug coupler in circuit).

During insulation resistance (Megger) testing of TPWS transmitter loop feeder cables and tail cables, damage might be caused to the loop tuning circuit if the cables are tested with the cable still connected to the loop.

All insulation resistance testing of TPWS transmitter loop feeder cables and tail cables shall be performed with the transmitter loop disconnected at the plug coupler.

The transmitter loop tuning unit can become detached from the loop itself if the tail cable is pulled to disconnect the tail cable from the loop.

The end caps of the transmitter loops, if they become detached from the Loop, can be glued back on if the transmitter loop is still working correctly, as described in NR/L3/SIG/11303 (Signalling Installation Handbook).

12. Plug Coupler Related Failures

TPWS cables are susceptible to damage at the point where the cable enters the plug coupler, caused by axial rotation or lateral flexing / twisting of the plug coupler.

This could lead to high resistance readings during insulation resistance testing or a short circuit between cores and the drain wire.

The plug coupler itself has an Ingress Protection (IP) rating of 67, which would allow it to maintain its internal electrical integrity when totally submerged in water.

This also has the effect that any dirt or moisture appearing on the mating halves of the plug coupler prior to installation remains when the plug coupler is mated, leading to failure possibility.

13. Differential Loop Readings

Voltage readings taken from the TSS / OSS module outputs measured at the baseplate where provided or trackside enclosure terminal rail (as per Section 19), for a pair of loops comprising one OSS or TSS function, should be roughly the same for the arming and trigger loop.

For a TSS loop pair, a difference between the two readings of more than 0.3V AC might indicate the possible presence of a fault in the loop feeder cable circuit for the higher of the two readings, as the length of the two loop feeder cables is generally equal.

For an OSS loop pair (other than buffer stop mini-loops), it is expected that the voltage on the arming loop output should be slightly higher than the trigger loop output as the loop feeder cable circuit is generally longer due to the relative distances of the two loops from the controlling apparatus case.

If the reading from the trigger loops is higher than the arming loop, or if the reading from the arming loop is significantly higher than the trigger loop, then this can also indicate the possible presence of a fault in the circuit giving the higher voltage reading.

14. Trends in Loop Voltage or Frequency

The record card should be available on site (if not inform the SM (S). Maintenance readings should be compared to those previously noted to observe any ongoing system deterioration.

Any continuing or sudden drift ft in the voltage or frequency readings for any particular loop, taken either from the OSS / TSS outputs to the transmitter loops or from the loops themselves, indicates the presence of a possible fault within either the OSS / TSS module, the loop feeder cable circuit, or the signalling power supply.

This depends on correct use of the maintenance jig and calibrated test equipment.

It is required that readings taken with the commissioning jig are recorded on the maintenance record card.

These readings are significantly lower than the readings taken with the maintenance jig and should not be confused with the downward drift in maintenance readings referred to above.

15. SSI Method 3 Timing Feature

For SSI interlockings installed using method 3, there is a potential timing feature such that, upon the signal returning to danger and energising TPWS, the fault reporting circuit, due to the slow to drop RECR, might not complete the lamp proving circuit within the settling time allowed by a TFM.

In this case, a loss of proving is reported to the central interlocking, which might immediately result in a blank signal aspect being displayed to the Signaller for 2 to 3 seconds (two or three major interlocking cycles).

If the signal in rear is showing a proceed aspect when the above situation occurs, then the signal in rear could revert to danger and then clear again when TPWS proving is correctly established.

This normally only becomes evident when a signal is replaced to danger by the Signaller (or by a track circuit failure), as during the normal passage of a train the signal in rear is already being held at danger.

The Technicians Terminal should filter out any interruptions lasting less than one major interlocking cycle and it is possible that a fault might be reported by the Signaller that is not actually recorded by the Technicians Terminal.

The above situation normally only occurs with TFMs with software to version SSI4311-C3 or earlier, which have a settling time of about 90ms. Later TFMs with software to SSI4311-C4/D1 or later have a settling time of around 250ms.

If a similar failure occurs with these TFMs, this generates an indication that either the signal lamp voltage is out of specification, or that the signal main filament has blown.

Persistent failures of TFMs with software to SSI4311-C4/D1 or later may be cured by installing SL35 8000-hour lamps and increasing the signal lamp voltage to 12 Volts.

16. Failures Related to A.C. Traction Units (Class 314/315)

Certain 25kV AC Electrical Multiple Units (EMUS), when pulling away under power, induce interference that might cause TPWS faults to be indicated, both by the TSM / OSM 'Fault' LED and to the Signaller.

The units that are known to cause such faults are Class 315 units.

It is also possible that Class 314 EMUs operating in the Glasgow area might cause TPWS faults.

The interference is caused by a magnetic field radiated from the traction equipment on the Driving Motor Cars, which is always mounted further back than the TPWS aerial, hence it is not likely that this would prevent TPWS from being operational when required, however it might cause a large amount of spurious fault indications.

Confirmation that spurious fault indications of the TPWS track sub-system are being caused by interference from traction units, can be obtained by observing the passage of trains accelerating over the energised TPWS transmitter loops (note no faults occur if the loops are not transmitting).

The effect is most consistent at locations where the units accelerate hard past a TPWS fitted signal that is replaced to danger before the traction unit of the train has passed over the transmitter loops.

The interference causes the 'Fault' LED on the TSM / OSM to illuminate and the 'Loops Active' LED on the associated SIM to be extinguished, and possibly cause a brief loss of lamp proving (or TPWS proving if a dedicated indication circuit is used) for approximately one second or less, as each driving motor car passes over an energised transmitter loop.

The TPWS System Authority is currently pursuing a solution to this problem.

17. Baseplate Fuses

The 250 mA fuses used in TPWS trackside enclosures and baseplates are fitted with indicating devices in one of the end caps.

These are a yellow disk attached to a spring, which when visible, show that the fuse has ruptured.

In some instances, the indicator device might become activated without the fuse having blown. This is a known defect with the fuses, and does not require the fuse to be replaced, provided that the 'Power On' indications on the TPWS equipment are still lit.

Do not drop the fuses when the fuse holder is pulled out.

Some installations where baseplates are not provided may be protected by 250mA MCB.

18. Power Supply Interruptions

Signalling power supply interruptions of between 70msec and 700msec can result in short duration TPWS faults, and hence a latched fault appearing on any TPWS module that is transmitting at the time of the power supply interruption. Normally this would occur on a number of the TPWS installations in an area and would almost certainly affect both the OSS and TSS on a signal installation that has both functions.

The presence of multiple latched fault indications in an area is indicative of a power supply interruption and not genuine TPWS faults.

Due to the short duration of the power supply fault the TPWS failure are not usually seen by the Signaller or by the remote fault reporting system.

Longer power supply faults can lead to any TPWS latched failures being reset. However, this would be seen by the Signaller and be recorded on any remote fault reporting system (e.g. Technicians' Terminal).

Following a reset of TPWS after a power supply interruption (see Section 2), it is still advisable to take a full set of voltage and frequency readings to identify any other latent failures.

A voltage reading on the TSS / OSS module output to the transmitter loops that is higher than expected (see Sections 13 and 14) would make the function more susceptible to failures caused by any fluctuations in the signalling power supply.

19. Voltage Testing and Dummy Load Testing

The expected voltage on the TSS / OSS module output to the transmitter loops when driving a nominal 75 Ohm load, should be approximately 4.2V. When connected to a TPWS Transmitter Loop circuit this can vary between 3.9 V and 5.1 V AC.

If there is a failure somewhere in the transmitter loop circuit that is causing the 'Fault' LED to remain lit when the TPWS equipment is reset, then a 75ohm 0.5 W resistor can be used to aid identification of the exact location of the failure.

This test method requires an electrical disconnection and appropriate protection of the operational railway, as the testing is intrusive and the signal in rear will be replaced to danger during the investigation process.

The TPWS BX 110 V AC supply shall be isolated using the 250mA fuse or MCB. The arming transmitter loop for the failed function shall be disconnected from the module outputs using the sliding links on the terminal rail of the baseplate in the trackside enclosure or the outgoing links where no baseplate provided.

The 75 Ohm load shall then be placed across the two legs of the output and the module output voltage recorded.

When the fuse to the module is replaced or the MCB switched back on, and the TPWS equipment is required to transmit, the 'Fault' LED should no longer light, indicating that the fault is in the loop feeder cable circuit or the transmitter loop itself. If the failure still does not clear then the failure is likely to be in either the trigger loop circuit (the above process shall then be followed for that circuit), or in the module / baseplate itself.

If the failure does clear then the module shall once again be isolated and this process repeated at various points in the loop feeder cable circuit (i.e. any disconnection boxes and the plug coupler) with the circuit disconnected downstream from the point at which the dummy load is inserted.

The voltage at the module output to the transmitted loop shall be recorded and the 'Fault' LED monitored in each case, to identify the failure point.

Once the component causing the failure has been identified using the above process, it shall be replaced, TPWS re-energised, and the testing of the equipment carried out.

It is essential that the 75 Ohm resistor is not left in circuit, as this prevents TPWS from working correctly. A final check shall be made for this, before leaving the site.

20. Resetting TPWS Equipment

To reset any lit 'Fault' LEDs on the TPWS equipment, isolate the BX110 supply to the TPWS equipment for at least five seconds by pulling out the 250mA power supply fuse holder or switching off the MCB to the SIM (position I on the baseplate, where provided or trackside enclosure terminal rail), and then replacing it.

Removing the 250mA fuse or switching off the MCB when TPWS is transmitting causes a TPWS fault to be reported and the signal in rear replaced to danger (with the exception of PSR installations), hence all resetting of TPWS shall be done with the full co-operation of the Signaller and when no trains are affected.

It is best to reset TPWS when the controlling signal is showing a proceed aspect, as this does not cause a TPWS fault to be reported and not lead to a reversion of the signal in rear to danger.

After re-applying the power, the green 'Power on' LEDs on all modules associated with the supply fuse/ MCB should be lit and all red 'Fault' LEDs should be unlit.

If they are not, then the fault-finding processes outlined in the flowcharts can be used to assist in identifying the cause of the fault.

When all other testing is completed, before a fault can be considered as rectified, it is necessary to wait for the TPWS to be required to transmit (signal at danger) to confirm that the 'Fault' LED does not relight, and that the 'Loops Active' LEDs and appropriate 'Main I/P' and 'Supp I/P' LEDs do light.

21. TPWS Failure Identification Flowcharts

The processes described in the flowcharts shown in NR/SMTH/Part10/FF13 detail methods of identification of faults likely to be found on installed TPWS equipment.

Before any of the following tests are carried out, a check should be made for obvious causes of failures such as loose connections on terminal rails or loose sliding links in apparatus cases.

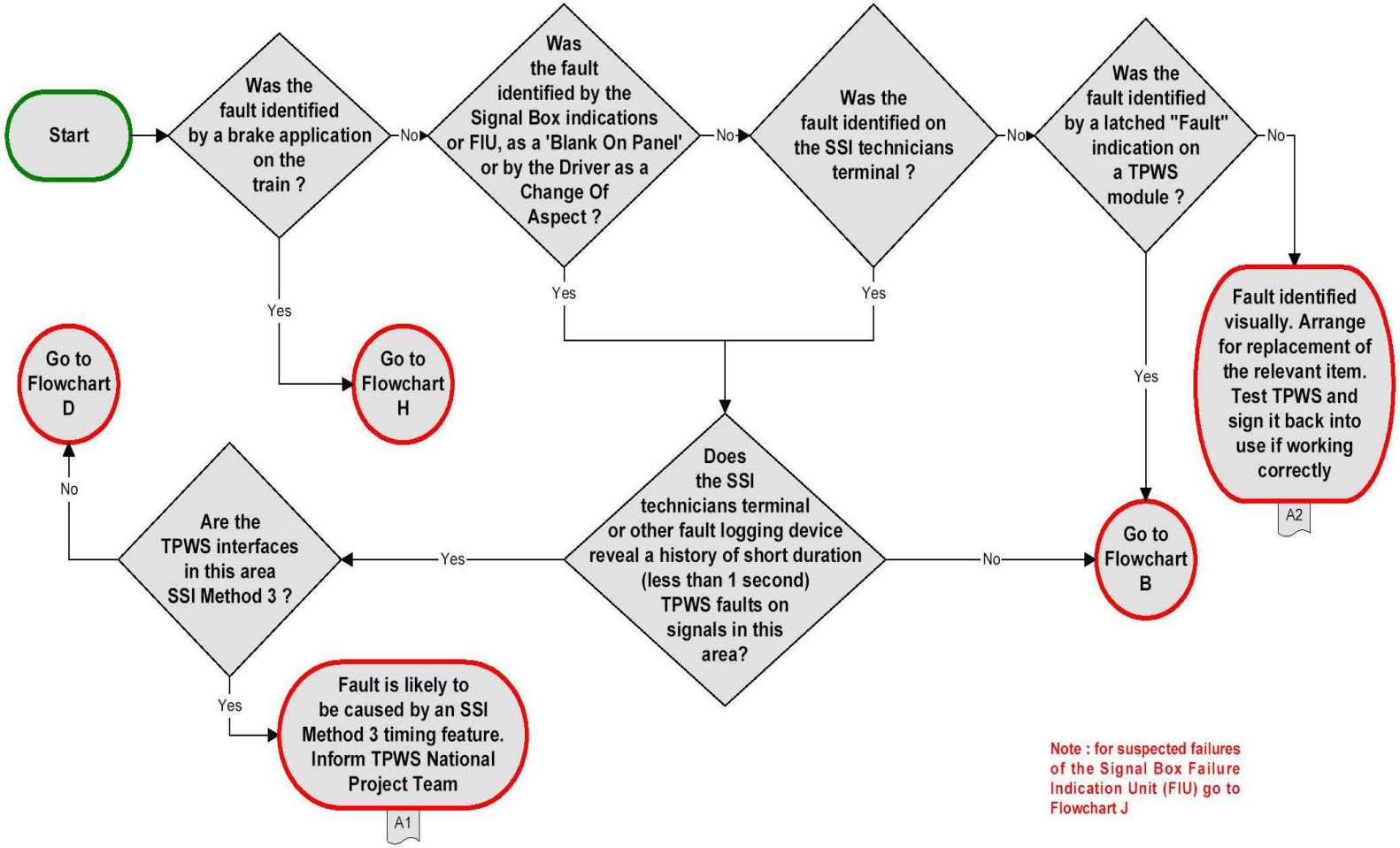
22. Failure Identification Codes

The outcome codes on the above flowcharts represent the TPWS fault finding fault codes shown in Table 1.

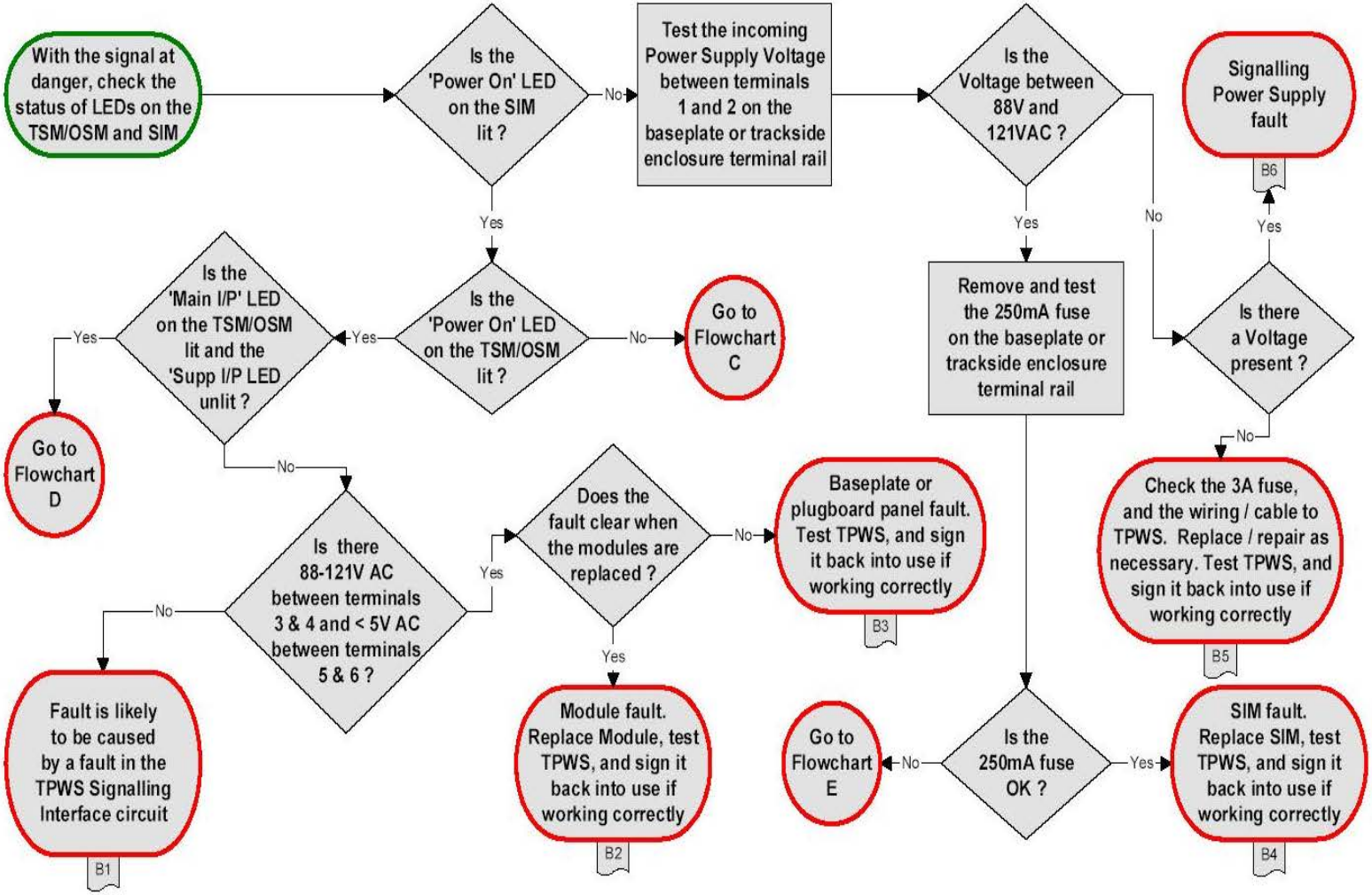
Fault Code	Meaning
A1	SSI Method 3 timing feature.
A2	Other item of equipment / fault identified visually.
B1	Signalling interface circuit fault.
B2	TSM / OSM module fault.
B3	Baseplate or plugboard panel fault.
B4	SIM module fault.

Fault Code	Meaning
B5	Fuse, MCB or cable fault to TPWS.
B6	Signalling power supply fault.
C1	SIM module fault.
C2	TSM / OSM module fault.
C3	Baseplate or plugboard panel fault.
C4	Fault cause not known - contact SM(S).
D1	Fault cause not known / not a TPWS fault - contact SM(S).
D2	Class 314/315 related fault.
D3	TSM / OSM / SIM module fault.
E1	OSM module ceramic capacitor fault.
E2	TSM module ceramic capacitor fault.
E3	Fault cause not known - contact SM(S).
E4	TSM / OSM module ceramic capacitor fault.
E5	250mA fuse of MCB fault.
F1	Module spring contact fault.
F2	Signalling power supply fault.
F3	Link or terminal connection fault.
F4	Module spring contact / baseplate or plugboard panel fault.
F5	Transmitter loop or tail cable fault.
F6	Fault cause not known - contact SM(S).
G1	TSM / OSM module fault.
G2	Baseplate or plugboard panel internal wiring fault.
G3	Transmitter loop cable fault.
G4	Tail cable fault or plug coupler.
G5	Transmitter loop fault.
G6	Fault cause not known - contact SM(S).
H1	OSS loop separation error or genuine over-speeding event.
H2	TPWS loops transposed or signalling interface circuit fault.
H3	Fault cause not known - contact SM(S).
H4	Intermittent signalling interface circuit fault or design error.
H5	TSM / OSM module fault.
H6	Intermittent signalling interface (suppression) circuit fault.
J1	Master FIU fault.
J2	Slave FIU fault.
J3	UPS fault or line termination plug fault.
J4	Signalling power supply fault.
J5	Master FIU fault.
J6	Master / Slave FIU fault.
J7	Fault cause not known - contact SM(S).

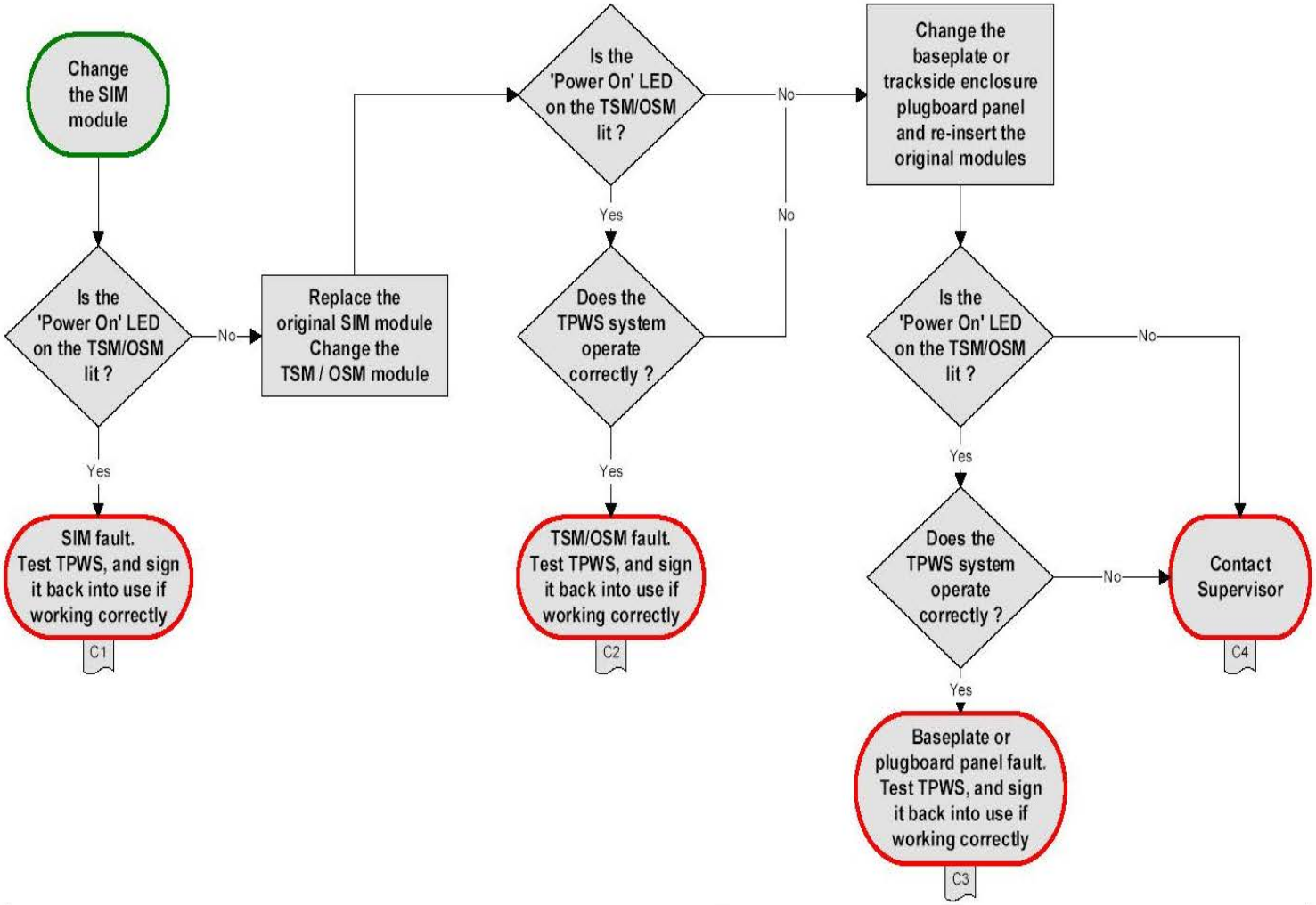
END



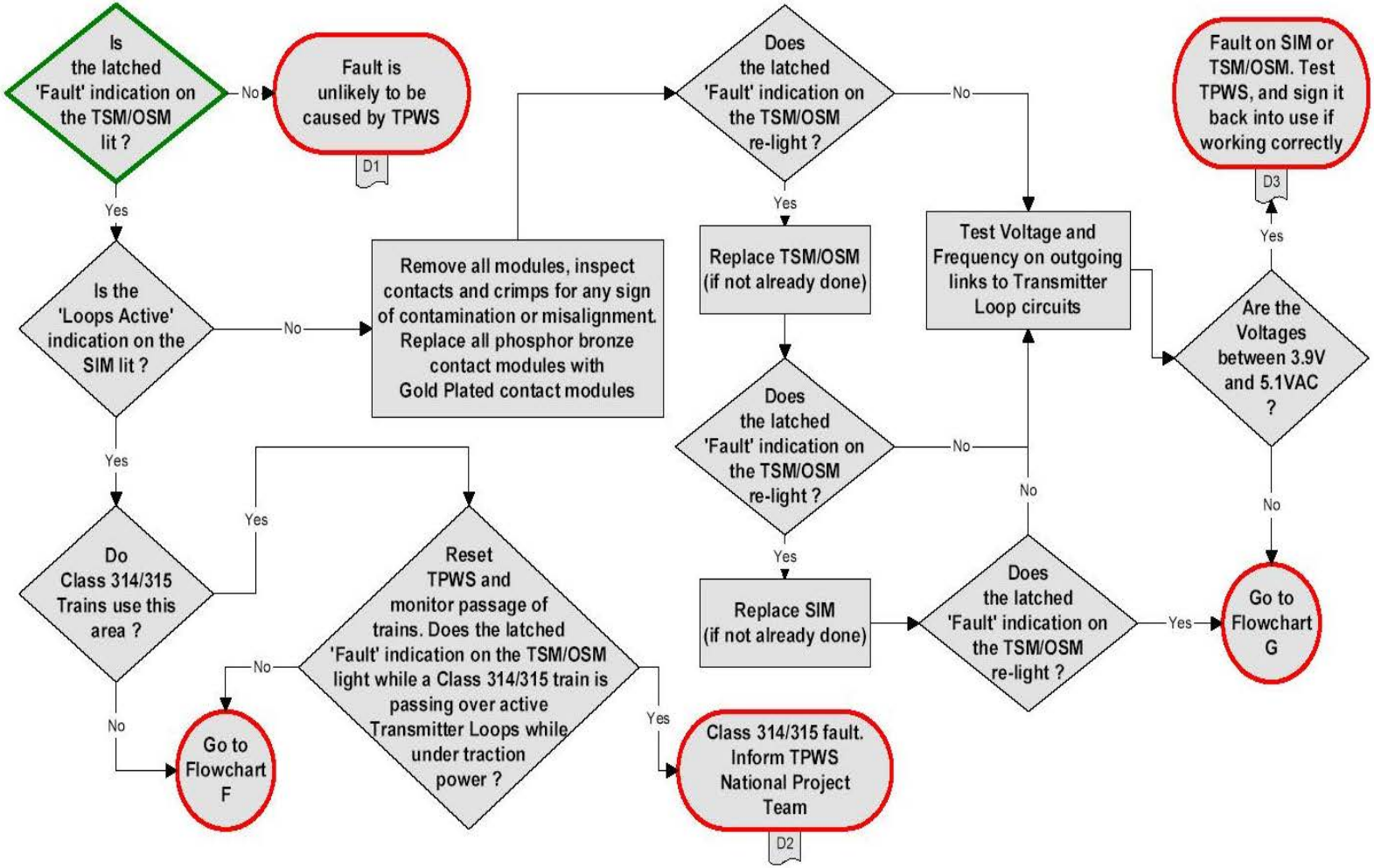
Flowchart A
Initial Fault Diagnosis - At Signal Box



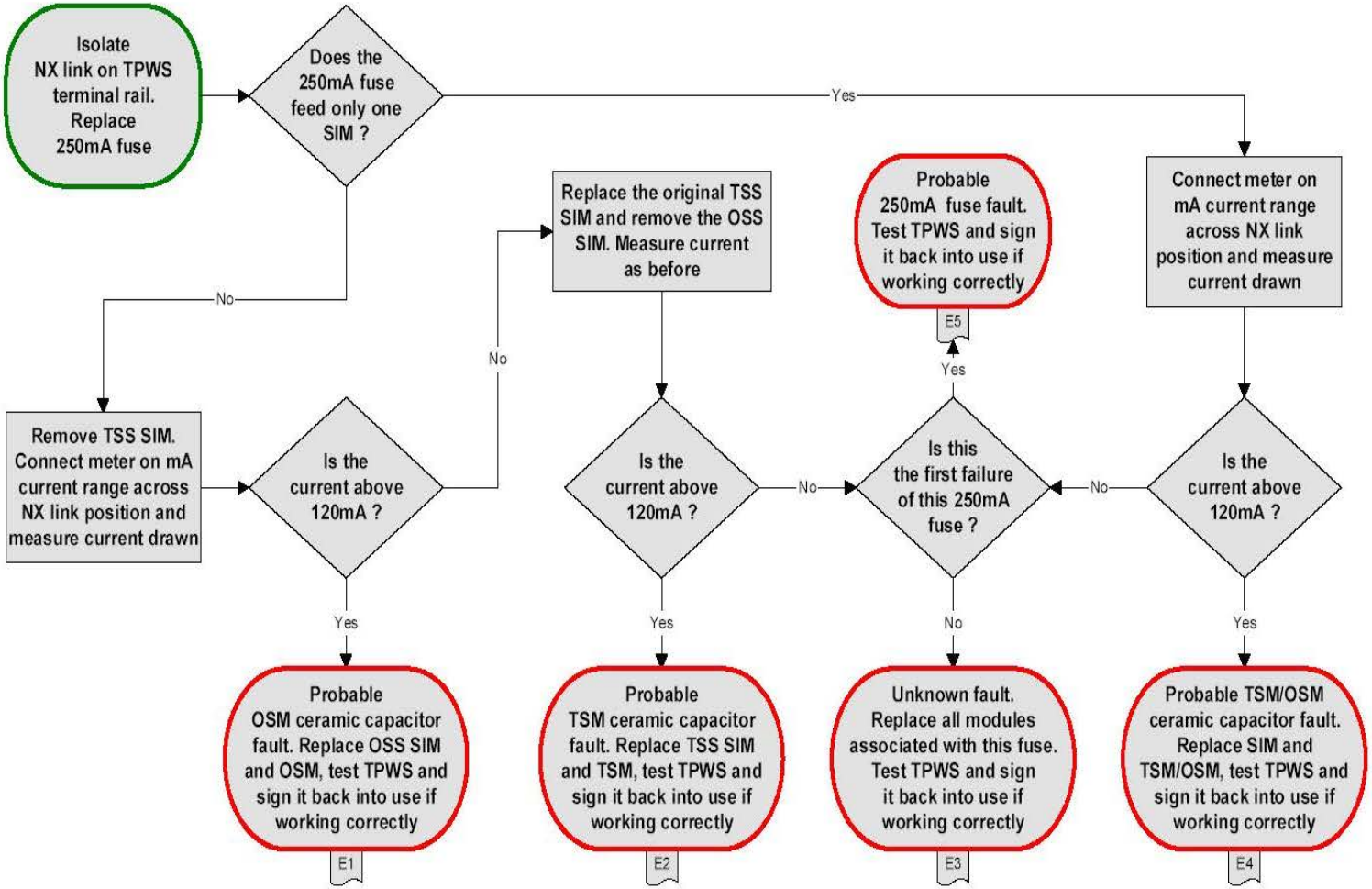
Flowchart B
Initial Fault Diagnosis - Trackside



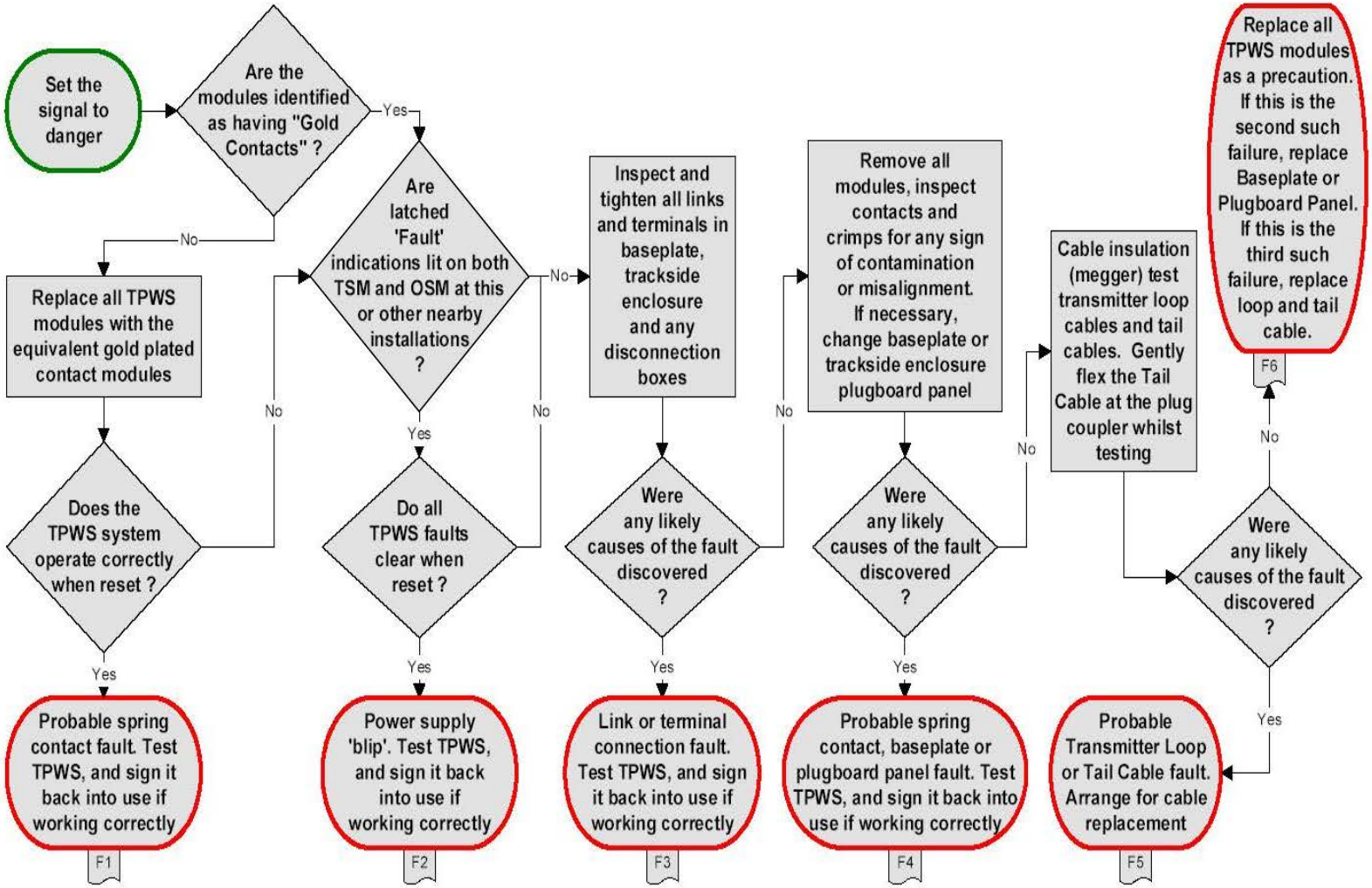
Flowchart C
No TSM / OSM Power - SIM / TSM / OSM / Baseplate / Plugboard Panel Faults

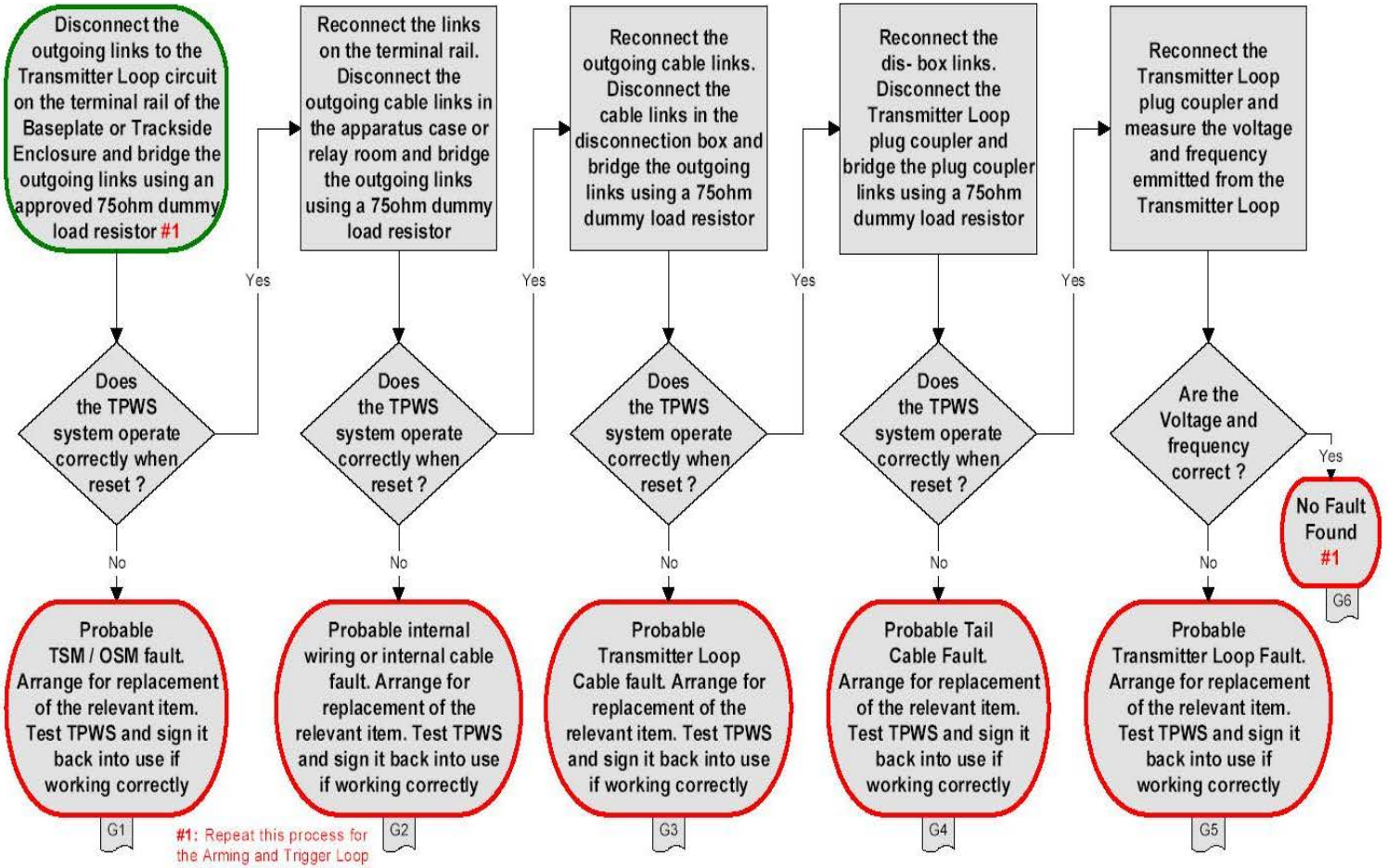


Flowchart D
TSM / OSM Fault LED Lit - TSM / OSM / Class 314/315 Fault



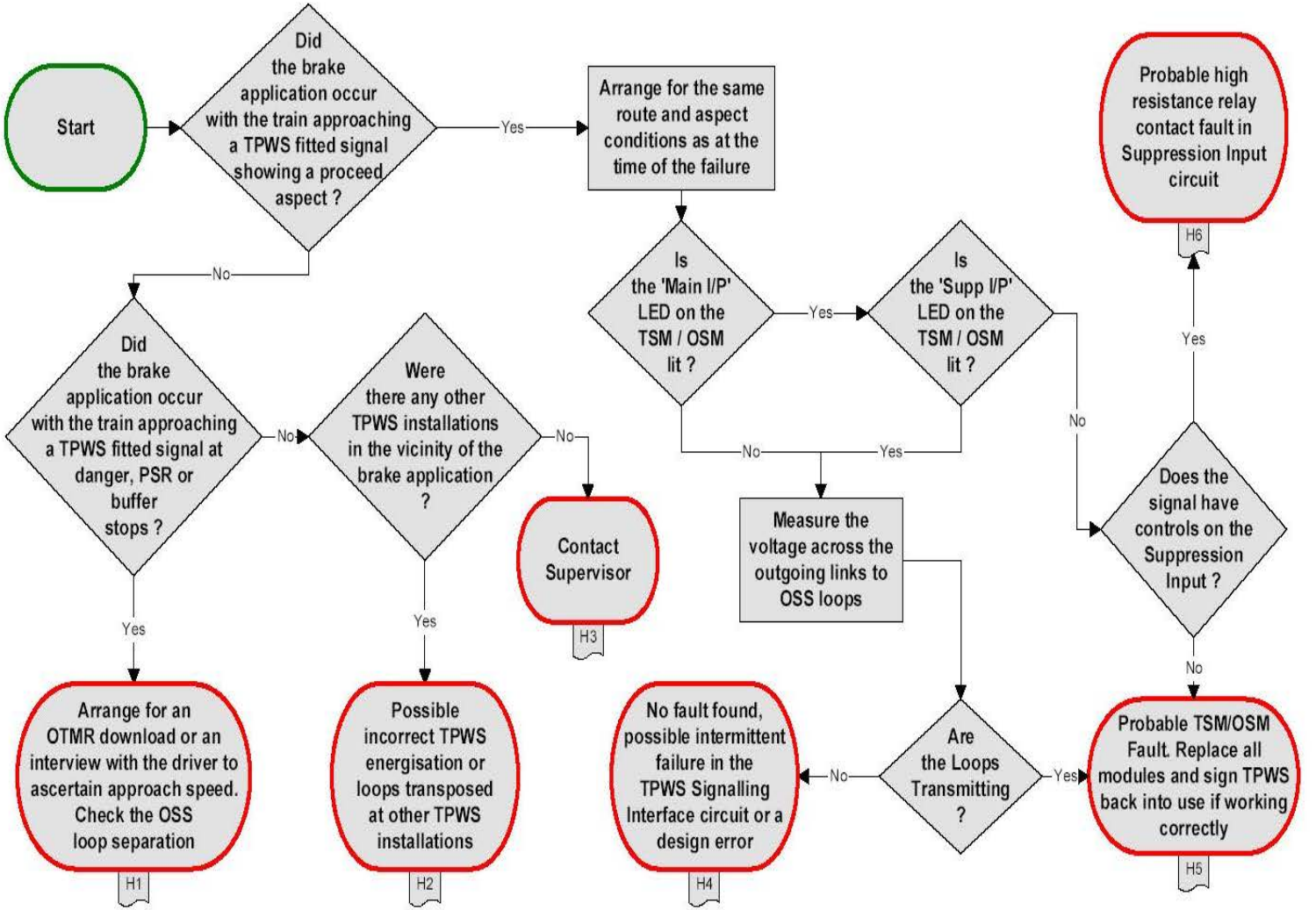
Flowchart E
No SIM Power - Blown 250mA Fuse / Ceramic Capacitor Fault In TSM / OSM



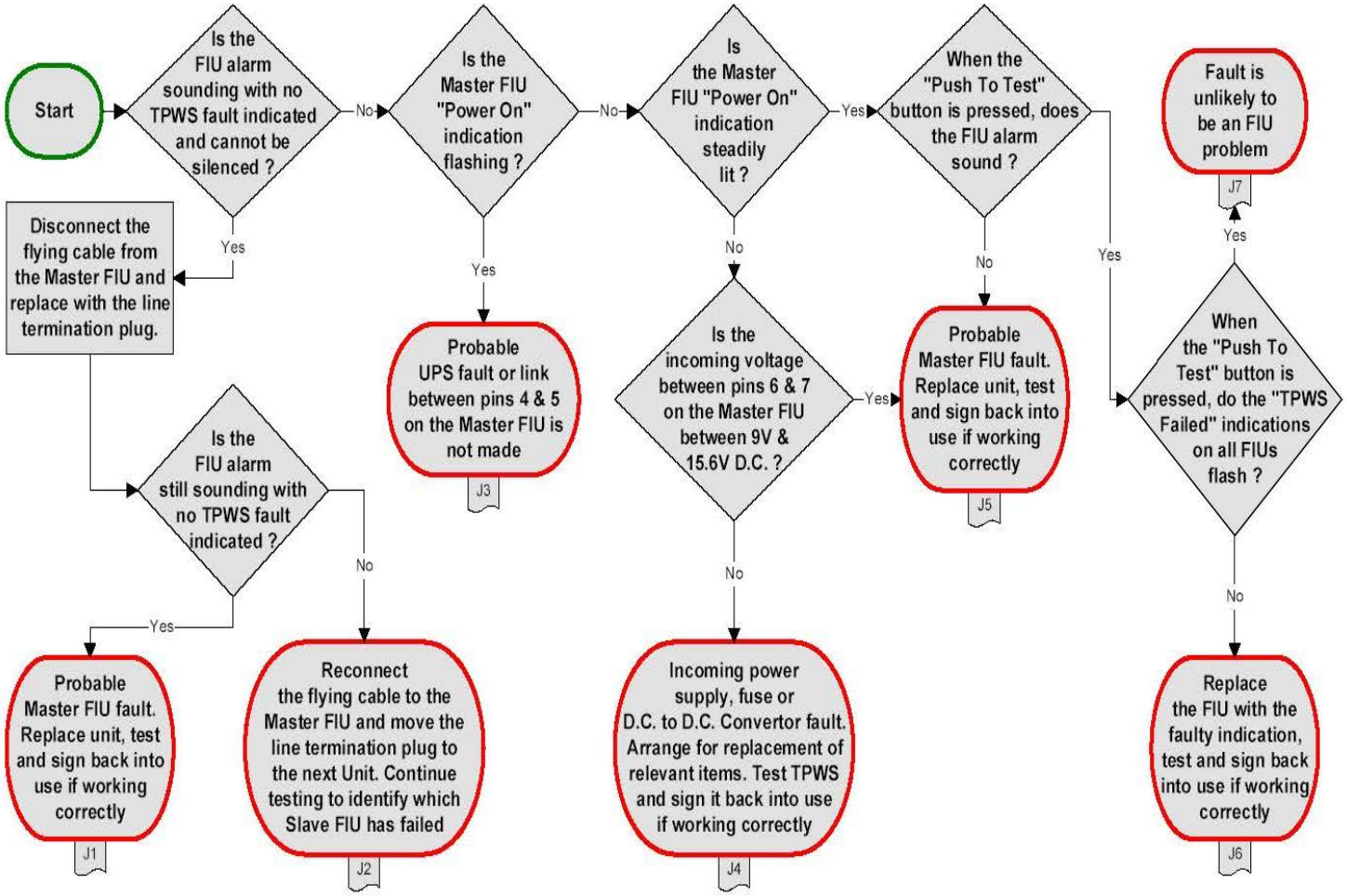


Flowchart G

Transmitter Loop / Plug Coupler / Cable Faults - 75 Ohm Dummy Load Testing



Flowchart H
Right Side Failures - TPWS Brake Applications



Flowchart J
Failure Indication Unit (F.I.U.) Faults

END

1. Faulting Guide

1.1 Upon notification of a signalling power failure the Technician should:

Refer to the signalling power schematic diagrams to ascertain which feeder or section of feeder has failed, the exact start of that feeder or section.

1.2 The Technician should then isolate the fault using NR/SMTH/Part10/FF15 (Faulting Guide: Signalling Power supplies over 175V Flowchart) to facilitate the rapid restoration of the signalling system.

1.3 Fault vehicles should be equipped with the following:

a) Crimps, fuses and heatshrinks as applicable.

b) A bar for lifting glued troughing lids.

c) Back to back radios.

d) Class 0 or 00 Insulated gloves are tested and in date.

e) Gas bottle with heatshrink attachments.

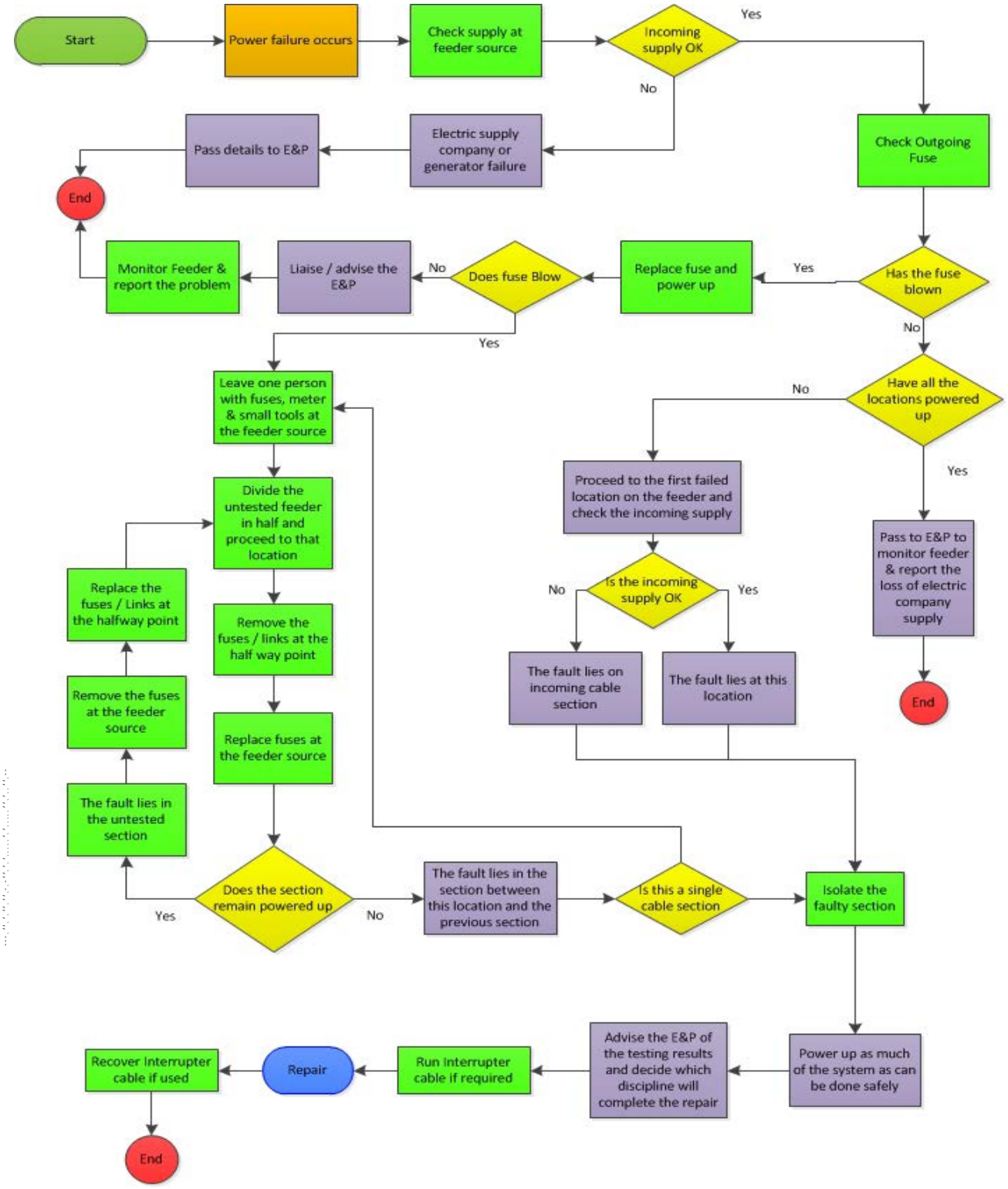
f) Personal padlocks and danger notices for power supply lockout devices/isolators/switches.

g) Pulse echo equipment.

h) Temporary cable jointing kits.

END

S&T may undertake this process when liaising with the E&P during a failure.



END

Do not smoke in the vicinity of the methanol fuel cell or fuel cartridge.

Protect from heat and ignition sources. Methanol is highly flammable!

Do not inhale exhaust gases directly for prolonged periods.

Do not touch leaked methanol.

The EFOY Pro fuel cell shall not be opened.

Gloves and eye protection shall be worn during this task

Leakage of a small quantity of methanol evaporates, leaving no residue.

For further information See NR/SMS/Appendix/26 (General Information on the Direct Methanol Fuel Cell System).

ERRORS AND SOLUTIONS

1. Error message on the display

In the event of interruptions and errors, the operating panel displays warning messages on the display panel, including an error code and instructions on how to resolve the error.

By following these instructions, you can quickly and easily eliminate some of the errors that might occur.

Error message on the display	Error code	Solution
Service is required. Protect device against frost! Please contact EFOY hotline or hotline@sfc.com.	1 10 15 76 83	Advise your SM(S).
A restart is required. If the error occurs again please contact EFOY hotline **or** hotline@sfc.com. Press OK for restart.	13 14 17 70 73 75 80 84	Select the "System reset" option in the main menu to restart the device (max. twice). If the error still occurs, Advise your SM(S).

Error message on the display	Error code	Solution
Please make sure the exhaust hose is not clogged, bent or frozen. Press OK for restart.	11 18	Check the installation of the exhaust hose and position it so that no condensation can gather. Do not bend the exhaust hose. If necessary, clean the exhaust hose and protect the opening from becoming clogged. Shorten the exhaust hose if condensation is gathering in it.
Fuel cartridge empty. Please replace the fuel cartridge, and press OK.	20 22	Replace Empty Fuel Cell.
Please refill service fluid. To restart press ok. If this problem occurs again, please contact your service partner.	30 31	Make sure that the off-heat can escape without obstruction and that the ambient temperature is below 50 °C / 122 °F. If the fuel cell is installed within a sealed container, please check that the opening for supply air has a diameter of at least 10 cm / 3.94 in. Then refill the fuel cell with EFOY service fluid (see chapter 7.3 "Adding EFOY service fluid" on page **Error! Bookmark not defined.**).
Interruption: Cooling insufficient. Please check installation and air supply!	32	The cooling air is insufficient, or the ambient air is too warm. Check whether the room in which the fuel cell is installed has sufficient ventilation, or whether the openings for the air supply in the EFOY Pro fuel cell are blocked.
Interruption: Device frozen. Please defrost device slowly for at least 24h at room temperature.	40	The device was exposed to temperatures below 1°C / 34°F without a connected battery and/or an EFOY fuel cartridge that was not filled sufficiently.

Error message on the display	Error code	Solution
		It has to be allowed to defrost for approx. 24 hours at room temperature.
Interruption: Surroundings too warm. Please wait for the device to cool down.	41	The ambient temperature is too high. The device starts automatically if the temperature drops to below 50 °C / 122 °F.
Battery voltage low. Please check battery connection and load battery.	50 52	Check the cabling and check whether an approved battery is connected. Check the battery voltage. If it is too low, load the battery with a battery charger. Also check other loading devices for defects, e.g. alternator or charge controller.
Battery voltage high. If applicable, please check additional charging devices.	51 53	Check the cabling and check whether an approved battery is connected. Also check other loading devices for defects, e.g. alternator or charge controller.
Please disconnect fuel cartridge connection, shake cartridge firmly and reconnect. Restart device at most 2 times. Press OK for restart.	72	Check the fuel cartridge connection and, if necessary, check for any contamination and remove it. Then perform a system reset (max. twice). If the error still occurs, Advise your SM(S).

Error message on the display	Error code	Solution
EFOY GO! cannot be charged currently. Please refer to the user manual of the EFOY GO!		The EFOY GO! includes a lithium battery (LiFePO4), which cannot be charged below 0°C. If this is recognized by the EFOY Pro fuel cell, the charging is interrupted, and the EFOY Pro switches in the manual off mode. A warning is displayed. The frost protection mode is not affected. Confirm the warning once the temperature has increased. The EFOY Pro returns to Automatic Mode.
Battery defective, too small or too old. Please check the battery and the battery parameters. Replace battery if necessary or review battery parameters.		The on-board electrical system including the battery has to be checked. The EFOY Pro has measured charging cycles which were too short. This is an indication of a defective, too old or too small battery. The battery parameters may also need to be reviewed. Advise your SM(S).

2. Errors without display messages

Possible cause	Solution
The operating panel is not connected or is not properly connected.	Check the connection to the operating panel.
No battery is connected, the battery has not been properly connected, or a deep discharge has occurred.	Check the pins, polarity and cables. Connect a charged battery to start the device.
Short-circuit has occurred.	Verify that the polarity of the charge line is correct. Switch off the device, check the cause of the short circuit or overload, and eliminate the error.

END

Siemens ACM 100 Axle Counter System

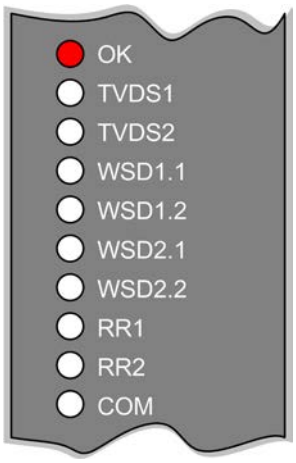
The diagnostic facilities of the ACM100 are via the ACMs front panel and via the webserver.

After a fault has occurred, it is displayed via the LEDs on the relevant ACM's front panel. The LED indications permit fault diagnostics. After the fault has been rectified, the ACM's operability can be checked via its LEDs.

Diagnostics is supported by an online diagnostic function via a webserver. The diagnostic information of the selected ACM is displayed on a graphical user interface. Additional diagnostic data can be called up via status, statistics and fault tables. Fault texts are highlighted in red.

Diagnostics via the ACM100 Front Panel and web-site

The ACM is shut down (safety cut-off).

LED indication on the ACM

The OK LED shows a steady red light. All other LEDs are off.

Measure

Step	Action
1	Restart the ACM module: Press the RST restart button of the affected ACM for a minimum of 2s.

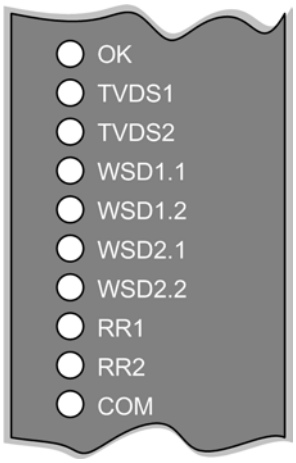
Cause / Measure

If …	**Then …**
the affected ACM shuts down frequently,	Replace the ACM.

Test

If …	**Then …**
the OK LED shows a steady green light after the restart,	Inform the Signaller that the restart has been successful. Request the Signaller to perform an axle count reset.
the OK LED shows the following after the restart: steady red light no light	Replace the ACM.
the OK LED shows the following after the restart: flashing red light	Check the other LEDs based on the LED indications.

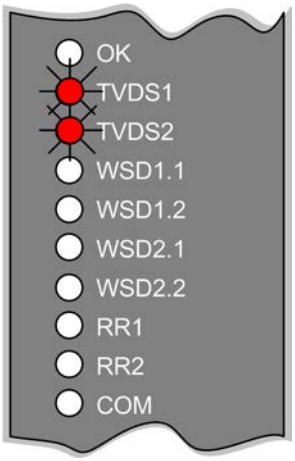
The Power supply has failed

LED indication on the ACM

All LEDs are off.

Test

If …	**Then …**
all LEDs on other ACMs are off as well,	the power supply is faulty. Check the power supply and UPS system if fitted.
all LEDs on only one ACM are off,	the ACM has failed or the cable connection is interrupted. First: Replace the ACM .
the LEDs still remain off after ACM replacement,	the cable connection is interrupted. Check the cable connection between the ACM and the power supply board. Check the connectors and check them for a secure fit. Perform a visual inspection to see if there is any damage (kinks, cable jammed, insulation damaged). Replace any faulty parts.

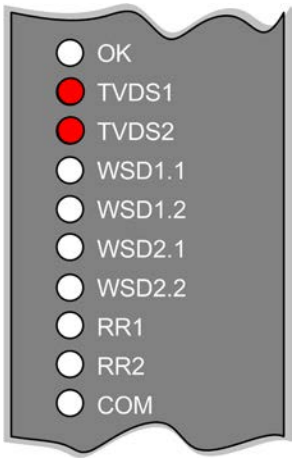
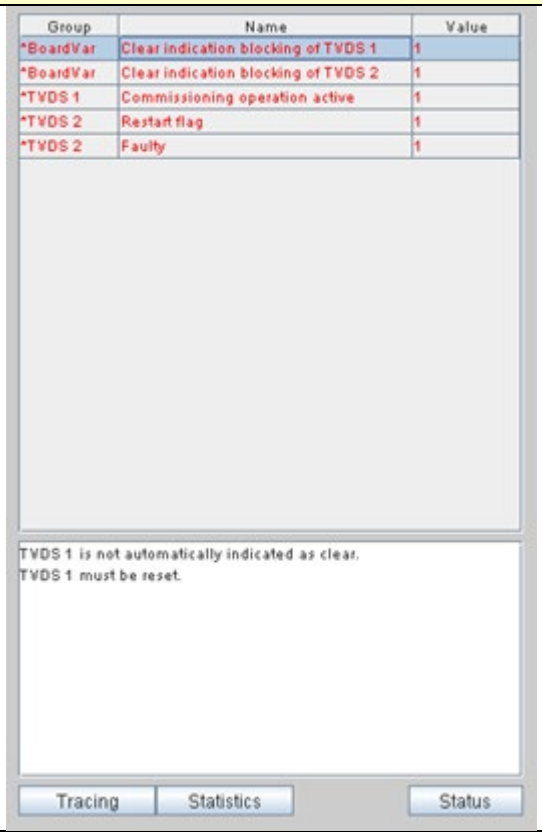
Track vacancy detection section faulty

LED indication on the ACM	**Indication on the web site**
	
The TVDS1 LED and / or TVDS2 LED show(s) a flashing red light.	The following is highlighted in the fault table: affected TVDS 1 and / or TVDS 2

Measure

Step	Action
1	Request the Signaller to perform an axle count reset for the affected track vacancy detection section.

Track vacancy detection section permanently occupied

LED indication on the ACM	Indication on the web site
	
The TVDS1 LED and / or TVDS2 LED show(s) a steady red light. The RR1 LED and / or RR2 LED do(es) not show a steady green light.	The following is highlighted in the fault table: affected TVDS 1 and / or TVDS 2 and "Commissioning operation active" or affected TVDS 1 and / or TVDS 2 and "Restart flag"

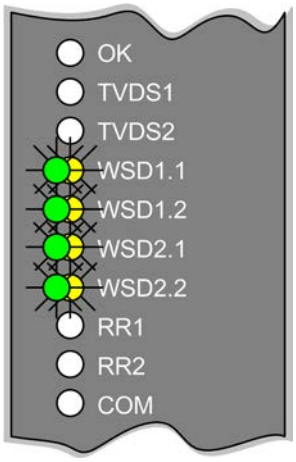
Cause

- There is no fault.
- Possible cause:
- The affected ACM has been restarted and has not been reset yet.
- The commissioning operation has been activated.

Measure

Step	Action
1	Request the Signaller to perform an axle count reset for the affected track vacancy detection section.

WSD wheel detector(s) faulty

LED indication on the ACM

The WSD1.1 / WSD1.2 LEDs and / or WSD2.1 / WSD2.2 LEDs show a flashing green or yellow light.

Cause

There is wheel detector monitoring error (not a fault: the wheel detector has detected wheel pulses on one channel). Possible cause:

a) The wheel detector has detected pulses without a train movement (e.g. due to a lightning strike or a metal object).

b) Wheels could not be detected unambiguously during a train movement (e.g. only one subsystem of the wheel detector has been traversed during a shunting movement).

Measure

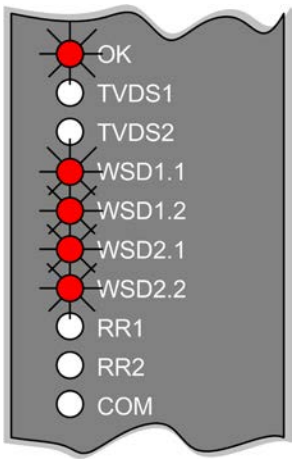
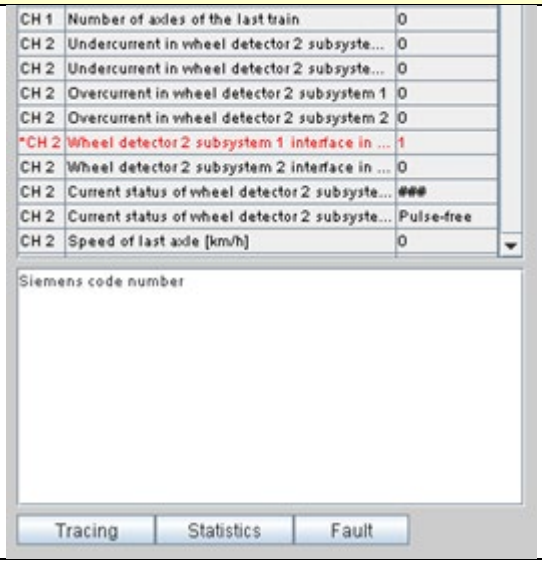
Agree with the Signaller on the following procedure:

Step	Action
1	Have a train movement performed over the affected wheel detector(s) or perform a functional test of the affected wheel detector(s) by simulating a train movement (move an adjustment gage over the wheel detector(s)). If the simulation of a train movement results in counting errors. The sections shall then be reset by means of an auxiliary and immediate axle count reset operation.
2	After simulation of a train movement: Request the person responsible to cancel the reset restriction by means of an auxiliary axle count reset operation and the Signaller to perform an axle count reset for the affected track vacancy detection sections.

Test

If …	Then …
the WSD1.1 / WSD1.2 LEDs and / or WSD2.1 / WSD2.2 LEDs show a steady green light,	the train movement or simulation has successfully eliminated the wheel detector monitoring error.
the WSD1.1 / WSD1.2 LEDs and / or WSD2.1 / WSD2.2 LEDs continue to show a flashing green or yellow light,	the affected WSD wheel detector shall be calibrated (NR/SMS/PartB/Test/038). If the fault persists after calibration the affected WSD wheel detector is faulty, replace the wheel detector (NR/SMS/PartC/AX51).

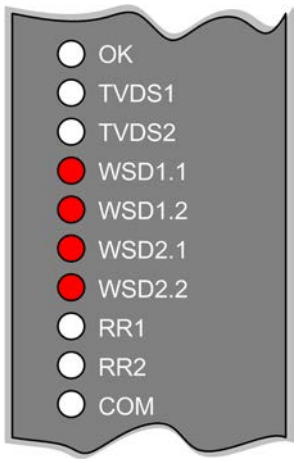
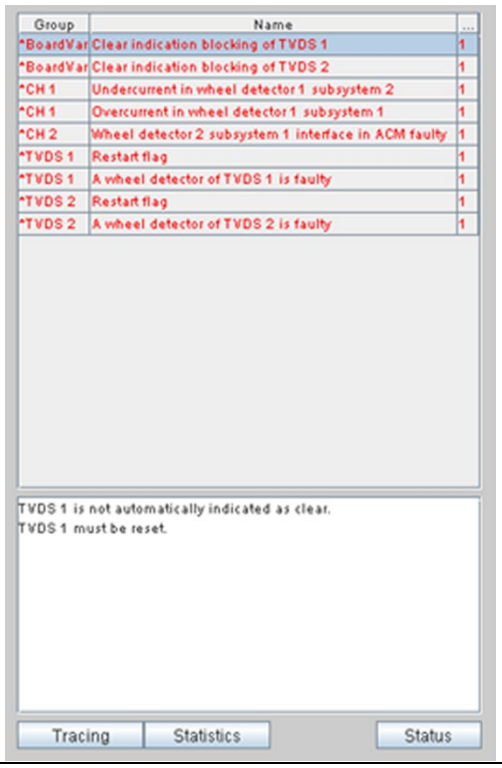
The ACM is faulty

LED indication on the ACM	Indication on the web site
	
The OK LED shows a flashing red light and the WSD1.1 / WSD1.2 and / or WSD2.1 / WSD2.2 LEDs show a flashing red light.	The following is highlighted in the fault table: type of fault

Cause / Test

If …	Then …
"Wheel detector ... subsystem ... interface in ACM faulty" or "Current status of wheel detector ...“ ”subsystem ...###" is displayed on the web site, Cause: internal test of ACM has failed	the ACM is faulty: Replace the ACM.

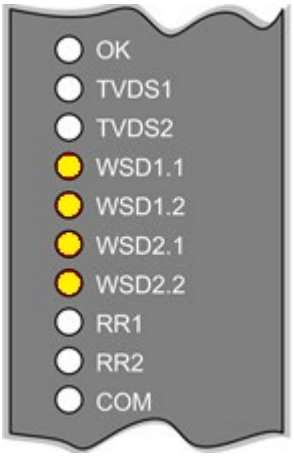
WSD wheel detector(s) or cable faulty

LED indication on the ACM	Indication on the web site
	
The WSD1.1 / WSD1.2 LEDs and / or WSD2.1 / WSD2.2 LEDs show a steady red light.	The following is highlighted in the fault table: affected wheel detectors, WSD 1 and / or WSD 2 (CH 1, CH 2)

Cause / Test

If …	**Then …**
"Overcurrent in ..." is displayed on the web site, Possible cause: ACM faulty WSD wheel detector faulty WSD wheel detector detached from rail short-circuit in signaling cable First check the ACM. To do so, query the current wheel detector status via the web site.	replace the ACM. If the fault persists: Check the affected WSD wheel detector and / or the cable connection to the wheel detector. If there is a fault, replace the wheel detector.
"Undercurrent in ..." is displayed on the web site, Possible cause: ACM faulty interrupted core in signaling cable First check the ACM. To do so, query the current wheel detector status via the web site.	replace the ACM. If the fault persists: Check the affected WSD wheel detector and / or the cable connection to the wheel detector. If there is a fault, replace the wheel detector (NR/SMS/PartC/AX51).

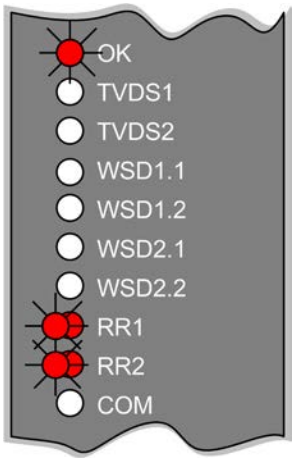
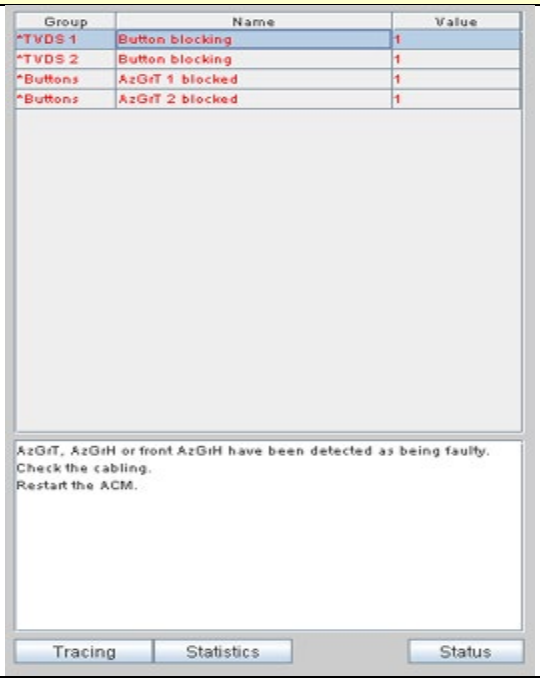
WSD wheel detector(s) Permanently Occupied

LED indication on the ACM

One or more of the WSD1.1 / WSD1.2 / WSD2.1 / WSD2.2 LEDs show a steady yellow light.

Cause / Test

If …	**Then …**
A train or track trolley wheel is stopped over the sensor	This is normal operation
No wheel is over the sensor	Check the affected WSD wheel detector. If there is metallic debris on or close to the wheel sensor, remove it. If the fault persists: Check the affected WSD wheel detector is at the correct height and parallel with the rail head. If necessary, adjust the mounting position and recalibrate the sensor (NR/SMS/PartC/AX51), (NR/SMS/PartB/Test/038). If the fault persists: Check the cable to the affected WSD wheel detector for loose or high resistance connections. If necessary, replace the cable. If the fault persists: Replace the wheel sensor (NR/SMTH/PartC/AX28)

Button fault

LED indication on the ACM	Indication on the web site
	
The OK LED shows a flashing red light. The RR1 LED and / or RR2 LED show(s) a steady or flashing red light.	The following is highlighted in the fault table: button blocking for affected TVDS 1 and / or TVDS 2 blocked type of button

Cause

The cause of button blocking for the AZG and / or AZGH buttons might be the following:

- The buttons have been operated incorrectly.
- The cabling is faulty.

Measure

The ACM shall be restarted:

Step	Action
1	Inform the Signaller that you want to restart the ACM.
2	Press the RST reset button of the affected ACM for a minimum of 2s.
3	Wait 15s until the LEDs are on.

Test

If …	Then …
the OK LED shows a steady green light,	inform the Signaller that the restart has been successful. Request the Signaller to perform an axle count reset.
the RR1 LED and / or RR2 LED continue(s) to show a steady red light, continue(s) to show a flashing red light,	replace the ACM (NR/SMTH/Part04/AX29).

Cause / measure: fault continues to be displayed although ACM has been replaced

The cable connection to the AZG and / or AZGH or SRI buttons shall be checked.

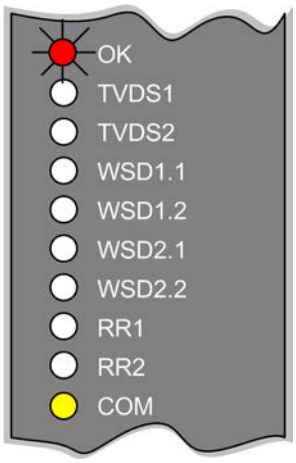
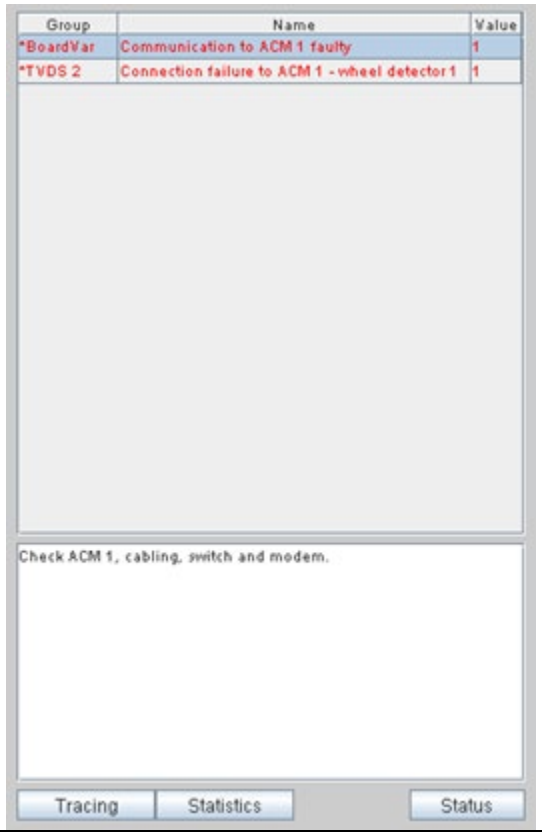
Step	Action
1	Locate the status of the affected buttons via the web site.
2	To do so, select the status table. The blocked button(s) is (are) displayed. The status of the blocked button(s) is displayed (operated / not operated).

Test

If …	Then …
the status **"operated"** is displayed for the blocked button on the web site,	a core might be broken: Check the connectors and check them for a secure fit. Perform a visual inspection to see if there is any damage (kinks, cable jammed, insulation damaged). Replace any faulty parts.
the status **"not operated"** is displayed for the blocked button on the web site,	a core might be broken: Check the connectors and check them for a secure fit. Perform a visual inspection to see if there is any damage (kinks, cable jammed, insulation damaged). Replace any faulty parts.

Connection to partner ACM has failed

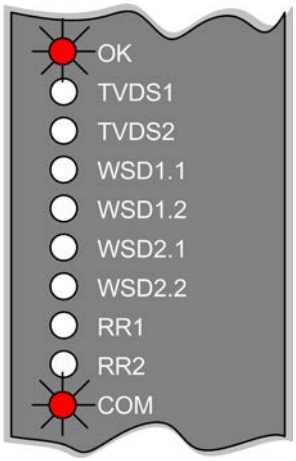
- Data exchange with one or more ACMs faulty

LED indication on the ACM	Indication on the web site
	
The OK LED shows a flashing red light and the COM LED shows a steady yellow light.	The following is highlighted in the fault table: affected partner ACM and associated track vacancy detection section.

Cause / Measure

If …	**Then …**
the connection failure of a partner ACM is displayed on the web site, The fault is in a partner ACM: the LEDs of this ACM are off or show a flashing red light.	proceed step by step as follows to locate the fault in the affected partner ACM: Check the cables of the Ethernet connection. Check the connectors and check them for a secure fit. Perform a visual inspection to see if there is any damage (kinks, cable jammed, insulation damaged). Replace any faulty parts. Check the connected switch(es) / modem(s) and replace it (them), if required. Detailed information can be found in the manufacturer documentation for the relevant switch / modem.

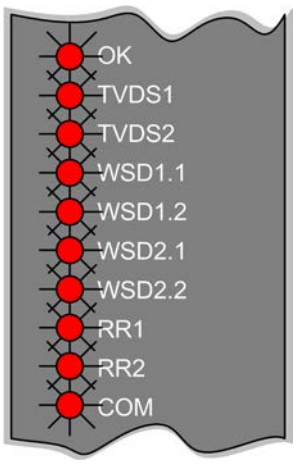
<u>Ethernet connection interrupted</u>

LED indication on the ACM

The OK LED and the COM LED show a flashing red light.

Measure

Step	Action
1	Check the power supply of the switch connected to this ACM.
2	Check the cables of the Ethernet connection. Check the connectors and check them for a secure fit. Perform a visual inspection to see if there is any damage (kinks, cable jammed, insulation damaged). Replace any faulty parts.
3	Replace the faulty ACM (NR/SMTH/Part04/AX29).
4	Check the connected switch(es) / modem(s) and replace it (them), if required. Detailed information can be found in the manufacturer documentation for the relevant switch / modem.

ID plug faulty

LED indication on the ACM

All LEDs show a flashing red light.

Measures

If …	**Then …**
there is an ID plug with identical configuration data,	replace the ID plug and restart the ACM. Inform the Signaller that you want to restart the ACM. Replace the ID plug with the failed ID plug. Press the RST reset button of the affected ACM for min. 2 s. Wait 15 s until the LEDs are on. Request the Signaller to perform an axle count reset for the affected track vacancy detection section.
there is an empty ID plug,	program the ID plug and agree on any further measures. Remove the connector of the Ethernet connection from the affected ACM. Remove the process connector Program the spare ID plug with the associated configuration data via the web site. Request an authorized person to perform correspondence checking and plan verification.

Checking of the power supply

Step	**Action**
1	Set the on / off switch to ON.

Test

Proceed as follows depending on the status of the DC 24 V LED on the front panel:

If …	**Then …**	
LED shows a flashing light,	the output circuit is overloaded. For voltage dip: automatic voltage restoration For voltage reduction: impairment of service life Check the circuit.	
If …	**And if …**	**Then …**
The LED is off	the output circuit is short-circuited (0 V),	remove the short-circuit (automatic voltage restoration after its removal).
	there is an under voltage on the input side (automatic shutdown, automatic voltage restoration),	check the mains voltage.
	there is an overvoltage on the input side, the power supply board is faulty,	replace the power supply.

WSD Wheel Detector

Troubleshooting

Step	**Action**
1	Perform measurements and tests on the interface components

Step	Action
2	If the results point to a fault in the wheel detector, proceed as follows: 1. Check the mounting height and correct it , if required. Required values for the mounting height- Rail Web Mounting: 43 to 45 mm Rail Clamp Mounting: 42 to 45mm 2. Check whether the wheel detector switches in response to the adjustment gage. Observe the switching points on the adjustment gage – a subsystem of the wheel detector can only switch when moving the adjustment gage if the area between the "On" and "Off" markings is above the subsystem. Required values for current consumption: 4.75 to 5.25 mA (for an untraversed wheel detector) 1.3 to 2.99 mA (for a traversed wheel detector)

If …	Then …
The wheel detector does not switch as required.	Measure the operating voltage at the wheel detector (required value between 10.5 V and 28 V). Calibrate the wheel detector (NR/SMS/PartB/Test/038). Check again whether the wheel detector switches in response to the adjustment gage. If the wheel detector again does not switch as required, replace it.
The wheel detector switches as required.	Search for the fault in the cabling or series-connected signaling and safety equipment.

Possible causes of faults

Fault	Possible cause	Remedy
Subsystem does not switch when a wheel passes, current consumption of 4.75 to 5.25 mA	Incorrect mounting height	1. Check the mounting height and correct it, if required. 2. Calibrate the wheel detector (NR/SMS/PartB/Test/038).
	Wheel detector not correctly calibrated	Calibrate the wheel detector (NR/SMS/PartB/Test/038).
	Wheel or wheel flange dimensions too small	Have usability of the wheel detector and the required mounting height checked by Siemens.
Subsystem does not switch when a wheel passes, current consumption of 1.3 to 2.99 mA	Foreign metal object(s) on wheel detector	Remove any foreign object(s).
	Incorrect mounting height	1. Check the mounting height and correct it, if required. 2. Calibrate the wheel detector (NR/SMS/PartB/Test/038).
	Wheel detector not correctly calibrated	Calibrate the wheel detector (NR/SMS/PartB/Test/038).
Subsystem does not switch when a wheel passes, current consumption of 5.76 to 7.0 mA OK again after interruption of operating voltage	Detachment detection function triggered	1. Check the mounting height and correct it, if required 2. Calibrate the wheel detector (NR/SMS/PartB/Test/038). 3. If unsuccessful (wheel detector returns to fault condition after 120 s): replace the wheel detector (NR/SMS/PartC/AX51).
Subsystem does not switch when a wheel passes, current consumption of 5.76 to 7.0 mA Fault persists after interruption of operating voltage	Subsystem connected wrong way round	Check the polarity of the wheel detector connection.
	a / b interchanged (wrong polarity of used pair of wires) in cable system	Check the cable system for a/b interchanging.

Fault	**Possible cause**	**Remedy**
Subsystem does not switch when a wheel passes, current consumption in one of the following ranges: < 1.3 mA 3.0 to 4.74 mA 5.26 to 5.75 mA	Insufficient supply from indoor equipment	1. Measure the voltage on the subsystem (required value 10.5 V to 28 V). 2. Check the connection of the wheel detector and the indoor equipment.
	Fault in signaling cable	Check the signaling cable.
Subsystem does not switch when a wheel passes, current consumption rises cyclically to 5.76 to 7.0 mA	Permitted temperature range of -40 °C to +85 °C considerably exceeded	Replace the wheel detector as components might be damaged (NR/SMS/PartC/AX51).
Subsystem does not switch when a wheel passes, current consumption > 7 mA	Operating voltage too high	1. Measure the voltage on the subsystem (required value 10.5 V to 28 V). 2. Check the connection of the wheel detector and the indoor equipment.
	Short-circuit in wheel detector	Replace the wheel detector (NR/SMS/PartC/AX51).
No measurable operating voltage between wires 1 and 2 (or wires 4 and 5) of wheel detector	Fault in indoor equipment	Check the interface component and its power supply.
	Wheel detector connected incorrectly	Check the wheel detector connection.
	Interruption or short-circuit in signaling cable	Check the cable system.
	Short-circuit in wheel detector	1. Measure the current consumption of the wheel detector directly at the connecting cable (in the trackside connection box). 2. Replace the wheel detector if the current consumption is > 7 mA (NR/SMS/PartC/AX51).

Fault	Possible cause	Remedy
Functional test after calibration unsuccessful Wheel detector does not switch at all or not between the relevant markings on the adjustment gage	Calibration failed: times not observed adjustment gage incorrectly placed. position of placed adjustment gage altered. additional damping due to tools, passing wheels, etc. during calibration.	Repeat the calibration (NR/SMS/PartB/Test/038).
	Rail currents (traction return currents) exceeding approx. 1000 A or electromagnetic interference occurred during calibration	Repeat the calibration (NR/SMS/PartB/Test/038).
Subsystem switches when a wheel passes but interface component does not respond	Wheel detector output faulty	Measure the current consumption of the wheel detector in the undamped and damped states. Required values: undamped: 4.75 to 5.25 mA damped: 1.3 to 2.99 mA
	Loop resistance too high	Check the cable system.
	Shunt in signaling cable	Check the cable system.
	Fault in interface component	Replace the interface component.
Subsystems switch when a wheel passes but interface component does not count axles or there are sporadic counting errors	Incorrect mounting height	1. Check the mounting height and correct it, if required 2. Calibrate the wheel detector (NR/SMS/PartB/Test/038).
	Wheel detector not correctly calibrated	Calibrate the wheel detector (NR/SMS/PartB/Test/038).
	Wheel or wheel flange dimensions too small	Have usability of the wheel detector and the required mounting height checked by Siemens.

Fault	Possible cause	Remedy
Axle counting system counts passing axles in wrong direction	Subsystems connected the wrong way round	1. Check the connection and mounting location (track layout plan) of the wheel detector. 2. Check the cable system and configuration of the axle counting system.

It might be necessary to replace the wheel detector (NR/SMS/PartC/AX51) if you cannot identify and rectify the cause of the fault.

END

1. Power supply testing flowchart

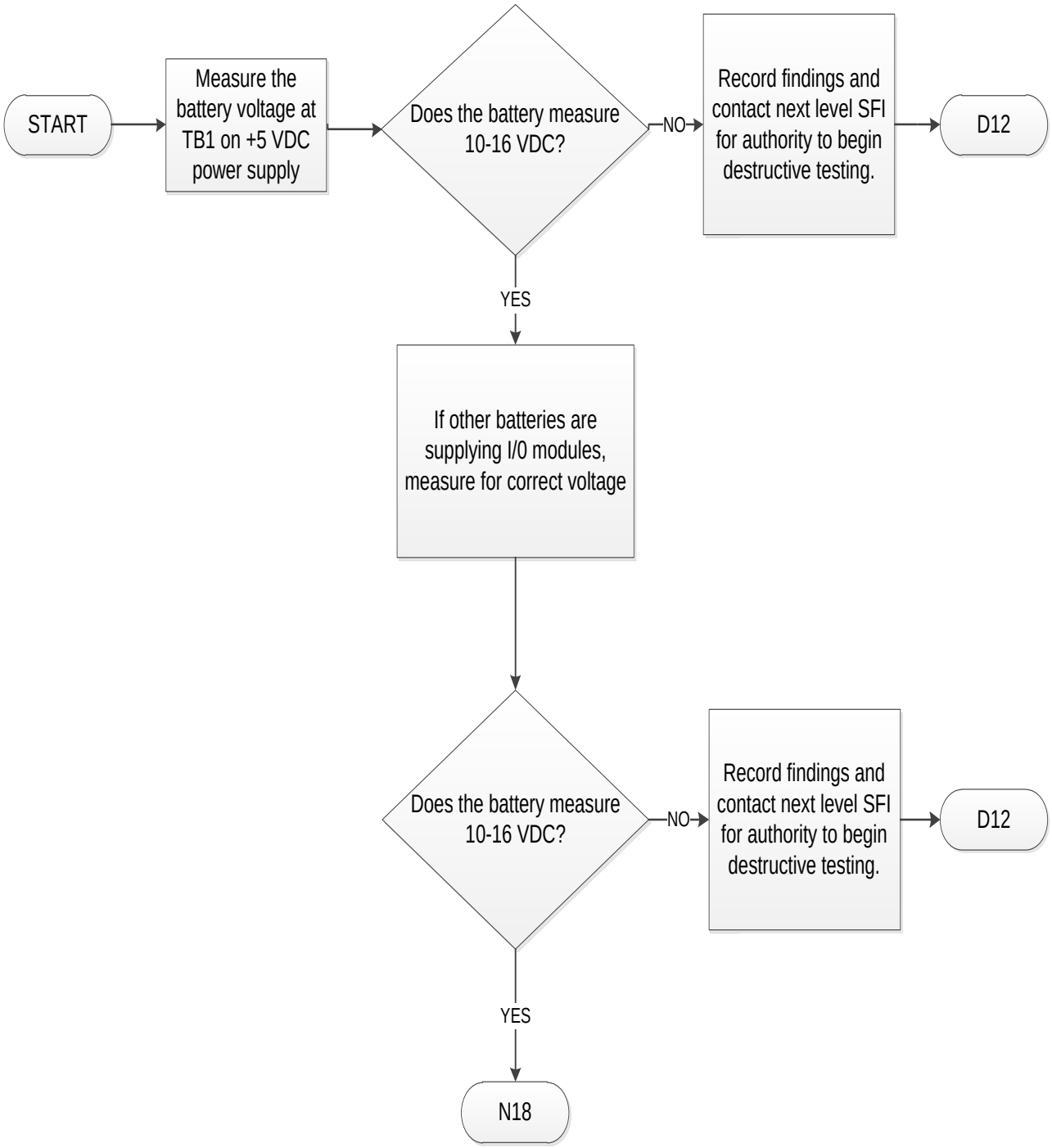


Figure 1 – Power supply testing flowchart

2. General Fault diagnostic flow chart.

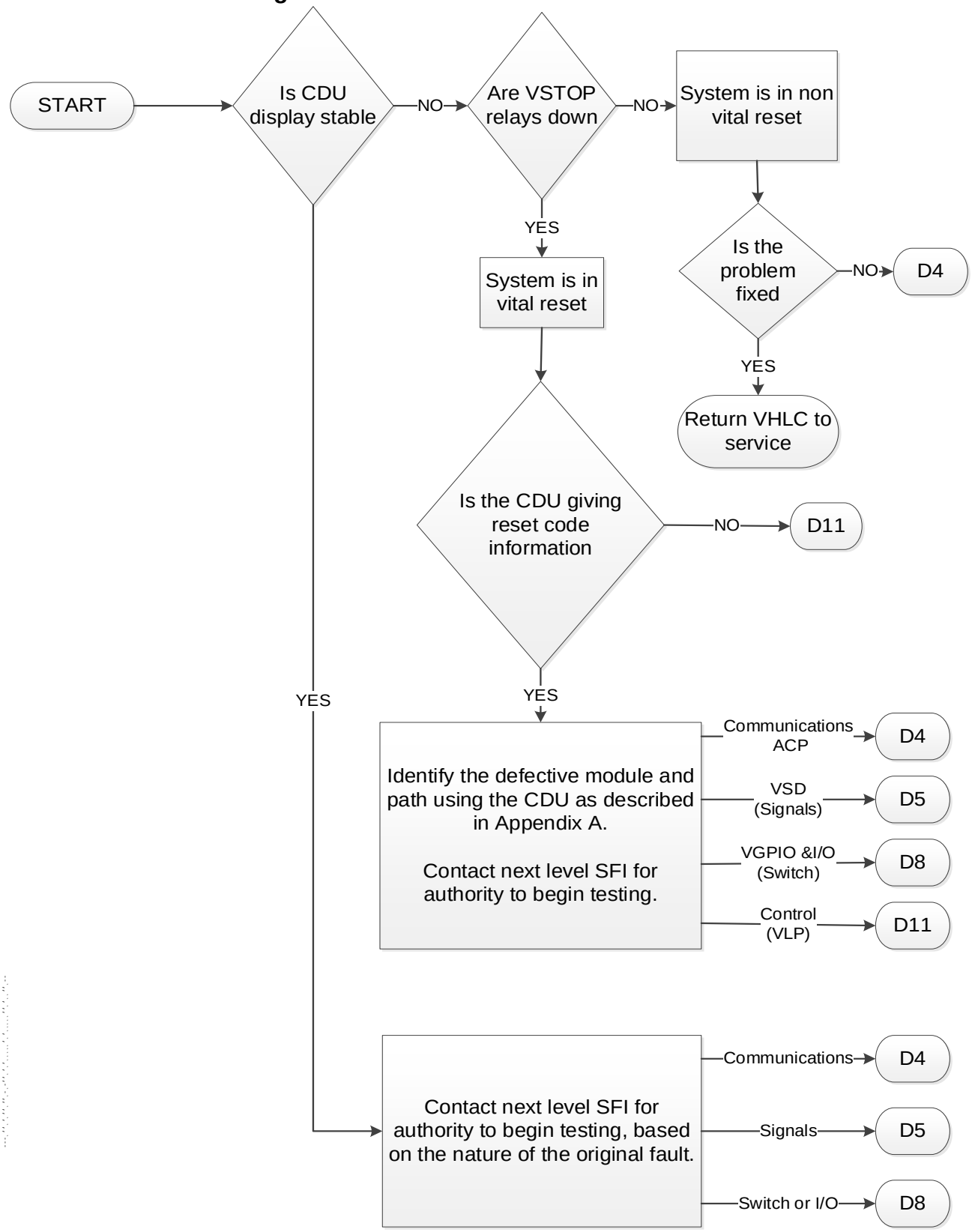
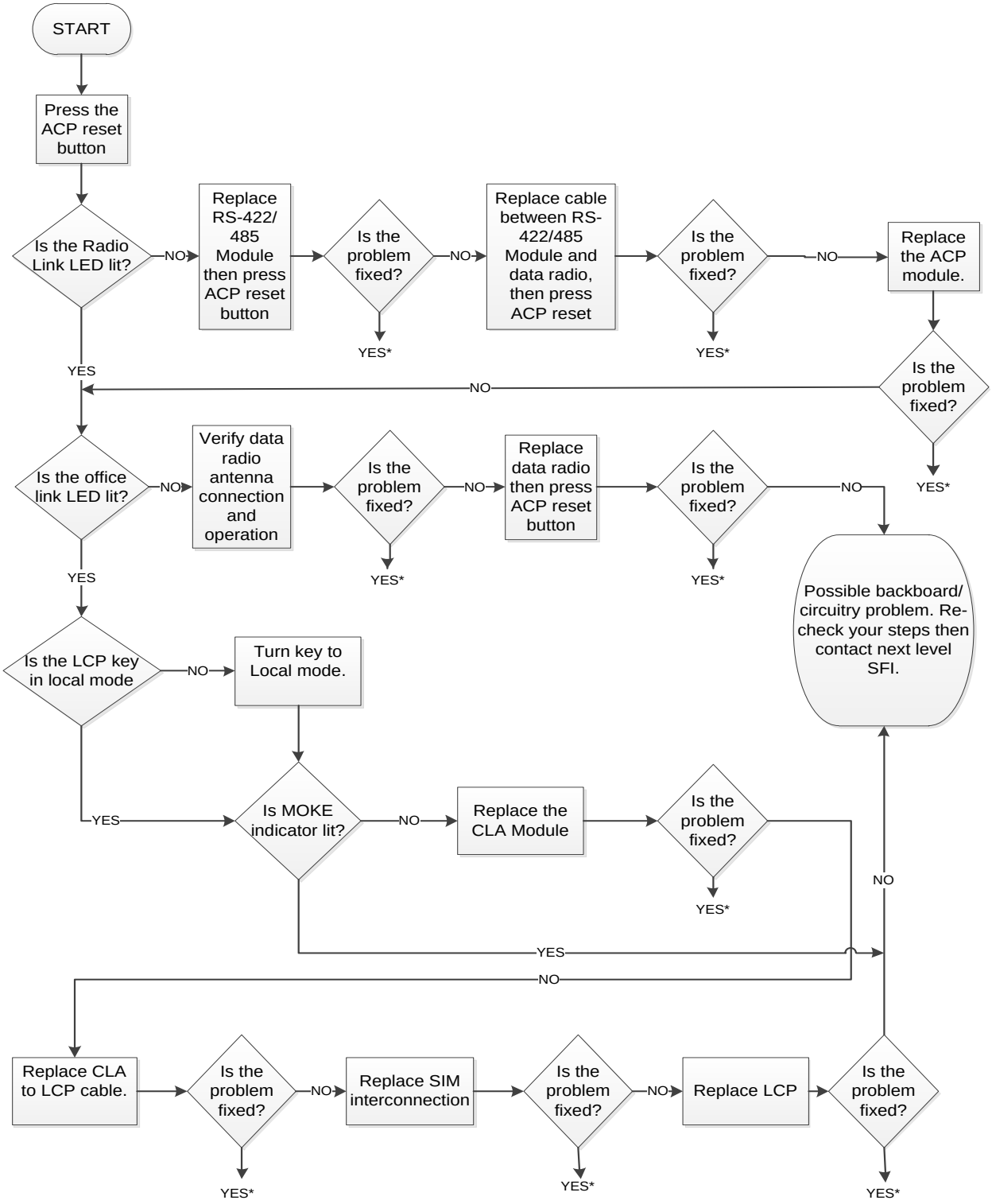


Figure 2 – General Fault diagnostic flow chart.

3. Auxiliary Communications Processor (ACP) fault finding flowchart



* Once the fault has been identified and fixed, return VHLC to service

Figure 3 – Auxiliary Communications Processor (ACP) fault finding flowchart

4. Vital Signal Driver AC (VSDAC) fault finding flow chart

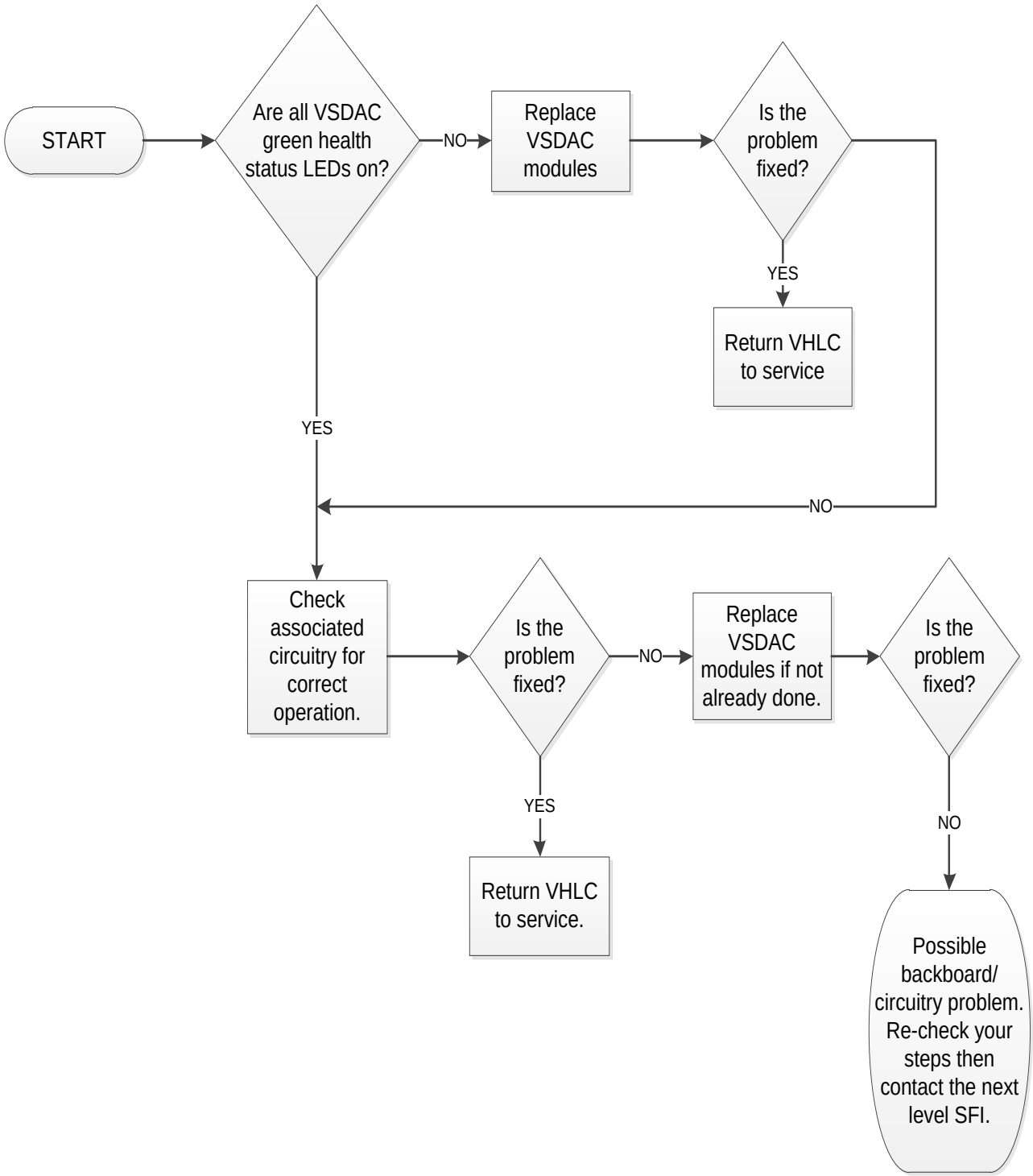


Figure 4 - Vital Signal Driver AC (VSDAC) fault finding flow chart

5. VGPIO and Input/output fault finding flowchart

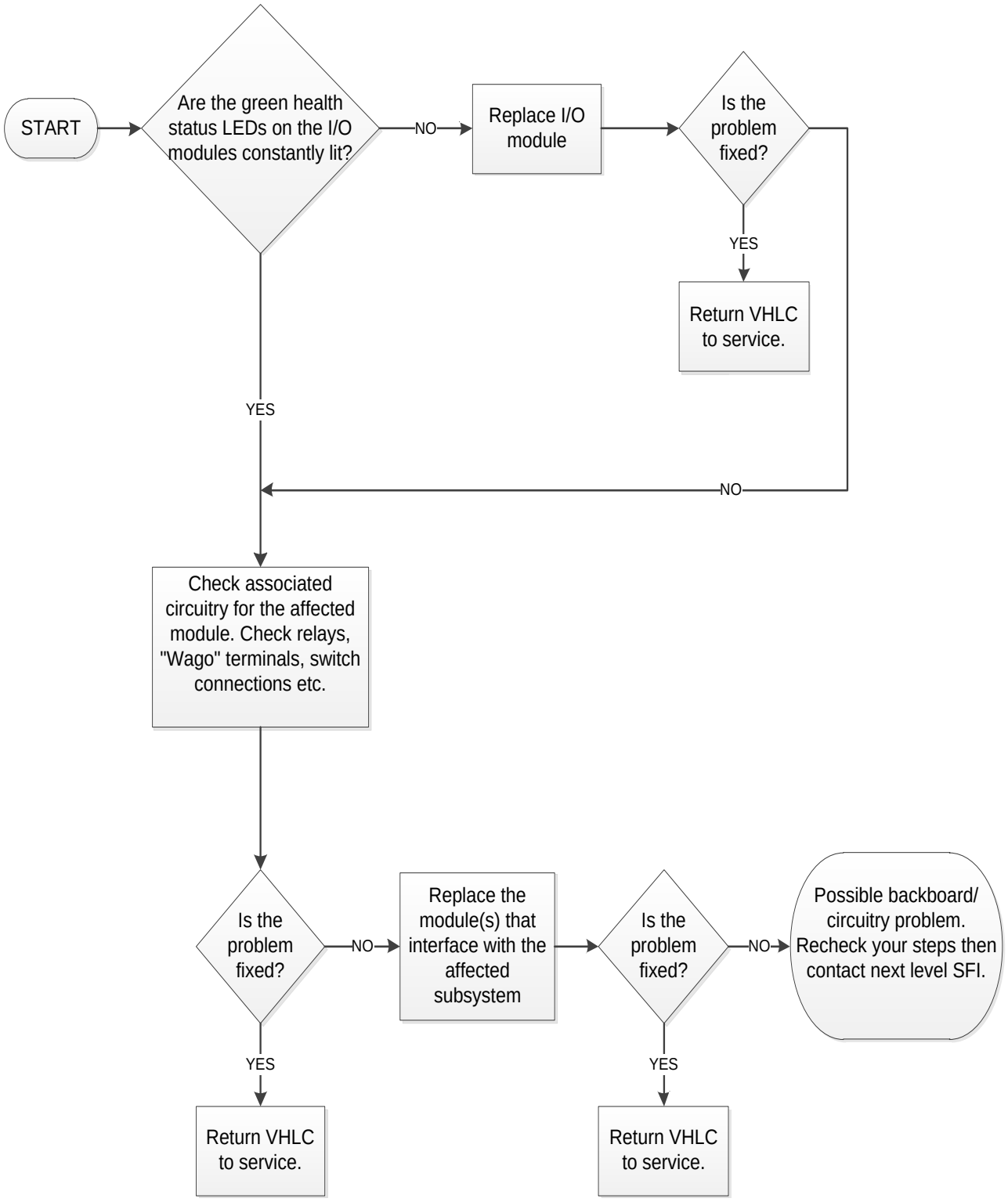


Figure 5 – VGPIO and Input/output fault finding flowchart

6. Vital Logic Processor (VLP) Fault finding flowchart

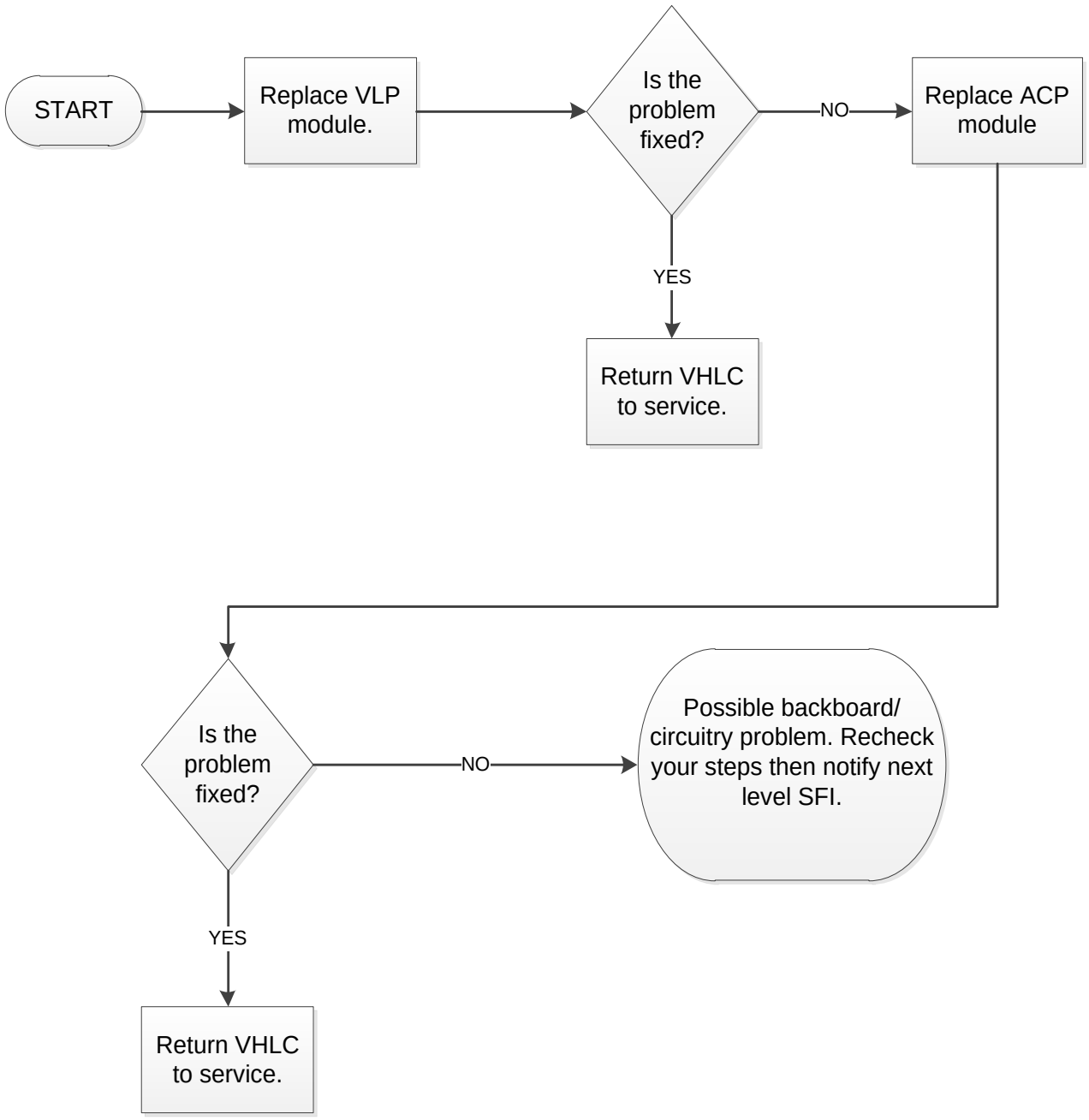


Figure 6 – Vital Logic Processor (VLP) Fault finding flowchart

7. Replacing a battery or 50vDC power supply flowchart

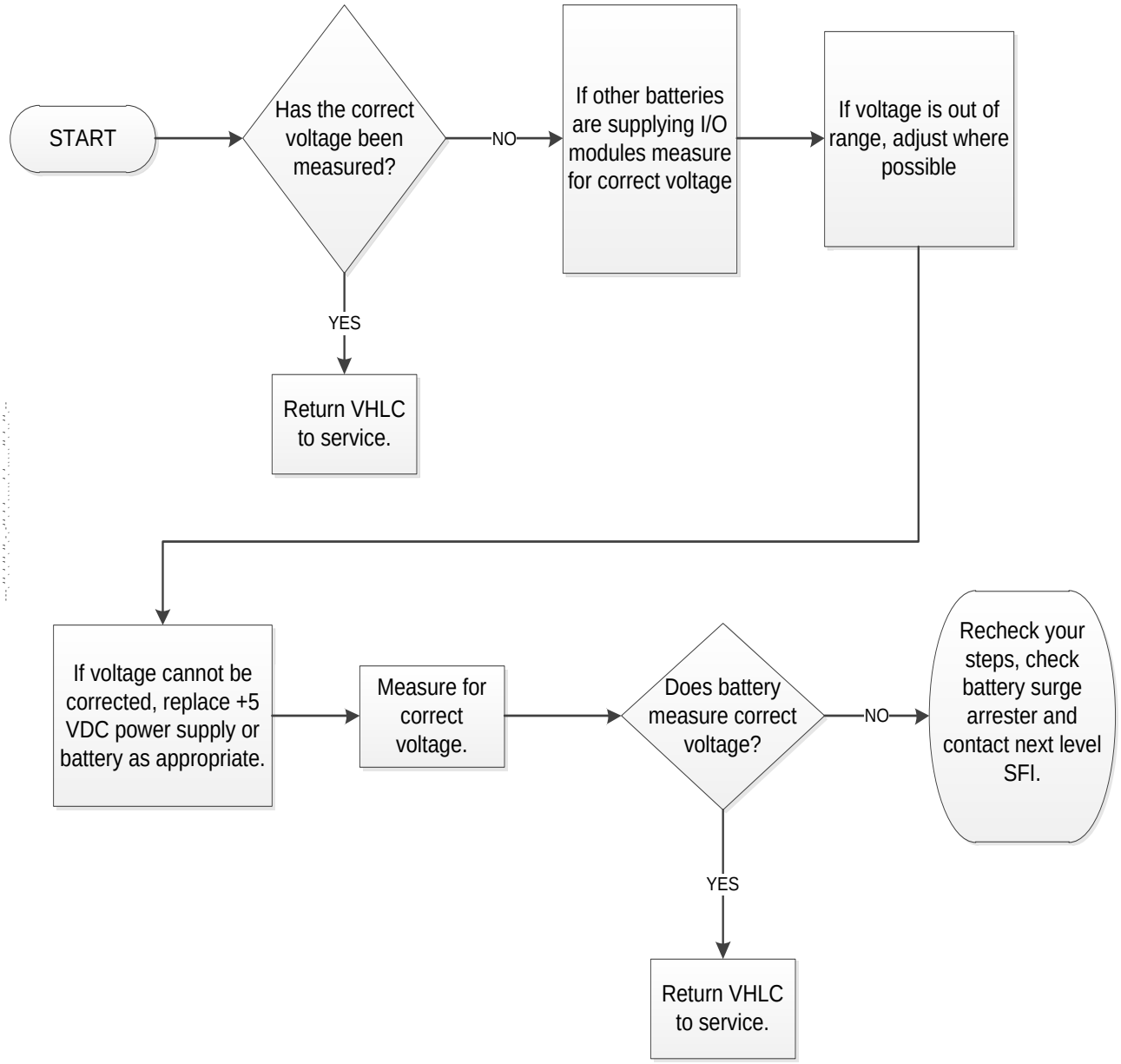


Figure 7 – Replacing a battery or 50vDC power supply flowchart

8. Fault finding using the CDU

Fault finding on the VHLC is carried out using the reset source code and software reset code, which are incorporated as part of the error messages displayed on the CDU. These error messages take two distinct forms:

a) VLP specific error messages.

b) ACP specific error messages.

These error messages are made up of a series of up to13 numbers and letters, which can be interpreted to give fault finding information.

The CDU can also be used to access the VHLC's fault log, which records faults codes for the last 16 faults experienced by the machine.

9. VLP Error Messages

The VLP specific error messages displayed by the CDU are made up of a series of 12 number and letters and take the following format:

a) 31 RS mm qqqq pp

All VLP error messages begin with the number 31, as shown here, and contain two elements specific to the fault finding process. These are the reset source code, indicated above as 'mm', and the software reset code, indicated above as 'qqqq'.

The remaining information contained within these error messages is not relevant to the fault finding process. A full list of VLP reset source codes and software reset codes is given in the following tables along with information on how to interpret them.

10. VLP reset source codes

Table 1 lists the VLP reset source codes, their possible causes and the corrective actions to take.

VLP Reset Source Codes: 31 RS mm qqqq pp		
Code	**Possible Cause**	**Corrective Action**
DF EF F7 FB FD FE FF	Any of these codes can indicate a problem with VLP hardware or software. See if the software reset code provides any further information.	1. Look up the software reset code. 2. If no software re-set code is given, replace the VLP module. 3. If problem continues, notify Manager.
7F	+5 VDC power failure.	1. Check battery voltage into power supply module. 2. Check voltage output of power supply module. 3. Replace power supply.

Table 1 – VLP Reset Source Codes

If an I/O module problem occurs, an error message identifying the slot number of the defective module will be displayed for a period of only 2 seconds.

The I/O specific error message will begin with the number 32 and appear directly after the VLP specific error message.

If an I/O specific error message is identified, remove the module in the specified slot and check to see if the system now functions correctly.

I/O module specific error messages will be in the format:

a) 32 IO SLOT nn

Where nn is the slot number of the I/O module causing the failure.

11. VLP software reset codes

Table 2 lists the VLP software reset codes, their possible causes and the corrective actions to take.

VLP Software Reset Codes: 31 RS mm qqqq pp		
Code	**Possible Cause**	**Corrective Action**
010F 0112 0114 0203 0207 0304 0402	Any of these codes can indicate a problem with the CCI module.	Replace the CCI module. Check the cable from the back of the VHLC to the Electro Code interface unit. Carry out a fault-finding exercise on the Electro Code section. Notify your manager.
0500 0503 0508	Any of these problems can indicate a problem with the VSD module or cable.	Replace the VSD module. Check the VSD cable. If you have another cable, replace it and see if the problem continues.
0501 0503 0504 0506	Any of these codes can indicate a problem with the VSDAC or VGPIO modules.	Replace the VSD module. Replace the VGPIO module.
0507	VGPIO module.	Replace VGPIO module.
0505	I/O module	Replace I/O module.
0700 0900 0901 0902 0904 0905 0906 0907 0908 0909 090A 090B 090C 090D 0C01	VLP module	Replace VLP module.
0B01 0B05	These codes could indicate: I/O module is in the wrong slot; There is a problem with the I/O module; or Chassis configuration is wrong.	Check to make sure the I/O module is in the correct spot. Replace I/O module. Check Chassis configuration against site plans.

VLP Software Reset Codes: 31 RS mm qqqq pp		
Code	**Possible Cause**	**Corrective Action**
0B02 0B03 0B04 0B06	These codes could indicate a problem with the I/O module or a motherboard failure.	Replace I/O module. Check Chassis configuration against site plans. Replace the motherboard.
0B07	Chassis ID wrong	Check that the chassis ID jumpers are set correctly by referring to the site plans.
Any other code	If you have any other code, the problem could be caused by either Software error; Memory failure of; Set-up error.	Notify your manager.

Table 2 - VLP Software Reset Codes: 31 RS mm qqqq pp

12. ACP Error Messages

The ACP specific error messages displayed by the CDU are made up of a series of 13 numbers and letters and take the following format:

a) 34 RST xxxx yyyy

All ACP specific error messages begin with the number 34, as shown here, and contain two elements specific to the fault finding process. These are the reset source code, indicated above as 'xxxx', and the software reset code, indicated above as 'yyyy'.

The remaining information contained within these error messages is not relevant to the fault finding process. A full list of reset source codes and software reset codes is given the following tables along with information on how to interpret them.

13. ACP reset source codes

Table 3 lists the ACP re-set source codes, their possible causes and the corrective actions to take.

VLP Reset Source Codes: 34 RST xxxx yyyy		
Code	**Possible Cause**	**Corrective Action**
0000	Low site battery voltage	1. Check the battery voltage. 2. If low repair battery related problem.
0001 0002	ACP module failure	Replace ACP module (be sure to install original EPROMs onto module).
0004	VLP module has initiated a system-wide re-set	Carry our fault finding on the VLP as described in section 7.2.
0010	ACP software has caused the re-set	Carry out fault finding using ACP software reset codes as described in section 7.3.5.
0080	Low +5 VDC power	1. Check the battery voltage into power supply module. 2. Check voltage output of power supply module. 3. Replace power supply if defective.

Table 3 – VLP Reset Source Codes: 34 RST xxxx yyyy

Table 4lists the ACP software re-set codes, their possible cause and the corrective action to take.

VLP Software Reset Codes: 34 RST xxxx yyyy		
Code	**Possible Cause**	**Corrective Action**
5102	Memory hardware error.	Check that memory chips IC30-33 are installed correctly on the ACP module. Check that these memory chips have the correct checksums. These are identified on the site plans. Notify your manager.
5107 5108 5109	Memory error	Check that memory chips U9 and U10 on the ACP module have the correct checksums. These are identified on the site plans. Notify your manager.
510A	Chassis ID error or memory error.	Check that the chassis ID jumpers are set correctly by referring to the site plans. Check that memory chips U9 and U10 on the ACP module have the correct checksums. These are identified on the site plans. Notify your manager.

VLP Software Reset Codes: 34 RST xxxx yyyy		
Code	**Possible Cause**	**Corrective Action**
510C	Memory hardware error	Look for loose or missing IC chips. Replace ACP module. Notify supervisor.
Any other code	If you have any other code, the problem could be caused by: Software error; Application logic error.	Notify your manager.

Table 4 – VLP Software Reset Codes: 34 RST xxxx yyyy cont

14. VHLC Fault Log

The fault log forms part of the information available through the CDU and can be used during the fault finding process. Its position within the memory of the CDU is described in the following menu map, see Figure 8.

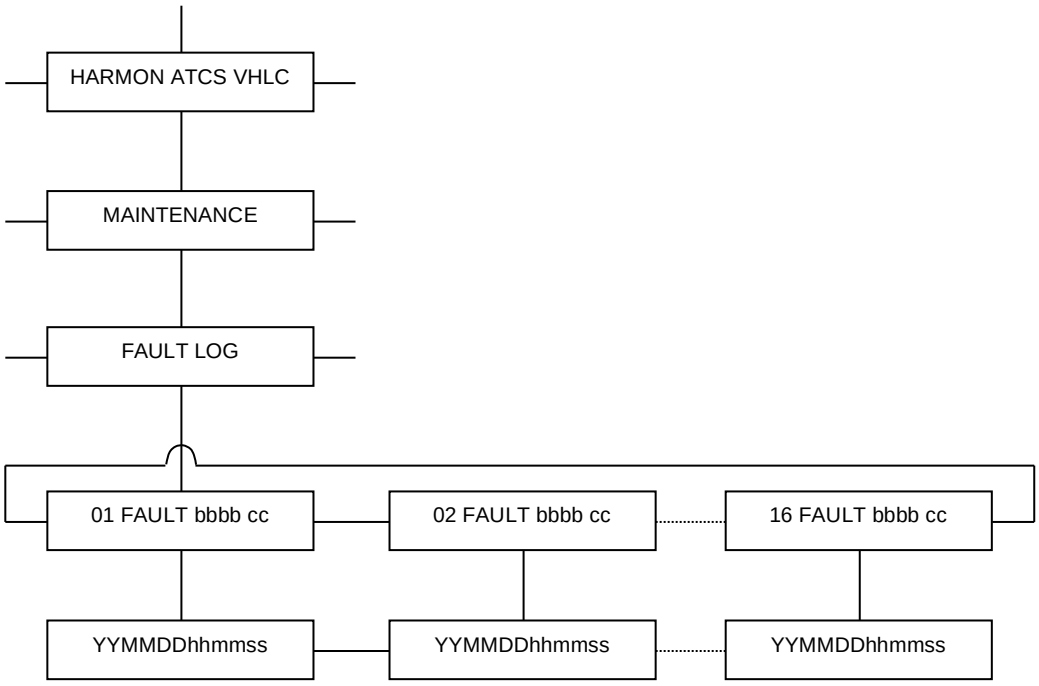


Figure 8 – VHLC Fault Log

The last 16 fault codes recorded can be displayed using the fault log and each memory location can be selected to display a fault code along with the date and time that the fault occurred.

Each fault that is logged is expressed in the following format.

a) aa FAULT bbbb cc

Where:

a) aa is the fault number

b) bbbb is the fault code; and

c) cc is the slot number of the defective module.

The fault will also be give a date and time code, expressed in the following format.

a) YYMMDDhhmmss

Where:

a) YY is the year

b) MM is the month

c) DD is the day

d) hh is the hour

e) mm is the minute

f) ss is the second.

Table 5 lists a number of problems, identifies their possible causes and gives corrective actions.

Fault Code	What it means	Slot Number
1807	Changing track rate	Track (1-8)
2801	I/O NVIO input error	Slot
2802	I/O NVIO output error	Slot
2803	I/O module output sense error	Slot
2804	I/O module output sense OK	Slot
2805	Remote CRC error	0 = Port B, 1 = Port D
2806	Remote destination error	0 = Port B, 1 = Port D
2807	Remote link down	0 = Port B, 1 = Port D

Fault Code	What it means	Slot Number
2808	Remote sequence error	0 = Port B, 1 = Port D
2809	Remote source ID error	0 = Port B, 1 = Port D
280A	I/O lamp out	Slot
280B	I/O lamp OK	Slot
280C	VSDAC vital AND fail	Slot
280D	VSDAC dual control error	Slot
280E	VSDAC cannot zero A to D	Slot
280F	VSDAC cannot read A to D	Slot
2810	VSDAC sense failure	Slot
2811	VSDAC power enable error	Slot
2812	Dual disabled VSDAC module	Slot
2813	Equations disabled VSDAC module	Slot
2814	VSDAC lamp intermittent	Slot
2815	Cannot zero vital input	Slot
2816	NV132 input error	Slot
2817	Remote link up	0 = Port B, 1 = Port D
2818	VSDAC module recovered	Slot
2819	Equations requested flash and steady on	Slot
281A	Noisy vital input	Slot

Table 5 – Fault codes

END

NR/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF19		
Faulting Guide: EBI Gate 2000 Level Crossing System		
Issue No. 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	EBI Gate 2000 Level Crossing Systems
Excludes:	All other types of Level Crossing System

Fault Finding

Power Supply and Control Rack (ERR-8) failures are reported by the Remote-Control Device (ERP-9).

The actions required to rectify these failures are presented below. In some more complex situations, it is required to work with signalling wiring diagrams

Usually it is recommended to observe related Programmable Logic Controller (PLC) inputs.

You shall not connect any diagnostic or additional devices to ETHERNET nets within ERR-8.

Failure Mode Index

1. Failure Mode: No battery charging of channel A / B / C

1.1 Check the fuse insert of TYTAN mains fuse.

1.2 Check all fuses – FZX, FZiX, FX (where X is A or B or C).

1.3 Check if the Residual Current is triggered.

1.4 Check the FLASHTRAB mains surge protection – observe inspection indicator

They should be green, red – means replacement is needed.

Figure 1 – FLASHTRAB mains surge protection

1.5 Measure the voltage on the input terminals of battery chargers.

1.6 Check the voltage on the disconnected batteries (20÷28Vdc).
Before measurement switch off fuse FZX (where X is A or B or C).

1.7 Switch off the TYTAN fused switch, then switch it back on.

1.8 Before the corresponding EMK-2 module is activated (indicated by audible click of contactor) measure the charging current of batteries.

To do this switch off the fuse FZX (where X is A or B or C) and measure the charging current (0,1÷20A DC) directly on terminals of the corresponding fuse.

1.9 Check continuity of the cabling towards the PLC inputs.

1.10 Check for indication on related PLC input (according to list of inputs).

2. Failure Mode: Battery voltage is too low

2.1 When this failure is reported together with indication “No battery charging of channel A/B/C” than it means that the batteries are discharged due to the lack of mains power supply.

2.2 The other option is that the batteries are broken. Disconnect the batteries using fuse FZX (where X is A or B or C) and measure the voltage directly on terminals of each battery (10÷15Vdc).

2.3 Reconnect the batteries (using the respective fuse) and cycle the mains power supply.

2.4 Observe the batteries voltage before and after the moment when module EMK-2 is activated (audible click of contactor). In each case the voltage of the battery should be in the range 10-15Vdc.

2.5 If the batteries voltage is above 25V DC and the failure is still reported this means failure of the EMK-2 module. Replace the faulty EMK-2 module.

2.6 Check continuity of the cabling towards the PLC inputs.

2.7 Check for indication on related PLC input (according to list of inputs).

3. Failure Mode: Battery voltage is too low

3.1 When this failure is reported together with indication „No battery charging of channel A/B/C” than it means that the batteries are discharged due to the lack of mains power supply.

3.2 The other option is that the batteries are broken. Disconnect the batteries using fuse FZX (where X is A or B or C) and measure the voltage directly on terminals of each battery (10÷15Vdc).

3.3 Reconnect the batteries (using the respective fuse) and cycle the mains power supply.

Observe the batteries voltage before and after the moment when module EMK-2 is activated (audible click of contactor). In each case the voltage of the battery should be in the range 10-15Vdc.

3.4 If the batteries voltage is above 25V DC and the failure is still reported this means failure of the EMK-2 module. Replace the faulty EMK-2 module.

3.5 Check continuity of the cabling towards the PLC inputs.

3.6 Check for indication on related PLC input (according to list of inputs).

4. Failure Mode: Earth leakage detection failure (first threshold/second threshold)

4.1 Check for readout of earth leakage detection modules (Bender Units) marked MD A, MD B, MD C. Compare readouts with defined values for first and second threshold (110kΩ and 100kΩ).

4.2 Check continuity of the cabling towards the PLC inputs.

4.3 Check for indication on related PLC input (according to list of inputs).

4.4 Disconnect external LX devices – this test allows you to narrow down the location of the earth leakage to either inside or outside of the LX hut.

4.5 Disconnect power supply and check the resistance between PE (Protective Earth) and both terminals of DC power supply in all sub circuits.

5. Failure Mode: Door of control cabinet is open

5.1 Check if the door is locked – otherwise the door limit switch is not activated.

5.2 Check continuity of the cabling towards the PLC inputs.

5.3 Check for indication on related PLC input (according to list of inputs) while closing and opening the door lock.

6. Failure Mode: Failure of EOD module & set of EOD related failures

6.1 Check continuity of the cabling towards the PLC inputs.

6.2 Check for indication on related PLC input (according to list of inputs). Test of the EOD module is visible as a short extinguish of the LED in the PLC input card.

6.3 If the result of the above inspection is negative replace the corresponding EOD module.

7. Failure Mode: Discrepancy of engagement in channels of LX controllers

7.1 Restart the LX system. This action should rectify the failure.

7.2 It is absolutely indispensable to inform the manufacturer about occurrence of this failure and all simultaneously reported failures (on the ERP-9).

8. Failure Mode: Road signals / Audible alarms communication failure

8.1 Check if EMF / EDG module is powered.

8.2 Observe and analyse the indications on module – LED indicators, activity of yellow and green LEDs on Ethernet socket of the module.

8.3 Check for communication activity on related Ethernet switch.

8.4 If the result of the above inspection is negative - replace faulty module.

9. Failure Mode: Road signals / Audible alarms hardware failure

9.1 Check if the EMF / EDG module is powered and its wiring is intact.

9.2 The diagnostic information on the ERP-9 provide more detailed information pointing the module for replacement.

10. Failure Mode: Failure of audible alarm

10.1 Check continuity of the cabling.

10.2 Check the overvoltage protection.

10.3 Check for the continuity of the primary winding of the acoustic transducer (KLD-5) sub-assembly within road signal (the measured resistance should be in a range of 50Ω-1kΩ).

10.4 Replace EDG module or the acoustic transducer (KLD-5) subassembly.

11. Failure Mode: Failure of red / amber road signal

11.1 Check if the corresponding chamber is lit – if it is working according to LX state.

11.2 Observe the LED indications on EMF module.

11.3 Measure the output voltage of EMF module (it should be 22V to 25V DC).

11.4 Check continuity of the cabling.

11.5 Replace EMF module.

12. Failure Mode: Failure of Crossing Clear Unit / Local Control Unit

12.1 Check for failures of related signals.

12.2 Check continuity of the cabling towards the PLC inputs.

12.3 Check the corresponding fuse.

12.4 Check for indication on related PLC input (according to list of inputs).

12.5 Observe if outputs (5Hz waveform) are returned to corresponding PLC inputs (LED indications on output/input cards).

12.6 Observe the signal on input and output of the EDZ modules.

12.7 Replace broken EDZ module, buttons and lamps.

13. Failure Mode: Failure of Signal Box control panel

13.1 Check for power supply delivered from channel C.

13.2 Check the Ethernet cabling if all plugs are latched correctly.

13.3 Check for the Ethernet communication activity on the switch towards DNC.

13.4 Observe the indications on local diagnostic panel.

14. Failure Mode: Failure of the barriers / exit barriers direction of movement

14.1 Check the presence of the power supply and output signal of EDL module while the barrier machines are supposed to be moving up.

14.2 Check the contactors for proper operation – contacts operation should follow the presence of coil voltage.

14.3 Observe the related PLC input.

14.4 Check the WAGO optocouplers for proper operation – output transistor keys operation should follow the presence of input current.

14.5 Check continuity of the cabling.

14.6 Depending on results of above checks replace EDL module / contactor / WAGO optocoupler respectively.

15. Failure Mode: Barrier machine not ready

15.1 Check if the crank flap of the individual barrier machine is open.

15.2 Check continuity of the cabling towards the PLC inputs.

15.3 Check the corresponding fuses.

15.4 Check the indications on related PLC inputs (according to list of inputs).

16. Failure Mode: Boom intact failure of barrier

16.1 Check the continuity of the cabling towards the PLC inputs (also in the barrier machine).

16.2 Check the corresponding fuses.

16.3 Check the indications on related PLC inputs (according to list of inputs).

17. Failure Mode: Failure of barrier machine position

17.1 Check the real position of the boom.

17.2 Check continuity of the cabling towards the PLC inputs (also in the barrier machine).

17.3 Check the corresponding fuses.

17.4 Check the operation of limit switches.

17.5 Check the indications on related PLC inputs (according to list of inputs).

17.6 Check the operation of all related WAGO optocouplers – output transistor keys operation should follow the presence of input current.

17.7 Check the operation of contactors – contacts operation should follow the presence of coil voltage.

18. Failure Mode: Failure of current transducer of barriers

18.1 Cycle the power of the current transducer using its plugs.

18.2 Check continuity of the cabling towards the PLC inputs.

18.3 Check for the ERROR (ERR) indication on the WAGO current measurement unit.

18.4 Replace the WAGO current measurement unit / PLC analogue input card.

19. Failure Mode: Overcurrent failure of barrier

19.1 Check if barrier machine is not broken or blocked.

19.2 Check for short-circuit in motor power supply circuit.

20. Failure Mode: Failure of event logger

20.1 Check presence of the CF card in PLC CPU.

20.2 Replace CF card in PLC CPU.

21. Failure Mode: Failure of event logger backup

21.1 Visually check continuity of the cabling.

22. Failure Mode: Failure of interlocking interface

22.1 Check the interface sub circuit accordingly to the reported failure.

END

Includes:	JE Style Trainstop
Excludes:	Any other type or make of Trainstop or sub-component

Trainstops contain moving parts which can cause severe personal injury.

Fault Finding Guide

1. Trip Arm Fails to Lower

1.1 Possible cause - Signalling System not set to Proceed

a) Check associated signal is set to the proceed aspect.

b) If signal not at proceed and Trip Arm is lowered – Follow actions for loss of motor drive voltage.

If signal is at danger, Trip Arm should not be lowered.

1.2 Possible cause - Loss of Motor Drive Voltage

With associated signal set to proceed:

a) Check for 110 V a.c. motor drive voltage at incoming terminals of the distribution box.

b) If voltage is not present, fault is external to the Trainstop.

c) If voltage is present, check disconnection box links are correctly made to pass voltage to the tail cables.

d) Check for 110 V a.c. voltage across Rectifier Assembly terminals 1 and 2.

e) If voltage is not present, check the tail cables for damage or disconnection and repair / re-connect as necessary.

f) If voltage is present, follow actions for Motor failure.

1.3 Possible cause - Trip Arm Jammed

a) Isolate the train stop and disconnect the tail cables.

b) Check for and remove any debris, ballast etc that can jam the Trip Arm.

c) Inspect the Trainstop looking for damage, distortion or cracks to the casing, Trip Arm or detector arm.

d) If the Trip Arm is damaged, but the remainder of the Trainstop is serviceable, replace the Trip Arm.

e) Other damages could require the replacement of the complete Trainstop.

f) If no damage is found, attempt to manually operate the Trip Arm.

g) If Trip Arm remains jammed, replace Trainstop.

h) If manual operation is satisfactory, re-connect the tail cables and supply.

i) Test the operation under power. If fault still present, replace the Trainstop.

1.4 Possible cause - Motor Failure.

a) With motor supply applied, at the Rectifier Assembly terminals measure the D.C. voltage between terminal 4 (+100 V) and terminal 5 (0 V).

b) If the voltage is present, replace the motor.

c) Isolate the supply from the Trainstop and disconnect the tail cables.

d) If the motor brushes are badly worn, replace them.

e) Re-connect the tail cables and the supply then check for correct operation.

f) If the voltage was not present, replace Trainstop.

1.5 Possible cause - Clutch Failure

a) A clutch failure is indicated by the motor operating, driving Gear C via Gear B (see Figure 1) but Gear D not being driven.

b) If Gear D is not being driven, then the replace the Trainstop.

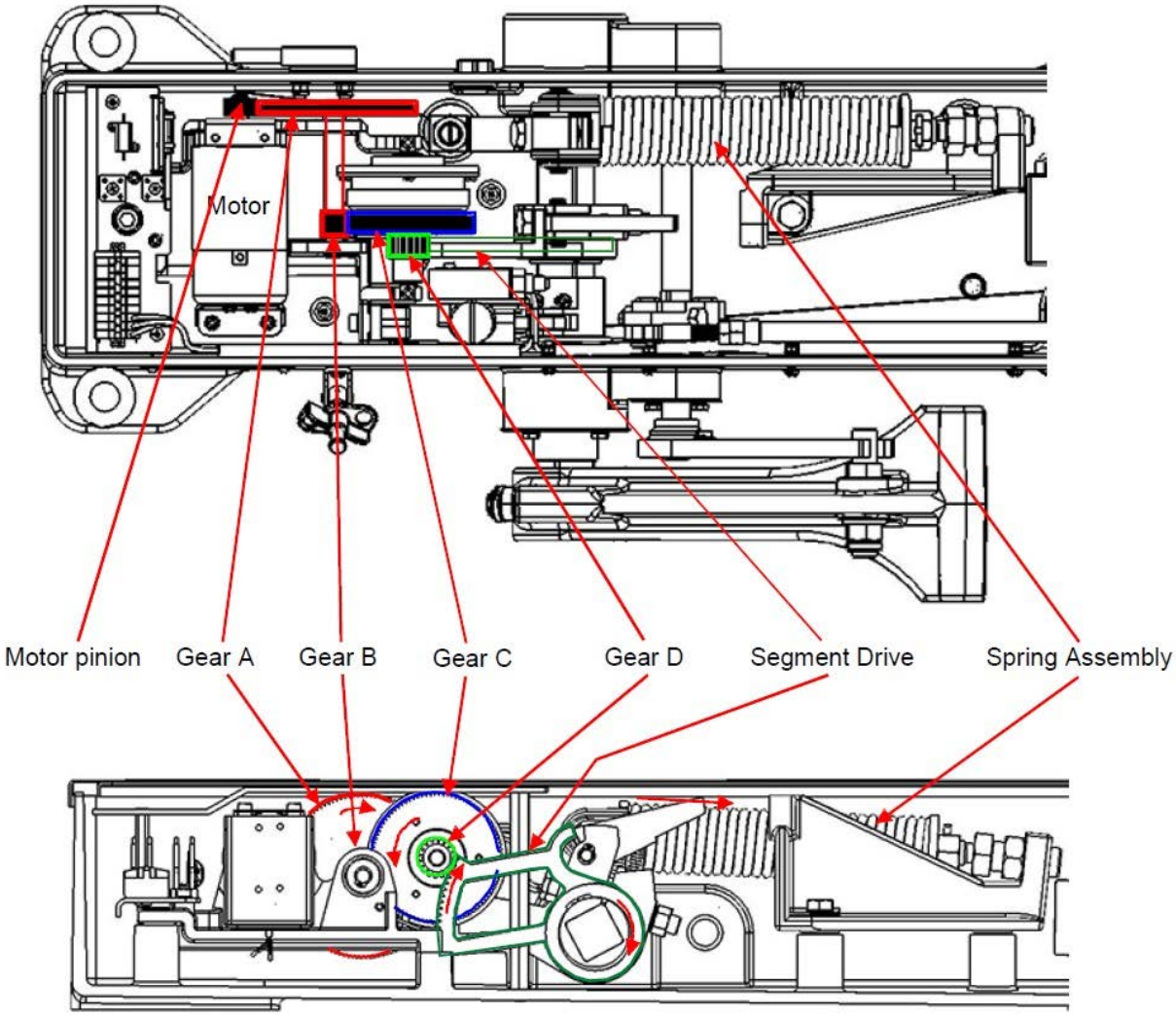


Figure 1 – Trainstop Drive System

2. Trip Arm Fails to Rise

2.1 Possible cause - Trainstop receiving motor drive voltage from signalling system.

a) Isolate the supply from the Trainstop and unplug the tail cables.

b) If Trip Arm immediately rises check for motor drive voltage of 110 V a.c. on the incoming terminals of the disconnection box.

c) If this voltage is present, the Trainstop is not faulty.

d) Report findings to the SM(S) and investigate.

e) Re-connect the tail cables then re-connect the supply.

2.2 Possible cause - Trip Arm jammed

a) Isolate the supply from the Trainstop and unplug the tail cables.

b) If the Trip Arm does not rise when the electrical supply is isolated, visually check for jamming of the Trip Arm.

c) If jammed by debris, manually depress the Trip Arm and carefully remove the debris.

d) Release the Trip Arm and check it moves freely to the fully raised position.

e) If not jammed by debris, but the Trip Arm does not rise, make the machine safe by securing the Trip Arm in the lowered position.

f) With the Trip Arm of the faulty machine secured, replace the Trainstop.

g) Mark the faulty Trainstop prominently with a warning “Not to release the Trip Arm”.

2.3 Possible cause - Return mechanism broken.

a) Replace the Trainstop.

3. Symptom – Trip Arm attempt to Lower and then Rises

3.1 Possible cause - Debris / ballast preventing Trip Arm from lowering fully.

a) Isolate the supply from the Trainstop and unplug the tail cables.

b) Remove any debris / ballast preventing the Trip Arm from lowering.

c) Manually lower the Trip Arm to check for correct operation.

d) If manual operation appears to be correct, re-connect the tail cables to the Trainstop and then re-connect the supply.

e) Request the Signaller to operate the signal associated with the Trainstop and check for correct operation of the Trainstop.

3.2 Possible cause – Clutch Failure.

a) A clutch failure is indicated by the motor operating, driving Gear C via Gear B (See Figure 1) but Gear D not being driven.

b) If Gear D is not being driven, then the replace the Trainstop.

3.3 Possible cause - Trip Arm distorted.

a) Isolate the supply from the Trainstop and unplug the tail cables.

b) Inspect the Trainstop looking for damage, distortion or cracks to the casing, Trip Arm or detector arm.

c) If the Trip Arm is damaged, but the remainder of the Trainstop is serviceable, replace the Trip Arm. Other damage entails replacement of the complete Trainstop.

3.4 Possible cause - Trainstop loose on fixings.

a) Keeping clear of the Trip Arm, isolate the supply from the Trainstop and unplug the tail cables.

b) Slacken the four fixings securing the Trainstop to the bearer.

c) Adjust the position of the Trainstop to give required distance of the Trip Arm from the running rail.

d) Tighten the fixings and re-check the measurement.

e) Re-connect the tail cables to the Trainstop and then re-connect the supply.

f) Request the Signaller to operate the signal associated with the Trainstop and check for correct operation of the Trainstop.

3.5 Possible cause - Trainstop badly damaged.

a) Replace the Trainstop.

4. Symptom – Trip Arm Out of Gauge

4.1 Possible cause - Trainstop loose on fixings.

a) Isolate the supply from the Trainstop and disconnect the tail cables.

b) Check the centre of the Trip Arm is 222 mm +/-3 mm from the inside of the running rail (Figure 2).

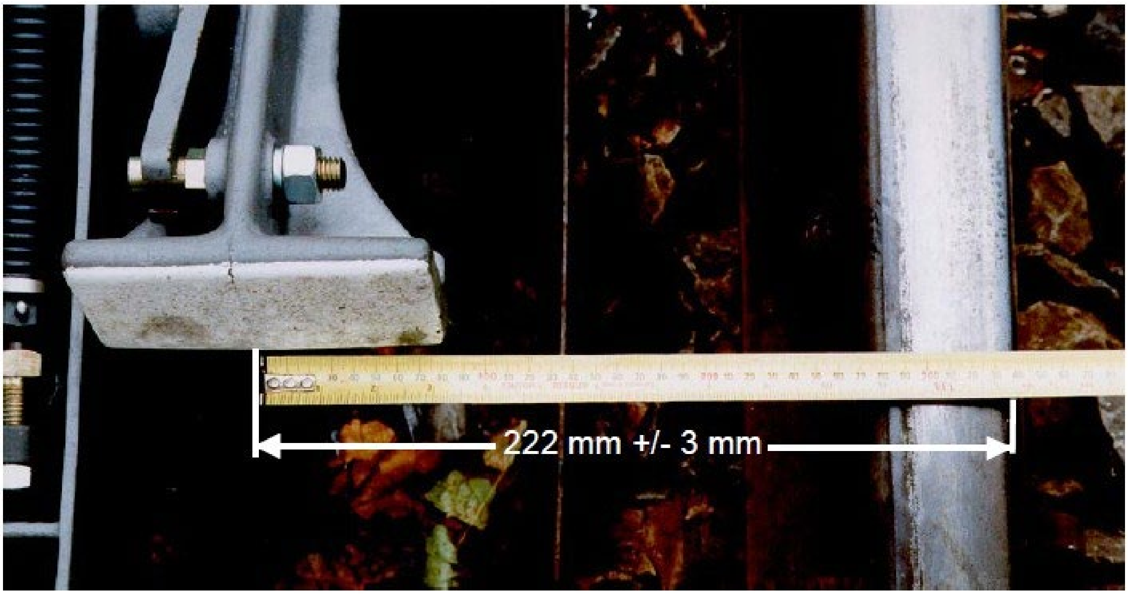


Figure 2 – Distance from Rail

c) Adjust as necessary by moving the complete Trainstop, keeping it parallel to the running rail.

d) Tighten the Trainstop fixings and re-check the dimension.

e) Place the Trip Arm Gauge in position and confirm the Trip Arm height is 76 mm +/- 3 mm above a line joining the tops of the running rails. If the height is incorrect, see Rail wear.

f) Remove the Trip Arm Gauge.

g) Re-connect the tail cables then re-connect the supply to the Trainstop.

h) Request the Signaller to operate the signal associated with the Trainstop and check for correct operation of the Trainstop.

4.2 Possible cause - Rail wear.

a) Isolate the supply from the Trainstop and disconnect the tail cables.

b) Place the Trip Arm Gauge in position and measure the Trip Arm height above a line joining the tops of the running rails.

c) If the Trip Arm height is greater than 79 mm above the line, carry out NR/SMS/PartB/Test/028 (JE Style TrainStop Positioning Check).

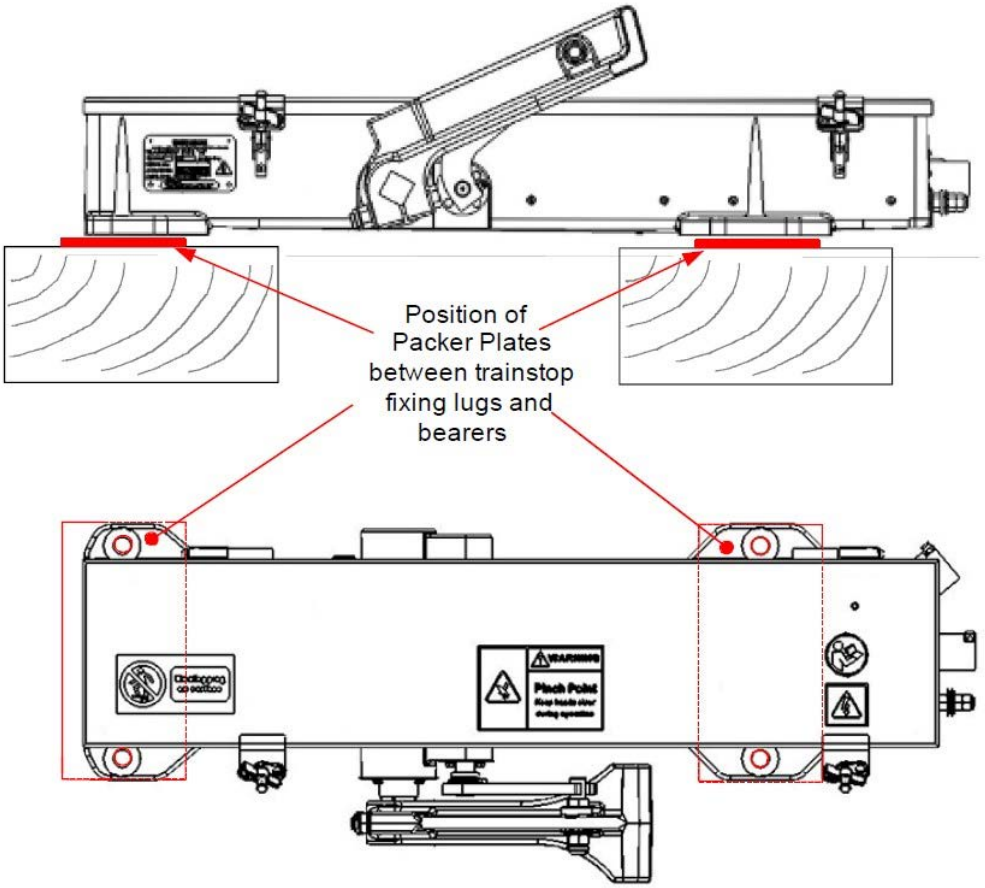


Figure 3 – Position of Packer Plates

5. Symptom - Detection Failure

5.1 Possible cause – Loss of detection voltage from signalling system.

a) Isolate the supply from the Trainstop and disconnect the tail cables.

b) Check for the presence of the detection voltage at the disconnection box terminals.

c) If the detection voltage is not present at the distribution box check the associated fuses.

d) If detection voltage is correct leaving location case / equipment room, report a cable fault between the location case / equipment room and the disconnection box.

e) If the detection voltage is present, re-connect the tail cables to the Trainstop, then re-connect the supply.

f) Proceed with actions listed under Tail cable fault.

5.2 Possible cause – Tail cable fault.

a) Visually check the tail cables between the disconnection box and the Trainstop for cuts, crushing or other damage likely to cause short or open circuits within the cable.

b) With the supply and tail cables connected to the Trainstop, undo the four screw fixings securing the polycarbonate cover over the Circuit Controller (see Figure 4).

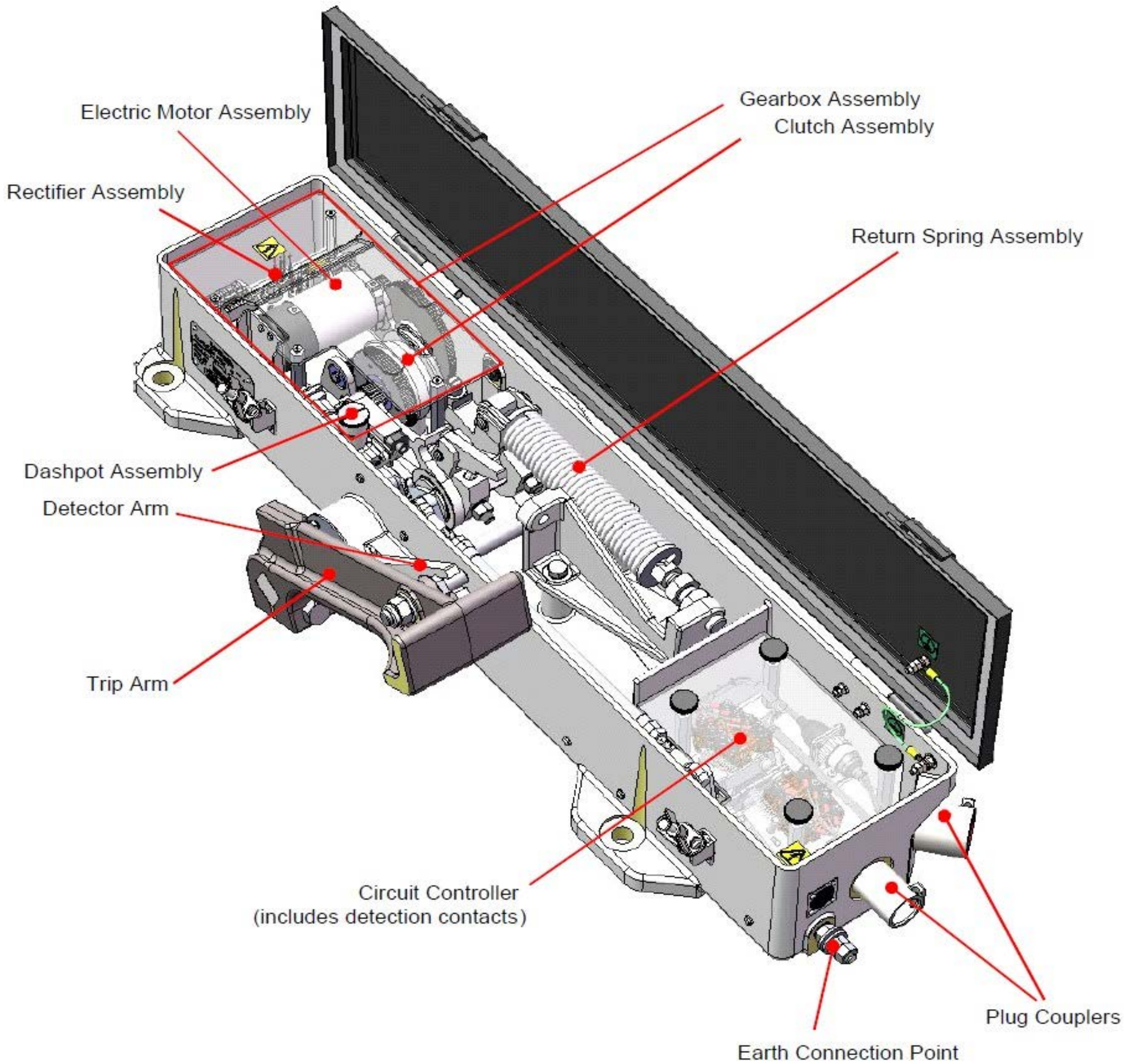


Figure 4 – JE Trainstop Main Assemblies

c) At Circuit Controller Switches (Figure 5), use a voltmeter to check for the presence of the detection voltage between Switch A terminals 3 and 7.

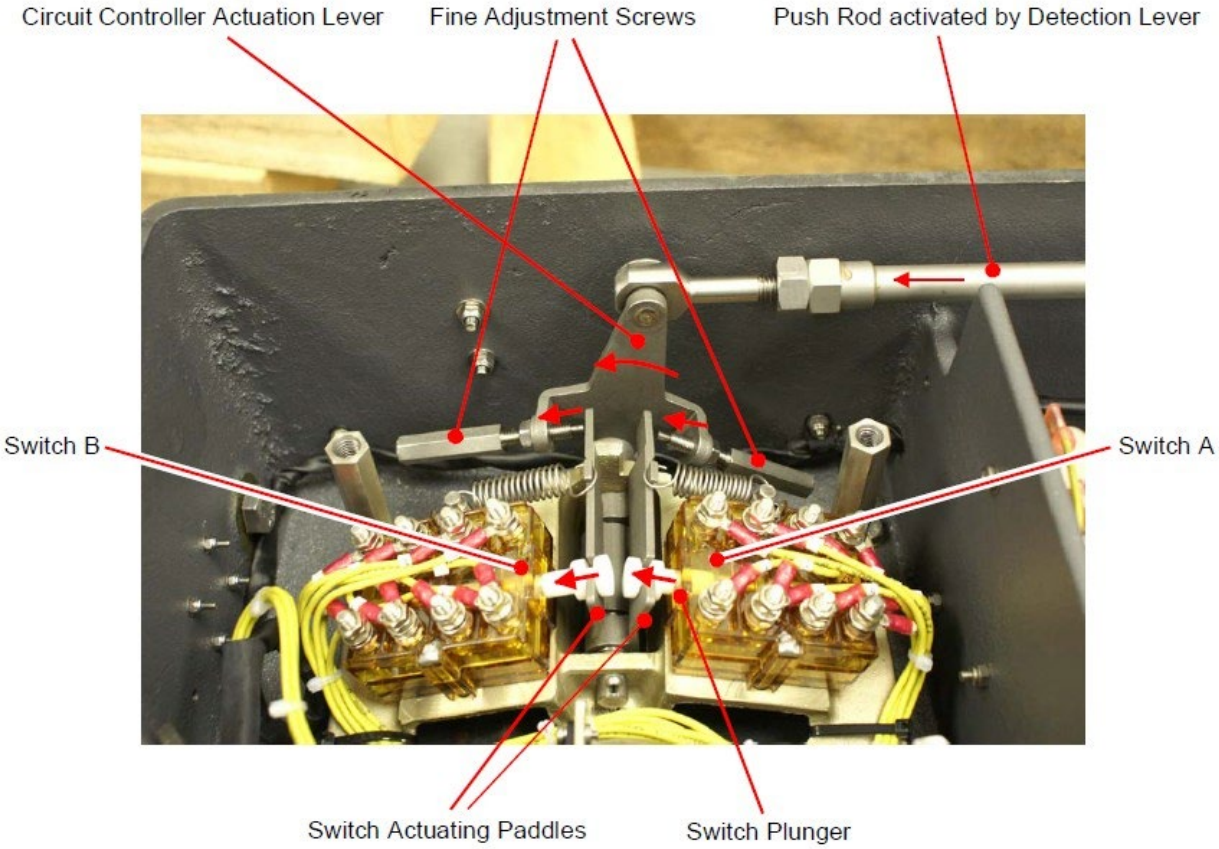


Figure 5 – Circuit Controller Detail
(shown with the Trip arm raised, with arrows indicating the direction of movement as the arm lowers)

d) If the detection voltage is present, keeping clear of the Trip Arm, isolate the supply from the Trainstop and disconnect the tail cables.

e) Check the detection contacts within the Trainstop by using a multimeter to check that continuity between the terminals of the Circuit Controller switches is as shown in Table 1 for the stated Trip Arm positions.

f) If the detection contacts are incorrect, replace the Trainstop.

g) If the detection voltage is not present, replace or repair the tail cables.

h) Re-fit the polycarbonate cover over the Circuit Controller.

i) If the detection check is satisfactory, or when the tail cables are repaired / replaced, re-connect the tail cables and re-connect the supply.

j) Request the Control Centre to operate the signal associated with the Trainstop and check for correct operation of the Trainstop.

k) Check the Trip Arm position corresponds with the associated stop signal.

l) Request the Signaller to alter the signal aspects and check the Trainstop operates correctly and that detection is correctly received at the Control Centre.

5.3 Possible cause – Fault within Trainstop.

a) Replace the Trainstop.

6. Circuit Controller Switches Detection Terminals

Trip Arm Position	Terminals	Switch A	Switch B
Raised	1-2	Open	Closed
	3-4	Closed	Open
	5-6	Open	Closed
	7-8	Closed	Open
Lowered	1-2	Closed	Open
	3-4	Open	Closed
	5-6	Closed	Open
	7-8	Open	Closed

Table 1 – Circuit Controller Switches Detection Terminals

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF23		
Faulting Guide: SmartIO resilient power supply sub-system		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	SmartIO Power Rack Systems
Excludes:	All other Power Rack Systems

1. SmartIO power rack fault indications

1.1 The SmartIO system has two methods of indicating faults in the resilient power supply systems located in the SmartIO housing; Alarms raised on the Support System (SSys) display, and visual indications (LEDs or flags) on the power supply sub-system devices located on the rack.

1.2 All incoming signalling supplies are monitored and protected by:

a) Supply availability monitors.

b) Surge arrestors.

c) MCBs.

d) Earth leakage detectors.

1.3 The supplies on the power rack are designed to be resilient such that failure of one incoming supply, or a single secondary supply device will not impact either the correct operation the SmartIO system, or the communication between the CIXL and the SmartIO.

2. Power rack resilient supplies block diagram

2.1 Double pole MCBs in the locations shown in Figure 1 are used to isolate supply devices before replacement and are test points for voltage measurements to confirm the correct operation of the power sub-system devices.

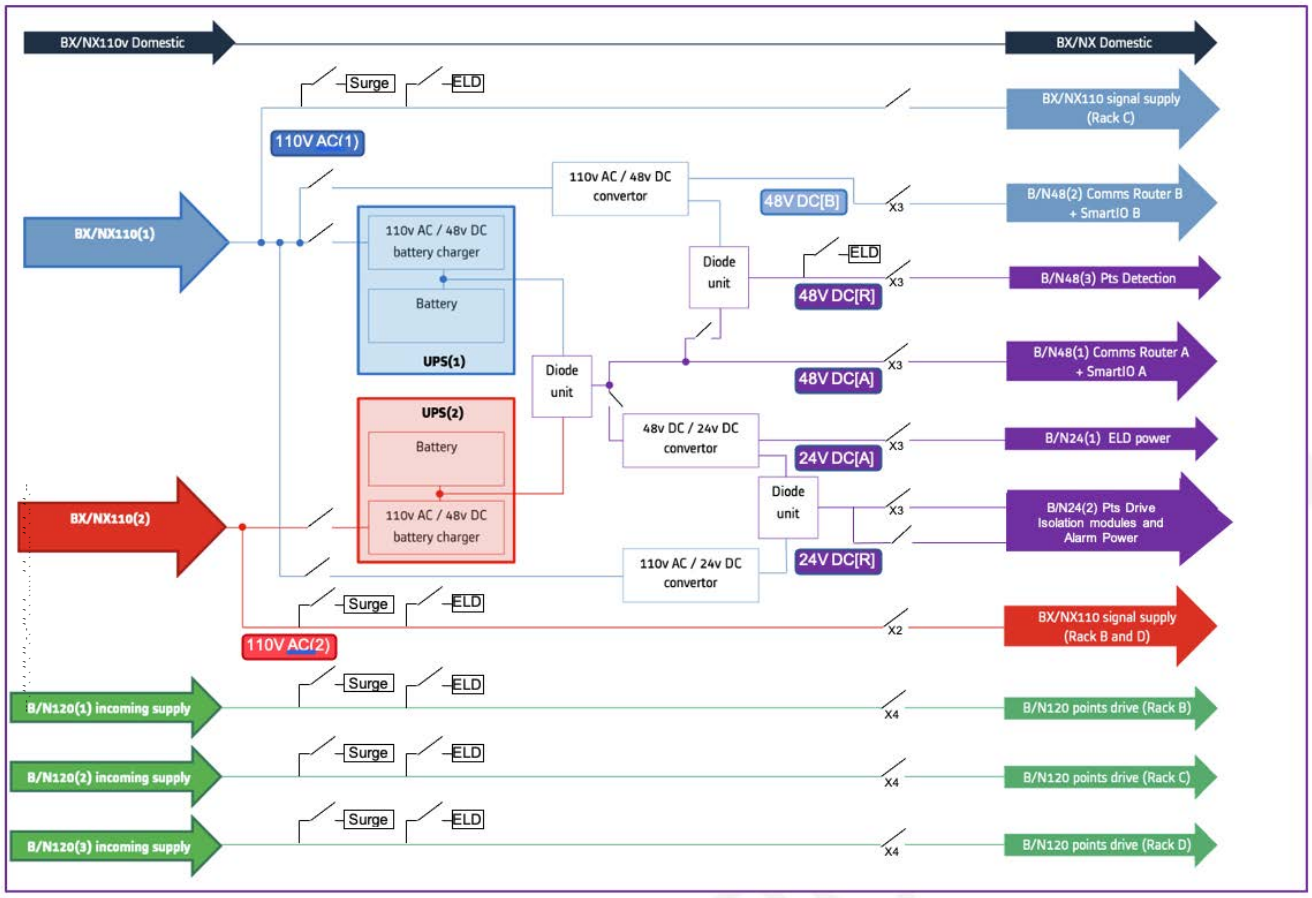


Figure 1 - SmartIO Power Rack block diagram

3. Support system fault reporting

3.1 The following faults are reported on the Support System display available in the SmartIO housing and in the Signalling Control Centre.

3.2 Where alerts are indicated as non-critical, they do not immediately impact the running of trains, however they indicate faults which shall be attended to with high priority before a subsequent failure does impact train operation.

Description and status	Likely Cause	Potential impact
110V AC (1) FAULT (Critical) *	Loss of incoming 110V FSP supply	**Signal aspects and train protection circuits connected to rack B unpowered.**
110V AC (2) FAULT (Critical) *	Loss of incoming 110V FSP supply	**Signal aspects and train protection circuits connected to racks C, D unpowered.**
120V SUPPLY 1 FAULT (Critical) *	Loss of incoming 120V DC FSP supply	**Loss of movement of points attached to rack B.**
120V SUPPLY 2 FAULT (Critical) *	Loss of incoming 120V DC FSP supply	**Loss of movement of points attached to rack C.**
120V SUPPLY 3 FAULT (Critical) *	Loss of incoming 120V DC FSP supply	**Loss of movement of points attached to rack D.**
CRITICAL COMBINED ELD (Critical) *	One or more ELDs insulation resistance below second threshold <20kΩ	Unreliable operation or proving detection of assets connected to affected circuits(s)
AC/DC CONVERTER UPS FAULT (Non-critical) *	Loss of either incoming 110v AC input to either UPS	No immediate impact due to resilient supply design.
48V UPS BATTERY FAULT (Non-critical) *	UPS indicates battery health is failing	No immediate impact due to resilient supply design.
110V-24V CONVERTER FAULT (Non-critical) *	Loss of, or out of spec, DC output (<90% of target voltage)	No immediate impact due to resilient supply design.
110V-48V CONVERTER FAULT (Non-critical) *	Loss of, or out of spec, DC output (<90% of target voltage)	No immediate impact due to resilient supply design.
48V-24V CONVERTER FAULT (Non-critical) *	Loss of or out of spec, DC output	No immediate impact due to resilient supply design.
110V AC SURGE PROTECTION FAULT (Warning) *	Either 110V surge protectors in critical alert state	No immediate impact, expired device requires replacement.
120V SURGE PROTECTION FAULT (Warning) *	Any 120V DC surge protectors in critical alert state	No immediate impact, expired device requires replacement.
EARTH LEAKAGE 110V (1) (Warning)	Insulation fault resistance below first threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.
EARTH LEAKAGE 110V (2) (Warning)	Insulation fault resistance below first threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.

Description and status	Likely Cause	Potential impact
EARTH LEAKAGE 120V (3) (Warning)	Insulation fault resistance below upper threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.
EARTH LEAKAGE 120V (2) (Warning)	Insulation fault resistance below upper threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.
EARTH LEAKAGE 120V (1) (Warning)	Insulation fault resistance below upper threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.
EARTH LEAKAGE 48V (Warning)	Insulation fault resistance below upper threshold (<200kΩ)	No immediate impact affected circuit shall be checked, and fault rectified.
110V DOMESTIC SUPPLY FAULT (Warning) *	Status of incoming 110V domestic supply	No impact on operation, loss of power for lighting, forced ventilation and Support System Client Terminal.
DOOR OPEN (Warning) *	SmartIO Housing door is open	No impact on operation, security issue.
LOW TEMPERATURE (Warning)	Temperature is above lower threshold (>40^{0}C)	No impact on operation, diagnostic message.
HIGH TEMPERATURE (Non-Critical)	Temperature is above upper threshold (>50^{0}C)	Potential impact on reliability of operation if condition is prolonged and not rectified.
FORCED AIR VENT FAULT (Warning) *	Failure of ventilation system. Refer to local building and equipment housing maintenance procedures.	Potential impact on reliability of operation if coupled with alarm 23 for prolonged period.
* Multiple simultaneous indication of these alarms	This indicates a failure of the 24V Alarms feed which will trigger multiple alarms	**Multiple error messages on Support System HMI and signallers console.**

Table 1 – Fault Indications and Possible Causes

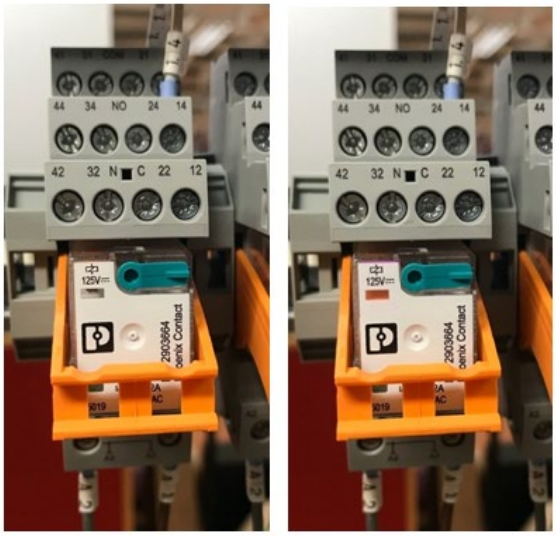
4. Failure of surge arrestors

4.1 Surge arrestors are a consumable item, they shall be replaced when they have been overloaded. The visual indication of failure is shown in Figure 2.

Figure 2 - Visual indication of an operational (green), and a blown Surge protector (red).

5. Failure of incoming supply

5.1 The availability of the incoming 110V AC and 120V DC signalling supplies from the FSP is indicated on the supply monitors shown in Figures 3 and 4.



Supply off Supply on

Figure 3 - 120V DC supply monitor relay

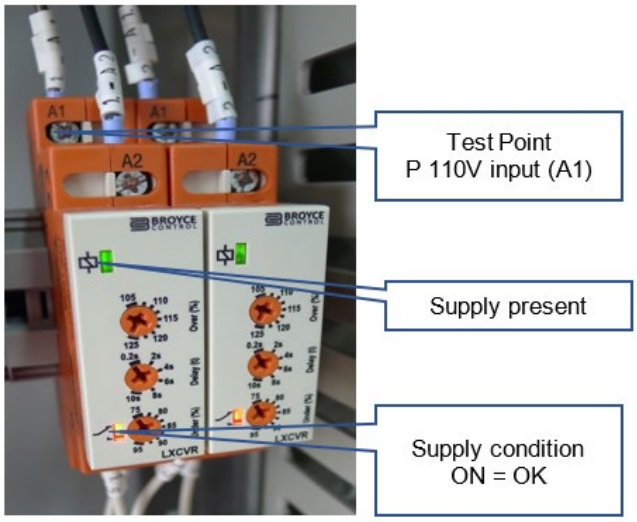


Figure 4 - 110V AC Supply monitor

5.2 If failure of an incoming supply is indicated, the supply shall be checked by measurement of the voltage at the input to the supply isolation switch as shown here in Figure 5.

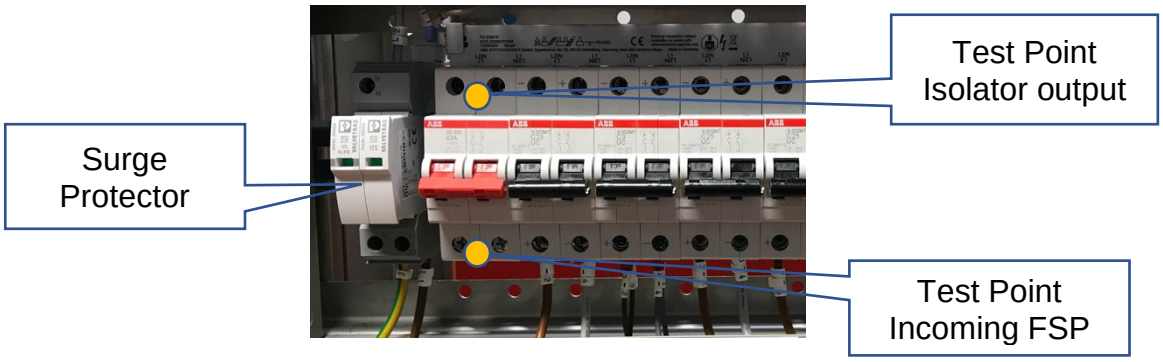


Figure 5 - Incoming supply isolation test point 110VAC and 120V DC

5.3 Failure of the incoming supply shall be reported to the SM(S).

6. Failure indication, Earth Leakage Detection

6.1 Earth leakage detection indicates a fault in a circuit which ultimately feeds trackside cables. When a critical earth leakage detection is indicated, a correlated non-critical indication occurs to identify the faulty circuit. To confirm that the fault is in the trackside cable, trackside cables can be isolated by opening the outgoing fuses on the SmartIO Object Controller rack.

6.2 Earth leakage faults in trackside cabling shall be investigated using established trackside cable fault finding processes.

6.3 If the fault is not in the trackside circuit, an earth leakage fault is indicated within the SmartIO system racks, the fault can be traced by opening MCBs and fuse holders indicated on the site-specific drawings to progressively isolate the SmartIO sub systems.

6.4 The correct operation of each earth leakage detector may be checked by operating the self-test function, press and hold the test button for longer than 1.5 seconds. During this test, internal functional faults, or connection faults are determined and appear in form of an error code on the display:

a) E01 = PE connection fault, no low-resistance connection between E and KE.

b) E02 = system connection fault, no low-resistance connection between L1 and L2.

c) E03...Exx = internal device error.

6.5 The alarm relays are checked during this test, an audible click should be heard from the relays.

7. Failure of AC-DC and DC-DC converters and UPSs

(Excluding 48V-24V DC-DC converter).

7.1 The front panels of the voltage converters and UPSs show a green indicator of correct operation as shown here in Figures 6 and 7.

7.2 The presence of the output supply from each converter can also be confirmed by voltage measurement at the next downstream device which is either an MCB or one of the three Y-Diode networks.

Figure 6 - AC-DC converters showing DC OK indication

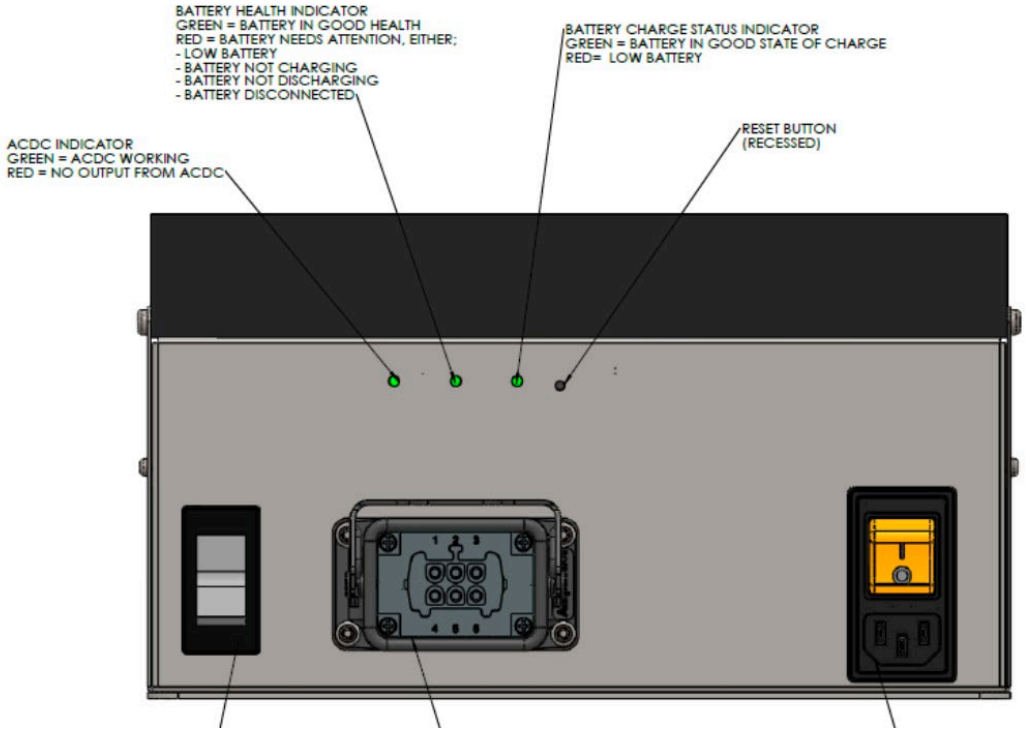


Figure 7 - UPS with indication of correct operation

8. Failure of MCBs

8.1 Open circuit failure of MCBs can be confirm by measurement of the voltages present on the input and output side of the device.

8.2 Incorrect tripping of MCBs can be confirmed by isolating the output side of the MCB. If isolating the output side clears the fault, then the output side wires shall be reconnected, and the downstream devices disconnected. Tripping of the MCB after disconnection of the downstream devices indicates a fault in the rack wiring which requires escalation to 2nd line maintenance.

8.3 If the MCB tripping has been cleared by disconnection of the downstream devices, each device may be reconnected in turn until the faulty device is identified.

9. Failure of the 48V-24V DC-DC converter

9.1 No indications are available on the device. Failure may be indicated in the Support System alarms. Failure of this converter can be verified by checking if the 24V feed has been lost on the input side of the MCB that switches this supply to the Earth Leakage detectors.

10. Failure of Y-Diode Network

10.1 The Power rack sub-system includes three Y-Diode networks as shown in Figure 8. Each diode unit has at least one downstream MCB where the Diode network output voltage can be checked.

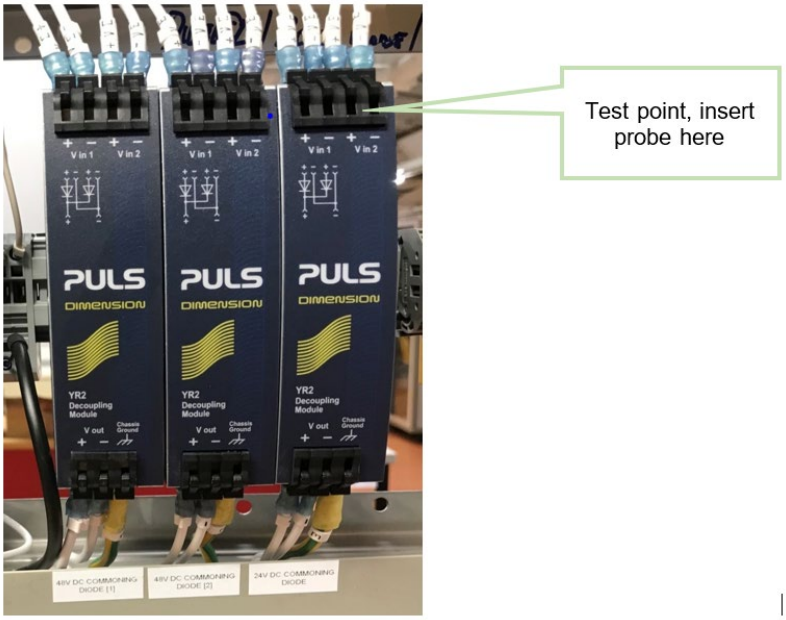


Figure 8 - Three Y-Diode networks showing a test point

10.2 If the output voltage is not present when either of the inputs is present the unit is faulty.

11. Failure of inter-rack cables

11.1 Cable damage which has resulted in short, open circuit or earth leakage fault on inter-rack cables is identified by checking the test points, alarms and indicators described here.

110V AC Signalling feeds

11.2 Test points on the incoming fuses to the SmartIO Object Controller racks can be used to check for the incoming 110V Signalling supply. Open circuit failure (or loss) of this supply is indicated by Support System alarms and the PW_TRK indication is switched off on the affected SmartIO SM module front panel.

11.3 Short circuits and earth leakage faults are detected by the MCB, or ELD display respectively.

120V DC Point drive feeds

11.4 Open circuit failure (or loss) of the 120V DC supply is indicated by Support System alarms when the points are driven. The error is indicated on the Support System, also the PW_TRK LED is switched off on the affected Smart IO PM module front panel when and after an attempt has been made to drive the point.

11.5 Short circuits and earth leakage are detected by the MCB tripping, or ELD display respectively when the points are driven.

11.6 The following 24V and 48V circuits are combined in a single cable between racks if faulty, the entire cable is replaced.

48V DC point detection feed

a) Test points on the incoming fuses to the SmartIO Object Controller racks can be used to check for the incoming 48V Point detection supply. Open circuit failure (or loss) of this supply is indicated by Support System alarms, also the PPM LED is switched off on the affected Smart IO PM module front panel.

b) Short circuits and earth leakage are indicated by the MCB tripping, or the ELD display respectively.

24V DC Point Drive Isolation Module (PDIM) supply

c) Test points on the incoming fuses to the SmartIO Object Controller racks can be used to check for the incoming 24V PDIM supply. Open circuit failure (or loss) of this supply is detected when the SmartIO PM module is commanded to drive the points. Open circuit failure of the supply is indicated by Support System alarms, also the PMC LED is switched off on the front panel of the affected Smart IO PM module when and after an attempt has been made to drive the point.

d) Short circuits and earth leakage are indicated by the MCB tripping, or the ELD display respectively.

48V DC supplies to Smart IO (and Network switch – rack B only)

e) Test points on the incoming fuses to the SmartIO Object Controller racks can be used to check for both of the incoming 48V SmartIO supplies. If either supply is not present, the “Vin OK” indication is switched off on the front panel of the affected SmartIO PS module.

f) Short circuits are indicated by the MCB tripping on the affected circuit. There is no ELD monitoring on these two 48V supplies to the SmartIO as they do not feed trackside circuits.

11.7 Damaged or faulty inter rack cables shall be replaced.

END

Contents

1. System Monitoring and Fault Identification

The ARAMIS Traffic Management system is deployed with a monitoring system which is based on the Nagios application.

This provides the maintainers primary system status overview and eliminates most of the requirements to attend a piece of equipment to determine its status.

Detailed information on the Nagios Monitoring system including the pertinent alerts can be found in the “Network Rail Traffic Management System Monitoring Solution SSD” document issued by Thales, reference 0001-0034989599.

1.1 WIKI

In order to enable users to understand the system, and to minimise the amount of training required a number of wiki articles are provided with the solution to reduce the amount of information that has to be remembered by the maintainers.

The WIKI is accessed by clicking the ‘document’ icon next to the relevant item on the Nagios screen. See circled area of Figure 1.

It should be noted that not all items have What I Know Is (WIKI) articles produced. In these cases, a blank screen is accessed.

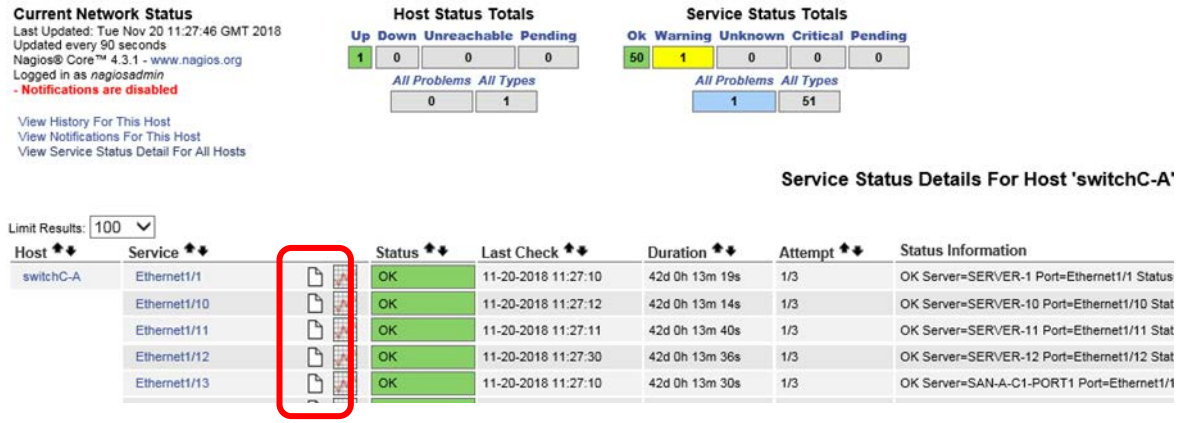


Figure 1 - Nagios screen with the link to WIKI entry circled

1.2 Alerts

Nagios is not an alarm management application. It is a status monitoring tool that raises alerts to indicate where a status has exceeded a defined threshold. Alerts are broken down into a number of sections:

Hardware

- Maintenance Switches.
- ARAMIS Client Machines.
- Core Servers.
- Maintenance Servers.
- Core Switches.
- Storage Area Network.
- Firewalls.
- Other switches.

Software

- Oracle Real Application Clusters (RAC) Storage.
- Oracle RAC Processing Nodes.
- ARAMIS Client Software.
- Application Virtual Machines.
- ESX Core.

A number of services and application level components are monitored for each of the above groups. Alerts fall into one of the categories detailed in Table 1:

State	Colour	Description
OK | UP	Green	All services are ok, and the item is functioning correctly.
WARNING	Yellow	The item being monitored is running but has breached a pre-determined tolerance.
FLAPPING	Blue	The item being monitored has changed status a number of times in a short period of time.
UNKNOWN	Orange	It was not possible to determine the state of the item being monitored. This usually indicates a failed state, or an item that is about to enter a failed state.
DOWN	Red	Unable to get a response from the remote item.
CRITICAL	Red	Unable to get a response from the remote item for a prolonged period.
UNREACHABLE	Grey	The monitoring solution is unable to reach the endpoint. This is usually in combination with other errors relating to networking or other hardware failure.
PENDING	Grey	The item is due for checking and is currently waiting in a queue for analysis. This is an unusual state and usually only occurs when a number of other faults are present on the system which increases the workload on the monitoring solution.

Table 1 - Categories

1.3 Alert Thresholds

The monitoring solution utilises generic alarm thresholds across all the hardware being monitored, detailed in Table 2.

Item	Warning Threshold	Critical Threshold
Disk Free	80% Utilised	90% Utilised
Memory Free	80% Utilised	90% Utilised
CPU Utilisation	80% Utilised	90% Utilised
SWAP Utilisation	>0% Utilised	25% Utilised

Table 2 - Thresholds

Remaining alerts have been set to manufacturers default settings.

1.4 Monitoring System Menu

The Nagios Monitoring System provides a comprehensive status monitoring tool. Figure 2 shows the Nagios menu which can be found at the right-hand side of all Nagios pages.

The two circled view options provide overviews for the Network Rail maintenance tasks.

These views are:

- Host Groups.
- Host Groups Summary.

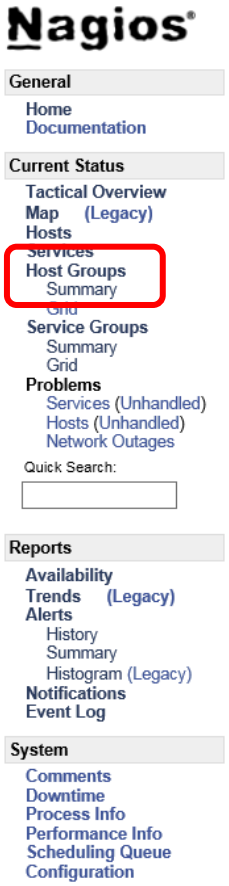


Figure 2 – Nagios Menu

1.5 Host Groups Summary Screen

The Host Groups Summary screen provides a clear, concise dashboard overview of the status of system components. This view is useful for a snapshot overview and is ideal to be left permanently displayed for a quick reference.

Figure 3 shows the host groups summary screen with the locations of the system hardware components identified.

A host group is a group of similar system components. For example, there are two Nexus switches deployed as core switches.

Figure 3 - Host Groups Summary Screen

The host status summary details the total number of components of a particular type that are up and also the number that are down.

The service status summary column provides an overview of the status of monitored parameters across an entire host group and an indication of the number and severity of alerts.

This overview screen can be used to identify the emergence of issues and guide the maintainer where to look next to obtain more detailed status information. As with all screens, most items are hyperlinks to navigate to a more detailed view.

Clicking on the host group name, e.g. NEXUS Switches, provides a status view for each individual component in a particular host group.

Details of these views are in the next section of this document.

Clicking on the coloured boxes provides a list of all alerts of the chosen severity within the host group.

Figure 4 - Top of Page Summary

Figure 4 shows the high-level system summary screen that is found at the top of every page.

This also provides a quick reference snapshot to determine if there are any issues with the system the maintainer needs to address.

1.6 Host Groups Screen

The Host Groups screen expands on the Host Groups Summary by displaying the high-level status of each individual component rather than an aggregated view per component type. The groupings tie in with the headings on the summary screen.

It should be noted that a piece of equipment can be repeated in multiple groupings.

For example, a client PC appears in both the client PC grouping and the Dell Agent Free servers grouping.

Figures 5 and 6 show the Host Groups screens. The primary hardware LRUs are identified by the red pointers.

Figure 5 – Host Groups Screen 1

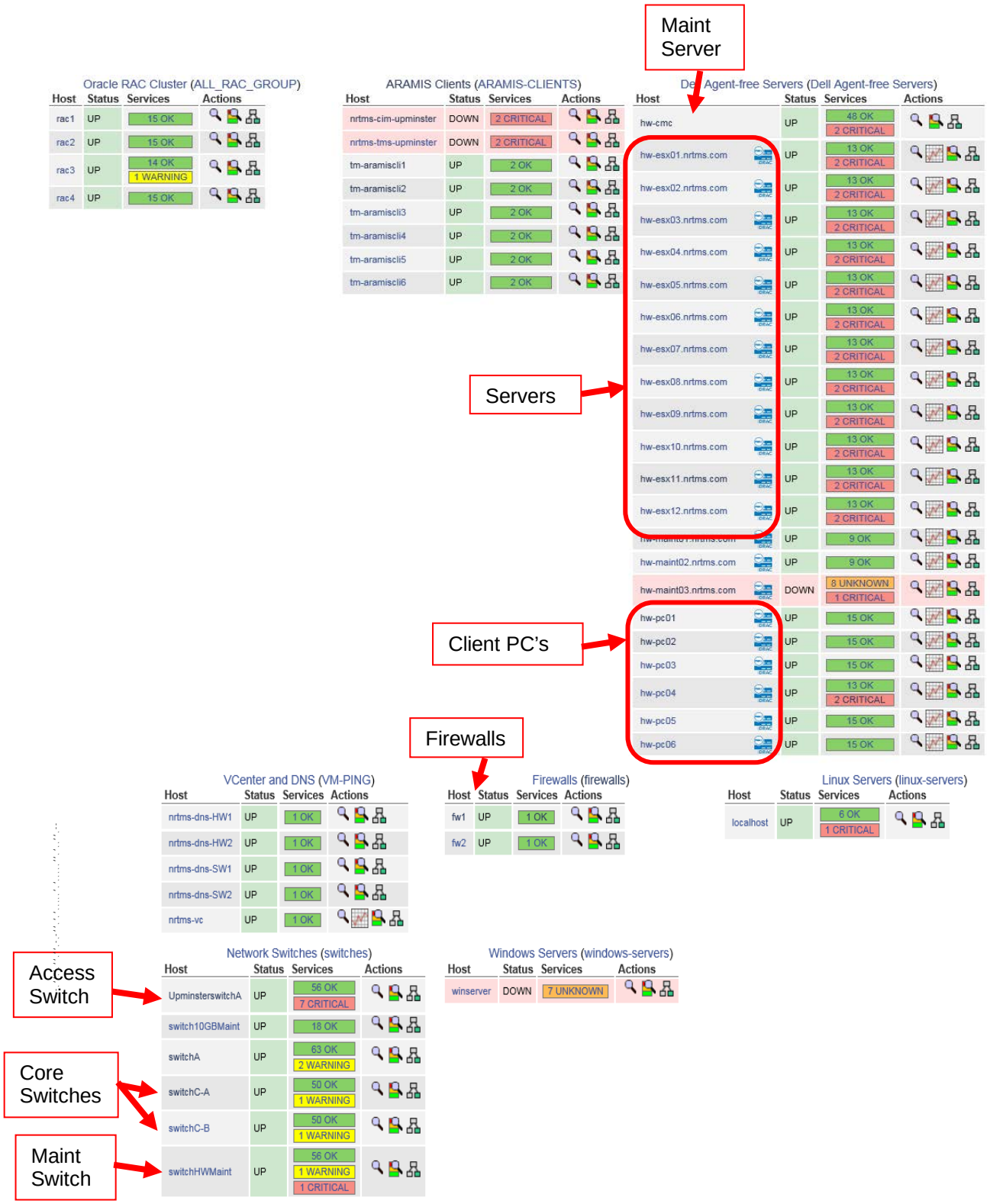


Figure 6 – Host Groups Screen 2

1.7 Fault Identification

The overview screens described above allow the maintainer to have an understanding of system status.

More detailed information can be found by navigating, using the hyper link component name, to the more detailed status screen for a particular component.

The remainder of this section describes the corrective maintenance procedures that the Network Rail Maintainer can undertake for each component.

Each section includes an overview of how the monitoring system and hardware status indications can be used to identify faults.

For all components with faults that are outside of the Network Rail maintainers scope of responsibility a call should be logged with the Thales Service Centre providing a full description of the incident that requires further investigation.

1.8 Wider Traffic Management Systems

The Nagios Monitoring System has been implemented to cover the ARAMIS software components and infrastructure.

Although Nagios does not monitor the wider systems that form the integrated Traffic Management System, it can provide some useful information that aids the maintainer in understanding the location of faults in these wider systems.

<u>Some issues with NRT equipment and services result in alerts on the Nagios system:</u>

- The failure of the NRT firewall produces a loss of signal alert on the associated ARAMIS firewall port. Alerts are also raised as a result of the loss of the NTP reference.
- Failures in message transfers to and from LINX as a result of the loss of NRT services could produce alerts from the ARAMIS TIL VMs.

<u>Some issues with LINX result in alerts on the Nagios system:</u>

- The failure of a LINX ROC Gateway could result in alerts from the ARAMIS TIL VMs.
- The failure of a LINX ROC FTP server could result in alerts from the ARAMIS TIL VMs.
- The failure of a message flow from LINX could result in alerts from the ARAMIS TIL VMs. These failures could be for missing expected messages or messages that have failed validation by ARAMIS.

Figure 7 shows the location of the ARAMIS TIL VMs on the Nagios host groups screen.

This is where alerts are shown that might relate to failures of other aspects of the integrated Traffic Management System.

Clicking on the VM name shows more detail for that particular VM.

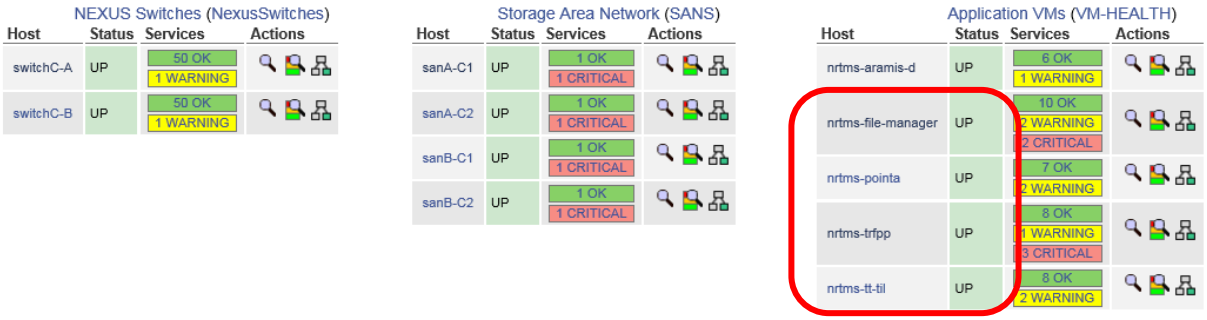


Figure 7 – The Location of ARAMIS TIL VMs on Host Groups Screen

2. Client PC

2.1 Monitoring System

An overview of the status of the client PCs can be viewed on the Host Groups screen on the monitoring system.

Figure 8 displays as section Host Groups Screen which contains the location of the Client PCs where the status of each is summarised.

Where issues are indicated, the hyperlink for the individual Client PC name can be clicked to view more details for that particular device.

Figure 8 – The bottom right side of Host Groups Screen with the Client PC's indicated

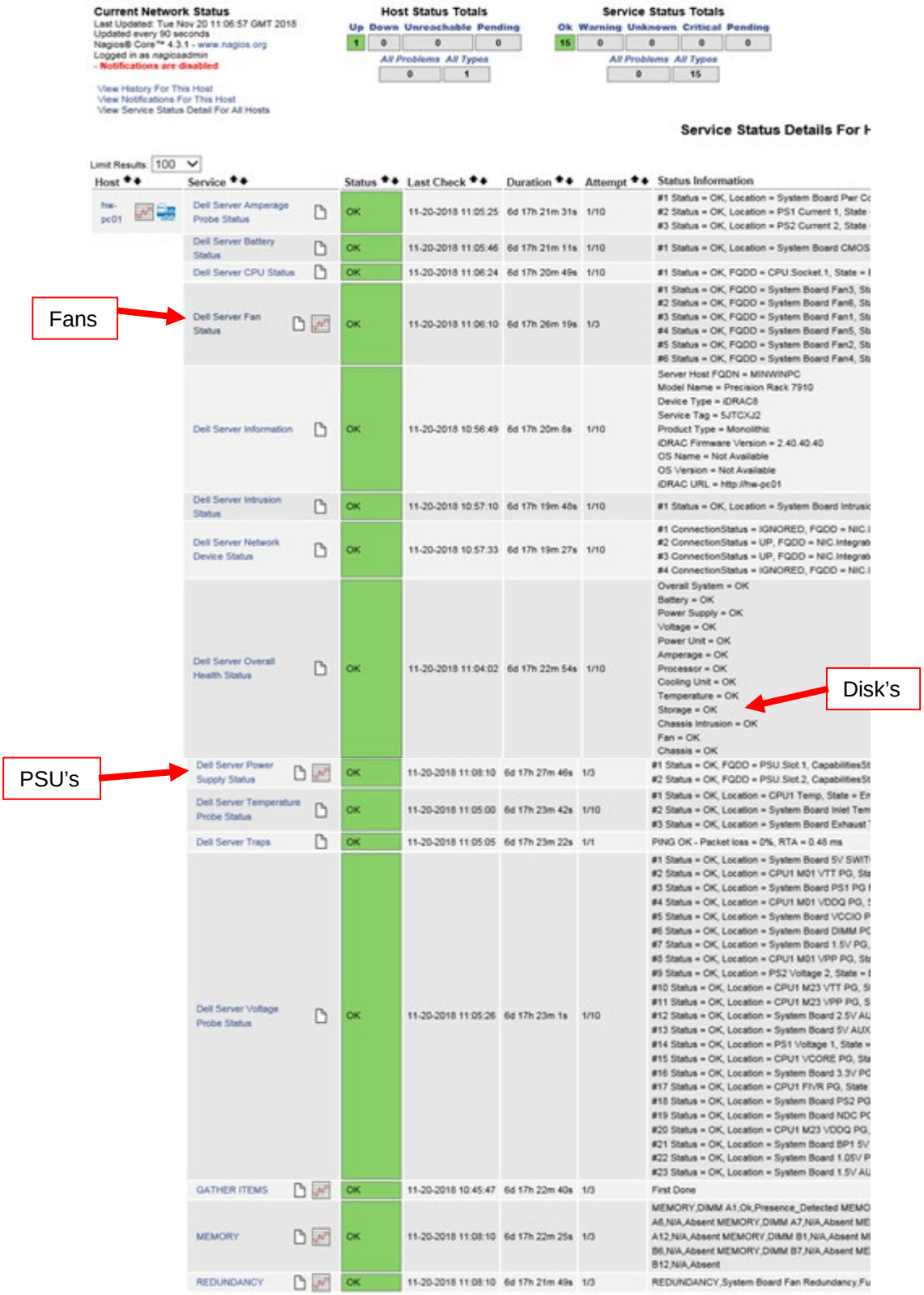


Figure 9 – A detailed view from the monitoring system for an individual Client PC.

The three secondary LRU types for which the Network Rail maintainer has responsibility for corrective maintenance are highlighted in this figure.

Any issues with the fans, disks (storage) and power supplies can be corrected by the Network Rail maintainer by following the maintenance instructions further in this section.

All other Client PC issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

3. Client PC - PSU

3.1 Hardware Indications

Indication	Meaning
Steady Green	PSU is operational.
Flashing Green	The firmware on the power supply unit is being updated
Flashs Green then turns Off	The PSU is mismatch with the other one (dual PSUs) and should be replaced.
Flashing Amber	There is a problem with the Power Supply Unit.
LED Blank	Indicates power is not connected.

Table 3 – Client PC – PSU Indications

3.2 Physical Faulting Procedure

a) Check that no loose connections exist, for example, loose power cables

b) Check that the power supply handle/LED indications to identify faulty PSU. If both PSU 1 & 2 are showing failure indications, then DO NOT PROCEED FURTHER and refer fault to Thales.

c) Verify that both the power supply units are of the same type and wattage

d) Check both power supply units have Extended Power Performance (EPP) label on the back

e) Disconnect the power cable from the back of the faulty PSU (access from the back of the cubicle) for a few seconds, and then reconnect again

f) Gently pull out the faulty PSU in part (so as to disconnect), and then reseat it back in again.

NOTE: *After re-seating the power supply unit, allow several seconds for the system to recognize the power supply unit and determine if it is working properly.*

g) Check the LED status indications on the hardware and also the status presented on the monitoring system to determine if the fault has been corrected.

h) The component should be replaced using the SMTH.

4. Client PC Fan

4.1 Hardware Indications

Indication	Meaning
Fan not turning	Fan Failed

Table 4 - Client PC Fan Indications

4.2 Physical Faulting Procedure

No specific LED indications present on the Client PC; a fault with a specific fan can be identified through item checking of the Client PC 'LCD Display', which display an amber backlight to indicate an error condition and give details of the faulty fan. The component should be replaced using the SMTH.

5. Client PC Hard Drive

5.1 Hardware Indications

Figure 10 – LED locations on the Hard Drive

LED	Status	Colour	Meaning
1	On	Green	Hard-drive activity
2	Off	N/A	Ready for insertion or removal of drive
2	On	Blue	hard drive identifying drive preparing for removal
2	Blinks	Green – Amber - Off	Predictive drive failure
2	Blinks	Amber 4 times per second	Drive failed
2	Blinks	Green slowly	Drive rebuilding
2	Blinks	Green slowly for 3 seconds then Amber for 3 seconds then off for 3 seconds	Re-build of the hard drive is aborted

Table 5 - Client PC Hard Drive Indications

5.2 Physical Faulting Procedure

a) A failed Client PC Hard Disk should be confirmed by observing the status LEDs. If both drives are showing failure indications, then DO NOT PROCEED and refer fault to Thales.

b) Eject and gently pull out in part the faulty drive (to disconnect), and then reseat it back in again. NOTE: After re-seating the disk, allow several seconds for the system to recognize the hard drive and determine if it is working properly

c) The component should be replaced using the SMTH.

6. Firewall

6.1 Monitoring System

An overview of the status of the Firewalls can be viewed on the Host Groups screen on the monitoring system. Figure 11 identifies the location of the Firewalls on the Host Groups screen where the status of each is summarised.

Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

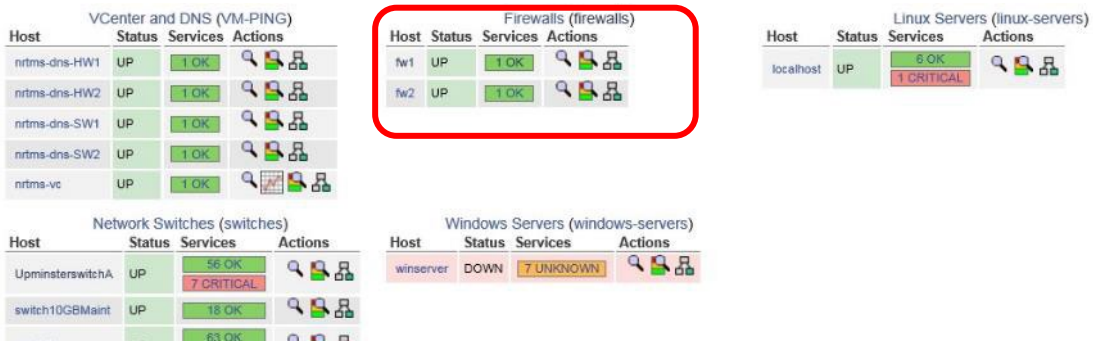


Figure 11 - Firewalls on the Host Groups screen

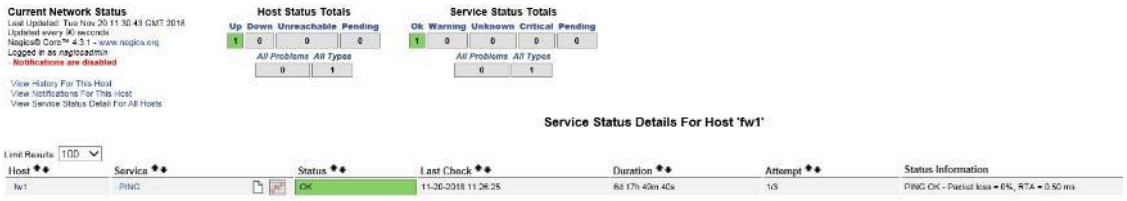


Figure 12 – A detailed view from the monitoring system for an individual Firewall

Any issues with the combined fan and power supply units and disks can be corrected by the Network Rail maintainer.

All other Firewall issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

6.2 Hardware Indications

The firewalls have a group of status lights that are repeated on the front and back of the chassis.

These show green indications for healthy and red indications for unhealthy status of the firewall subsystems.

There are LEDs for the two PSUs and the two disk drives.

The hot swappable power supplies also contain status indications utilising the same green and red scheme.

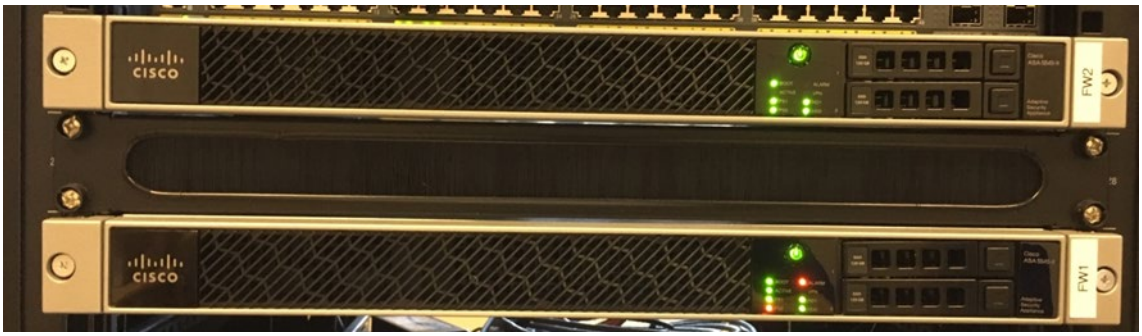


Figure 13 - Status Lights on Front of Firewall

6.3 Monitoring System

An overview of the status of the Firewalls can be viewed on the Host Groups screen on the monitoring system.

Figure 14 identifies the location of the Firewalls on the Host Groups screen where the status of each is summarised.

Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

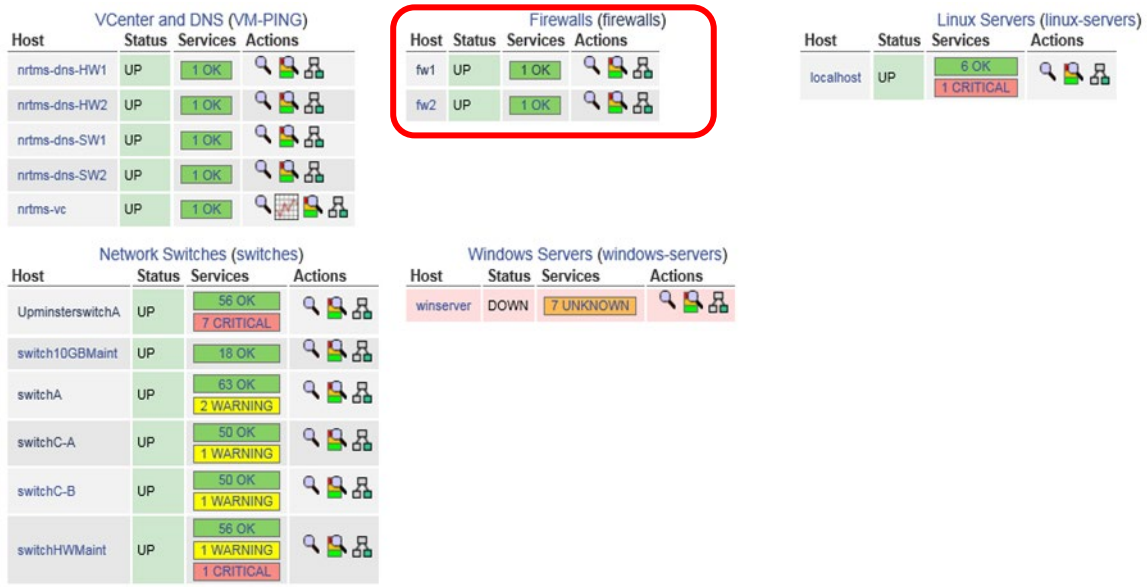


Figure 14 – Firewalls ringed in red on the Host Groups Screen

Figure 15 – A Detailed View from the Monitoring System for an Individual Firewall.

Any issues with the combined fan and power supply units and disks can be corrected by the Network Rail maintainer.

All other **Firewall** issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

7. Core Switch

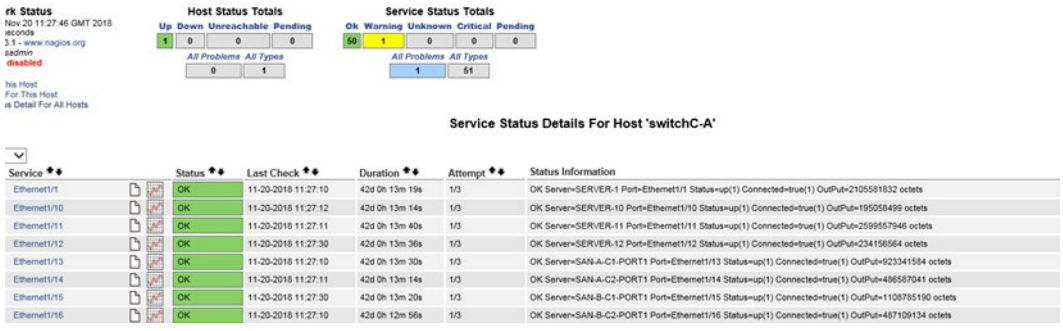
7.1 Monitoring System

An overview of the status of the Core Switches can be viewed on the Host Groups screen on the monitoring system.

Figure 6 identifies the location of the Core Switches on the Host Groups screen where the status of each is summarised.

Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

Figure 16 – Core Switches ringed in red on the Host Groups Screen



A number of lines have been removed from this screenshot for illustration purposes.

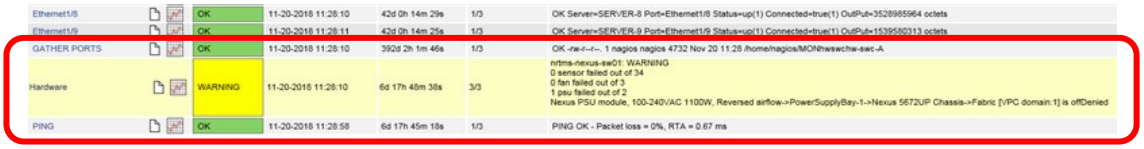


Figure 17 – A detailed view from the monitoring system for an individual Core Switch showing the status of the PSU and fan components.

Any issues with the power supply units and fans can be corrected by the Network Rail maintainer.

All other **Core Switch** issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

8. ARAMIS Server

8.1 Monitoring System

An overview of the status of the Application Servers can be viewed on the Host Groups screen on the monitoring system.

Figure 18 identifies the location of the Severs on the Host Groups screen where the status of each is summarised. Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

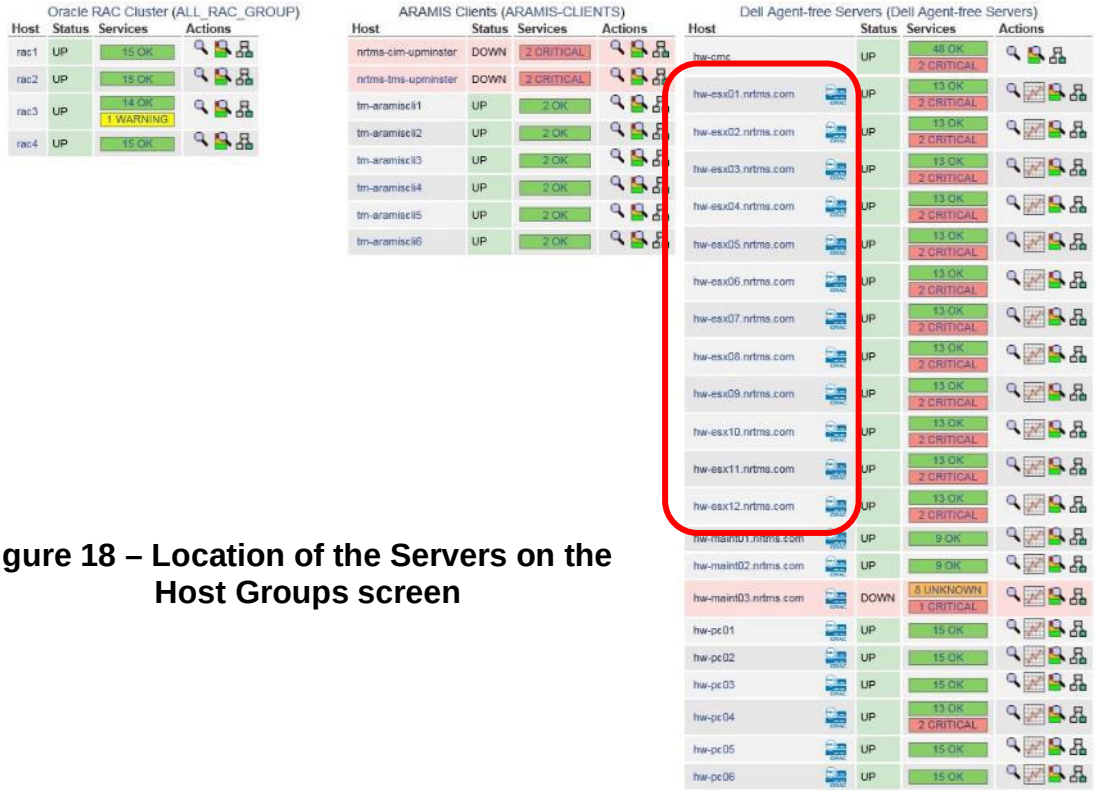


Figure 18 – Location of the Servers on the Host Groups screen

Figure 19 shows a detailed view from the monitoring system for an individual Server.

The locations of the status information for the components under the responsibility of the Network Rail Maintainer (PSUs, fans, disks) are indicated.

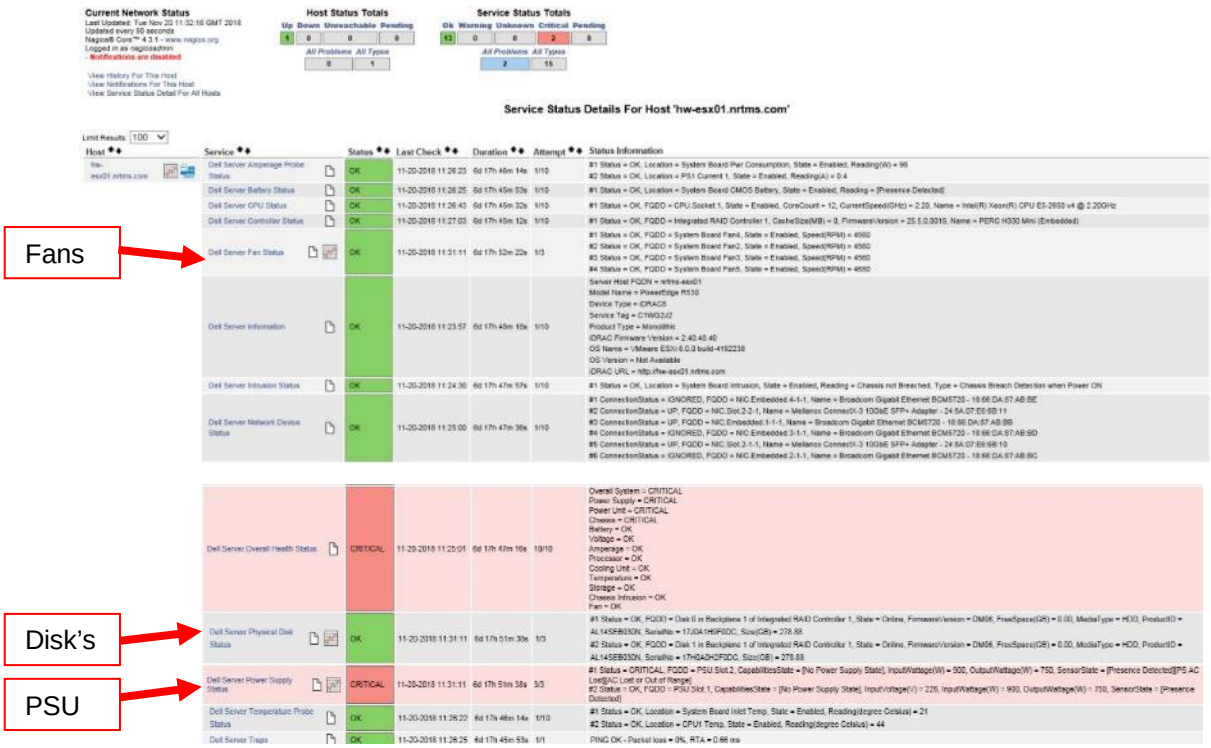


Figure 19 – Server Monitoring

Any issues with the fans, power supply units and disks can be corrected by the Network Rail maintainer.

All other Server issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

8.2 Hardware Indications

The physical servers also present a limited number of status LEDs that give an indication of system health.

A = Steady GREEN indicates a valid power source is connected to the Power Supply Unit and that the Power Supply Unit is operational

B = Flashing GREEN indicates the firmware on the power supply unit is being updated

C = Flashing Green & Turns Off indicates this power supply unit is mismatch with the other one (dual PSUs) in terms of efficiency, feature, health and voltage), hence should be replaced

D = Flashing AMBER indicates a problem with the Power Supply Unit

E = Indicates power is not connected.

Figure 20 - Server – PSU Indications

LED	Status	Colour	Meaning
1	On	Green	Hard-drive activity
2	Off	N/A	Ready for insertion or removal of drive
2	On	Blue	hard drive identifying drive preparing for removal
2	Blinks	Green – Amber - Off	Predictive drive failure
2	Blinks	Amber 4 times per second	Drive failed
2	Blinks	Green slowly	Drive rebuilding
2	Blinks	Green slowly for 3 seconds then Amber for 3 seconds then off for 3 seconds	Re-build of the hard drive is aborted

Table 6 - Server Hard Drive (RAID) Indications

9. Server - PSU

9.1 Physical Faulting Procedure

The following faulting procedure should be followed when attending the Server prior to undertaking any component replacement.

a) Check that no loose connections exist, for example, loose power cables.

b) Check that the power supply handle/LED indications to identify faulty PSU. If both PSU 1 & 2 are showing failure indications, then DO NOT PROCEED FURTHER and refer fault to Thales.

c) Verify that both the power supply units are of the same type and wattage.

d) Verify both power supply units have Extended Power Performance (EPP) label on the back.

e) Disconnect the power cable from the back of the faulty PSU (access from the back of the cubicle) for a few seconds, and then reconnect again.

f) Gently pull out the faulty PSU gently in part (so as to disconnect), and then reseat it back in again.

NOTE: After re-seating the power supply unit, allow several seconds for the system to recognize the power supply unit and determine if it is working properly.

g) Check the LED status indications on the hardware and also the status presented on the monitoring system to determine if the fault has been corrected.

h) If the problem persists undertake the component replacement using SMTH.

10. Server – Fan

10.1 Physical Faulting Procedure

Replace on Failure.

11. Server - Hard Disk

11.1 Physical Faulting Procedure.

Replace on Failure.

12. Access Switch

12.1 Monitoring System

An overview of the status of the Access Switches can be viewed on the Host Groups screen on the monitoring system.

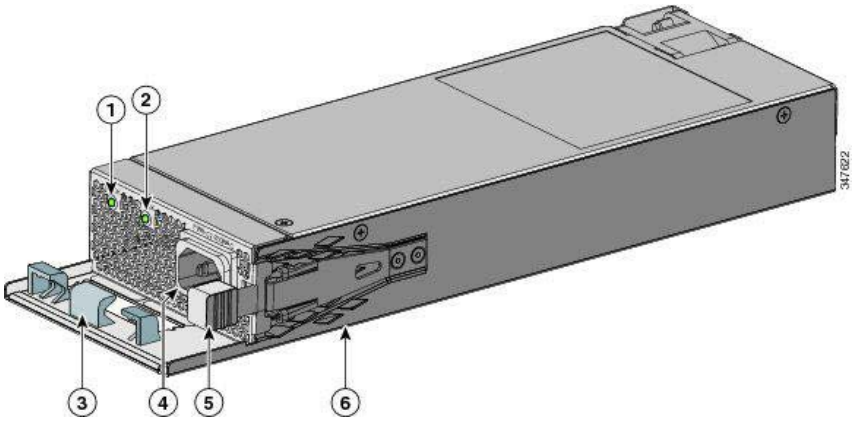
Figure 21 - Location of the Access Switches on the Host Groups screen where the status is summarised

It should be noted that although there are two physical switches they are configured as a resilient pair and as such appear as a single entity on the monitoring system.

Where issues are indicated, the hyperlink name can be clicked to view more details for the switches.

13. Access Switch – PSU

13.1 Hardware Indications



No	Description	No	Description
1	AC OK LED	4	AC power cord connector
2	PS OK LED	5	Release latch
3	AC power cord retainer	6	Power supply

LED Illumination Meanings			
AC OK LED	Description	PS OK LED	Description
Extinguished (off)	No AC input power.	Off	Output is disabled, or input is outside operating range.
Green	AC input power is present.	Green	Power output to switch.
		Red	Output has failed.

Figure 22 - Access Switch – PSU (including indications)

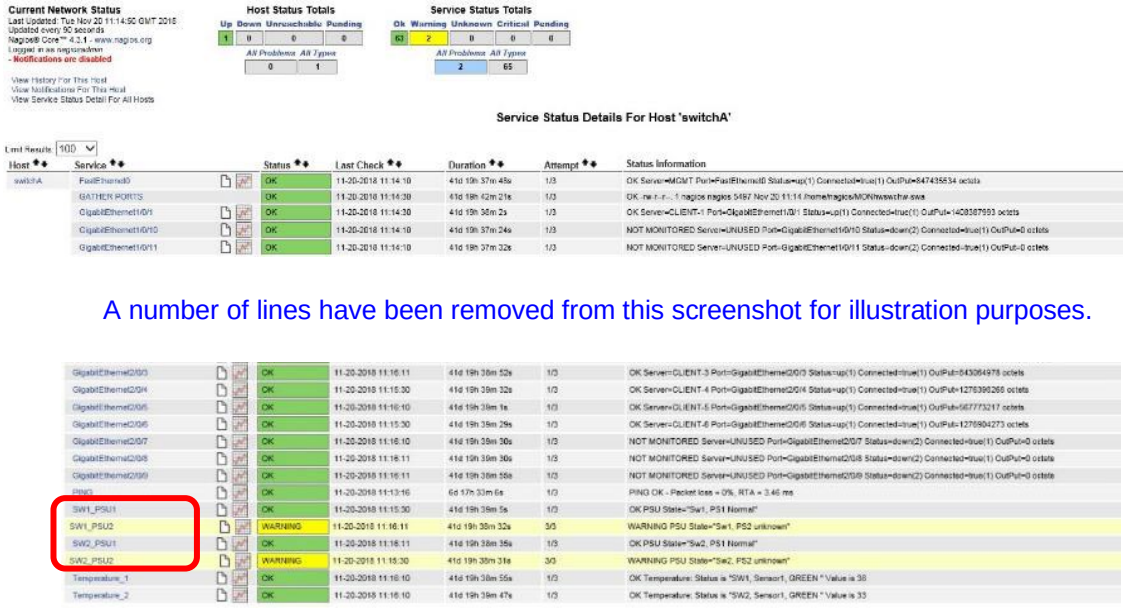
13.2 Monitoring System

The location of the status of the PSU that the Network Rail maintainer has the responsibility to undertake corrective maintenance for, is highlighted.

Four PSUs are displayed, two for Switch 1 and two for Switch 2.

Any issues with the power supply units can be corrected by the Network Rail maintainer.

All other Access Switch issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.



A number of lines have been removed from this screenshot for illustration purposes.

Figure 23 – A detailed view from the monitoring system for the Access Switches.

14. Maintenance Switch

14.1 Monitoring System

An overview of the status of the Maintenance Switch can be viewed on the Host Groups screen on the monitoring system.

Figure 24 identifies the location of the Maintenance Switch on the Host Groups screen where the status is summarised.

Where issues are indicated, the hyperlink name can be clicked to view more details for the switch.

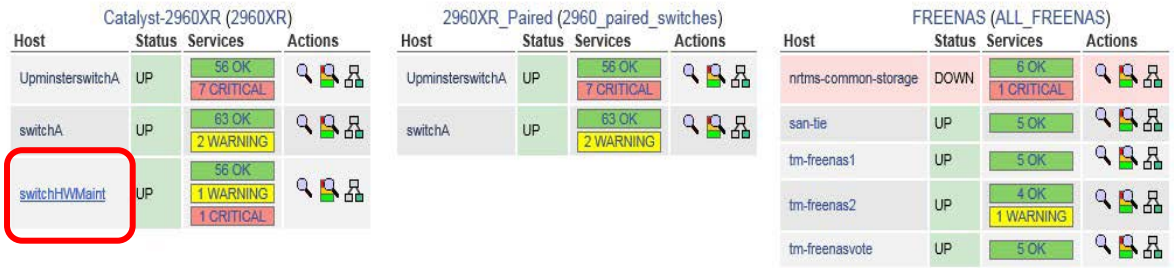


Figure 24 – Location of the Maintenance Switch on the Host Groups screen

15. Maintenance Switch - PSU

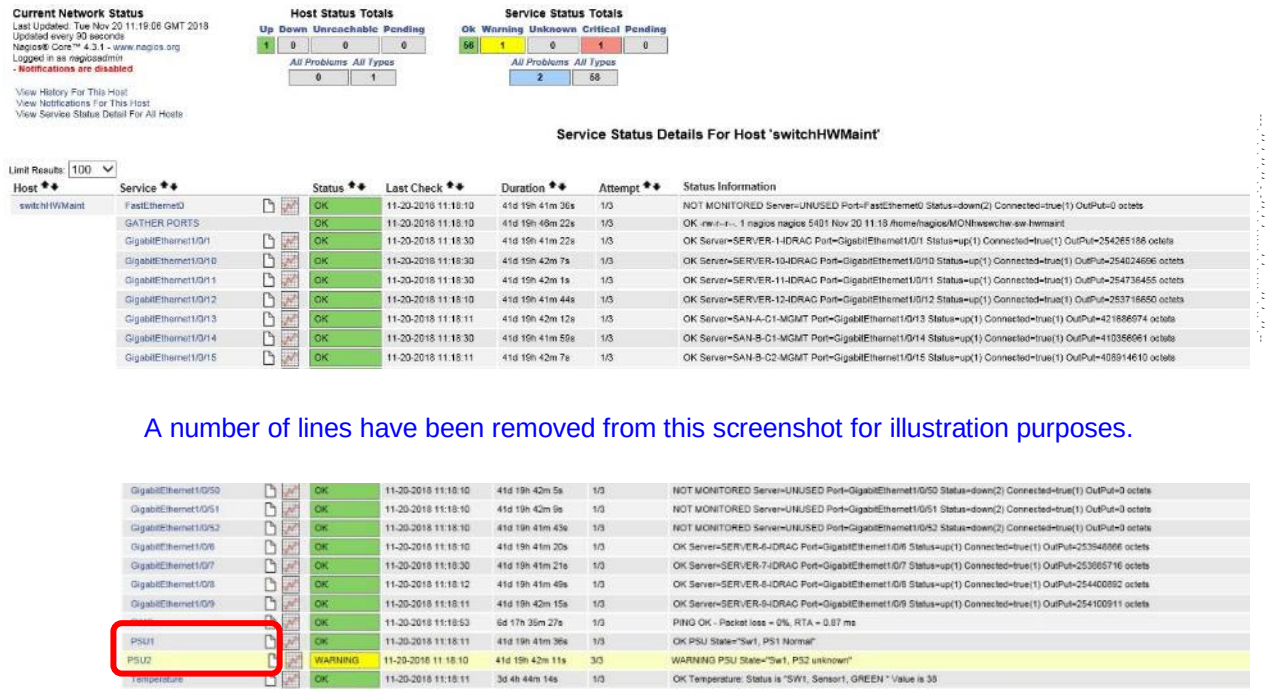
15.1 Monitoring System

Figure 25 shows the position of the PSU's on a detailed view from the monitoring system for the Maintenance Switch.

The location of the status of the PSU that the Network Rail maintainer has the responsibility to undertake corrective maintenance for is highlighted.

Any issues with the power supply units can be corrected by the Network Rail maintainer.

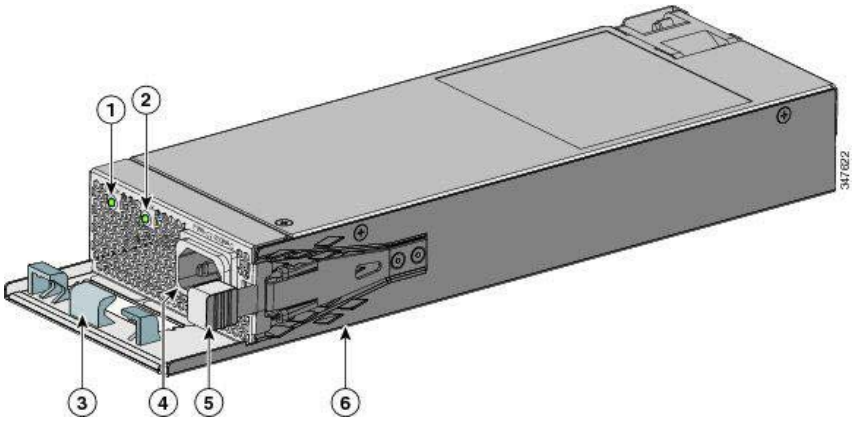
All other Access Switch issues should be raised with the Thales Service desk.



A number of lines have been removed from this screenshot for illustration purposes.

Figure 25 – Maintenance Switch PSU location

15.2 Hardware Indications



No	Description	No	Description
1	AC OK LED	4	AC power cord connector
2	PS OK LED	5	Release latch
3	AC power cord retainer	6	Power supply

LED Illumination Meanings			
AC OK LED	Description	PS OK LED	Description
Extinguished (off)	No AC input power.	Off	Output is disabled, or input is outside operating range.
Green	AC input power is present.	Green	Power output to switch.
		Red	Output has failed.

Figure 26 - Maintenance Switch – PSU (including indications)

16. Maintenance Server

16.1 Monitoring System

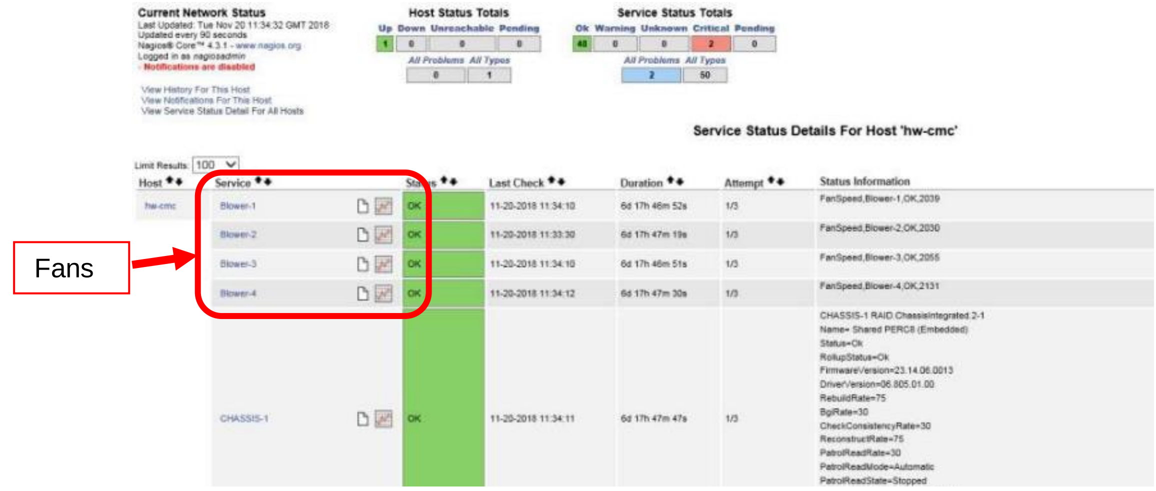
An overview of the status of the Maintenance Server can be viewed on the Host Groups screen on the monitoring system.

Figure 27 identifies the location of the Maintenance Server on the Host Groups screen.

Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

A number of lines have been removed from this screenshot for illustration purposes.

Figure 27 – Location of the Maintenance Server on the Host Groups screen.



A number of lines have been removed from this screenshot for illustration purposes.

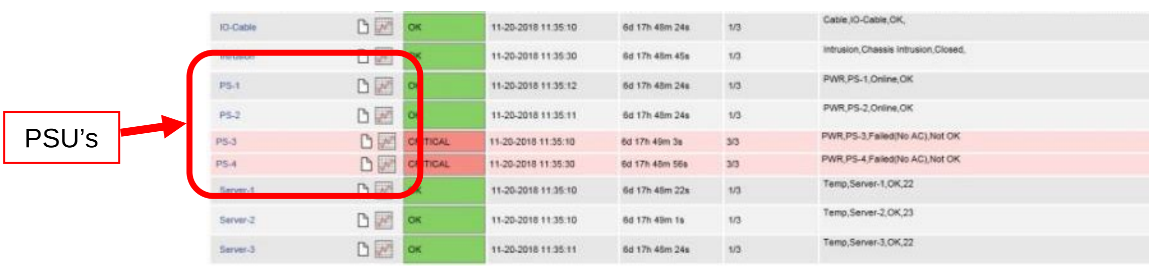


Figure 28 – The Locations of the Maintenance Server PSU's and Fans

The locations of the status information for the components under the responsibility of the Network Rail Maintainer (PSUs, fans) are highlighted.

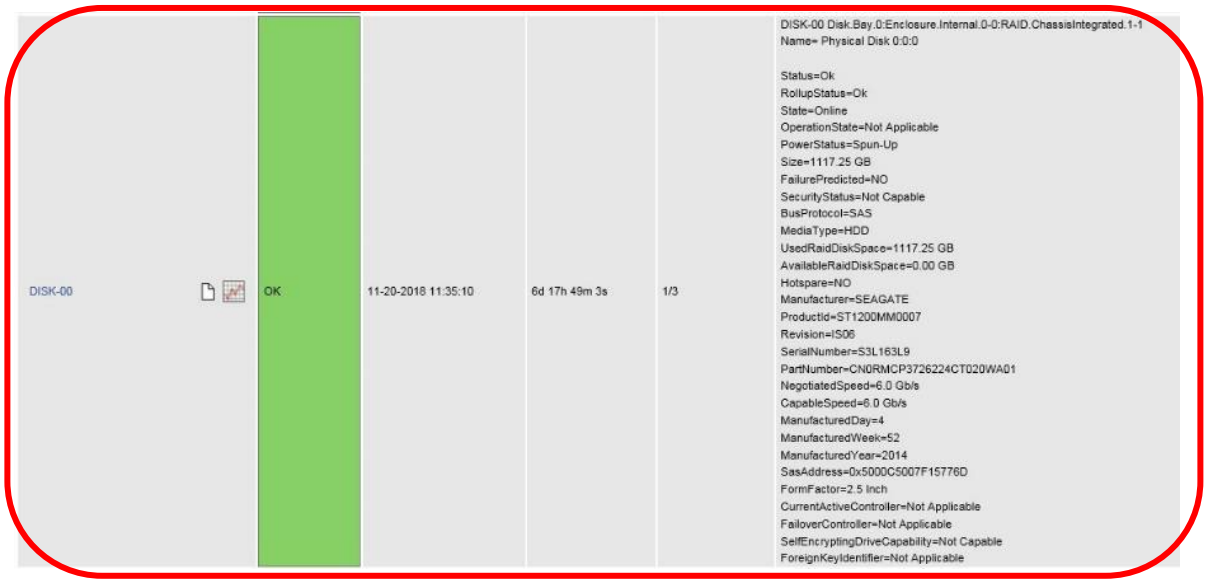


Figure 29 - Maintenance Server Monitoring - Disks

Figure 29 presents the monitoring system view for a single disk. The maintenance server contains 25 disks in total.

Any issues with the fans, power supply units and disks can be corrected by the Network Rail maintainer.

All other Maintenance Server issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

17. SAN Controller (Shared Area Networks)

17.1 Monitoring System

An overview of the status of the SANs can be viewed on the Host Groups screen on the monitoring system.

Figure 30 identifies the location of the SANs on the Host Groups screen where the status of each is summarised.

Where issues are indicated, the hyperlink for the individual component name can be clicked to view more details for that particular device.

The host groups screen shows the SAN controllers. There are two SANs each with two controllers.

Figure 30 – The Location of the SAN's on the Host Groups Screen

Figure 31 - SAN Controller Monitoring

Figure 31 presents the detailed view from the monitoring system for a SAN controller. The status information fields contain the status and alerts for the components under the responsibility of the Network Rail Maintainer (PSUs, fans, disks).

Any issues with the controllers, power supply units and disks can be corrected by the Network Rail maintainer.

All other Server issues should be raised with the Thales Service Centre providing a full description of the incident that requires further investigation.

17.2 Hardware Indications

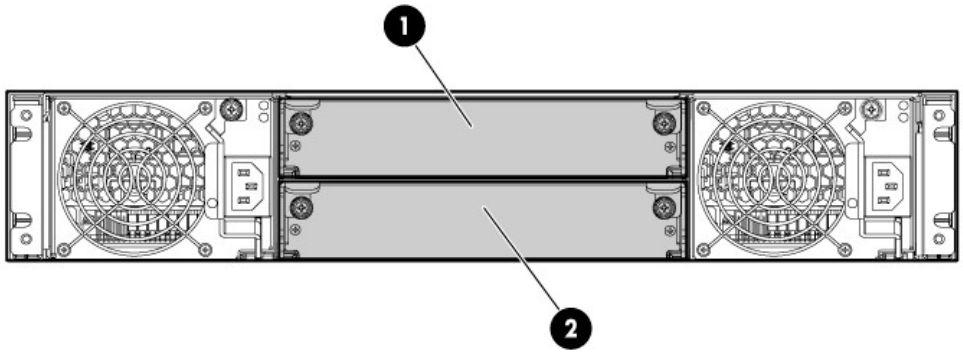


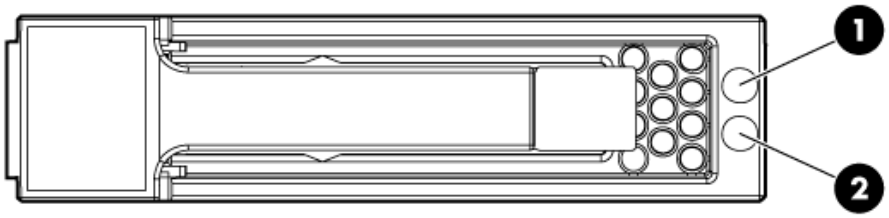
Figure 32 – SAN Controller Module Positioning

Module LED	Description
FRU OK	**Solid Green** = Module is operating normally
	Blinking = System is starting up
	Off = Module is not operating normally
Fault / Service Required	**Solid Amber** = Fault condition
	Blinking Amber = Hardware-controlled power-up or cache flush/restore error
	Off = No fault conditions

Table 7 – SAN Controller Module Indications

18. SAN Disk (Shared Area Networks)

18.1 Hardware Indications



LED Designation	LED Colour	LED Status	Definition
1 (UID /Fault)	Blue	Solid or Blinking	Drive was selected by a management application to locate the drive
	Amber	Solid or Blinking	Failed or failing
2 (Online/Activity)	Green	Solid or Blinking	Online and active
		Off	No diagnostic value

Figure 33 – SAN Disk Hardware Indications

19. Client Workstation

19.1 Monitoring System

The monitoring system does not cover client workstation equipment.

19.2 Hardware Indications

Workstation Monitor

Power Button Indications codes:

- BLUE indicates monitor is ON.
- AMBER indicates monitor is in STANDBY, and
- No INDICATION indicates monitor is OFF.

Workstation Keyboard

The keyboard does not have any LED indications, to identify whether the equipment is operating or at fault, keyboard press should be observed on the Monitor. When failed – no key press can be observed on the monitor.

Workstation Mouse

No LED indication on the mouse, when operating response to key press can be seen on the Monitor. When failed – no key press can be observed on the monitor.

Amulet KVM

DXZ4 zero clients are fitted with front panel LEDs and switches which light in various colours to communicate device status:

Power switch - all models

- Red Unit is in standby, with power applied.
- Amber flash Unit is starting up.

Power switch - DXZ4-M only

- Turquoise flash - SFP modules not recognized.
- Blue flash - SFP fibre modules; no network connection.
- Blue - SFP fibre modules; connected to network.
- Green flash - SFP copper modules; no network connection.
- Green - SFP copper modules; connected to network.
- Alternate green and blue flash - SFP copper module and SFP fibre module; no network connection.
- Alternate green and blue - SFP copper module and SFP fibre module; one module is connected to network. A longer green pulse indicates the SFP copper module is connected to the network. A longer blue pulse indicates the SFP fibre module is connected.

Link LED - all models

- Off - No PCoIP link is established.
- Green flash - PCoIP link is available but not in session.
- Green - PCoIP session is active.

20. Maintenance Terminal

20.1 Monitoring System

If the maintenance terminal has failed it is not possible to view the monitoring system. Faults are identified as the maintainer uses the maintenance terminal.

21. Rack KVM

21.1 Monitoring System

The KVMs are used for server hardware maintenance only and as such it is not monitored or used by the Network Rail Maintainer. Faults are identified by opening the KVM and confirming it is active.

22. Visual Fault Finding

The Nagios Application should be used to investigate all faults. If the Nagios system is not available the following visual checks can to be to ascertain the status of the components which make up the ARAMIS system.

22.1 Workstation

a) Check the monitor is displaying the “On” (blue) LED indication.

b) Verify server connection by checking the ARAMIS Toolbar (bottom right-hand corner) displaying green indication.

c) Check the keyboard is working by observing its operation.

d) Check the mouse is working, by observing its operation.

e) Check the ‘LINK LED’ is displaying steady green indication on the Zero Client – Amulet.

22.2 Equipment Room Cubicles

Client PC - Dell Precision 7910 Rackmount

a) Check the ‘LED Panel’ on each unit is displaying a blue backlight for normal working.

b) Check the occupied ‘Hard Drive Bays’ are displaying steady green indication.

c) Check the back of Client PC; ‘Power Supply Unit 1 & 2’ are displaying steady green LED indications.

d) Check the LED status light is illuminated.

Virtual Server Dell PowerEdge R530 Rackmount

a) Check the ‘LED Panel’ on each unit is displaying a blue backlight for normal working.

b) Check the occupied ‘Hard Drive Bays’ are displaying steady green indication.

c) Check the back of Client PC; ‘Power Supply Unit 1 & 2’ are displaying steady green LED indications.

d) Check the LED status light is illuminated.

Maintenance Server - PowerEdge M620 Blade*

a) Observe the ‘Status Indicator’ is displaying steady green indication.

b) Check each occupied ‘Hard Drive Bay’ is displaying steady green indication.

c) Check the LED status light is illuminated.

Server Storage SAN - HP MSA 2040

a) Check the 2040 SAN ‘Heartbeat LED’ lamp is illuminated.

b) Check the fault light LED is not illuminated on the SAN.

c) Check ‘Disk Drive Online / Activity LED’ on each hard drive is displaying steady green indication.

d) Check the ‘Disk Drive Fault LED’ on each hard drive is NOT alight.

e) At the rear of SAN Power Supply check:

f) The input source power voltage LED is illuminated.

g) The ‘Voltage/Fan Fault /Service Required’ LED not illuminated.

h) At the rear of HP MSA SAN controller check:

- The ‘Voltage/Fan Fault /Service Required’ LED not illuminated.

Network Core Switch - Cisco Nexus 5672UP

a) Check the ‘Chassis Locator LED’ is displaying steady blue indication.

b) Check the ‘Power Status LED’ is displaying steady green indication.

c) Check the rear side ‘PSU OK LED’ on both supplies is displaying steady green indication.

d) Check the back of the fan unit that 3 x ‘Fan Blower LEDs’ are displaying steady green indications.

Network Access Switch - Cisco Catalyst 2960XR-24TS-I

a) Check Stack LED is displaying a steady green indication.

b) Check the ‘System LED’ displaying steady green indication.

c) Check the ‘STAT LED’ is not illuminated.

d) Check the ‘System LED’ is displaying a green indication

e) Check the ‘IPRS LED’ is displaying steady green.

Network Management Switch - Cisco Catalyst 2960XR-48TS-I

a) Check the ‘System LED’ is displaying steady green indication.

b) Check the ‘STAT LED’ is not illuminated.

c) Check the power supply ‘System LED’ is displaying steady green indication.

d) Check the power supply ‘IPRS LED’ is displaying steady green.

Firewall - CISCO ASA 5545-X with fire power Services

a) Check the ‘Power Button’ is displaying power symbol in steady green.

b) Check the ‘ALARM LED’ is not displaying steady amber.

c) Check the PSU ‘PS1 & PS0 LED’ is displaying steady green.

d) Check the hard disk drive ‘HD1 and HD0 LED’ are displaying steady green or flashing green.

Server HMI - KVM Rackmount Console Unicorn 17

a) Check each KVM is displaying steady GREEN ‘Power Indication’.

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 VIS OTU relay module transmits failure indications to the signal box/control centre, this allows for immediate identification of a failure of a part of the Vehicle Identification System. This in turn prompts the need for reactive maintenance and a visit to the affected location. The protocol for reactive maintenance in the event of VIS system failure is as follows:

For information on Loop Tuning see NR/SMS/PartB/025 (Vehicle Identification Loops (VIS) Loop Tuning Setup).

1. VIS Loop Antenna, Tuning Unit and Tail Cable

1.1 Visual confirmation that the VIS loop antenna and its fixings are free from ballast.

1.2 Visual confirmation that tail cables are correctly located, secured and free from damage.

1.3 Visual confirmation that tuning unit is correctly located, secured and free from damage.

1.4 Visual confirmation there is no physical damage to the VIS loop antenna, its mountings and fixings.

1.5 Visual confirmation that the VIS loop antenna is mounted centrally in the 4ft, rectify as necessary.

If rack output test probe readings in the OTU cubicle are outside of the normal levels detailed in Table 1, use the Orion test meter on the loop antenna to determine if the corresponding field level values are within the parameters specified in the table in the NR VIS maintenance handbook (OP/89296/NR VIS Trackside Sim HB/ Issue 1).

Reading	Approx. Output Volts (pp)
10	1.7
20	3.3
30	5
40	6.7
50	8.3
60	10
70	11.7 (Normal Setting)
80	13.3
90	15
100	16.7

Table 1 – Rack Output Voltages using Test Probes

2. LED Diagnostics

2.1 Check each module's LEDs in accordance with the Tables 2, 3, 4 and 5. If the LED status indicates a card fault, then the card shall be replaced with a spare, configured with identical switch/link arrangements.

LED Ident	Function	Operation
3.3V	3.3V voltage ok	Illuminates when 3.3V is present
LINK	Ethernet Link	Illuminates when Ethernet status/connection is OK
10	10MB operation	Illuminates for 10MB operation (not applicable)
100	100MB operation	Illuminates for 100MB operation
COL	Collision	Illuminates when a collision id detected
STAT	Ethernet Connection Status	Illuminates when the Ethernet connection is active.
KEY	Key Connected Status	Illuminates when the Memory Key is inserted
RXD	WIZNET receive LED	Illuminates when WIZNET data is received
TXD	WIZNET transmit LED	Illuminates when WIZNET data is transmitted
ST1	Card Status 1	Future Use
ST2	Card Status 2	Future Use
ST3	Card Status 3	Future Use
I/P4	SCADA Input 1	Used for RTC 1 Watchdog, on when OK
I/P3	SCADA Input 2	Used for RTC 2 Watchdog, on when OK
I/P2	SCADA Input 3	Used for RTC 3 Watchdog, on when OK
I/P1	SCADA Input 4	Used for RTC 4 Watchdog, on when OK

Table 2 - Microcontroller Module LED's

PCB Ident	Function	Operation
10V	10V Voltage OK	Illuminates when voltage is within acceptable band
DET	Data Detect LED	Illuminates on when modulation is turned on
CD	Carrier Detect LED	Illuminates on when transponder is turned on
I	Current Status	Illuminates on when current is in range
COM	Comms Status	Flash every 6 seconds to denote Comms status OK

Table 3 - Loop Module LED's

PCB Ident	Function	Operation
+V	Voltage Monitor	Illuminates when voltage is present
24V	24V Monitor	Illuminates when voltage is present
5V	5V Monitor	Illuminates when voltage is present

Table 4 - Power Supply LED's

PCB Ident	Function	Operation
4 WDG to RTC	Watchdog Output 3	Illuminates when OUT watchdog OK
3 WDG to RTC	Watchdog Output 2	Illuminates when OUT watchdog OK
2 WDG to RTC	Watchdog Output 1	Illuminates when OUT watchdog OK
1 LOOP FAULT	Output Relay 13	Illuminates when on Loop fault
12	Output Relay 12	Illuminates when relay is activated
11	Output Relay 11	Illuminates when relay is activated
10	Output Relay 10	Illuminates when relay is activated
9	Output Relay 9	Illuminates when relay is activated
8	Output Relay 8	Illuminates when relay is activated
7	Output Relay 7	Illuminates when relay is activated
6	Output Relay 6	Illuminates when relay is activated
5	Output Relay 5	Illuminates when relay is activated
4	Output Relay 4	Illuminates when relay is activated
3	Output Relay 3	Illuminates when relay is activated
2	Output Relay 2	Illuminates when relay is activated
1	Output Relay 1	Illuminates when relay is activated

Table 5 - Relay Module LED's

2.2 If the Micro module at the Tinsley OTU has to be changed, it is imperative that the Wiznet module settings on the new card are correctly set.

2.3 If a loop module requires replacement, the new module shall be re-phased, See Section 10.5.3 of the NR VIS maintenance handbook (OP/89296 for Tinsley OTU and OP/89322 for Mainline and Parkgate OTUs) for details on configuring the phasing utility.

It is imperative that the new module has the same address switch (SW1) setting as the one being replaced.

3. Full System Reset

3.1 The reset button on the loop module should be depressed for 10 seconds and released.

3.2 The reset button on the microcontroller module should be depressed for 10 seconds and released.

3.3 If the system does not reset correctly (confirmed by LED diagnostics) then the VIS equipment should be powered down and subsequently powered up again.

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF26		
Faulting Guide: KVB Balise		
Issue No. 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

Includes:	KVB Balise (Contrôle de Vitesse par Balises) Used in Ashford, Kent
Excludes:	All other types of Balise

1. KVB Fault Finding

Tools required:

a) KVB Tester.

b) KVB DCO Configuration Files.

c) Commissioning Record Card.

d) Wiring Diagrams.

e) A Calibrated Meter.

2. Ask the Signaller

a) What type of alarm did the driver report? (“Panne Sol” or “Panne Engin”).

b) Where and when did the incident occur?

c) What was the status of the signal?

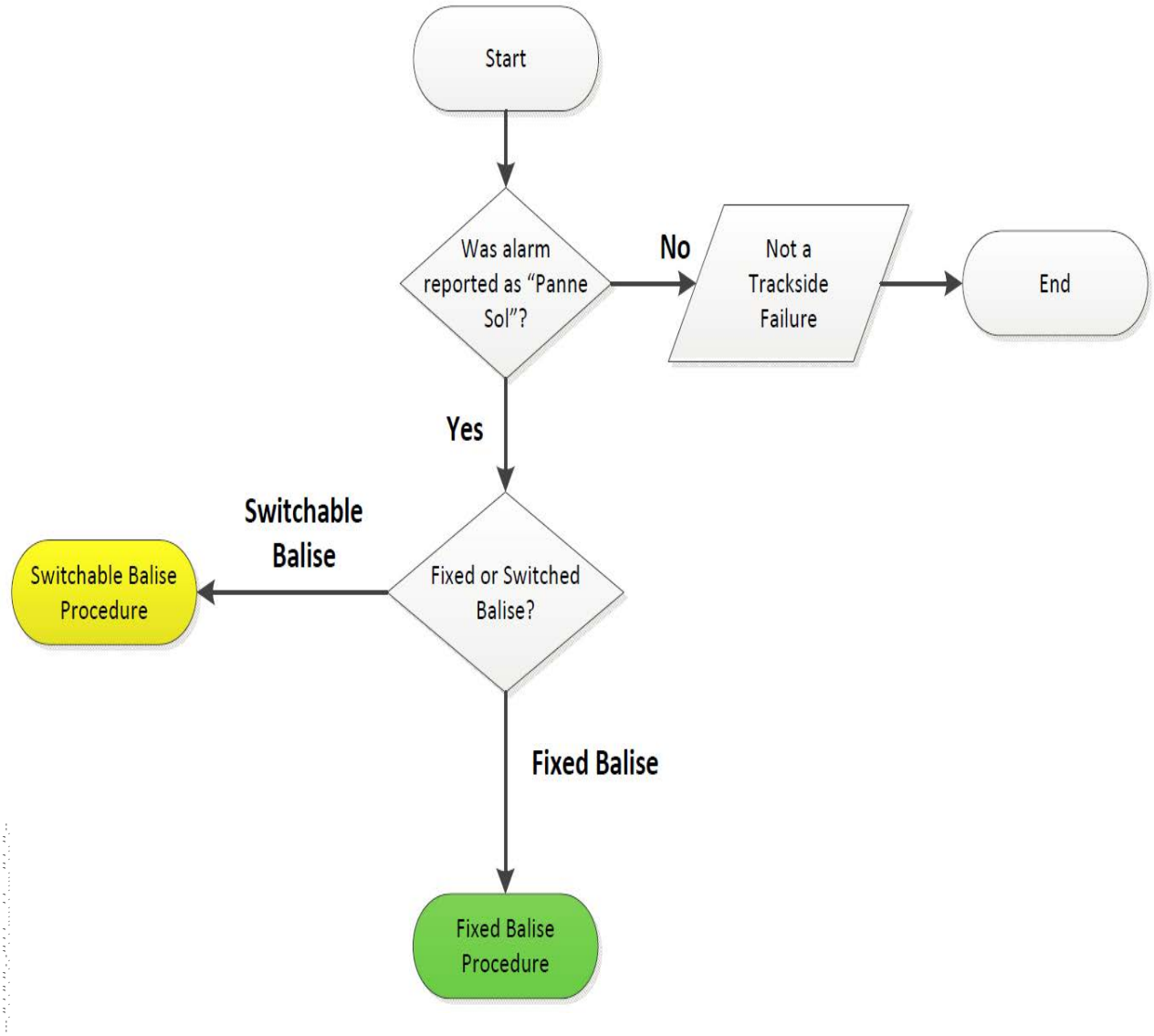
Once these facts have been noted move to the start of the flow chart

3. Faulting flowchart

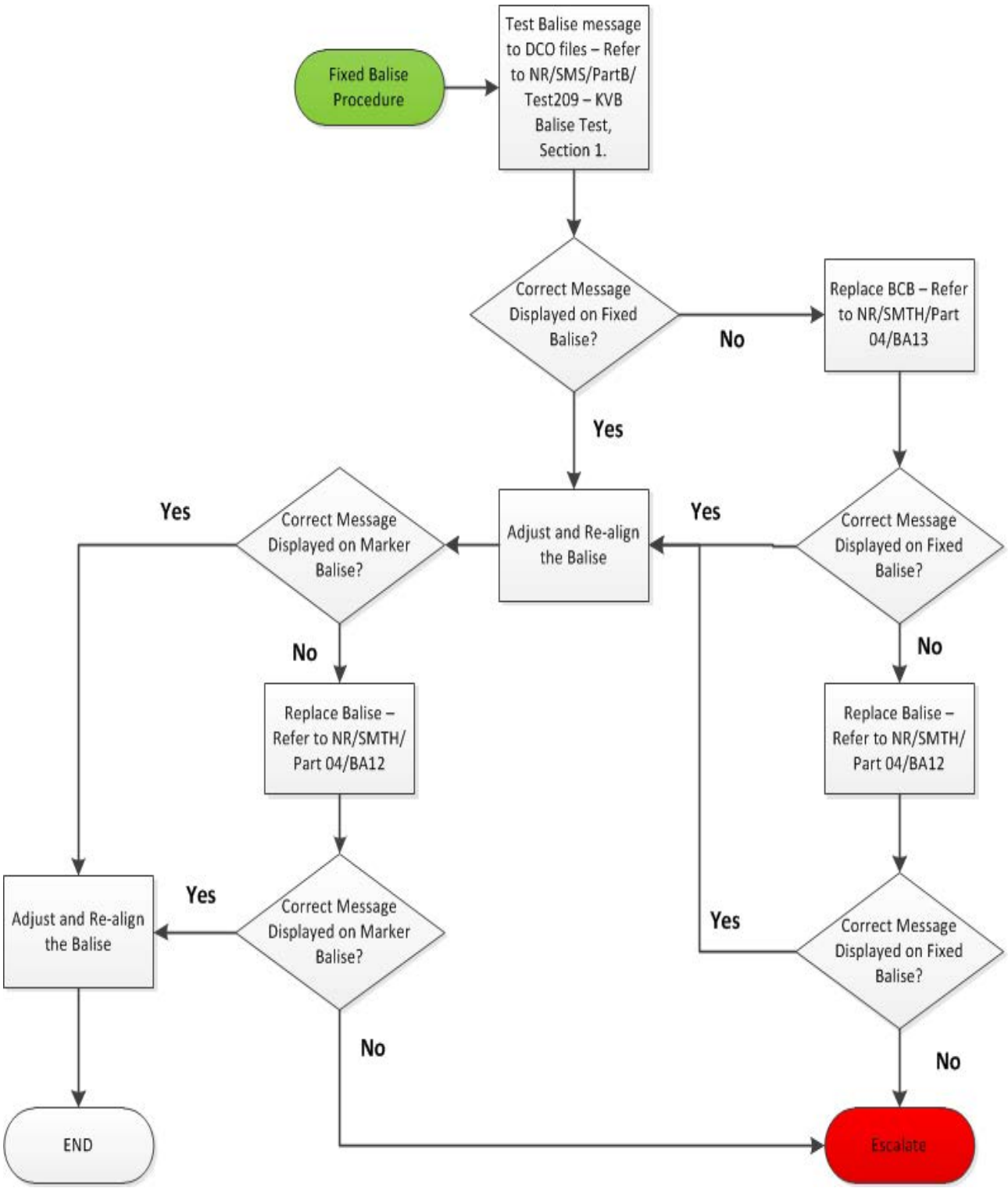
For details of the Test set refer to NR/SMS/Appendix/23 (General information on the KVB Test Set).

See the following pages for fault finding flow charts.

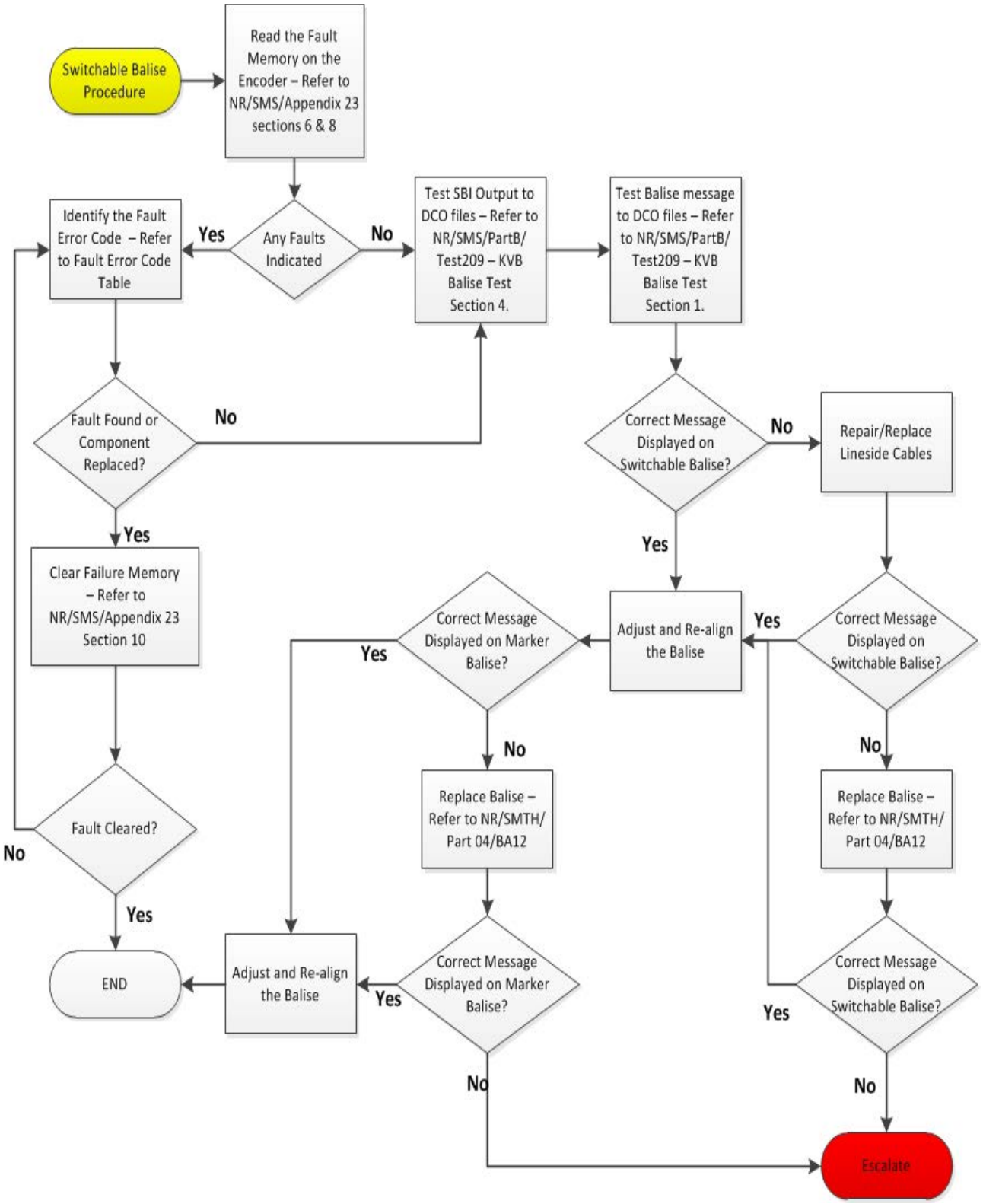
4. Start Point.



5. Fixed Balise Procedure



6. Switchable Balise Procedure



7. Example of a Test Set Failure Screen

8. Explanation of the Test Set Failure Screen

Line 1

Shows the failure number and the total number of failures recorded, in the example this is failure 3 of 3.

Line 2

Shows which type of encoder software is at fault. LA (firmware) or LB (application), in the example it is LA.

Line 3

Shows the software address (if the information is available) where the failure happened.

Line 4

Specifies the time that has elapsed between the failure occurring and it being read by the Test Set, shown in days, hours, minutes and seconds.

So the example failure occurred 1 day 9 hours 29minute and 12 seconds before it was read by the Test Set.

9. Meanings Main Failure Codes

The tables showing the main failure codes and their meanings.

An encoder power supply failure will disturb the earlier failures dating information.

If the Test Set detects a power supply failure (by inconsistencies between the failure order in the memory and dating values): it will not display any time values for the earlier failures. If it does not detect it the time values will be distorted.

LA + Software Fault

Error	Description	Check /Change
100	No error	No Action
101	Non detected breakdown	Change BCC or UCS
107	Lack of BCC	Change BCC or UCS
108	New BCC	Change BCC or UCS
109	BCC reading anomaly	Change BCC or UCS
110	Incorrect checking sum	Change BCC or UCS
111	Incorrect signature	Change BCC or UCS
112	Incorrect Nº1 input card signature	Change ECI
113	Incorrect Nº2 input card signature	Change ECI
114	Incorrect Nº3 input card signature	Change ECI
115	Incorrect Nº4 input card signature	Change ECI
116	Incorrect input card signature	Change ECI
117	Incorrect SBI card signature	Change SBI
124	Incorrect output card signatures	Change SBI
125	Incorrect card signatures	Change ECI or SBI
126	Nº1 exit message anolmaly	Check Input Status
127	Nº2 exit message anolmaly	Check Input Status
128	Nº3 exit message anolmaly	Check Input Status
129	Nº4 exit message anolmaly	Check Input Status
130	Anomaly messages on several exits	Check Input Status

LB + Firmware Fault

Error	Description	Check /Change
1	No mistake detected	No action
2	Incorrect reading memory checking sum	Change BCC or UCS
3	BCC error	Change BCC or UCS
4	Saved memory error	Change UCS
5	No error in the saved memory	No action

END

NR/L3/SIG/11231 Signal Maintenance Testing Handbook		
NR/SMTH/Part10/FF27		
Faulting Guide: Residual Voltage Fault		
Issue No: 01	Issue Date: 04/09/2021	Compliance Date: 04/12/2021

GENERAL

This guide is to be used when a residual voltage has been found, with a residual percentage exceeding 30%. The attached result sheet is be filled out, as a record of the testing and results.

The correct escalation process shall be used, as stated in NR/SMS/PartB/Test/251 (DC Track Circuit Test).

All tests to be recorded on the Residual Voltage Test Record Sheet, see Appendix A, also on any relevant equipment record card.

Pictures can be taken of any issues, and to be forwarded to SM (Level 2) and Fault Control to be attached to the fault report.

This Fault finding guide is to be used in conjunction with, NR/SMS/PartB/Test/251 (DC Track Circuit Test) and NR/SMTH/Part10/FF02 (Faulting Guide: DC Track Circuits).

FAULT FINDING GUIDE

1. Record the drop away, pick up resistances and voltages, of the effected track circuit.
2. Record the coil voltage of the effected TR. Record the Residual voltage and percentage of the effected track circuit.
3. Identify the track circuits that are adjacent and parallel with the effected circuit.
4. Record the track IDs on the diagram. Identify which is the Feed and the Relay end.
5. Draw the IBJ's on the parallel track diagram to identify where they are in relation to the effected track circuits IBJ's.
6. Record the bonding and cables on the diagram.
7. Record the track circuit information on the result sheet. This includes track length, type of track (low, medium, high), type of sleepers, condition of ballast, pads and clips. Any level crossings that cross the track need naming and there location indicating where on the track circuit they are.
8. Test and record the readings of the IBJ's on the effected track circuit.
9. Test and record the earths in the feed and relay locations.
10. Isolate both adjacent track circuits and all parallel track circuit feeds and test/record the effected track circuit residual voltage.

11. Reconnect the track circuits in term, starting with the parallel track circuits, retest/record the effected residual voltage.

12. At the feed end of the effected track circuit switch positive and negative cable cores. This puts the reverse feed onto the track circuit, this should destroy stored residual voltage.

13. After 5 minutes record the coil voltage. Then test the residual voltage of the effected track circuit, using the normal method. Record the residual voltage at 0 and 120 seconds.

14. If the original recorded residual voltage is there straight away it would indicate a stray voltage is been inducted onto the track circuit by an external source. If it creeps up over time it would indicate a battery effect on the track circuit, due to ballast and ground conditions.

15. Record all treadles that are connected to the effected track circuit, include all treadles even if not associated with the effected track circuit (such as entrance/exit treadle for AHB crossings).

16. Record if the treadles have the track feed through it, or a different supply (e.g. 50v for QNR).

17. If the treadles have a different supply, then disconnect the incoming/outgoing links in the treadles feed location. Test and record the effected track circuit residual voltage.

APPENDIX A - Residual Voltage Test Results

1. Track Details

Track ID		To be completed with 150KΩ shunt meter				
Drop Away	Ω	v	Coil Voltage	v	Percentage*	%
Pick Up	Ω	v	Residual Voltage	v		

Table 1 – Track Details

NOTE: **Residual percentage 30 – 70% investigate and inform SM,*
Above 70% investigate and sign out effected TC after informing SM.

2. General Details

Fault No		Track circuit type	
Signal Box		Weather conditions	
Track Circuit ID		Type of sleepers	
Length		Condition of ballast	
Level Crossings		Condition of pads/ clips	
Material of deck		Condition through crossing	
Sleeper ends clear of ballast		Under rail clear of ballast	

Table 2 - General Details

3. Block Joint Testing

	IBJ1	IBJ2	IBJ3	IBJ4
Rail to Rail V1	v	v	v	v
Inner Plate to Rail V2	v	v	v	v
Inner Plate to Rail V3	v	v	v	v
Outer Plate to Rail V4	v	v	v	v
Outer Plate to Rail V5	v	v	v	v

Table 3 – Block Joint Testing Results

4. Earth Testing

Earth Test - Feed Location				
Supply (AC)	Busbar	V1	V2	Vb
	v	v	v	v
	v	v	v	v
Supply (DC)	Busbar	V1 B-E	V2 N-E	
	v	v	v	
	v	v	v	
	v	v	v	
	v	v	v	
Earth Test - Relay Location				
Supply (AC)	Busbar	V1	V2	Vb
	v	v	v	v
	v	v	v	v
Supply (DC)	Busbar	V1 B-E	V2 N-E	
	v	v	v	
	v	v	v	
	v	v	v	
	v	v	v	

Table 4 – Earth Testing Results

5. Track Layout Sketch

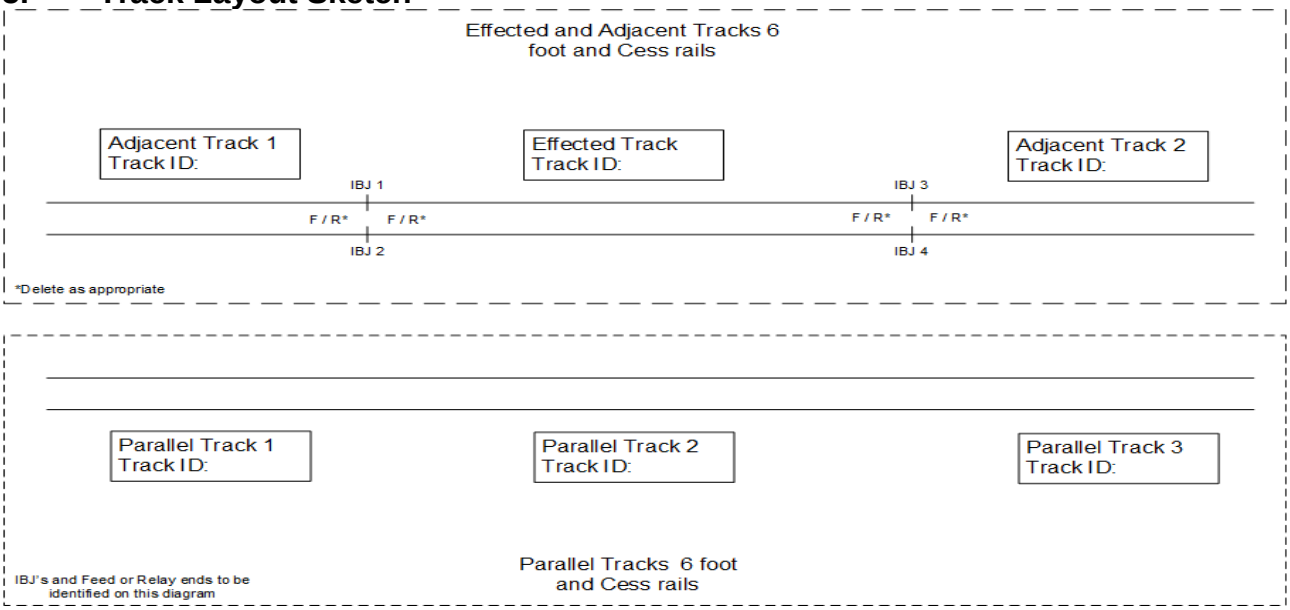


Figure 1 – Track Layout Sketch

5.1 The location of any level crossings should be indicated on the above diagram.

6. Testing

6.1 Temporarily Switch Feed End Polarity and record the results.

Coil voltage power in reverse for 5 mins	v
Residual voltage at 0 secs	v
Residual voltage at 120 secs	v

Table 5 - Feed End Polarity Switch

6.2 Isolate Track feeds and retest Residual Voltage.

Track circuits to be disconnected	Residual Voltage
All Adjacent & Parallel Tracks	v
Adjacent Track 1 & 2	v
Adjacent Track 2	v
Adjacent Track 1	v

Table 6 – Track Isolated Results

6.3 Treadle check, Isolate Track feeds and retest Residual Voltage.

Treadle ID	Treadle Location	Supply (Track/other)	Residual Voltage
			v
			v
			v
			v

Table 7 – Treadle Check Results

7. General Notes

END

INDEX

GENERAL

This Faulting Guide is to be used in conjunction with the applicable Faulting Guide for the HIMatrix application, e.g., manually controlled barrier level crossing.

This Faulting Guide uses questions to diagnose a HIMatrix fault and determine the rectifying action. The user selects the most appropriate answer to each question and the Faulting Guide will then specify the next Faulting Step. Faulting Steps are numerically numbered from 1 to 16.

Faulting Information in support of the Faulting Guide steps can be found at the end of the Faulting Guide in Appendix A in sections 17 to 27.

Before handling any electronic equipment observe electrostatic discharge precautions.

Protection / Possession arrangements shall be made before commencing work on a HIMatrix signalling or level crossing system.

Before powering down a HIMatrix unit or Ethernet switch or disconnecting any plug coupler or signalling equipment, inform the Signaller as to the effect on the operational railway.

DEFINITIONS

Term or Abbreviation	Definition
Centrix	An optional software platform for advanced performance monitoring of HIMatrix systems.
Crosstalk	Two circuit conductors that should be electrically insulated, become electrically connected by a short circuit or earth fault. This includes positive and negative conductors of the same circuit.
F3	A HIMatrix F3 object controller.
F30	A HIMatrix F30 interlocking (programmable logic controller) or object controller.
HIMatrix	Either an F30 or an F3.
I/O	input / output
II	Intelligent Infrastructure.
IP address	Internet protocol address. IP addresses uniquely identify F3s and the F30 to each other. They are downloaded to F3s and the F30 using SILworX.
MCB	Miniature circuit breaker.
PSU	Power supply unit.
User Programme	The signalling “data” that programmes each F30. It is downloaded to an F30 using SILworX. Each HIMatrix F30 has a unique user programme.

Table 1 – Definitions

1. Faulting steps

1.1 Check the data logger (see Step 20) or Centrix or II for critical, high alert and warning alarms.

1.2 If there is more than one critical or high alert or warning alarm, first investigate critical, then high alert and then warning alarms.

1.3 Identify the first alarm to be investigated from Table 2 and then go to the indicated Step. After each alarm has been investigated, return to this Step.

Data Logger Alarm Identity [HIMatrix ID, *** Ethernet Switch ID]**	**Go to Step:**
MODBUS OFFLINE	4
** COMM ERROR	5
** ID OK	6
** OVERLOAD	7.4
** HIGH TEMP	7.2
** MODULE FAULT	7.3
** IP SHORT CCT	11
** IP X-TALK	11
** OP OVERLOAD	11
** OP SHORT CCT	11
** OP FAULT	7.5
S(***)K	8
ELK	9
(PSU)K	10
Other alarm reported	Refer to application specific Guide NR/SMTH/Part10/FF29 (Faulting Guide: HIMatrix Manually Controlled Barrier Level Crossing)
No alarm reported	2

Table 2 - Data logger alarm identity

2. Faults not specifically alarmed by the data logger

2.1 Select the first applicable description of the fault report from Table 3:

Fault report description	Go to Faulting Step:
Unable to download user programme or IP address to a replaced HIMatrix.	16
HIMatrix is not responding to a contactor or contact being closed.	14
HIMatrix is not responding to a contactor or contact being opened (possible wrong-side failure).	15
An object is not being switched on when expected.	12
An object is not being switched off when expected (possible wrong-side failure).	13
HIMatrix status LEDs indicate a fault.	3
Other fault	Refer to application specific Guide NR/SMTH/Part10/FF29 (Faulting Guide: HIMatrix Manually Controlled Barrier Level Crossing)

Table 3 - Fault report description.

3. HIMatrix status LED faults and errors

3.1 Check the HIMatrix status LEDs (Step 17) and carry out the rectification tasks for any fault or error found.

4. Data logger or serial link fault

4.1 Check that the F30 has not failed (Step 17) before moving on to Step 4.2.

If the F30 has failed, go to Step 7.

4.2 Check the data logger status LED. If the data logger is not powered on, test its power supply (see Step 21). If the power supply has failed, test whether the MCB or PSU has failed and rectify power supply fault.

4.3 Check the data logger and Centrix or II for changing function values in response to changes to the signalling system, e.g., track circuit occupancy.

a) If the data logger function values do not change, check the serial cable for correct connection to the F30 and check the data logger for signs of damage. Replace the serial cable if damaged.

b) Power the data logger off and on using its supply fuse/MCB. If the fault persists, replace the data logger.

c) If the values of data logger functions change and there is no update to Centrix / II then follow the data logger manual to check the data logger connection with Centrix or II.

5. HIMatrix Ethernet communication fault

5.1 Check the data logger for COMM ERROR alarms and note which F3 is affected. If the fault occurred after replacing the affected HIMatrix, complete Step 6.2 before moving to Step 5.2.

5.2 Check if an Ethernet switch has failed (Step 8) before moving to Faulting Step 5.3.

5.3 Check the HIMatrix and Ethernet switch port LEDs (see Step 19) for data transmission. Check the affected Ethernet cables for correct connection between Ethernet switch and connected devices shown in the location case diagrams.

5.4 Check if the F30 or F3 has failed (Step 7) before moving to Step 5.5.

5.5 Check Ethernet cables for signs of damage. Replace Ethernet cables either if damaged or if no fault found with the F30, F3(s) and Ethernet switch(es).

6. HIMatrix identity fault

6.1 Check the data logger for ID OK and VER OK alarms for all HIMatrix and note which HIMatrix are affected.

6.2 Did the fault occur after replacing a HIMatrix? If yes, then:

a) Check the HIMatrix I/O plug couplers (Step 23) are inserted into the correct I/O ports.

b) Check the HIMatrix I/O plug couplers are firmly inserted.

c) If the F30 has been replaced, carry out NR/SMTH/Part04/IS17 (Download Data to a HIMatrix Programmable Logic Controller (PLC) F30 and F3) to download a new user programme to the F30.

d) If the F3 has been replaced, carry out NR/SMTH/Part04/IS17 (Download Data to a HIMatrix Programmable Logic Controller (PLC) F30 and F3) to download a new IP Address and Rack ID to the F3.

e) Check the HIMatrix status LEDs (Step 17). If the Prog, Force, Fault, OSL and BL LEDs are simultaneously blinking then another HIMatrix on the Ethernet network has a duplicate IP address – re-check the data logger for other HIMatrix identity faults and rectify.

6.3 Did the fault occur during operational service? If yes, then:

a) Check the data logger for an IP X-TALK alarm for the failed HIMatrix. If an HIMatrix IP X-TALK fault is alarmed, then move to Step 15.

b) Check that the HIMatrix input LEDs (Step 18) correspond with the location case diagrams identity wiring. If any identity input status LEDs are not on/off as per the identity wiring (Step 27) carry out Steps 14 and 15.

7. HIMatrix hardware fault

7.1 Check the HIMatrix status LEDs (Step 17). If the 24V DC LED is off or the Error LED is blinking, test the HIMatrix power supply (Step 21).

a) If the power supply has failed, investigate, and rectify.

b) If the HIMatrix power supply is normal and the 24V DC LED is off, power off and on the HIMatrix using its supply fuse/MCB. If the 24V DC LED is still off, replace the HIMatrix.

c) If the Error LED continues blinking, replace the HIMatrix.

7.2 Check the data logger for HIGH TEMP alarms and note which HIMatrix is affected. If a HIGH TEMP is alarmed:

a) Check the data logger for the location case temperature. If it exceeds 60°c, then increase the apparatus housing ventilation.

b) Check the front and top of the affected HIMatrix by hand but without directly touching the HIMatrix. If it feels uncomfortably warm and the apparatus housing temperature is acceptable, then check the HIMatrix vents are clear and remove any obstructions.

c) If the HIMatrix temperature remains high or the fault is not resolved, replace the HIMatrix.

7.3 Check the data logger for MODULE FAULT alarms and note which HIMatrix is affected. If a MODULE FAULT is alarmed, power off and on, the affected HIMatrix using its supply fuse/MCB. If the fault persists, replace the HIMatrix.

7.4 Check the data logger for OP OVERLOAD and OVERLOAD alarms and note which HIMatrix is affected. If an OP OVERLOAD or OVERLOAD is alarmed, go to Step 11.

7.5 Check the data logger for OP FAULT alarms and note which HIMatrix is affected. If an OP FAULT is alarmed, power off and on, the affected HIMatrix using its supply fuse/MCB. If the fault persists, replace the HIMatrix.

8. Ethernet switch fault

One or more Ethernet switches are provided to connect HIMatrix units. A fault of an Ethernet switch will be reported by the data logger to Centrix / II.

8.1 Check the Ethernet switch status LED. If no status LED is on, test the power supply (see Step 21) to the Ethernet switch.

8.2 If the status LED is on and the Ethernet switch is healthy, move to Step 14 and check the HIMatrix detection input of the Ethernet switch.

8.3 Power off and on the failed Ethernet switch using its supply fuse/MCB. If the fault persists, replace the Ethernet switch.

9. Earth fault

Insulation monitoring is provided for all HIMatrix busbars. An insulation resistance less than the threshold level stated in the location case diagrams will be alarmed by the data logger to Centrix / II.

9.1 Check the ELK status LED. If no LED is on, test the power supply (Step 21) to the ELK.

9.2 If a fault LED is on, investigate the monitored busbar for an earth fault.

9.3 If the ELK status LED is on and the ELK is healthy, move to Step 14 and check the HIMatrix detection input of the ELK.

9.4 Power off and on the failed ELK using its supply fuse/MCB. If the fault persists, replace the ELK using SMTH.

10. PSU fault

Redundant 24Vdc PSUs are provided to supply HIMatrix. A first fault of a PSU will be reported by the data logger to Centrix / II.

10.1 Check the PSU status LED. If no LED is on, test the power supply (Step 21) to the PSU.

10.2 If the PSU status LED is on and the PSU is healthy, move to Step 14 and check the HIMatrix detection input of the PSU.

10.3 Power off and on the failed PSU using its supply fuse/MCB. If the fault persists, replace the PSU.

11. HIMatrix unknown I/O fault

An unknown I/O fault is one where a generic I/O fault is reported for a HIMatrix. The Run LED will be illuminated steady and the Fault LED of the affected HIMatrix will be blinking. This Faulting Guide step will not identify all I/O faults. Specific I/O faults are expected to be faulted from an observed failed object, e.g., a failed lamp.

11.1 Check the data logger for OP OVERLOAD, OVERLOAD, OP FAULT, OP SHORT CCT, IP SHORT CCT and IP X-TALK alarms and note which HIMatrix is affected.

a) If there is an OP OVERLOAD, OVERLOAD or OP FAULT alarm go to Faulting Step 11.2.

b) It there is an IP SHORT CCT or IP X-TALK alarm move to Step 11.3.

11.2 Check the HIMatrix output circuit wiring sheets for external relay contacts or contactors in the circuit and check that these are all closed.

Check output status LEDs (Step 18) against the corresponding controlled objects.

a) If an output status LED is on and the object is de-energised, record the affected output and move to Step 12.

b) If an output status LED is off and the object is energised, record the affected output and move to Step 13.

11.3 Check the input circuit relay contact or contactor is closed.

Check input status LEDs (Step 18) against the corresponding relay contact or contactors.

a) If an input status LED is off and the contact/contactor is closed, record the affected input and move to Step 14.

b) If an input status LED is on and the contact/contactor is open, record the affected input and move to Step 15.

12. HIMatrix output circuit off fault

An output circuit off fault is one where a connected object is expected to be energised and is not. This occurs when either a component of the circuit has become high resistance, or a conductor is broken, or there is a short circuit, or the HIMatrix has failed.

If an output is provided with line monitoring (Step 26), an open circuit fault will be detected and the HIMatrix Fault LED blinking even if the connected object is not switched on.

12.1 Check the output circuit wiring sheets for external relay contacts or contactors and check that these are all closed.

Check the data logger for OP OVERLOAD or OP SHORT CCT alarms. If there is an OP OVERLOAD or OP SHORT CCT alarm move to Step 13.

12.2 Check the output status LED (Step 18):

a) If the output status LED is off, there is no output open circuit fault.

b) If the output status LED is on there is an open circuit fault – move to Step 12.3.

12.3 Use a multimeter set to range 24Vdc to test the voltage across the object. If 24Vdc (nominal) is measured, then investigate the object fault and rectify or replace.

12.4 Check the HIMatrix has not failed – move to Step 7 then Step 12.5.

12.5 Use a multimeter set to range 24Vdc to test the output voltage of the HIMatrix.

a) If it is less than 20Vdc or more than 28Vdc replace the HIMatrix.

b) Continue to test the remainder of the circuit to find any breaks or high resistance.

13. HIMatrix output crosstalk circuit fault

Crosstalk occurs due to low resistance (a short circuit) between the conductors of different circuits or the positive and negative legs of the same circuit. There are two types of output crosstalk faults:

- *Wrong-side. A controlled object is falsely energised by the crosstalk voltage. The controlled object HIMatrix output status LED is off.*
- *Right-side. The controlled object HIMatrix output status LED is on and voltage is applied to the circuit, but a short circuit prevents the energisation of the object.*

If an output is provided with line monitoring (see Step 26), a crosstalk circuit fault will be detected and the HIMatrix Fault LED blinking even if the connected object is not switched on.

13.1 Check the object should be de-energised by HIMatrix.

Check the output status LED (Step 18):

a) If the output status LED is off and the object is energised, then there is a wrong-side crosstalk circuit fault.

This might be wrong-side failure depending on the criticality of the object. **If it is a wrong-side failure, immediately contact the Signaller and stop all trains.** Then move to Step 13.2.

b) If the output status LED is on and the object is de-energised, then there is a right-side crosstalk circuit fault. Move to Step 13.2.

13.2 Test for the crosstalk source by planning the disconnection of plug couplers from the affected HIMatrix except the plug coupler for the affected input. Isolate other potential voltage sources of the crosstalk. Test conductor insulation resistance to identify short circuits (Step 22).

14. HIMatrix input open circuit fault

An input open circuit fault is one where an input should be on, but the HIMatrix input status LED is off. This occurs when either a component of the circuit has become high resistance, or a conductor is broken.

14.1 Check the input circuit relay contact or contactor is closed.

Check the input status LED (Step 18):

a) If the input status LED is on and there is no IP X-TALK alarm, there is no open circuit fault.

b) If the input is provided with anti-valence proving (Step 25), check the other input status LED if off. If the other input status LED is on, move to Step 15.

c) If the input status LED is on and there is an IP X-TALK or IP SHORT CCT alarm, there is a crosstalk fault. Move to Step 15.

d) If the input status LED is off and there is no IP X-TALK or IP SHORT CCT alarm, move to Step 14.2.

14.2 Check the HIMatrix has not failed – move to Step 7 then Step 14.3.

14.3 Use a multimeter set to range 24Vdc to test the source voltage of the HIMatrix input.

a) If it is less than 20Vdc or more than 28Vdc replace the HIMatrix.

b) Continue to test the remainder of the circuit to find any breaks. If no breaks are found, move to Step 14.4.

14.4 Remember that F3 line control circuits (Step 24) require two separate inputs and both shall be tested for high resistance.

Disconnect the plug coupler of the input and the plug coupler of its voltage source. Use a multimeter set to resistance range 1kΩ to test the input circuit between the pins of the plug coupler. If the loop resistance exceeds 100Ω, the circuit is high resistance. Locate the high resistance circuit component and replace.

15. HIMatrix input crosstalk circuit fault

Crosstalk occurs due to low resistance (short circuit) between the conductors of different circuits or positive and negative legs of the same circuit. There are two types of input crosstalk faults:

- *Unprotected wrong side. An input without either line control (Step 24) or anti-valence proving (Step 25) should be off, a crosstalk voltage is present, and the HIMatrix input status LED is on.*
- *Protected wrong side. An input provided with line control (Step 24) or anti-valence proving (Step 25) should be off, a crosstalk voltage is present, and the HIMatrix input status LED is on but the HIMatrix unit ignores the input due to crosstalk being detected or anti-valence proving.*

15.1 Before commencing Faulting Step 15.1, check the input circuit relay contact or contactor is open.

Check the input status LED (Step 18) and check the data logger for the input name and state:

a) If the input status LED is on and there is no IP X-TALK or the input is not provided with anti-valence control, then there is an unprotected wrong-side crosstalk circuit fault.

This might be a wrong-side failure depending on the safety criticality of the input. **If it is a wrong-side failure, immediately contact the Signaller and stop all trains.** Then move to Step 15.2.

b) If the input status LED is on and there is an IP X-TALK alarm (line control) or the data logger reports the input as off (= DN, anti-valence proving),then there is a protected wrong-side crosstalk circuit fault. Move to Step 15.2.

15.2 Test for the crosstalk source by planning the disconnection plug couplers from the affected HIMatrix (except the plug coupler for the affected input) and isolating other potential voltage sources of the crosstalk. Test conductor insulation resistance to identify short circuits (Step 22).

16. Unable to download user programme or IP address

Downloading a user programme or IP address to HIMatrix requires specific tools and information covered by SMTH. This Faulting Step covers only hardware problems that might be encountered.

16.1 Check the laptop Ethernet cable for damage and replace.

16.2 Check if the HIMatrix has failed – move to Step 7.

APPENDIX A - Faulting Information

17. Check HIMatrix Status LEDs

All HIMatrix units have the same status LEDs. A full description of the function of each of these LEDs can be found in the location case diagrams alongside the HIMatrix analysis sheets. Table 4 highlights the principal error LEDs.

17.1 Check the HIMatrix status LEDs against the fault LED states listed in Table 4.

LED(s)	Illumination	Issue or Fault(s)
24V DC	Off	Power fault – go to Step 7.1.
Run	Blinking green	i. A new user programme is being loaded – no fault. ii. Temperature warning – go to Step 7.2.
Error	Steady red	Missing software licence or in test mode – not a maintenance fault.
	Blinking red	i. Power fault or hardware fault – go to Step 7. ii. Fault while downloading user programme - re-attempt download.
Prog	Steady yellow	A new user programme is being loaded – no fault.
	Blinking yellow	Reload is being performed – no fault.
Force	Steady yellow	Forcing is prepared – not a maintenance fault.
	Blinking yellow	Forcing is active – not a maintenance fault.
Fault	Blinking yellow	i. With Run LED steady green: HIMatrix I/O Fault – go to Step 11. ii. With Run LED blinking: fault while downloading user programme - re-attempt download.
OSL	Blinking yellow	Operating system loader active – no fault.
BL	Blinking yellow	i. Binary loader defective – not a maintenance fault. ii. Hardware fault – go to Step 7. iii. (F30 only) Communication fault with one or more F3s.
Prog & Force & Fault & OSL & BL	Blinking yellow	A duplicate IP address has been detected – go to Step 6.

Table 4 – HIMatrix status LED fault states

18. Check HIMatrix I/O LEDs

All HIMatrix I/O have yellow status LEDs reporting whether the I/O is on. The I/O LEDs are positioned directly above / below the I/O as illustrated in Figure 1.

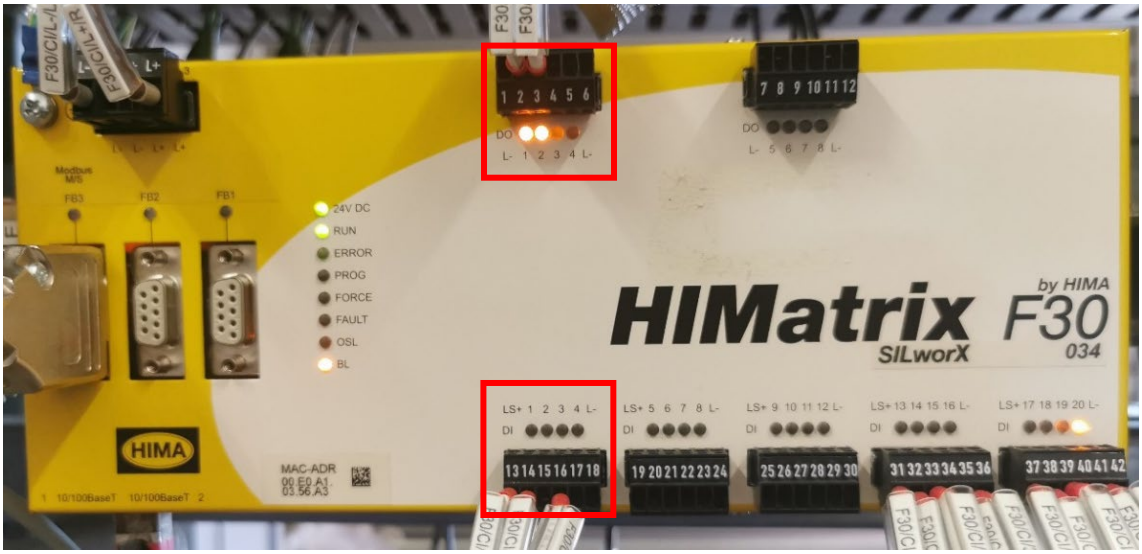


Figure 1 – HIMatrix Status LEDs

F30 outputs are all single pole.

F3 outputs are double pole but can also be configured as single pole with either the positive or negative leg of the circuit switched. The location case diagram HIMatrix analysis and wiring sheets depict whether an output is configured as double pole or single pole.

18.1 Check an output is on. Status LEDs are provided for each output pole. If the corresponding status LED is on, the output pole is switched on.

18.2 Check an input is on. Status LEDs are provided for each input. If the corresponding status LED is on, voltage is detected, and the input is on. For inputs with line control (Step 24), the input status LED will be on, but it is only recognised as on if no crosstalk is detected. If crosstalk is detected, the input will not be recognised as on and the HIMatrix Fault LED will blink (Step 17).

19. Check Ethernet port LEDs

Every HIMatrix Ethernet port has two LEDs as illustrated in Figure 2.

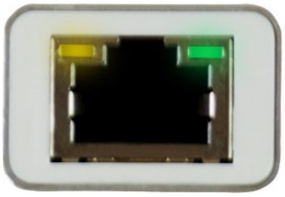


Figure 2 – Port with two LEDs

19.1 Check the Ethernet port LEDs to determine the status of the Ethernet port. The following LED states indicate faults:

a) Yellow LED on – connection available but no transmission or receiving communication. Indicates an F30 or F3 fault.

b) Yellow LED off – no connection available. Indicates an Ethernet cable or Ethernet switch fault.

c) Green LED off – only transmission or communication but not both. Indicates an F30 or F3 fault.

19.2 Ethernet switch port LEDs indicate:

a) Data “in” from the F30 “to” the switch.

b) Data “out” from the switch “to” the F3.

Figure 3 shows the unlit status LED for a failed connection between the switch and the F3 identified as “M01”.

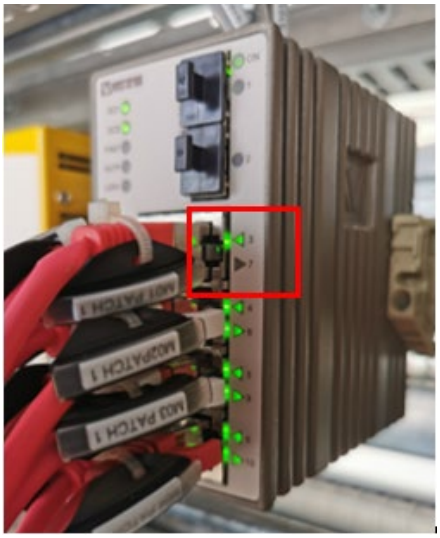


Figure 3 – Unlit Status LED

20. Check the data logger

The data logger has a touch screen display that is used to view logged functions. Logged functions are listed in the location case diagrams. Refer to the location case diagrams for whether there is an alarm for a logged function. If there is an alarm, the location case diagrams will also specify what function state corresponds to an alarm: on = UP or off = DN.

21. Test the power supply

All the PSU, HIMatrix and Ethernet components have status LEDs.

21.1 Check that one or more status LEDs, except a fault LED, are on. If so, then the component power supply is normal.

21.2 Check if a fault LED is on. If a fault LED is on, then test the supplying busbar voltage.

22. Test HIMatrix conductor insulation

22.1 Power off all equipment sharing the HIMatrix 24Vdc busbar supplying the affected HIMatrix. Disconnect all plug couplers from all HIMatrix sharing the same busbar.

22.2 Confirm all HIMatrix power ports and I/O are disconnected or isolated from every circuit conductor under test.

22.3 Remove flyback diodes from circuits being insulation resistance tested.

22.4 Using an insulation test meter, measure the resistance between the affected circuit and other circuits that are potential sources of the crosstalk voltage. If the resistance between any pair of circuits is less than 150kΩ locate the low insulation resistance and rectify.

22.5 Confirm flyback diodes are reinserted with the correct polarity bias when insulation resistance testing is complete.

The correct flyback diode polarity bias is shown in the location case diagrams.

23. Check HIMatrix I/O wiring

Each HIMatrix has wiring looms terminated in plug couplers that are inserted into the front plug coupler sockets.

23.1 Check the labelling on the wiring loom matches the identity of the HIMatrix in the location case diagrams and the I/O numbering on the front of the HIMatrix (Figure 4).

DIGITAL OUTPUT (DO) TERMINALS

ID	DES	FUNCTION	SHT	SAFE STATE	LINE MONITORING	COUPLER ID	PIN ID	W
9	1-	(YO) (BOOM) EN	W06	ON	NOT USED	M03-09-16	01	1
10	1+	(YO) (BOOM) E	W06				02	1
11	2-	(YO) ZRN	W06	OFF	NOT USED		03	1
12	2+	(YO) ZR	W06				04	1
13	3-	(YO) RE(L) N	W10	ON	INDUCTIVE		05	1
14	3+	(YO) RE(L)	W10				06	1
15	4-	(YO) RE(R) N	W10	ON	INDUCTIVE		07	1
16	4+	(YO) RE(R)	W10				08	1
17	5-	(YO) HEN	W10	OFF	INDUCTIVE	M03-17-24	01	1
18	5+	(YO) HE	W10				02	1
19	6-	SPARE	-	-	-		03	-
20	6+	SPARE	-				04	-
21	7-	(YO) (VALVE) N	W06	OFF	NOT USED		05	1
22	7+	(YO) (VALVE)	W06				06	1
23	8-	SPARE	-	-	-		07	-
24	8+	SPARE	-				08	-

Figure 4 – Wiring Loom and Location Case Diagram

24. Check if a HIMatrix circuit is provided with line control

Line control is present on a circuit if:

a) The circuit is an input and

b) The “BIT CHK” column in location case diagram HIMatrix analysis sheets (Figure 5) have an entry next to the input of “T1” or “T2” for F3s and “T1” or “T2” or “T3” etc. for F30s.

DIGITAL INPUT (DI) TERMINALS

ID	DES	FUNCTION	BIT CHK	SHT	COUPLER ID	PIN ID	W
13	LS+	DI3 B	X	P01	I/L-13-18	01	1
14	1	(TECH RESET)	=T1	T07		02	1
15	2	SPARE	-	-		03	-
16	3	(PO)	-	P01		04	1
17	4	SPARE	-	-		05	-

Figure 5 – HIMatrix Analysis Sheets

Line control inputs to F3s are always in pairs using the T1 and T2 power supply sources on the F3 and both inputs must be on for the HIMatrix system to detect the state of the object.

25. Check if a HIMatrix circuit is provided with anti-valence proving

Some critical interface relays may be input to HIMatrix using both a front contact and a back contact of the relay. This pair of inputs is cross proved by HIMatrix. This is called anti-valence proving. Anti-valence proving is present on a pair of circuits if:

a) The circuits are inputs.

b) The “BIT CHK” column in location diagram HIMatrix analysis sheets have an entry next to the inputs of <>#, where # is the number of the other cross proved input circuit. See Figure 6.

DIGITAL INPUT (DI) TERMINALS

ID	DES	FUNCTION	BIT CHK	SHT	COUPLER ID	PIN ID	W
33	LS+	DI1-2 B		R01	M07-	01	1
34	LS+	DI3-4 B		R01	33-42	02	1
35	1	8812 TP	<>2	R01		03	1
36	2	8812 TPZ	<>1	R01		04	1
37	3	9013 TP	<>4	R01		05	1
38	4	9013 TPZ	<>3	R01		06	1
39	L-	NOT USED		-		07	
40	L-	NOT USED		-		08	
41	PA	NOT USED		-		09	
42	PA	NOT USED		-		10	

Figure 6 - HIMatrix Analysis Sheets

Anti-valence inputs status LEDs must not be both simultaneously on or off (except briefly as the relay picks or drops) – this indicates a circuit fault.

26. Check if a HIMatrix circuit is provided with line monitoring

Line monitoring is present on a circuit if the circuit is connected to an F3 and the location case diagrams HIMatrix analysis LINE MONITORING column has an entry of “INDUCTIVE” or “CAPACITIVE”. See Figure 7.

DIGITAL OUTPUT (DO) TERMINALS

ID	DES	FUNCTION	SHT	SAFE STATE	LINE MONITORING	COUPLER ID	PIN ID	W
9	1-	(YN)(BOOM)EN	W04	ON	NOT USED	M01-	01	1
10	1+	(YN)(BOOM)E	W04			09-16	02	1
11	2-	(YN)ZRN	W04	OFF	NOT USED		03	1
12	2+	(YN)ZR	W04				04	1
13	3-	(YN)RE(L)N	W08	ON	INDUCTIVE		05	1
14	3+	(YN)RE(L)	W08				06	1
15	4-	(YN)RE(R)N	W08	ON	INDUCTIVE		07	1
16	4+	(YN)RE(R)	W08				08	1

Figure 7 - HIMatrix Analysis Sheets

27. Check HIMatrix identity wiring I/O

Identity wiring for F30s and F3s is shown in the HIMatrix location case diagrams “Module ID / Data Version” sheets. For each HIMatrix, one or more straps shall connect either an LS+ or T1/T2 supply to inputs.

27.1 For every HIMatrix identity input connected by a strap to one of these supplies, check:

a) The corresponding input status LEDs are on.

b) All other input status LEDs are off.

c) Check the data logger has no IP X-TALK alarm.

In the example below (Figure 8), the LEDs for inputs 13, 15 and 16 should be on.

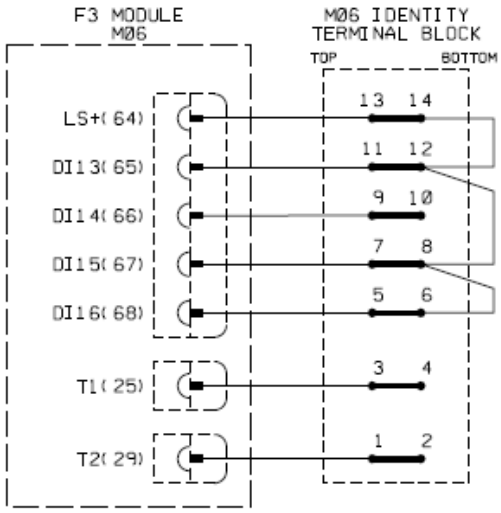


Figure 8 - Example

END

INTRODUCTION

This Faulting Guide is for a HIMatrix manually controlled barrier Level Crossing (LC). It should be used in conjunction with NR/SMTH/Part10/FF28, which provides guidance for general faulting of HIMatrix.

The HIMatrix manually controlled barrier Level Crossing uses standard Level Crossing lineside equipment. Faulting of standard Level Crossing lineside equipment is not covered by this Faulting Guide.

GENERAL

Before handling any electronic equipment observe electrostatic discharge precautions.

Protection / Possession arrangement shall be taken before commencing work on a HIMatrix Level Crossing system.

Before powering down a HIMatrix unit or Ethernet switch or disconnecting any plug coupler or Level Crossing equipment, inform the Signaller as to the effect on the operational railway.

DEFINITIONS

Term or Abbreviation	Definition
Crosstalk	Two circuit conductors that should be electrically insulated become electrically connected by a short circuit or earth fault. This includes positive and negative conductors of the same circuit.
HIMatrix	Either an F30 or an F3.
LC	Level Crossing.
LCU	Local Control Unit.
RTL	Road Traffic Light.

Table 1 – Definitions

1. Has a fault been reported in response to a Signaller's LC alarm? If yes:

1.1 Refer to the Fault Alarms and Indications Control Table in the location case diagrams to determine the possible failures to investigate.

2. Has a fault been reported in response to a data logger alarm? If yes:

2.1 Refer to the Fault Alarms and Indications Control Table in the location case diagrams to determine the possible failures to investigate.

3. Does the fault report have only an incomplete or unclear description of the failure? If yes:

3.1 Operate the LC and observe which LC equipment does not operate in accordance with the Level Crossing Control Table.

4. Is there a failure of LC lineside equipment to operate? If yes:

4.1 If a HIMatrix has been replaced or powered off, confirm the LCU switch was in the Hand / Lower position when the LC was set to work. If the LCU switch was not, return the LC to local control by switching the LCU to Hand / Lower and then switch it to Normal / Stop.

4.2 Do some, but not all, of the LC equipment not operate as expected? If so, identify the affected LC equipment output circuit and controlling HIMatrix and investigate:

a) Carry out NR/SMTH/Part10/FF28 – Step 3 - HIMatrix status LED faults and errors.

b) Carry out NR/SMTH/Part10/FF28 - Step 8 - Ethernet switch fault.

c) Carry out NR/SMTH/Part10/FF28 - Step 12 - HIMatrix output circuit off fault (if it is not switching on).

d) Carry out NR/SMTH/Part10/FF28 - Step 13 - HIMatrix output crosstalk circuit fault (if it is not switching off).

4.3 Does the LC not operate in response to a specific button or switch? If so, identify the affected LC input circuit and controlling HIMatrix and investigate:

a) Carry out NR/SMTH/Part10/FF28 - Step 3 - HIMatrix status LED faults and errors.

b) Carry out NR/SMTH/Part10/FF28 - Step 8 - Ethernet switch fault.

c) Carry out NR/SMTH/Part10/FF28 - Step 14 - HIMatrix input open circuit fault.

4.4 If no fault is found with the operating switch or button, refer to the Level Crossing Control Table and check all other button, switch, and interface relay (including track circuits) input status LEDs are on or off as required. Take account of line control and anti-valence proving, when inspecting input status LEDs.

a) Carry out NR/SMTH/Part10/FF28 - Step 24 - Check if a HIMatrix circuit is provided with line control.

b) Carry out NR/SMTH/Part10/FF28 - Step 25 - Check if a HIMatrix circuit is provided with anti-valence proving.

Identify the relevant button, switch and interface relay input circuits and controlling HIMatrix and investigate:

c) Carry out NR/SMTH/Part10/FF28 - Step 3 - HIMatrix status LED faults and errors.

d) Carry out NR/SMTH/Part10/FF28 - Step 8 - Ethernet switch fault.

e) Carry out NR/SMTH/Part10/FF28 - Step 12 - HIMatrix output circuit off fault (if it is not switching on).

f) Carry out NR/SMTH/Part10/FF28 – Step 13 - HIMatrix output crosstalk circuit fault (if it is not switching off).

5. Has a fault been reported in response to a signal failing to clear? If yes:

5.1 Refer to the location case diagrams Signal Control Table and the signal circuits to determine which interface relays are needed for the signal to clear. Identify which relays are not in the required up or down state and investigate:

a) Carry out NR/SMTH/Part10/FF28 - Step 3 - HIMatrix status LED faults and errors.

b) Carry out NR/SMTH/Part10/FF28 - Step 8 - Ethernet switch fault.

c) Carry out NR/SMTH/Part10/FF28 - Step 12 - HIMatrix output circuit off fault (if the relay is not up when expected).

d) Carry out NR/SMTH/Part10/FF28 - Step 13 - HIMatrix output crosstalk circuit fault (if the relay is not down when expected).

6. Has a fault with the red road traffic light(s) fault been reported but no fault found? If yes:

6.1 Check the Technician Reset button has been pressed. Press again and check it is detected by the HIMatrix unit.

6.2 Check the failed RTL LED module shunt resistor is installed as per the location case diagrams. If it is missing, replace it.

7. Has a fault been rectified but the Signaller's Failed/Local indication and alarm remain operated? If yes:

7.1 Check that the LC barriers have been fully raised or fully lowered to reset the fault indication.

7.2 Check the Technician Reset button has been pressed. Press again and check it is detected by the HIMatrix unit.

END