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END

General

These systems have one type (DEK43) of rail mounted wheel detectors (heads). Wheel detection is provided by two different types of systems: ZP 43V Analogue (the original type) and ZPD 43 Digital.

The differences are limited to the components and method of operation of the equipment within the trackside connection box.

The voltages and frequencies transmitted between an axle counter evaluator and the ZP 43V and the ZPD 43 wheel detection systems are essentially the same

Currently two different AzS axle counter evaluator systems are in use on Network Rail infrastructure; these are the AzSM (E) and the AzS 350U.

Overview - Siemens (AzS series) Axle Counters

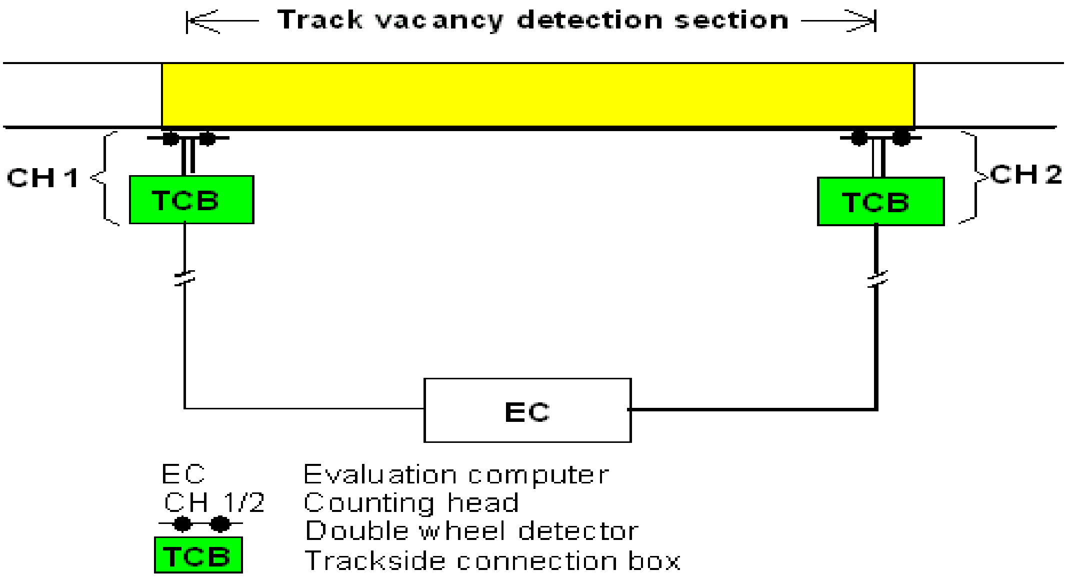


Figure 1 - Layout of Wheel Detection Equipment and associated components

The Wheel Detection Equipment consists of a rail mounted double wheel sensor and equipment within the trackside connection box that provides an output to the axle counter evaluator.

The DEK 43 consists of two detectors mounted in one unit on one rail that detects the passing wheels of the vehicles. As they pass, the wheels influence the electromagnetic field between the transmitter and the receiver of each detector; this alters the voltage induced in the receiving coil of the detector.

This voltage is converted by the trackside connection box to frequency/amplitude–modulated signals, which are transmitted to the evaluation computer.

The Evaluation Computer used can be either a AzSM (E) or a AzS 350U system. The ZAN card (in the AzSM (E)) or the VESBA card (in the AzS 350U) converts the signals from wheel detection equipment into a series of logic pulses so that the microprocessor in the evaluation computer can determine the train's direction of travel & the number of axles.

The Evaluation Computer interprets the signals transmitted by the counting heads. It then compares the numbers of axles, which have entered and left a track vacancy detection section to determine whether that track vacancy detection section is clear or occupied.

In the case of the AzS 350U evaluator the clear/occupied state of each track vacancy detection section determines whether the corresponding TR (track relay) is energised or de-energised, while the AzSM (E)) transmits the states of the track sections directly to the interlocking via the IL bus.

Up to 16 counting heads (ZP 43 V units) can be connected per evaluation computer in the AzSM (E) system. The AzS350U can have up to 5 counting heads (ZP 43 V units) connected per evaluation computer

DEK 43 Double Wheel Detector

The DEK 43 Double Wheel Detector consists of two electronic sensors. Each sensor (detector) has a transmitter and a receiver section.

The transmitter housing is located on the outer side of the rail, the receiver housing being on the gauge side of the rail.

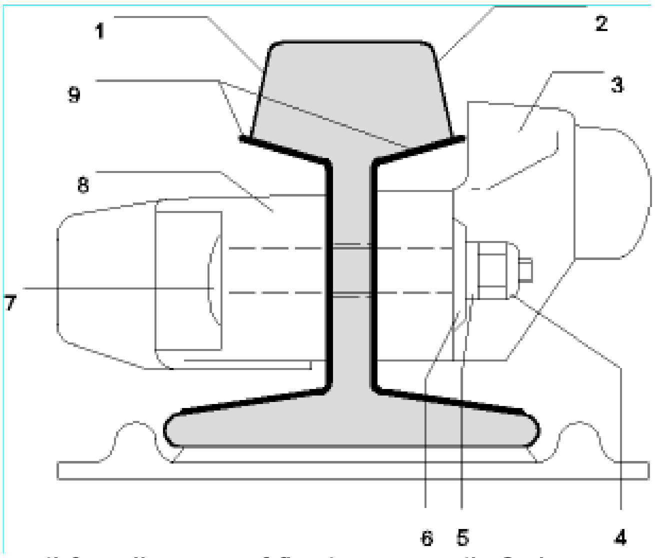
To prevent interference from the rail (due to track return currents), a reducing plate is fitted to both the transmitter & receiver.

The reducing plate is mounted on the side facing the rail. It is matched to the rail profile and reaches from the rail base across the web to below the railhead.

The double wheel detector is attached to the neutral zone of the rail web by two bolts.

DEK 43 Components

1. Gauge side of rail.
2. Outer side of rail.
3. Transmitter.
4. M12 prevailing-torque hexagon nut.
5. Spring washer.
6. Square washer.
7. Mushroom-head bolt.
8. Receiver.
9. Reducing plates.



Reduction plates are fitted to both sides of the rail for all types of flat bottom rail. Only one reduction plate is fitted on the receiver side for all types of Bull head rail.

ZP 43V Wheel Detection Equipment

This is used on the AzSM (E) and AzS 350U systems.

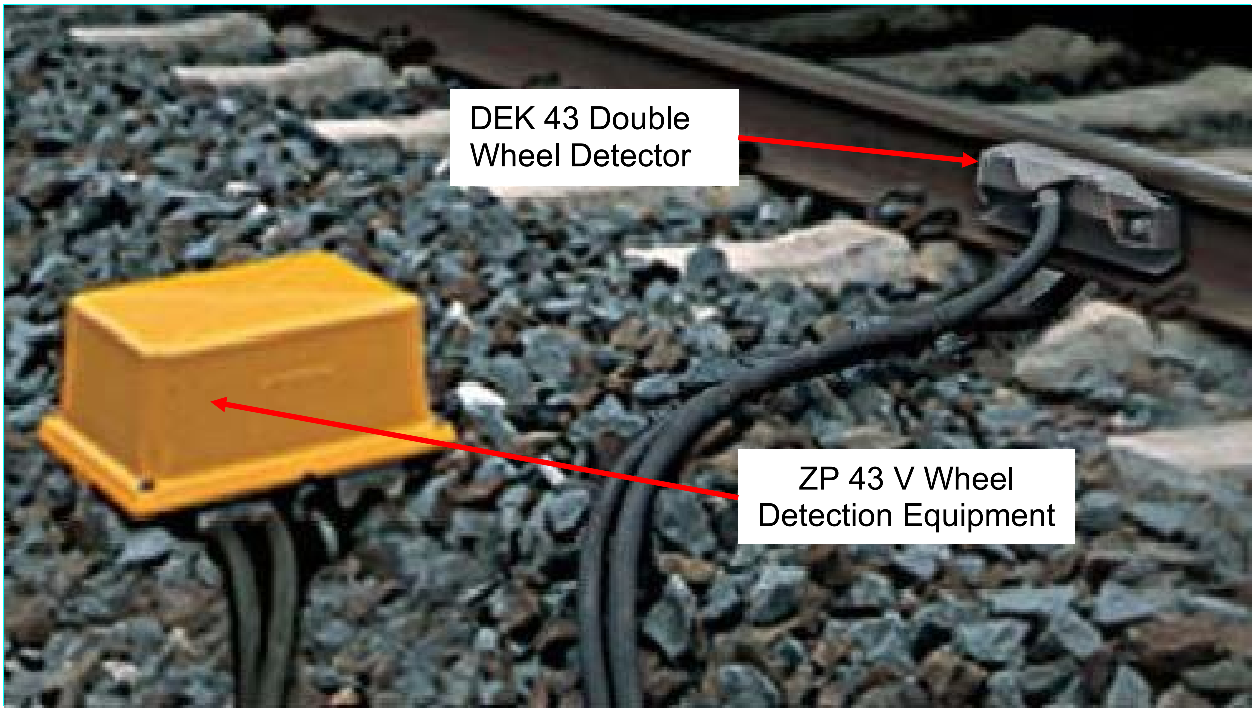


Figure 2 - ZP 43 V Wheel Detector Equipment

This equipment consists of a double wheel sensor (two detectors mounted in one unit on one rail) that detects the passing wheels of the vehicles. As they pass, the wheels influence the electromagnetic field between the transmitter and the receiver of each detector; this alters the voltage induced in the receiving coil of the detector.

This voltage is converted by the trackside connection box to frequency/amplitude–modulated signals, which are transmitted to the evaluation computer.

The ZAN card (in the AzSM (E)) or the VESBA card (in the AzS 350U) then converts these signals in to a series of logic pulses so that the microprocessor can determine the train’s direction of travel & number of axles.

The equipment within the trackside connection box consists of vertical backplane with connectors where all incoming wires are terminated.

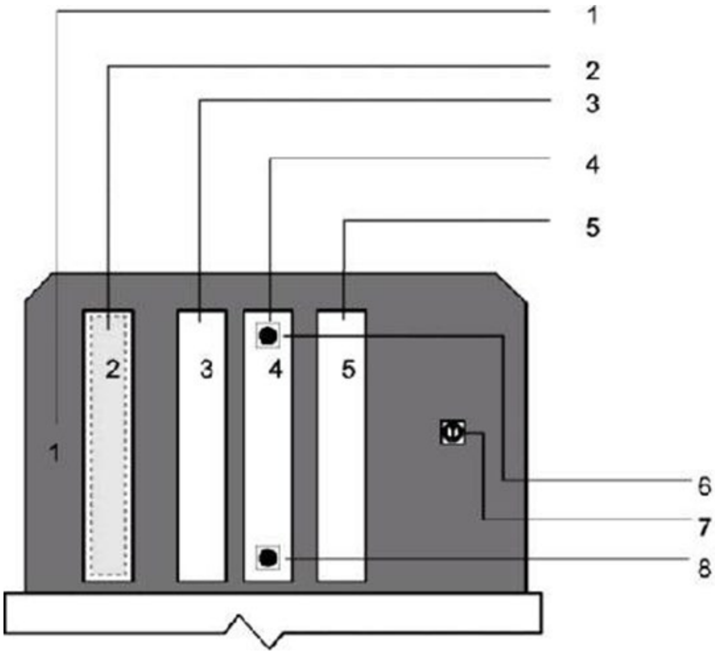
The backplane provides four circuit board connectors into which circuit boards can be plugged. Connector 3 is used for the Band Pass Filter board and connector 4 is used for the Generator board.

When it is necessary to take measurements, the PEGA 1121 test set is plugged into connector 2 (on the left hand side).

When adjustments have to be made during set-up and maintenance, this is done using potentiometers on the cards and on the backplane.

ZP 43 V Internal Layout

1 Wiring backplane.
2 Connection for WDE service equipment.
3 Band-pass filter board.
4 Generator board with adjusting control for signal frequencies.
5 Double-usage board.
6 Adjusting control for signal frequency f2(6.52 kHz)
7 Rotary switch for transmitting frequency (43 kHz)
8 Adjusting control for signal frequency f1(3.60 kHz)



Test Equipment

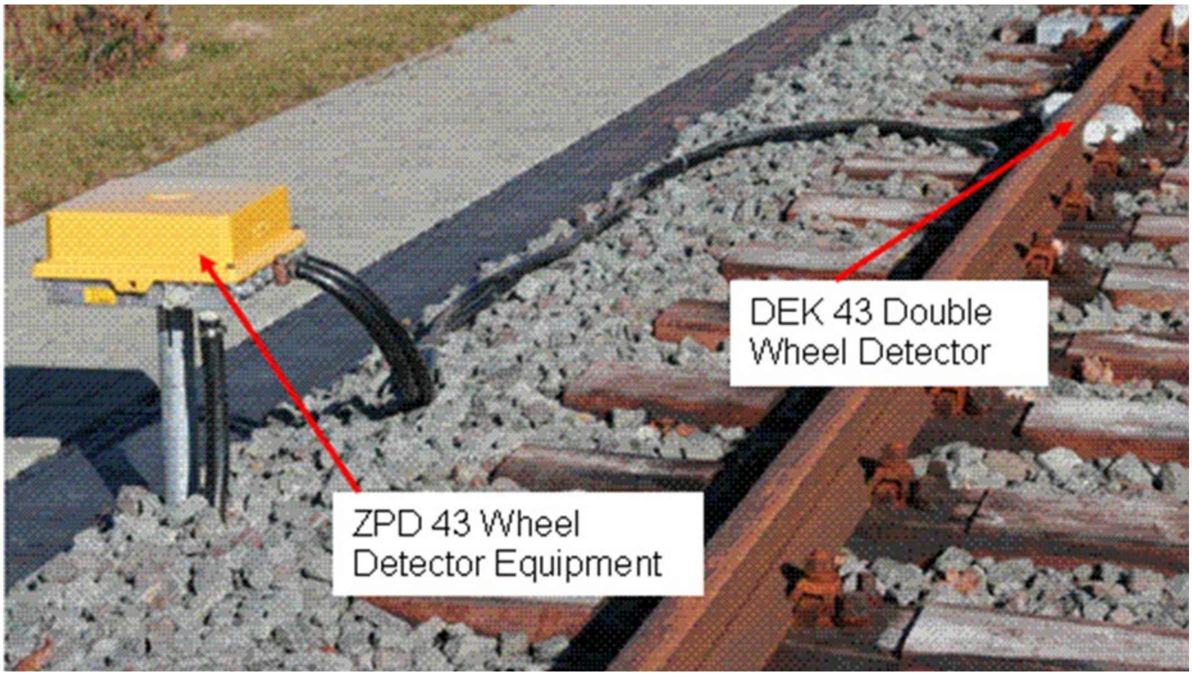
The PEGA 1121 test set is used for testing the ZP 43V.

1 Display
2 Test socket, positive input
3 Test socket, negative input
4 Round socket for WDE adaptor (WDE = Wheel Detector Equipment)
5 Display illumination, on/off
6 Operating mode/function indicator
7 Operating mode selector
8 Confirmation
9 Previous function/next-lower frequency
10 Next function/next-higher frequency

Check that the “ZP43” mode has been selected on the PEGA 1121 test set Check that the switch on the plug-in module has been set to “ZP43” (down) (The setting of the rotary switch is immaterial)

ZPD 43 Wheel Detection Equipment

This is used on the AzSM (E) and AzS 350U systems.



ZPD 43 Wheel Detection Equipment

This equipment consists of a double wheel sensor (two detectors mounted in one unit on one rail) that detects the passing wheels of the vehicles.

As they pass, the wheels influence the electromagnetic field between the transmitter and the receiver of each detector; this alters the voltage induced in the receiving coil of the detector.

This voltage is converted by the trackside connection box to frequency/amplitude–modulated signals, which are transmitted to the evaluation computer.

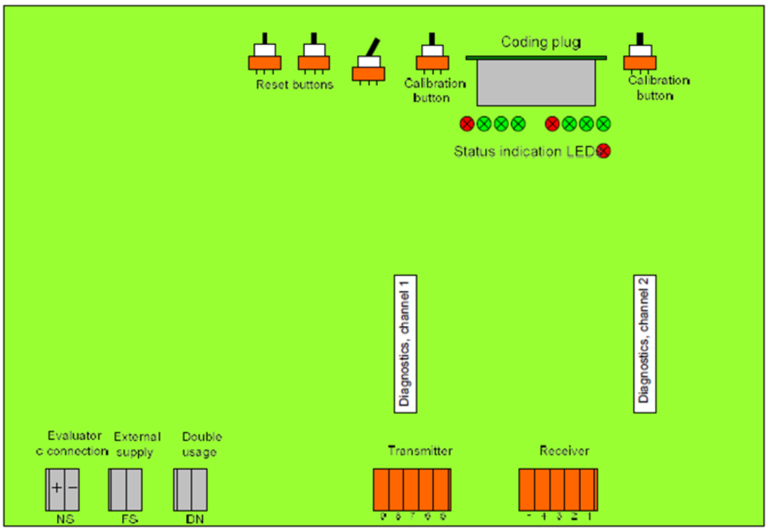
The ZAN card (in the AzSM (E)) or the VESBA card (in the AzS 350U) then converts these signals in to a series logic pulses so that the microprocessor can determine the train's direction of travel & number of axles.

The equipment within the trackside connection box consists of a single horizontal circuit board with connectors where all incoming wires are terminated, and on which the coding (identity) plug is located.

When it is necessary to take measurements, these are taken at the connector terminals, using an approved meter (Fluke 187 or similar).

When adjustments have to be made during set-up and maintenance, this is done using the pushbuttons this circuit board. The process is automated with no manual adjustments required.

ZPD 43 Internal Layout



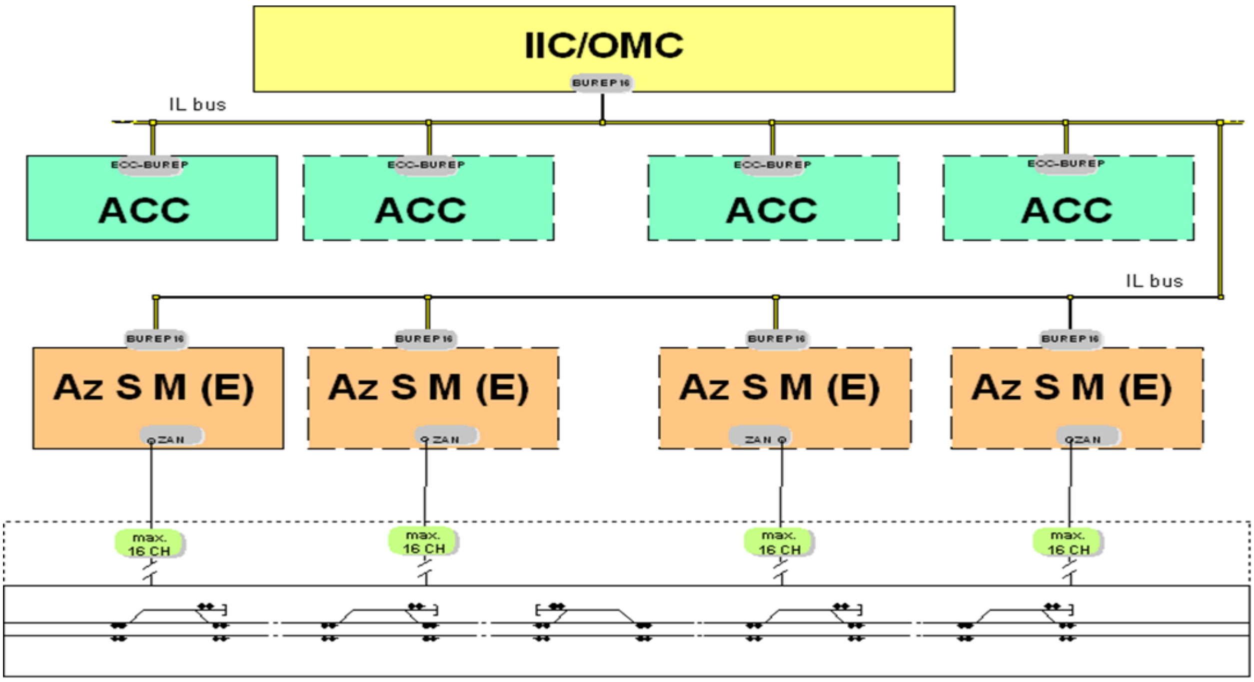
Test Equipment

All measurements are to be taken using an approved true RMS meter with frequency scale and with an internal resistance ≥ 50 kΩ (e.g. Fluke 187).

AzSM (E) Systems

The AzSM axle counter is a microcomputer based system with a multiple section evaluation computer for the track vacancy detection of track sections. The AzSM (E) variant is designed to interface with the Siemens SIMIS-W interlocking:

AzSM (E) System Architecture



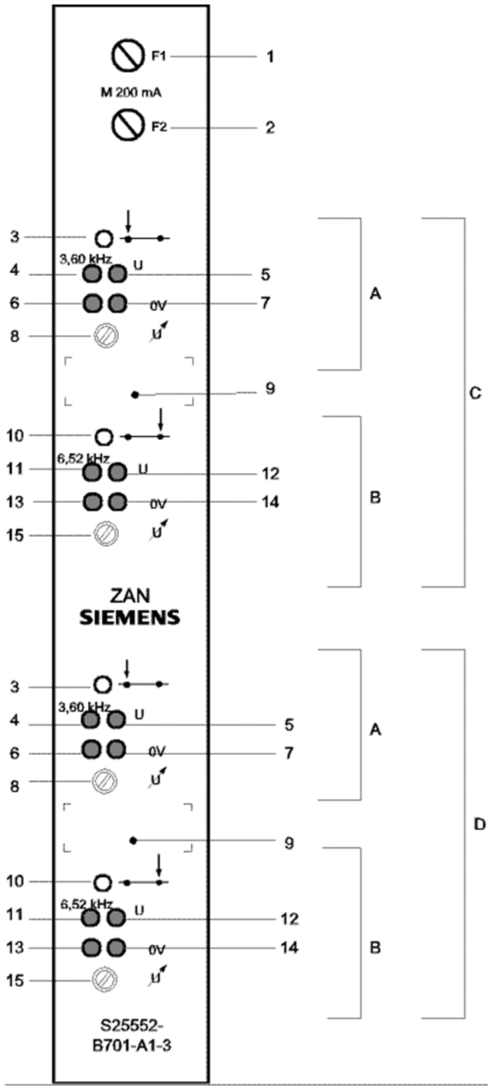
Abbreviation	Meaning
IIC/OMC	Overhead computer
ECC-BUREP	Element Control Computer interface board between computer & bus
BUREP	Interface board between computer bus
IL Bus	Interlocking Bus
ACC	Area Control Component (computer)
AzSM (E)	Axle counting system for multiple sections

Structure/Function

The AzSM (E) Axle Counting System consists of two main components:

a) Indoor system: evaluation computer (EC). The hardware is based on the SIMIS 3216 computer, connected to the ACC via the IL bus.
b) Outdoor system: ZP 43V Wheel Detection Equipment.

Evaluation Computer Test Points & Indications



Key to Test Points & Indications		
No.	**Item**	**Comment**
A	System 1	
B	System 2	
C	Counting Head 1	(System 1 & 2 of double wheel detector)
D	Counting Head 2	(System 1 & 2 of double wheel detector)
1	M 200mA	Fuse, counting head1
2	M 200mA	Fuse, counting head 2
3	LED Yellow	System 1 of double wheel detector being traversed.
4	Test Socket	F1 = 3.60khz +/- 0.05 KHz (frequency adjustment at
5	Test Socket	Voltage U1 = 3.0V DC +/- 0.10v
6 & 7	Test Socket	0v sockets for both systems.
8	Potentiometer	Voltage adjustment to 3.0 V DC +/- 0.10V
9	Space for Label with CH	
10	LED Yellow	System 2 of double wheel detector being traversed
11	Test Socket	f2 = 6.52khz +/- 0.10 KHz (frequency adjustment at counting head)
12	Test Socket	Voltage U2 = 3.0v +/- 0.10v
13 & 14	Test Socket	0V socket for both systems
15	Potentiometer	Voltage adjustment to 3.0 V DC +/- 0.10V

AzSM (E) - Reset & Restore Procedures

The re-set and restore of the Siemens AzSM (E) axle counter is performed by the signaller.

The reset & restore procedure can be performed only when:

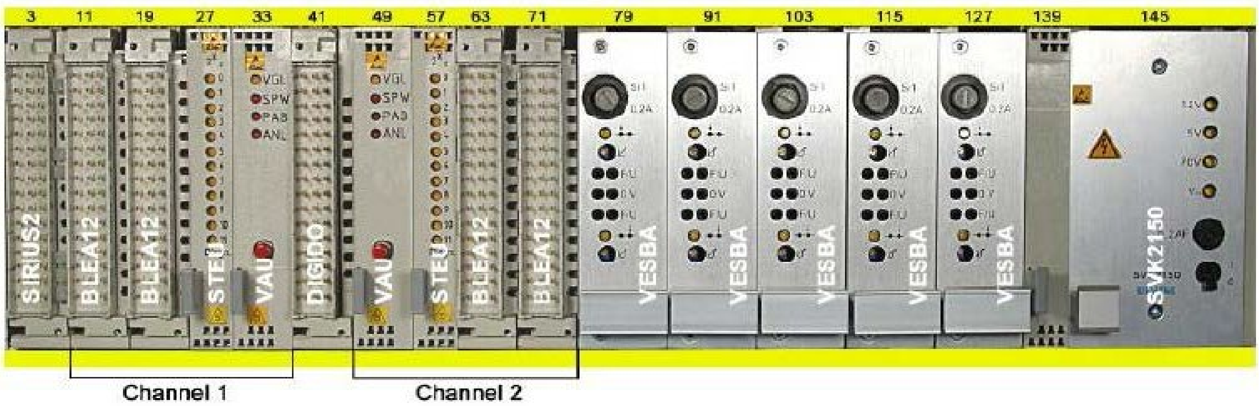
a) An axle counter section remains occupied after the passage of a train when the track section is "clear" or
b) Requested by the technician if the elements are indicated as being occupied when the axle counter section (s) is 'clear' (e.g. after the restart of an evaluation computer (EC) due to failure or maintenance work or after other faults)

The axle counter reset & restore procedure is split into the following stages:

a) Applying protection
b) Resetting the section
c) Restoration to normal working

AzS 350U Systems

AzS 350U ACE rack



The system can evaluate up to four track sections.

Structure/Function

The AzS 350U Axle Counting System consists of two main components:

a) Indoor system: evaluation computer (EC). The hardware is based on the 8085 microprocessor VAU board microcomputer system.
b) Outdoor system: ZP 43 Wheel Detection Equipment.

Evaluator Computer

This interprets the signals transmitted by the ZP 43 wheel detection equipment. It can connect to five ZP 43s directly and a further six remotely via two other evaluator computers. It compares the number of axles entering and leaving a tack section and outputs the track section state via voltage free contact relays. The evaluator computer can also be used as a transmission system for vital signal functions.

Before removing any board reference should be made to the Siemens maintenance manual. Following the correct removal/re-fitment procedures is critical to the operation of the axle counter.

AzS 350U - Reset, & Restore Procedures

The re-set and restore of the Siemens AzS 350U axle counter is performed by the signaller.

The reset & restore procedure can be performed only when:

a) An axle counter section remains occupied after the passage of a train when the track section is “clear” or
b) Requested by the technician if the elements are indicated as being occupied when the axle counter section (s) is ‘clear’ (e.g. after the restart of an evaluation computer (EC) due to failure or maintenance work or after other faults)

The axle counter reset & restore procedure is split into the following stages:

a) Applying protection
b) Resetting the section
c) Restoration to normal working

End

Contents

1 T72 POINT MACHINE

1.1 General Information

Any deficiency or failure, which could affect the safe running of trains or the integrity of the signalling system, shall be reported to the signaller immediately.

Before working on points:

- Set up possession and protection arrangements with the signaller.
- Check that a route cannot be set over the points being worked on (staff and safety of trains). This requires the implementation of a safe system of work which may include:
- Provision of a point operator at the controlling point.
- Verify the point end by asking the signaller to swing the points prior to starting work.
- A locally documented procedure.

1.1.1 Defects

Defects that could affect the safe operation of trains shall be advised to the signaller immediately.

Defects should be repaired as soon as possible. Where not rectified at the time, inform your SM (S).

If the point identification number is displayed on the detachable lid instead of on the machine body, check that when working on adjacent machines the lids are not inadvertently swapped. Incorrect point identification may result.

1.2 Mechanical Information

The Ansaldo Signal (CSEE Transport) type T72 point machine has a cast iron body which houses the control module, motor, and gear train with integral clutch. A lip is incorporated along each side of the machine body to enable it to be carried ‘stretcher style’ with two crowbars.

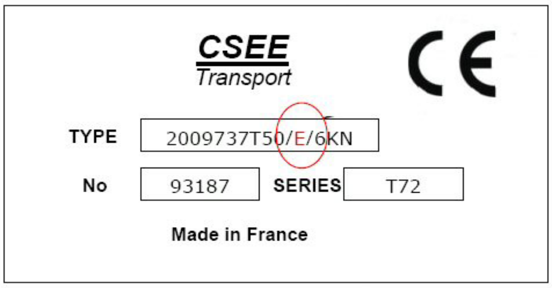
The separate steel lid is normally secured with four quick release clips, two of which can be secured with padlocks. However, to provide a more robust means of securing the machine against unauthorised access, the lid has been fitted with two lugs which engage the slotted blocks fitted to the machine body. A hasp and staple has also been fitted and is secured with an RKB221 padlock. A second RKB221 may be fitted to one of the quick release clips.

An RKB222 padlock is fitted to the crank handle access lever bracket.

In addition to the RKB222 padlock, the crank handle access lever is also secured by a fixed lock operated by a barrel type key. The fixed lock shall also be unlocked to allow the lever to be moved to the '*Hand'* position. The key is captive in the lock until the lever is restored and locked in the '*Motor'* position.

When the lid is removed, put it in a place of safety, preferably under cover or face down to prevent accumulation of rain, dust, grit, or foreign bodies in the cover being inadvertently transferred to the machine.

The first version of the point machine supplied to the UK had a 4.7 kN clutch setting, an internal diode, a thermostat plate that restricted the access to the fourth motor brush and a wiring anomaly. These machines have been superseded by machines with a 6 kN setting to meet the requirements for operating RT60 layouts and have been modified to remove the diode, provide an alternative thermostat mounting plate which allows access to the fourth motor brush and corrects the wiring anomaly. 6 kN machines are identified by means of the identification plate on the outside of the machine as follows:



Point machine label showing version E and 6 kN

Only machines with labels as shown above bearing the version E and 6 kN markings can be used. Any machines found without these labels or with other than version E and 6 kN shall NOT be used and your SM (S) shall be informed immediately so the machine may be placed in quarantine until it can be returned to the servicing agent or manufacturer.

1.2.1 Fixing

Four lugs each with a 20 mm diameter hole.

1.2.2 Size

750 mm (L) x 620 mm (W) x 215 mm (H)

1.2.3 Weight

150 kg

1.2.4 Throw

The throw of the machine can be adjusted between 105 mm and 260 mm by loosening the drive arm clamp and shortening or lengthening the drive arm as required. See Ansaldo Signal – T72 Point Motor DC Permanent Magnet Type - Manual 2 - Installation and Use – section 6.5 - Setting and Adjusting the Throw.

The drive arm clamp is secured with two hexagonal head screws locked with tabs on a common tab washer plate.

The tab washer plate shall be renewed every time the tabs are bent away to permit loosening / removal of the hexagonal headed screws (i.e. the tab(s) shall not be re-used).

The required drive rod varies according to the point layout on which it is being used. The drawings detail the components required for each layout.

1.2.5 Balance

The balance of the throw can be adjusted by shortening or lengthening the drive rod, such adjustment is necessary, in conjunction with the adjustment of the throw of the machines, to check that the correct switch openings are achieved.

1.2.6 Mid stroke indication

The point machine is in the mid stroke position when the line or groove on the output shaft is aligned with the pointer on the machine nose. Some machines may have spots of red paint as alignment indicators.

1.2.7 Drainage

A water drain device is fitted adjacent to the gear wheel assembly. A screw driver is required to open it. The device should be closed when drainage is complete.

If the machine has been flooded or is suspected of having been flooded, then the complete machine shall be replaced and the ‘flooded machine’ returned for refurbishing.

1.3 Electrical Information

1.3.1 External connection

Either a single 3 m or 5 m length of CMA 24 cable terminated with plug couplers connects the machine to the junction box. The threaded connector ring at the point machine end is tightened with a hook spanner. Provision is made for fitting locking wire. The armour cable sheath is secured to the plug coupler body with a worm drive clip.

During transit the plug coupler sockets are fitted with protective caps.

Before connection, especially if replacing a machine check that the plug coupler is free of any debris and contamination.

1.3.2 Internal connection

The internal cable connections are secured with ‘Faston’ clips. However, no internal connections are required to be made during installation or removal of the machine.

1.3.3 Motor

DC permanent magnet type motor operating between 90 volts dc to 170 volts dc. The control module restricts the current delivered to the machine to 7A, so that the 7A rating of the motor contacts is not exceeded.

The control module cuts off the power supply to the motor when the current falls to zero as a result of the internal control contact in the T72 opening when it nears the end of its travel. The control circuit includes a timer that cuts the current after between 6 - 9 seconds if the contacts have not opened in this time.

The T72 clutch protects the motor between encountering an obstruction and the timer becoming effective.

The motor cannot be replaced on site.

1.3.4 Motor brushes

The motor is fitted with four brushes. Each spring loaded brush assembly is retained by a threaded plug slotted to accept a wide blade screwdriver or coin. The brush cap may require assistance to ‘pop-up’ if the side arms bind in the brush guide slots.

When a brush has worn to the minimum permitted length (8 mm), renew it.

1.3.5 Heater

A thermostatically controlled 100 W (at 110 V) heating resistor is fitted to the gear train cover plate.

1.3.6 Clutch

A friction type clutch, mounted in the reduction gear assembly, absorbs the inertia of the motor and gears as the motor starts and stops or in the event of an obstruction preventing closure.

The clutch cannot be adjusted or serviced on site.

1.3.7 Isolation

Moving the selector lever from *‘Motor’* to *‘Hand’* causes an internal isolation switch to operate and permits access for the point crank handle.

1.3.8 Manual operation

Manual operation is via a spring loaded shaft fitted with a small gear wheel. The spring checks that the gear wheel is disengaged from the motor driven gear train when not required. Consequently, the crank handle should be pushed in during manual operation to keep the small gear wheel engaged with the main gear.

Non-UK versions of the T72 are manually operated by a long lever which is normally secured flat to the ground by a padlock. The crank handle is provided for the UK version of the T72, but the claw type clutch / bevel gear assembly for manual operation by lever remains. This is engaged and operates during manual operation.

1.3.9 Heater or Thermostat - replacement

If the heater and / or thermostat are replaced their correct operation shall be checked (NR/SMS/Test/170).

1.4 Spares and Replacements for the T72 Point Machine)

The following components can be replaced on site:

Component	CSEE Transport Part Number
Motor brushes	6520403-00 (electric motor reference)
Drive arm	6520354-01
Lid	2012491
Heater kit	6522389-10
Thermostat	6004122-00
Crank handle	2010063

Other components may be specific to the particular layout on which it is used. The drawings detail the replacement components required for specific layouts.

1.5 Tools

Open-ended spanner – 27 mm.

Hexagonal sockets – 24 mm and 27 mm.

‘Hook’ spanner (plug coupler) ‘FACOM’ – number 125 – 120.

Grease gun with Tecalmit type fitting

Other tools required include hammer, small drift (for securing washer tabs), combination pliers, insulated metre rule, and screwdriver (water drainage screw).

1.6 Torque Values

Component	Torque Values
Bolt and castellated nut connecting each crank control arm to coupling rod	15 Nm (maximum)#
T72 point machine fixing bolts	110 ± 10 Nm

#: If, when the nut has been tightened to 15 Nm, the security split pin cannot be fitted, the nut should be carefully slackened to align the first available slot with the hole in the bolt.

1.7 Lubricants

Lubricant	CSEE Transport part number
'SHELL' Rimula C oil for diesel engine Viscosity SAE 20W-40	6004075-00
'SHELL' Retinax HD Grade 2 grease – Multipurpose grease (blue)	6004075-00

The named lubricants shown above are recommended by the equipment manufacturer. Equivalent lubricants may be used.

2 COGIFER VCC LOCK & DETECTION MECHANISM

2.1 VCC Lock

2.1.1 Lock Mechanism

The VCC lock mechanism for the Network Rail applications are supplied to fit 113lb FB, UIC54, and RT60 rail sections. These three types are identified as follows:

The P80 version is used on full depth switch rails (113lb).

The M89 version is used on shallow depth switch rails (UIC54).

The M80 version is used for RT60/NR60 layouts.

The version of the VCC is stamped on the C-arm and adjacent to the entry hole for the "hammer head bolt" on the inside of the body of the VCC itself.

They differ in the switch rail fittings, the design of the switch rail bracket being the most obvious difference. The M80 and M89 bodies are similar but the RT60 version is for inclined rail and the UIC54 for vertical.

Check that the correct components for the particular configuration are available to suit the particular site requirements before starting work.

A left and right hand assembly is required for each installation. The handing is embossed on the lock body casting adjacent to the hole in the web that fits to the rail. 'G' Gauche - Left hand or 'D' Droite - Right hand. (The 'handing' is determined by facing the point toe).

The upper surface of the bearer on which the VCC lock and detection assembly is mounted shall be lower than the adjacent bearers to accommodate the VCC base plate which is an integral part of the VCC assembly. This bearer is usually a hollow steel bearer which is thinner than the surrounding concrete bearers.

2.1.2 Required Switch Opening

The required switch opening is greater than that normally provided on UK point layouts. The locking arrangement not only locks the switch rail to the stock rail but also locks the open switch open.

If the switch opening is insufficient, the crank arm is unable to complete its travel and lock the switch rail open. Failure to lock may therefore be due to the lock being tight on the closed switch side or inadequate switch opening on the open switch side.

The required switch opening for a 113A full depth layout is 115mm. 110 mm is the required switch opening on a shallow depth (UIC54) and RT60 switches.

2.1.3 VCC Exterior Cover

The crank head, locking piece and detector are protected by a cast iron cover retained by two spring hooks and secured against unauthorised access with an RKB221 padlock.

2.1.4 Lock Arm Stroke Balance

The crank head of a lock arm shall fully engage its respective locking piece when the switch rail is closed and locked in either normal or reverse position.

The amount of engagement for either lie of points should be as near the same as possible. To achieve this condition the coupling rod that operates the lock arms shall be adjusted so that the stroke of both lock arms is the same (in balance).

2.1.5 Checking the Lock Arm Stroke Balance

When the points are correctly set, the lock arms should both cover the locking surfaces fully and equally. If the stroke balance is incorrect – i.e. one lock arm travels further than the other, then the drive rod length is incorrect. If both lock arms travel the same distance but either travel too far or not far enough, then the drive arm of the T72 is the incorrect length.

The stroke balance can be checked by manually operating the points and noting the position of the crank head relative to its locking piece (distance of crank head from inner face of the casting) when the relevant switch rail is closed and locked. Repeat the procedure for the opposite lie of points and compare the amount of engagement (distance of crank head from inner face of the casting) with that previously observed.

For either lie of points, the amount of engagement should be approximately the same ± 3mm.

If the amount of engagement is not within the permitted tolerance then the cause shall be investigated and remedial action taken.

For further details refer to Cogifer VCC Clamp Lock Maintenance Manual 1010-100-005 or VCC Clamp Lock Installation Manual 1010-100-004

2.2 Detector

2.2.1 Detector Mechanism

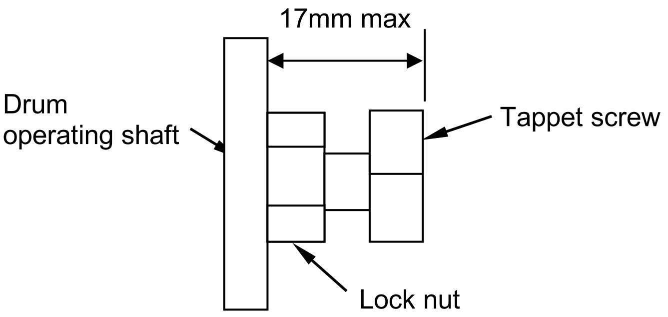
The detector drum and contacts are protected by an internal metal cover incorporating an insulation strip secured with rivets. The cover is a push fit and there is a risk that the wire insulation may be damaged by the sharp edge of the cover especially when the cover is refitted. Take care when fitting these covers as it is possible that, in extreme circumstances, damage to two of the wires insulation could result in false detection. If the wire insulation has been damaged arrange remedial action as appropriate.

2.2.2 Replacing a detector

If it is necessary to replace a detector, take care as it is very easy to bend the detector finger and/or damage the contacts.

It is very important that the following procedure for changing a detector is followed.

- Check that the detector is in switch open position (finger in pre-engagement notch).
- Check that the points are in the switch open position.
- Insert the plunger gauge through the hole in the stock rail.
- Fix the detector in place – 2 screws (cross-corners) will suffice at this stage.
- Set the tappet screw on the detector so that it is one to two turns out.
- Lever the finger open so that 6 mm gauge can be inserted — don’t lever against plunger gauge.
- Close and lock the switch (do this slowly, checking that the finger engages with the slot in the lock arm).
- Unscrew plunger gauge until it makes contact with tappet screw head.
- Unlock and open the points.
- Remove the 6 mm gauge checking that the finger is in the detector’s pre-engagement notch.
- Remove the detector.
- Remove plunger gauge without adjusting it.
- Cut the new plunger to the gauge length.
- Insert the plunger through the stock rail.
- Fix the detector using all four screws.
- Close and lock the points – watch the movement to check that it operates properly.
- Adjust the tappet screw (max. 17 mm) until the gauge is a sliding fit.



Detector adjustment showing maximum screw extension

- Repeat for the other detector.

2.2.3 Detector Electrical Connections

The terminal connectors used on the VCC are standard M6 ring tongue crimps with a black sleeve.

2.2.4 Cable Clamps

The cable clamps supplied with the equipment do not always adequately clamp the cables. Consequently the standard tail cable may not be sufficiently secured by the cable clamp. An additional sleeve may be required.

An alternative clamp has been supplied so that the cable is secured correctly; these should be recovered from units being replaced and re-used on the new units.

2.3 VCC Lock and Detector Spares and Replacements

2.3.1 VCC Lock and Detector

The following components can be replaced on site. However, due to the dismantling required to replace the lock crank wear pads, it is recommended that the complete lock crank assembly is replaced.

The oblong plastic sleeve on which the lock crank assembly slides should also be replaced to avoid unnecessary dismantling.

When replacing a lock crank assembly you cannot assume that the previous settings, packing and gauging of the associated components are still valid. The lock crank assembly may appear like for like but the replacement shall be treated as a new installation and the full installation procedure shall be applied.

See the relevant sections in Cogifer VCC Lock and Detector Mechanism manual.

When replacing the detector, check that the finger correctly engages the notch in the crank head. Otherwise the lock contact fingers, beneath the white plastic cover hinge, will be twisted and the contact gap reduced. A false circuit may be created.

If the VCC lock frame assembly requires replacement because of a ‘run through’ or suspected ‘run through’ then both VCC assemblies shall be replaced.

Component	COGIFER part number
Plastic sleeve	Specify VCC type
Wear pad kit: 1 x crank head pad 1 x fixing screw 1 x crank support pad 2 x fixing screws	871920025
Locking piece kit: 1 x locking piece 1 x castellated screw 1 x securing screw	871920009
Adjusting Shim Set (various thicknesses) (different material)	Specify VCC type Specify :stainless steel
Stabilising device: 1 x roller stabiliser 1 x spring 1 x stopping plate 1 x stopping ring	871920056
VCC cover retaining spring (2 required for each cover)	314040003
Hollow bolt kit: 1 x Ø27mm hollow bolt 1 x spring washer 1 x nut	Specify VCC type
Hammer head bolt kit: 1 x hammer head bolt 2 x spring washers 2 x flat washers 1 x slotted nut 1 x split pin	Specify VCC type
Lock crank assembly: 1 x lock crank 1 x lock crank bracket 2 x hammer head bolt kits 1 x stabilising device 1 x crank head pad 1 x control arm support pad	Specify VCC type

Component	COGIFER part number
VCC Detector kit: 1 x detector 1 x brass plunger 1 x terminal bag* *Note: Only the flat washers and nuts are required. The wires are terminated with black ring tongue crimps. Dispose of the remaining Paulvé terminal components in accordance with local instructions.	872220002 (Left hand model P80 - C9470)
	872120002 (Right hand model P80 - C9470)
	872220001 (Left hand model M80 & M89)
	872120001 (Right hand model M80 & M89)
Brass plunger (VCC Lock) (length 135 mm)	333050001

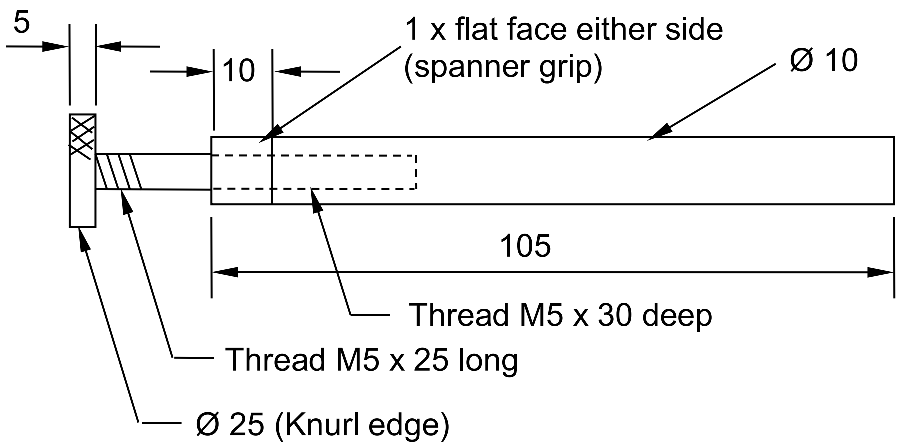
2.3.2 Wire Termination

Description	NRS part number
Terminal, crimp, ring tongue, M6, black sleeve	0054/119568

2.3.3 Gauges

Description	COGIFER part number
13/26mm	377001002
6mm (‘U’ shaped)	377001000

2.3.4 Special Gauge (Plunger Length Assessment)



Material: Silver steel or similar non rusting material (remove burrs and sharp edges)
Dimensions are in mm

The gauge may provide an alternative means of assessing the length of a replacement plunger

An alternative method for determining the plunger length is detailed in the manufacturer's installation manuals making use of callipers, a ruler and marking device if the above 'Gauge' is not available.

2.3.5 VCC Lock and Detector Lubrication

Description	Type
Lubricant	BP Energrease LS EP

The named lubricant shown above is recommended by the equipment manufacturer. An equivalent lubricant may be used.

2.3.6 VCC Lock and Detector Tools

Open-ended spanner – 13mm (2 required)

Hexagonal socket – 10mm

Torque wrench – range up to 400Nm

Other tools required include: feeler gauges, file, hacksaw, rule, screwdriver, and drill.

A small pair of inside callipers may be useful when:

- Measuring the projection of the brass plunger.
  (7.3).
- Measuring the gap between the hollow bolt and the top face of the tappet screw.
  (7.3).
- Measuring the length of the tappet / lock nut assembly.
  (7.3).

Ø 4mm drill – drilling hammer head bolt for split pin to secure castellated nut.

2.3.7 VCC Lock and Detector Torque Values

Component	Torque Values
VCC lock body to stock rail (Ø27mm hollow bolt)	40 Nm (maximum) *(Initial assembly to mate lock body with rail web) Shall be loosened before finally tightening to value below*
VCC lock body to stock rail (Ø27 mm hollow bolt)	300 ± 20 Nm
Bolts [3 off] securing VCC body to concrete bearer	300 ± 20 Nm
'T' head bolt with rail foot clamp securing rail to VCC body (steel or concrete bearer)	160 ± 15 Nm
Bolt with rail foot clamp securing rail foot to VCC body through to concrete bearer	160 ± 15 Nm
M12 x 35 hex. head screw either side of lock body	50 ± 5 Nm
Coupling rod / control arm connecting bolts	15 Nm (maximum) *(Slacken nut if necessary to insert split pin)*
Drive rod / coupling rod connecting bolt	15 Nm (maximum) *(Slacken nut if necessary to insert split pin)*

2.4 Fault Finding on the Detection Circuit

Typical faults on the detection circuit are likely to be:

- **Open Circuit:** Contact open because detection should not be made or broken wire;
- **Short Circuit:** Cable damage;
- **High Resistance:** Defective contact.

The conventional means of testing for the presence of a voltage is difficult with this circuit and so an alternative method is available. The circuit is terminated in a capacitor which is part of a tuned circuit. There is a 33 kΩ resistor across this capacitor which can be used for testing purposes.

The circuit should be first disconnected at the Junction Box by slipping the incoming detection feed links T1 1, T1 3 and T3 3. A meter on resistance setting is then put across the detection circuit T1 1 (right hand) or T1 3 (right hand) to T3 3 (right hand).

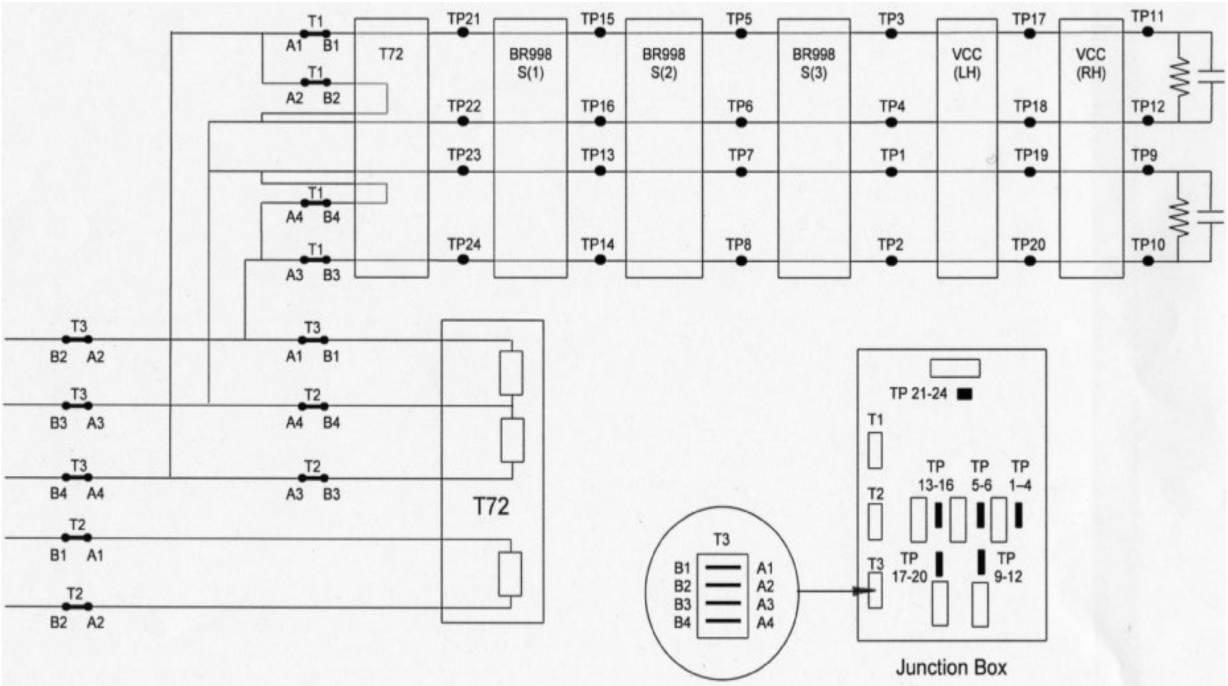
If the meter reads much greater than 33 kΩ, then it is likely that there is an **open circuit**. The test should be carried out on other sections of the circuit to localise the fault.

If it reads only a few ohms then this indicates a **short circuit**. Further testing is then required to localise the fault.

If the meter reads about 33 kΩ but the detection circuit does not operate, the n **high contact resistance** should be suspected. Test points are provided to test most contacts in the circuit (see simplified diagram for details of the test points). Test each contact in turn to determine its contribution to the total circuit resistance. The total series resistance of all the detection contacts measured at the junction box should be less than 1 Ohm. Cable resistance should be 5 Ohms or less. The total detection circuit resistance measured at the DEV card input should not be more than about 5 Ohms. If the total resistance exceeds 45 Ohms the DEV card will not operate correctly.

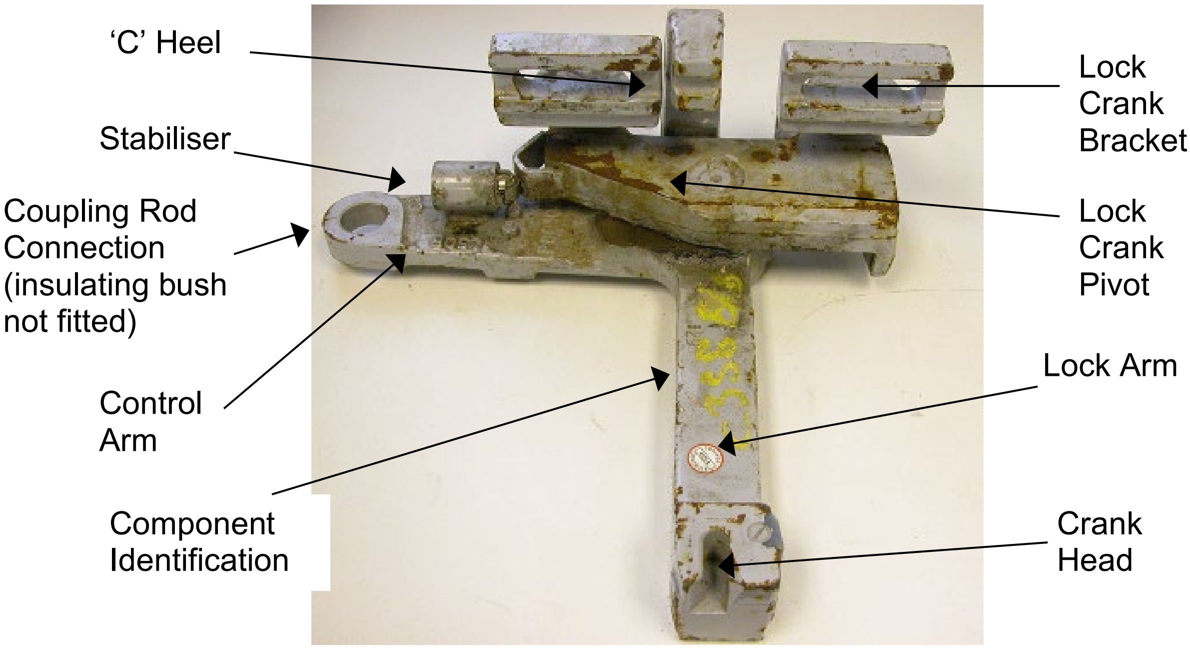
Simplified Point Circuit – New Junction Box

NOTE Only the Test Points and principal components are shown in the diagram, i.e. contacts within the equipment are not shown.



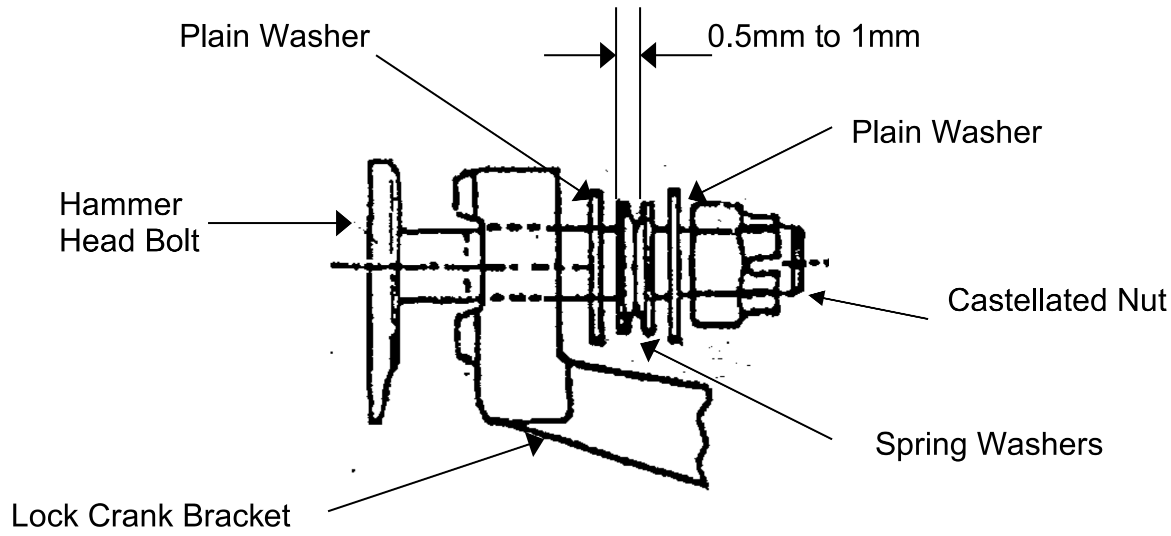
2.5 Component Details

2.5.1 Lock Crank Bracket ('C' arm) Assembly



Lock crank bracket ('C' arm) assembly for RT60 type rail. (Assemblies for UIC54 and 113A rail types are similar)

2.5.2 Detail (Hammer head bolt assembly)



3 CORRECTIVE & PREVENATIVE MAINTENANCE DETAILS FOR THE T72 POINT MACHINE AND VCC LOCK AND DETECTOR

3.1 Method of performing the Detection Test on the VCC Detector

Use the double ended 13/26 mm gauge to determine the operation of the lock contacts relative to the crank head position as it engages the locking piece during manual operation.

Figure 1

To check that the point detection is not 'light', the optimum moment of detection should occur midway between the 13 mm and 26 mm gauge positions. (Figures 2 and 3).

In Figure 2 and Figure 3 the crank head is shown moving towards the locked position (manual operation).
(The detector body has been removed for clarity).

Figure 2

The 13 mm gauge shall NOT overlap the locking piece.
If the gauge distance is less than 13 mm then the contacts are making late.

Figure 3

The 26 mm gauge shall overlap the locking piece.
If the gauge distance is greater than 26 mm then the contacts are making early.

3.2 Adjustment of the Detector Cam Stroke Tappet Screw

1. Open the switch blade.
2. Release the tappet screw lock nut.
   (Two 13 mm spanners are required)
3. Close and lock the switch blade.
4. Adjust the tappet screw until the 6 mm 'U' shaped gauge is a sliding fit.
5. Remove the gauge.
6. Open the switch blade.
7. Tighten the tappet screw lock nut.
   Check that the tappet screw does not move.
8. Close and lock the switch blade.
9. *Gauge* the stroke of the detector cam shaft.
   If correct proceed to clause 10 otherwise remove gauge and return to clause 1.
10. Remove gauge.
11. Open the switch blade.
12. *Measure* the overall length of the tappet screw and lock nut assembly (*7.3, Figure 4*).
    If greater than 17 mm, the cause shall be investigated and rectified. Possible causes may include a worn stock rail or damaged / worn brass plunger.

    NOTE If the tappet screw is unscrewed more than the 17 mm maximum to compensate for worn components it may become detached from the cam shaft. Renewal of the brass plunger is described in the next section.
    Return to DETECTION TEST VCC DETECTOR TEST (NR/SMS/Test/007).

3.3 Renewing the Brass Plunger

1. Disconnect CMA 24 cable connector in junction box. *(If applicable).*
2. Set the point machine selector lever to *'Hand'*.
3. Remove the VCC cover.
4. Remove the detector cover.
5. Manually operate the points to open the switch blade on the side to be fitted *(if applicable).*
6. Check detector finger is in pre-engagement notch. *(Switch open position, Figure 3).*

Figure 3

7. Remove detector from VCC lock body.
8. Remove plunger.
   (Dispose of in accordance with local instructions).
9. Insert plunger gauge into hollow bolt.
10. Re-fit detector.
    (2 screws in opposite corners sufficient).
11. Set tappet screw one to two turns out.
    *(Do **NOT** tighten lock nut).*
12. Lever the finger open and insert 6 mm gauge.
    *(Do **NOT** lever against plunger gauge adjusting screw. Insert screw driver behind finger pointing downwards towards pre-engagement notch with blade against base of terminal block to prevent damaging the plastic body, Figure 4).*

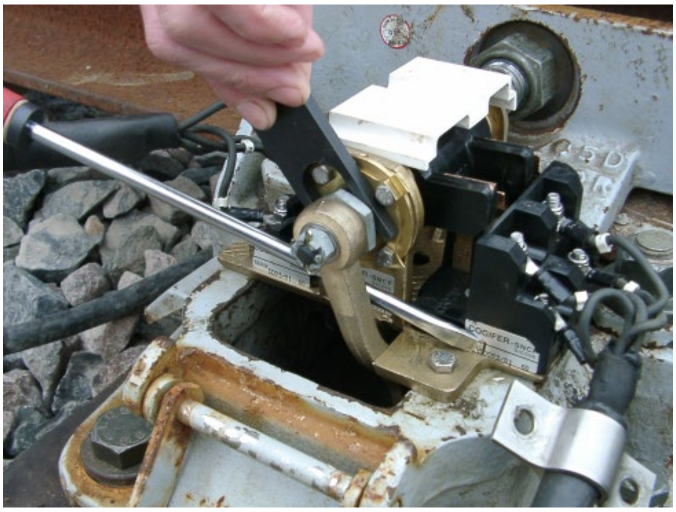
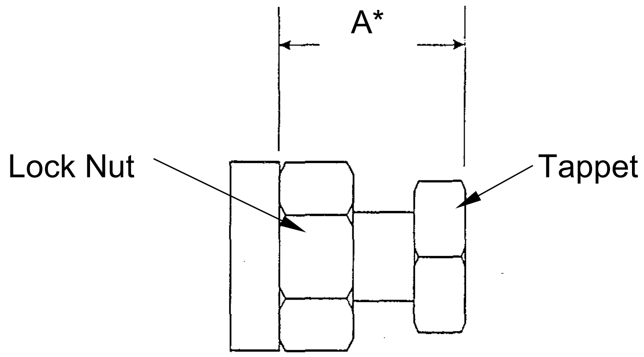


Figure 4

13. Slowly close and lock the switch.
    (Checking that the finger engages with the slot in the crank head).
14. Unscrew plunger gauge adjusting screw until it makes contact with head of tappet screw.
15. Unlock and open the switch.
16. Insert screwdriver to prevent finger springing back. *(Figure 4).*
17. Remove the 6 mm gauge whilst easing the finger into the pre-engagement notch.
18. Remove detector.
19. Remove plunger gauge without adjusting it.
20. Mark gauged length onto new plunger. Figure 5.

Figure 5

21. Cut plunger to plunger gauge length.
22. Insert plunger.
23. Re-fit and secure detector *(4 screws).*
24. Close and lock points.
    (Checking finger engages with slot in crank head).
25. Adjust detection tappet screw until 6 mm gauge is a sliding fit.
26. Open switch and tighten tappet screw lock nut.
27. Close and lock points. Re-check detector operation with 6 mm gauge.
28. *Measure* the overall length of the tappet screw and lock nut assembly.
    (dimension 'A' – Figure 6).



*Note: Maximum permitted length 17mm.

Figure 6

29. *Check* all fixings are secure.
30. *Lubricate* cam shaft. (NR/SMS/PC61).
31. Manually operate the points (over and back).
32. *Check* that the detector and lock operate correctly.
33. Refit the detector cover.
34. Refit the VCC cover and secure with the spring clips and RKB221 padlock.
35. Re-connect CMA 24 cable connector in junction box. *(If applicable).*
36. *FACING POINT LOCK TEST (NR/SMS/Test/005).*
    DETECTION TEST VCC DETECTOR TEST (NR/SMS/Test/007).

3.4 Procedure Following a 'Run-through'

To prevent damage to the VCC lock assembly in the event of a run through the crank lock arm has been designed to fail. The mode of failure will be by bowing, either concave or convex according to whether the associated switch rail was open or closed.

If a run through is suspected, examine the 'C' portion of the crank lock arm for each lie of points. An obvious gap between the 'C' heel and the switch rail shim pack when the associated switch rail is closed and locked will indicate a run through has probably occurred. In addition to the probable deformation of the 'C' arm, it is likely the detector contacts and "finger" will have become distorted – see Detector Mechanism section of this document if a run through has occurred.

To confirm the occurrence of a run through the crank lock assembly should be removed and the lock arm checked for distortion by placing it on a flat surface.

If the lock arm is found to be distorted, either concave or convex, then a run through has occurred and **both** lock crank assemblies shall be replaced along with a thorough examination and possible replacement of the detector mechanism.

The damaged lock crank assemblies and any elements of damaged detectors shall be destroyed to prevent accidental re-use.

If a run through has occurred the coupling and / or drive rods may have been distorted and other point equipment and fittings damaged.

Inform your SM (S) so that the necessary inspection and remedial action can be arranged.

3.5 Replacement of the Printed Circuit Board (PCB) in an Ansaldo T72 Point Machine Junction Box

- Isolate point machine *(disconnect CMA 24 cable plug coupler from junction box PCB).*
- Isolate junction box PCB, point machine heater supply cable (2 core), point control/detection cable (3 core).
- Note wire number and corresponding terminal block identity for the point machine heater supply also point control and detection.
- Unplug plug couplers and dummy plug coupler(s) if fitted.
- Disconnect point heater supply also point control and detection wires from respective terminal blocks.
- Carefully remove PCB assembly from junction box (retain fixings).
- Carefully install new PCB assembly in junction box and secure. *(Retain packaging for salvaged PCB).*
- Re-connect CMA 24 cable plug coupler.
- Re-connect plug couplers and dummy plug coupler(s) if applicable.
- Refit point heater supply and point control and detection wires in respective terminal block connections.
- Protect salvaged PCB with suitable packaging and return to the MSSCC for refurbishment.

3.6 Sources of Additional Information

The information contained within the maintenance specifications was sourced from the following documents. They may be used as a source of additional information.

Manufacturer's design changes may supersede the information contained within the documents listed below.

3.6.1 Ansaldo Signal: T72 Point Motor DC Permanent Magnet Type:

- Manual 2 Installation and Use
  Document No. 103 00 T 6520619-03 Rev. C
  2nd December 2002

3.6.2 Ansaldo Signal: T72 Point Motor DC Permanent Magnet Type:

- Manual 3 Preventative and Corrective Maintenance On-site
  Document No. 103 00 T 6520654-03 Rev. C
  2nd December 2002

3.6.3 Cogifer VCC Clamp Lock:

- Installation Manual
  Document No. 1010-100-004-A
  (1st October 2001 Edition)
- Maintenance Manual
  Document No. 1010-100-005-A
  (1st October 2001 Edition)

3.6.4 Cogifer VCC Detector:

- Maintenance Manual
  Document No. 1010-200-001-A
  (1st October 2001 Edition)

4 SD321 COLOUR LIGHT SIGNAL

The last function of maintenance is to test and observe that the equipment operates correctly from the controlling point.

Signal lamp voltage and proving tests shall not be carried out if a train is approaching as this may cause the displayed aspect to change from the lower to the upper unit.

4.1 SD321 Signal Details

4.1.1 Development

The SD 321 signal used with the Ansaldo ACC system has three aspects displayed from a single aperture which are operated and proved alight over a single pair of wires.

A signal head consists of two light units, each consisting of an optical assembly and an electrical filter unit. They are connected by a plug coupler and short cable.

The optical assembly contains 3 halogen lamps, one for the red aspect, one for the yellow and one for the green. Each lamp is mounted in a removable lamp holder. The optical assembly is sealed. It contains three filters, two dichroic mirrors and a lens. It is secured into the signal head by three bolts.

A dichroic mirror reflects light of one colour but allows light of other colours to pass through. The three light sources are mounted at right angles to each other.

The light from the red lamp passes straight though a red filter and then through the yellow and green dichroic mirrors.

The yellow light (from the top lamp) passes though a yellow filter and is reflected into the lens by the yellow dichroic mirror after passing through the green dichroic mirror.

The green light (from the bottom lamp) passes though a green filter and is reflected into the lens by the green dichroic mirror.

In the horizontal plane, the beam is slightly wider than a conventional signal but the beam is very narrow in the vertical plane. Correct adjustment of the signal head is therefore critical in the vertical plane.

4.1.2 Degraded modes

As each lamp is fitted with only a single filament, when a lamp fails, it cannot revert to an auxiliary filament. The failure of a lamp in one optical unit will cause a switch over to the other unit. The degraded mode ‘corresponding auxiliary aspect’ will be displayed.

If a train has passed the previous signal when a lamp failure occurs, then a more restrictive aspect may be displayed.

The normal aspects and degraded modes are shown below.

Aspect	Normal Aspect	Corresponding Auxiliary Aspect	Aspect Type
Red	Bottom red	Top red (previous signal at red)	2, 3 & 4
Yellow	Bottom yellow	Top yellow	2, 3 & 4
Double yellow	Top and bottom yellow	Top or bottom yellow (previous signal at double yellow)	4
Flashing yellow (single)	Bottom yellow	Top yellow (steady) **OR** Top yellow (flashing) see note below.	2, 3 & 4
Green	Top green	Bottom green	2, 3 & 4
Flashing yellow (double)	Top and bottom yellow	Top or bottom yellow (steady)	4

The flashing yellow auxiliary aspect is only available if the main flashing yellow aspect was already declared failed when a flashing yellow aspect is commanded to be displayed <u>and</u> there is no train approaching.

4.1.3 Failure of Corresponding Auxiliary Aspect

In the event that a corresponding auxiliary lamp should fail before the ‘normally lit’ lamp can be replaced then the next most restrictive aspect will be displayed.

4.1.4 Signal Lamp

The lamp is mounted in a holder which is secured to the optical unit with a bayonet type connection which also provides connection to the power supply.

The use of the correct lamp is vital to the performance of the signal. To produce light of the correct colour and intensity, the GE type M47 12 volt halogen lamp shall be used**.**

4.1.5 Signal Lamp Voltage

The signal lamp voltage shall be set to operate within the range **11.6** volts to **12.2** volts ac.

4.1.6 Maintaining the Specified Voltage Range

The lamp voltage cannot be adjusted at the signal head other than by means of adjusting the transformer in the lineside location case. However, this only provides a coarse form of adjustment. The lamp operating voltage is set up at installation and the control equipment maintains this voltage.

The set up voltage includes allowance for the length and type of cable feeding the signal. This is referred to as the 'C – parameter'. If the cable is repaired or replaced, the lamp voltage shall be checked. If it is incorrect, the voltage parameters for the signal may need adjusting. This requires a data change, which currently has to be done by the manufacturer (Ansaldo), and a full re-test.

Conversely if the lamp voltage is found to be incorrect then the cable details, length, type, core size etc. shall be checked for compliance with the site drawings.

It is emphasised that any cable replacement shall be 'like for like'.

Similarly cable repair shall not result in degradation of the original set up parameters.

On completion of the repair the lamp voltage shall be checked as follows:

(a) Check the lamp voltage of the most restrictive aspect is not less than 11.6V

then

(b) Check the lamp voltage of the normally lit aspect is not more than 12.2V (signals subject to the signallers extensive use of the auto-working facility should also be considered), i.e. predominant aspect displayed – green and not red.

The voltage is preset in the ACC and cannot be altered and should never require adjustment for maintenance purposes.

If the correct voltage cannot be maintained, report the problem to your SM(S) immediately.

4.1.7 Voltage on an Unlit Signal Lamp

If the voltage on any unlit lamp exceeds 0.8 volts report the situation to your SM(S) immediately.

A possible cause may be a faulty power supply unit. The unit cannot be serviced on site and should be replaced.

4.1.8 Signal Lamp Power Supply

All SDO signals are fed by POT / LAP circuits, with the exception of signals used to control the Cheadle Junction, Adswood Road, and the Macclesfield line. These signals are fed from PLS: 01, 51, 51A, 52, and 53 by POT / CLAM circuits.

4.1.9 Service Replacement

The GE type M47 12 volt halogen lamp is the only acceptable service replacement lamp.

Check that sufficient spare lamps are readily available.

If the lamp has recently been illuminated, the envelope and some metal components of the lamp holder will be very hot.

When changing the lamp take precautions to keep the lamp envelope clean, see *'Caution'* below.

The lamp shall be pushed completely into the lamp holder and shall be upright in the holder. Failure to do so may cause the beam to be out of alignment by up to 1.5° in the vertical plane.

Misalignment of the lamp can lead to the signal appearing dim when viewed from a train and in certain circumstances, when viewed off axis and close up; the signal may appear slightly discoloured.

It is therefore extremely important that after replacing a lamp, the colour of the particular aspect is checked from a position adjacent to where a train would normally stop.

If the signal appears discoloured re-check the lamp fitting and alignment and repeat the lineside check.

When replacing a lamp holder, the red notch on the lamp holder should align with the red notch on the optical assembly to check correct polarisation.

This lamp replacement procedure is described below:

- Turn the lamp holder counter-clockwise to release / remove the holder
- Remove the lamp
- Insert both pins of the new lamp into the sockets of the lamp holder
- Push the lamp firmly into its seat. Take care to avoid bending the pins
- Check the lamp is centred relative to the lamp holder. This is to check correct focusing of the optical system and the required visibility
- Align the red notches and re-insert the lamp holder

- Turn the lamp holder clockwise until locked
- Check that the lamp illuminates correctly

The glass envelope of a signal lamp, especially a halogen lamp, shall not be touched with bare hands because the skin's natural oils will cause the glass to blacken when the lamp gets hot. The light output will be reduced. Always use tissue paper or similar clean material when handling a signal lamp.

If the lamp becomes contaminated, clean it with methylated spirit.

4.1.10 Signal Lamp Failure Mode

An apparently 'healthy' lamp was found to be the cause of an intermittent signal failure. This incident has revealed that this type of lamp may fail intermittently prior to total failure. It is recommended that lamp substitution is considered as the first option when rectifying a similar fault. Recovered lamps shall be disposed of in accordance with local instructions to prevent accidental re-use which could result in a similar failure elsewhere and / or invalidate the lamp life monitoring data.

4.1.11 Replacement – Frequency

The GE type M47 12 volt halogen lamp has a rated life of 2000 hours when run at 12.0 volts as specified to check optimum luminance and aspect colour.

The lamp shall be changed when the aggregate operational hours are within 1750 and 1800 hours.

The actual period over which the hours are accrued will vary according to the typical daily operation of the signal and the usual aspect displayed.

To enable a robust and effective replacement schedule to be maintained, the operational life of each lamp in the signal head assembly is monitored. Therefore when a signal lamp is replaced, the MSSCC Box Technician shall be informed to enable the particular lamp life counter to be reset to zero ('no hours'). The ONLD PC at the Maintenance Desk in the MSSCC is used to extract and review this data. For further information refer to the Manchester South Signalling System O&M manuals.

4.1.12 Dispersing Lens

The dispersing lens (outer lens) spreads the light from the lens so as to provide the desired beam shape. There are three types of lens available for the SD 321 signal. Type 'A' (the 'standard') lens, type 'Bd' and type 'Bs'. The lens type is indicated by a small 'A' or 'Bd' or 'Bs' adjacent to the lens locating lug / nib on the rim at the bottom of the lens.

The type 'Bd' lens spreads the light to the right of the signal axis - 'd' (destro – right).

The type 'Bs' lens spreads the light to the left of the signal axis - 's' (sinistro – left).

The direction of the light spread is also indicated by a small arrow adjacent to the 'Bd' or 'Bs' identification. .

The majority of UK signals are fitted with the type ‘A’ lens.

It is important that the correct lens is fitted or the signal beam will not be aligned as specified on the signal head record card or sighting form. The beam produced by the lens will also be different.

The lens type and orientation marking is obscured by the lens retaining ring when mounted in the signal head.

4.1.13 Hot Strip

Unlike the lenses fitted to typical colour light signals the ‘hot strip’ is at the **top** of the lens and directs part of the beam downwards. The position of the lens is fixed by the small locating lug / nib engaging a slot in the lens retaining ring. The ring is secured by five screws arranged in a pattern to check correct orientation. Consequently the position of the ‘hot strip’ is not adjustable to operate at different angles.

4.1.14 Lens Replacement

Check that when replacing a dispersing lens that the small locating lug / nib on the rim at the bottom of the lens engages the **correct** slot in the lens retaining ring.

The centre slot is marked ‘A’ and is used for type ‘A’ lenses. The adjacent slots are marked ‘Bd’ and ‘Bs’ as appropriate. The locating lug / nib of the type ‘Bd’ lens shall be inserted in the slot marked ‘Bd’. The locating lug / nib of the type ‘Bs’ lens shall be inserted in the slot marked ‘Bs’.

Unless correctly seated, the lens will be mis-aligned reducing light output in the required direction.

4.1.15 Hood Replacement

There are three types of hood fitted to the SDO type signal. Each hood has been designed to check the optimum performance from the particular dispersing lens.

It is extremely important that the correct hood is fitted in conjunction with the particular lens type. For further details refer to ‘Service Replacements (Signal Head Assembly)’.

4.1.16 Lens Cleaning

External

The external surface of the dispersing lens should be cleaned with a clean soft cloth dampened with water or similar non abrasive cleaning agent to remove dust and grime.

Internal

If it becomes necessary to clean the internal surface of the dispersing lens the optical unit will have to be removed. The method of cleaning is the same as for the external surface.

The reflectors and dichroic filters are sealed within the optical unit, and do not require any maintenance procedures.

To reduce the ingress of insects, dust, smoke or similar contaminants check that the door seal is in good condition. Arrange replacement if damaged or missing.

4.1.17 Signal Light Beam Alignment

Always refer to the signal head record card for the signal alignment details. If the details are not available or clarification is required, report it to your SM (S).

In the case of the 'Bd' and 'Bs' lens the alignment device does not align with the centre of the beam. The designated alignment point is specified at site and does not represent the point at which the signal will appear at its brightest.

The alignment procedure for the SD 321 signal is different to that used for other types of colour light signal.

The alignment device is a small portable telescope which is only fitted to the signal head for the duration of the alignment procedure. This permits use at other sites as necessary.

The signal head can be aligned by adjusting the nuts on the four M16 studs securing the signal head to the base plate. Four slotted holes in the base plate permit limited lateral rotation.

Because of the narrowness of the beam in the vertical plane, care should be taken to check that the signal head is correctly aligned.

The signal head is aligned as follows:

- Fit the small telescope to the two supports on the left side of the housing
- Raise the panel obscuring the corresponding hole in the background
- Adjust the signal head to align the centre of the cross on the alignment point
- Tighten the nuts and lock nuts on the four M16 base plate studs
- Tighten the nuts on the four M20 bolts securing the base plate to the post
- Check that the signal head is still aligned on the alignment point
- Remove the telescope
- Lower the obscuring panel
- Close and secure the access door

Check that the telescope is protected from damage during storage.

4.2 Item Replacement Procedures

4.2.1 Optical Unit

- Disconnect the plug coupler.
- Unscrew the M5 screw securing the lower lug of the unit.
- Unscrew the two M10 captive screws securing the side lugs of the unit.

- Remove the unit.
- Install the replacement unit into the aperture and firmly tighten the two M10 captive screws.
- Re-fit and tighten the M5 screw to check that optical unit is firmly locked in place.
- Reconnect the plug coupler.
- Confirm correct operation.

4.2.2 Filter / Power Supply Unit

- Remove the two 'U' links (power supply connection).
- Disconnect the earth connection.
- Disconnect the plug coupler.
- Unscrew the lower two knurled fixing nuts.
- Slide unit out of the signal head.
- Slide the replacement unit into position.
- Re-fit and tighten the lower two knurled fixing nuts.
- Reconnect the earth connection.
- Reconnect the plug coupler.
- Re-fit the two 'U' links (power supply connection).
- Confirm correct operation.

4.3 Construction Details

4.3.1 Signal Head Assembly Service Replacements

Component	Ansaldo Signal Part number
Housing assembly comprises: Housing Lower fixing / adjustment flange Cable terminal board Dispersing lenses type 'A' Hoods (compatible with lens) Background (1120 x 600mm)	P21B.000006
Housing assembly as above Dispersing lenses type 'Bs'	P21B.000007
Housing assembly as above Dispersing lenses type 'Bd'	P21B.000008

Hood (Signal fitted with a type 'A' lens)	109E.A29003
Hood *(Signal fitted with a type 'Bd' lens)*	109E.A29018
Hood (Signal fitted with a type 'Bs' lens)	109E.A29019
Dispersing lens (type 'A') (Standard lens)	2/993117
Dispersing lens (type 'Bs') (Where specified on site record card or sighting form)	2/993118
Dispersing lens (type 'Bd') (Where specified on site record card or sighting form)	2/993119
Optical unit	P21B.000003
Filter / Power supply unit	P31B.000001

4.3.2 Signal Lamp Service Replacement

Component	GEC Part number
12 volt halogen lamp	GE type M47

4.3.3 Fixings

Four slotted holes in flange (M20 bolts) – (typical signal head fixing / adjustment flange)

4.3.4 Weight

A complete signal assembly comprises of:

A housing unit: 58 Kg (approx.)

2 x Optical unit 7Kg (3.5 Kg each)*

2 x Filter unit 11Kg (5.5 Kg each)*

This makes a total weight of the signal assembly of approximately 76 Kg.

*The optical units and filter units are usually fitted after the housing unit has been fixed to the post or gantry.

4.3.5 Special Tools

Tools required in addition to the standard toolkit.

Component	Ansaldo Signal Part Number
Signal alignment telescope	109E.A29015

4.4 Ancillary Signals

These consist of the following:

- Position Light Junction Indicator (PLJI)
- Position Light Signal (PLS)
- Ground Position Light Signal (GPLS)
- Banner
- OFF Indicator

4.4.1 The Basic Lamp Driving Circuit

Each lamp (or pair of lamps for a PLJI) is driven directly by a POT (via a CLAM) over a 2-core cable, the maximum output of the POT being 60W. The POT provides the lamp feed and lamp proving.

The POT/CLAM combination produces a feed at 200 volts at a frequency of 250Hz. This is stepped down to 110 volts at an intermediate apparatus case. This then feeds to the transformer in the signal where it is transformed to 12 volts.

The POT provides a carefully regulated supply for the lamp and monitors that the current flowing is between pre-set limits. In the event of the lamp failing, its POT recognises that the current has fallen to nearly zero (a small amount of current still flows through the transformers). The POT then shuts down its output and provides an alarm to the signaller and MSSCC Box Technician.

The signal units and associated lamp details are shown below:

Unit	Lamps	Number of POTs	Rated Life (Hours)
PLJI	5 x 12V 24W SL35 2 pairs in parallel and 1 pivot	2 per route and 1 for pivot	Standard 2000 Long life 8000
GPL	3 x 10V 50W halogen (2 ON, 1 OFF)	3 (2 ON, 1 OFF)	6000
PLS	1 x 10V 50W halogen (1 OFF)	1 (1 OFF)	6000
Banner	3 x 12V 55W halogen (2 ON, 1 OFF)	3 (2 ON, 1 OFF)	1000

The rated life is dependant on the lamp being operated at the specified voltage.

4.4.2 Position Light Junction Indicator

The PLJI used in the Ansaldo ACC signalling system is optically similar with conventional PLJIs and uses the same SL35 lamps. The differences are in the internal wiring and the transformers provided.

To light a junction indicator requires three POTs, one for the pivot lamp and two POTs each driving two lamps wired in parallel. Lamps 1 and 3 are paired as are lamps 2 and 4.

The current sensing limits are set differently for the POT feeding the pivot to the other two POTs. Those feeding the junction arm lamps will detect the current falling below that required for two lamps but is more than that required to feed one lamp. It can thus detect a single lamp failure and shut down. The other lamp of the pair will be switched off. The POT feeding the pivot will detect when the current falls below that required to light one lamp and will switch off the feed to that lamp.

With a single POT shut down, there are at least 3 lamps lit so the signal is allowed to clear. If it is the pivot lamp that has failed, 4 lamps remain lit. Should a further lamp fail, this will shut down an additional POT. With 2 POTs shut down, the signal is prevented from clearing.

The PLJI transformers are of toroidal design. In the case of the single arm PLJI there is insufficient room for the three transformers and so theses are accommodated within a separate enclosure mounted within 5 metres of the PLJI with cabling between.

4.4.3 Position Light Signal

The PLS used in the Ansaldo ACC signalling system is optically and electrically similar to the fibre optic PLS and uses the same 10 volt 50 watt halogen lamps.

Normally a PLS is provided with a main and standby lamp, the auxiliary being switched in when the main lamp fails. Because of the relatively low usage of the OFF indication and the hours lit being monitored by the system, only a single lamp is provided. The lamp can be replaced after a specified number of hours before failure is likely.

The PLS unit is a standard fibre optic unit but with the auxiliary lamp and lamp proving relay omitted.

4.4.4 Ground Position Light Signal

The GPLS used in the Ansaldo ACC signalling system is optically similar to the fibre optic GPLS and uses the same 10 volt 50 watt halogen lamps. The differences are in the internal wiring and the transformers provided.

Normally a GPLS is provided with a main and standby lamp for both ON and OFF aspects, the auxiliary being switched in when the main lamp fails. Because of the low usage of the OFF indication and the hours lit being monitored by the system, only a single lamp is provided for the OFF indication. Main and auxiliary ON lamps are provided. The unit is wired differently to a standard unit. It is provided with three transformers (one per lamp) instead of the usual two.

The GPLS is directly fed by 3 POTs (via CLAMs). POTs are provided for the Main ON lamp, the Auxiliary ON lamp and the (Main) OFF lamp. Failure of the Main ON lamp will cause the Auxiliary ON lamp to light. Failure of the OFF lamp to light will cause an ON lamp to light so that the signal is not blacked out.

4.4.5 Banner Signal

The Banner Signal used in the Ansaldo ACC signalling system is optically and electrically similar to the fibre optic Banner and uses the same 12 volt 55 watt halogen lamps. Two ON lamps and one OFF lamp are provided.

4.4.6 OFF Indicator

The OFF Indicator used in the Ansaldo ACC signalling system is optically and electrically similar to the fibre optic OFF Indicator and uses the same 12 volt 55 watt halogen lamp.

4.4.7 Signal Lamp Replacement (PLJI)

The life of each signal lamp is monitored, consequently it is essential that if one of the non-pivot lamps is replaced then the other lamp fed from the same POT shall be replaced and the MSSCC Box Technician informed so that the lamp life counter for that particular circuit can be reset to zero (‘no hours’). Similarly, if the pivot lamp is replaced the MSSCC Box Technician shall be informed to enable that particular counter to be reset to zero. For further information refer to the O & M manuals.

4.4.8 Signal Lamp Replacement (PLS and GPLS)

When a lamp is replaced the MSSCC Box Technician shall be informed to enable that particular lamp life counter to be reset to zero. For further information refer to the O & M manuals.

5 CABLE MAINTENANCE

A safe system of work shall be agreed and implemented before any work is undertaken. The safe system of work may be by local directive.

Signal control cables, track circuit feed cables and apparatus case power supply cables operate at 230 volts. Before working on a cable, the cable shall be isolated at the Peripheral Location and steps taken to check that power cannot be re-connected before work is complete. (details can be found in NR/SMS/EL00).

Prior to working on any lineside circuit(s) check it is isolated and the MSSCC Box Technician made aware of the isolation.

Do not rely on the Field Device Controller disconnection switch alone to provide circuit isolation. Remove (and retain) the relevant ‘U’ link from the back of the unit or, where provided, slip the appropriate 2BA terminal link.

Do not rely on SW(2) or SW(3) disconnection switches alone to provide circuit isolation.

Isolate and lock S1 to isolate supplies to both SW(2) and SW(3).

5.1 Cables

Cables fall into one of five categories comprising: Monitored Cables, VIO Fed Cables, Non-Monitored Cables, Signal Control Tail Cables, and Other Tail Cables.

5.1.1 Monitored Cables

Signal Control Cables (ACC SIM PC monitored)

LAPS fed signals – Normally between the LAPS in the Peripheral Post and the filter in the signal head.

CLAM fed signals (only applies to signals fed from PLSs 01, 11, 51, 51A, 52 and 53) - Normally between the CLAM in the Peripheral Post and the step down transformer in the signal location.

In the rare cases where an isolation transformer is provided if the cable length exceeds 1300 metres, the monitored cable is between the CLAM in the Peripheral Post and the isolation transformer.

Point Control Cables (ACC SIM PC monitored)

All cables associated with point control and detection between the C-DEV in the Peripheral Post and the point junction box.

Track Circuit Cables (ACC SIM PC monitored)

The cables between the CTRC in the Peripheral Post and the step down transformer feeding the track feed unit (referred to as the Track Feed cables).

The detection and diagnostic cables between the track circuit relay/ICDR and the CTRC in the Peripheral Post (referred to as the Track Relay cables).

Power cables (SCADA Monitored)

Power cables connected to the SECAP 230 V power supplies between the Peripheral Location (PL) and apparatus cases, supplying the power for equipment such as AWS, TPWS, location heaters and lighting etc. are monitored by the in-built ELDs within the SECAP units. The alarms from these units are collected on the SCADA system and displayed on the SCADA terminal on the MSSCC Box Technicians desk.

5.1.2 Non-Monitored Cables

Indication cables

All VIO cables (control and indication) including:

Cables between the VIO or Terminal Board Rack in the Peripheral Post and the relay in the location case for equipment such as AWS and TPWS. The cables between the location case for equipment and the VIO or Terminal Board Rack in the Peripheral Post indicating the state of TPWS.

Multicore Cables

Multicore Cables between the Terminal Board Rack in the Peripheral Posts and the Fringe Boxes.

Signal Control Tail Cables

LAPS fed signals**;** not applicable.

CLAM fed signals (only applies to signals fed from PLS 01, 11, 51, 51A, 52 and 53),

The cables between the isolation transformer and step down transformer (where an isolation transformer is provided) and between the step down transformer and the filter unit in the signal head.

Track Circuit Tail Cables

The cables between the location case and lineside disconnection boxes and/or rails.

Other Tail Cables

The cables between the location case and equipment such as AWS, TPWS, etc.

5.2 Insulation Integrity Testing

5.2.1 Monitored Cables - ACC

These cables are continuously monitored by the ACC equipment. Should the leakage to earth exceed a pre-set level, an alarm is produced.

As set, the system will report the cable condition. If the cable resistance is greater than 5000kOhm, the Diagnostic Console will display **'Rd: > 5.0M'** with a status of **'Insulation OK'**.

If the resistance is between 5000kΩ and 1000kΩ, the actual value is displayed e.g. *1732K* with a status of **'Insulation OK'**.

If the resistance is less than 1000kOhm, the actual value is displayed, e.g. *135K* with a status of **'Insulation Error! <->'**.

Periodically, a record should be made of the actual values for earth leakage as measured by the monitoring equipment where these are less than 5000kΩ so that trends can be detected.

5.2.2 Monitored Cables - SCADA

Treat power cables as any other cable fitted with ELD.
High voltages are present on power cables, the appropriate precautions for working on high voltage equipment shall be implemented and observed (see NR/SMS/EL00).

5.3 Earth Monitoring Integrity Testing - ACC

This tests that the ACC's integral earth monitoring system is working correctly. The method of testing is described in NR/SMS/Test/171.

5.3.1 Equipment

The following equipment is required:

A calibrated resistance decade box with 'flying leads' that can be clipped to the Earth Bus-Bar (or similar suitable earth point) and inserted in to the 'test hole' on the 'U-Link' (see below).

Each 'U-Link' is provided with a 'test hole' in its insulation to enable the circuit to be tested without the need to partially withdraw the link thereby risking circuit interruption.

The actual circuits to be tested are detailed in the O&M manuals for the system.

5.3.2 Resources

Personnel will be required at the Peripheral Post and at the MSSCC as described below.

Peripheral Post: – to undertake the tests and to record the resistance shown on the CNT diagnostic screen section of the SIM PC (alternatively this can be viewed from the SIM PC on the "on-line" diagnostic terminal located on the Maintainers Operating Terminal in the MSSCC).

MSSCC: – to observe that the alarm is displayed on the Maintainers Operating Terminal.

5.3.3 Records

A list of the circuits tested, and a log of the test results shall be kept.

5.4 Monitored Cables – SECAP Insulation Monitor

The integrity of the signal power cable insulation is monitored by the Earth Leakage Detectors (ELDs) contained within the SECAP 230 volt power supply units fitted in the Peripheral Location. Each unit contains an integral audible alarm and LEDS which indicate the severity of the earth fault (local monitoring).
An alarm message will be displayed on the SCADA terminal on the MSSCC Box Technicians desk when the earth resistance drops below 5000k Ohm.
A typical message format is:
'North West Zone Manchester South – Middlewich South – REB 91 - PL 91 ELD FAILURE ALARM '

Earth alarms are to be investigated with on-site attendance at the earliest opportunity.

5.4.1 Non-Monitored Cables – Earth testing

V10 Fed Circuits:
These cables should be dealt with as any other tail cable connected to similar equipment, see NR/SMS/Test/051

Signal Control Tail Cables

These cables should be treated as any other tail cable and should be tested as specified in NR/SMS/Test/054

Track Circuit Tail Cables

These cables should be dealt with as any track circuit tail cable

Other Tail Cables

These cables should be dealt with as any other tail cable connected to similar equipment see NR/SMS/Test/051

5.5 Corrective Maintenance on Cables

5.5.1 Monitored, VIO Fed (Control), Signal Control Tail Cables and Power Cables

The cabling differs from conventional signalling in that most cables are two core rather than multicore and the distances between disconnection points are much greater. Different techniques are therefore required for fault location.

Earth faults on these types of cable shall be located and repaired promptly. The system can tolerate a single fault. Such a fault shall be removed before a second fault occurs at a different point on the cable. This allows, in normal circumstances, up to two weeks for remedial action.

As the monitoring system can cover groups of cables, the actual defective cable shall be localised.

Testing with the 1000 volt insulation tester will escalate the breakdown of defective cable insulation thereby reducing the time scale for remedial action.

Cables showing values between 5000kΩ and 1000kΩ

- The specific defective cable should be identified and tested within four weeks (maximum).
- The defective cable should be regularly monitored and remedial action agreed with the SM (S).

Monitored cables showing values between 1000kΩ and 100kΩ inclusive

- The S&TME shall authorise retention in service and manage the repair within two weeks (maximum).
- The Route Asset Manager (Signals) shall be advised of the situation as soon as practicable.
- All actions taken shall be recorded.
- The insulation resistance of any cable in this insulation range shall be re-checked every 24 hours.

- The insulation resistance values shall be recorded to enable the rate of degradation to be assessed.

If the rate of degradation increases rapidly the S&TME shall be informed and urgent remedial action taken.

The S&TME authority to retain in service is extended down to 100kΩ.

Cables showing values below 100kΩ (except track circuit feed circuits)

- The Route Asset Manager (Signals) has the discretion to retain in service.
- There will be no need to sign out of use in this range pending this permission.
- The defective cable should not be allowed to remain in service for more than two weeks (maximum).
- During this period the insulation resistance value of the affected circuit shall be checked and recorded on every shift to enable the rate of degradation to be assessed.

If the rate of degradation increases rapidly the S&TME shall be informed and urgent remedial action taken.

Track circuit feed cables showing values at or below 50kOhm

- The affected circuit shall be repaired within 2 days, if this is not possible:
- The signaller will invoke GE/RT8000 Rule Book Module TS2 'Track circuit block regulations' - Section 10 – 'Failure of signalling equipment' until such time as the failure is repaired.

With the proposed method of testing, there is a risk that an earth fault may be present and undiscovered for some time. Any earth fault discovered shall be promptly located and repaired.

The location of a fault might require the use of a Time Domain Reflectometer. Once localised it is necessary to identify at site which cable is the one in question.

Spare cables have not been provided so there is no easy means of cable diversion available. Any substitute cable used shall be of the same conductor size and length as the defective cable. Any cable inserted as part of a repair shall be of the same conductor size and length as the cable it replaces.

Cable jointing techniques are the same as for normal signalling cables.

Before re-commissioning a previously defective circuit, the requirements of SMTH shall be followed.

A particular hazard is that of cables being connected to the wrong function. A crossed cable may cause a wrong signal to show a proceed aspect. Where more than one cable is cut, it is essential that it is positively established that the correct cables are being rejoined.

Track Circuit Tail Cables

These are repaired, tested, and re-commissioned in the appropriate way for that type of conventional equipment.

Other Tail Cables

These are repaired, tested, and re-commissioned in the appropriate way for that type of conventional equipment.

Service Replacement

For details of replacement components refer to section 11.

6 CONTROL ROOM EQUIPMENT

6.1 Display System

6.1.1 Rear Projection Display System

The image displayed on the rear projection cube screens (wall display) is produced by a GraphXMaster Projector. To promote optimum performance of the projector the optical system shall be kept scrupulously clean, preferably by keeping invasive maintenance to the absolute minimum.

Personal protective equipment will be required when servicing this apparatus, especially when handling the lamp.

6.1.2 GraphXMaster Projector

High voltages are present in the projector.

When performing any service on this equipment, precautions for working on high voltage equipment shall be implemented and observed.

An AC leakage test shall be performed on completion of any service to check the equipment is safe to operate.

A 500 volt dc Insulation Tester is required; the test is detailed in NR/SMS/Test/173.

For further information see GraphXMaster Service Manual - 54-017145-02P - section 2.3 General Guidelines – AC Leakage Test – Cold Check.

6.1.3 Electro Static Sensitive Devices (ESSDs)

ESSDs are installed in this equipment. Electro Static Sensitive precautions shall be taken during all servicing of this equipment.

6.1.4 Projector Lamp

The lamp used in the ‘GraphXMaster’ projector is a 100W Ultra High Pressure (UHP) lamp which produces an intense source of light and heat. The lamp should be enclosed during operation and shall be treated with care.

Never look directly into the lens of the projector. The brilliant light emitted may cause permanent damage to your eyes.

The ultra-violet light generated by the lamp can have the same effect on the skin and the eyes as sunlight. Wear ultra-violet protective goggles with side guards when servicing the lamp.

6.1.5 Ventilation

To check that the lamp and projector do not overheat the ventilation slots shall not be obstructed.

6.2 Lamp Replacement in the GraphXMaster Projector

6.2.1 Aggregate Hours

The aggregate operational hours of the lamp are monitored by the system software and can be ascertained by pressing the 'Display' key on the keypad.

It is recommended that the lamp should be changed when its aggregate operational hours total 6000. If the lamp is used in excess of 6000 hours the risk of the lamp shattering is increased as a result of changes in the quartz glass.

Never remove the lamp from its housing immediately after it has been powered down. The lamp is under great pressure when hot and may explode causing personal injury and / or property damage.

6.2.2 Precautions

After turning off the projector wait at least 20 minutes before unplugging it to allow sufficient time for the internal fans to cool the lamp and for the projector to automatically turn off. The fans will shut off when the lamp has cooled sufficiently.

The lamp shall be allowed to cool for at least 1 hour before removing it from the lamp compartment.

When replacing the lamp, do not touch the sapphire (glass) surface of the lamp otherwise the output will be seriously degraded. Intense heat (hotspots) can occur where fingerprints are left and could cause the lamp to explode.

If the surface is accidentally touched it shall be cleaned with a lint-free cloth moistened with isopropyl alcohol.

Always wear clean cotton gloves and protective UV goggles with side protection when handling the lamp.

6.2.3 Procedure

- Press 'POWER OFF' on keypad to isolate the projector.
- Wait until the fans automatically shut off.
  Approximately 20 minutes.

- Remove the 2 small panels on the rear panel to gain access to the input panel and the lamp.
  4 screws per panel.
- Turn OFF the MAIN POWER SWITCH
  Located on the input pane).
- Unplug the projector and allow the lamp to cool
  Approximately 1 hour.
- Loosen the captive screws securing lamp module.
- Pull the lamp module from its compartment using the handle provided.
  Keep the module level as it is withdrawn by supporting it underneath with your other hand.
- Slide the new lamp module into position using the handle provided.
  Keep the module level as it is inserted by supporting it underneath with your other hand).
- Check that it is fully inserted into its compartment and secure in position with the captive screws.
- Plug in the projector.
- Turn ON the MAIN POWER SWITCH.
- Replace both access panels and secure in position.

NOTE If the lamp module is not seated properly in the compartment or the captive screws are not tightened sufficiently the lamp module will not strike and the lamp error code '**4**' will appear on the status screen.

- Reset the lamp timer to record the aggregate operating hours of the new lamp.
  Service Menu.
- *Adjust the CSC (primary colour purity).
- (Adjust CSC)
  Highly recommended.
- *Align the lamp unit.
  6-Axis Adjuster.

*: For procedure refer to GraphXMaster CX50-100U Installation and Maintenance Manual - 54-017148-02P - section 2 - Installation and Setup.

6.2.4 CSC

The function of the CSC is to adjust the actual colour of the primary colours (red, blue, and green) to achieve optimum matching between cube screens in the video wall (wall display). Adjustment may be required when a lamp is renewed. Check that sufficient time has elapsed for the new lamp to warm up before proceeding.

The quality of the primary colours may deteriorate when a lamp is nearing its maximum permitted operational life (6000 hours).

6.2.5 6-Axis Adjuster

The 6 axis adjuster comprises 4 screws and a 2 position lever. Any distortion observed in the displayed image can be corrected by adjusting the screws using the 5mm and 2 mm Allen keys provided in the User's Kit.

6.2.6 Focus

Once set, adjustment of the image focus should not be necessary. Any subsequent adjustment to counteract distortion of the projected image may require the attention of a skilled technician. The focus can be manually adjusted by turning the thumb screws on the lens barrel but is not normally required.

6.3 Cleaning

The projector shall be unplugged before cleaning.

Generally, cleaning should not be necessary and should be avoided unless absolutely essential. This is to prevent accidental contamination of the optical surfaces and subsequent degradation of the projector output.

Maintaining the cleanliness of the projector and its components during servicing is essential to the continued optimum performance of the projector.

During servicing take every precaution to avoid contaminating the optical surfaces. Fingerprints on the optical components may cause a noticeable reduction in lamp output. Wear clean cotton gloves when handling internal components.

6.3.1 Projector Lens

To avoid the risk of scratching the lens it should only be cleaned when it is absolutely necessary, i.e. degradation of the image and / or foreign bodies appearing on the wall display.

A light coating of dust will not adversely affect the quality of the image.

If cleaning is required, use a clean DRY soft cotton cloth rubbing gently in a circular motion.

6.3.2 Projector Lamp

The lamp should not require cleaning during its lifetime.

However, if the sapphire (glass) surface is accidentally touched with bare hands it shall be cleaned with a lint-free cloth moistened with isopropyl alcohol.

Finger marks or similar contamination will reduce the output of the lamp and create ‘hotspots’ which may cause the lamp to explode.

6.3.3 Cube Screens (Low glare and High contrast type)

Clean with a clean soft damp cloth rubbing gently in a circular motion.

6.3.4 Cube Enclosure

Clean with a clean soft damp cloth. Do not use liquid or aerosol cleaners.

6.4 Keypad, IR, and Wired Type

6.4.1 Keypad Batteries

The keypad is powered by 4 AA size alkaline batteries.

6.4.2 Battery Replacement Procedure

- Remove cover on the underside of the keypad.
  Push the small tab in and up at the same time.
- Remove old batteries.
  Dispose of in accordance with local directive(s).
- Fit the new batteries.
  The battery orientation is marked in the battery compartment.
- Refit the battery cover.
  Check the bottom edge of the cover engages the rim of the compartment before closing. An audible 'click' will indicate that the cover has been refitted correctly.

6.5 Sources of Information

For further information refer to the relevant sections of:

GraphXMaster User Manual - 54-017144-02P (© 2001).

GraphXMaster Service Manual - 54-017145-02P (© 2001).

GraphXMaster CX50-100U Installation and Maintenance Manual - 54-017148-02P (© 2001).

6.6 Ordering Service Replacements

The equipment is covered by the ACC system product approval, projector lamps (and other components) can be ordered direct from Christie.

The following details are required:

- Christie Digital System part number (each item)
- Projector model number*
- Serial number*
- Date of manufacture*

*These details are on the projector license label.

The Christie Digital System part numbers are shown in the parts index list in section 5 (Parts and Module Replacement) of the GraphXMaster Service Manual - 54-017145-02P. Exploded views of the equipment to assist identification of the components are also included.

7 MSCC System Layout - Fibre Optic Configuration

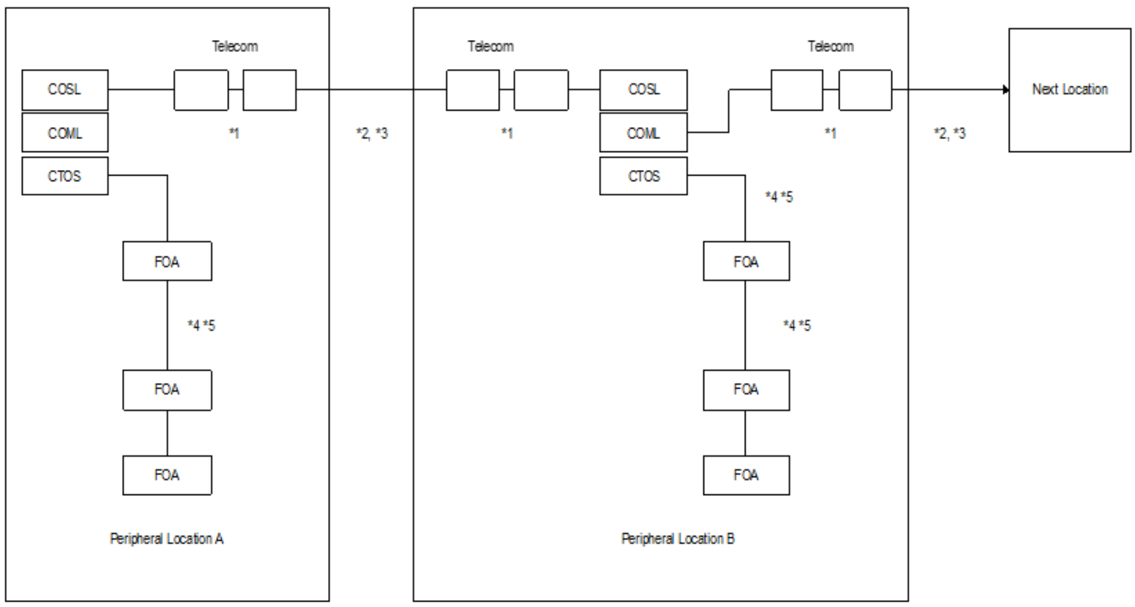
The infra-red light used for transmitting data in the fibre optic system is not visible but the intensity is sufficient to cause permanent eye damage. Do not look into the end of a fibre, nor directly into the open connectors of a fibre optic card while the card is plugged into a working system.

Module(s) shall only be changed with the co-operation of the maintenance desk operator. The signaller shall be informed of any likely effects.

Determine whether the fibre optic cable(s) to be tested are part of the primary or the secondary system. If the system on which tests are to be performed is active, check that the alternative system and its components are functioning correctly before commencing tests.

These tests require use of specialist test equipment that shall only be used by an ‘Instrument Engineer’ or a ‘Special User’ who has been suitably trained in their use.

7.1 MSCC System Layout - Fibre Optic Interconnection



Simplified Layout – Single Link

Transmission between peripheral locations is at 1310 nm over single mode fibre, with SC-AP end connectors.

Transmission within the peripheral location between CTOS and FOA, FOA - FOA is at 850 nm over multi mode fibre, with ST end connectors.

The entire transmission network duplicated with automatic changeover to check system availability.

Notes:

*1: SC-AP connectors

*2: 1310 nm transmission over single mode fibre

*3: Fibre in external telecomm cable

*4: Multi mode fibre with ST connectors

*5: 850 nm transmission

7.2 Values

Minimum bending radius **20 mm**

Transmission Level

Module	Input Sensitivity	Output Power
COML	-15 dBm	-31 dBm
COSL	-15 dBm	-31 dBm
CTOS	-15 dBm	-31 dBm
CTOM	-11.5 dBm	-24 dBm
COMX	-11.5 dBm	-24 dBm
FOA	-15 dBm	-31 dBm
PCDR	-11.5 dBm	-24 dBm

Maximum permissible loss

Component	Loss
Fibre optic patch cord	1 dB
Fibre optic cable section (Single mode, 1310 nm)	23 dB

For actual fibre optic cable section losses refer to loss budget records in local documentation.

Permissible attenuation for fibre optic components

Component	Loss
Connector (two connectors mated = one connection)	0.40 dB
Splice	0.05 dB
Fibre Loss (Single mode, 1550nm)	0.22 dB per km
Fibre Loss (Single mode, 1310nm)	0.22 dB per km

Calculated Attenuation for a Fibre Optic Cable Section

If the actual loss exceeds the budget records or the calculated section loss, investigation is required. Tables for calculation of expected section loss are given below.

Permissible attenuation for fibre optic cable section

Component	Quantity	Loss (dB)	Product
Connector		0.40 dB	
Splice		0.05 dB	
Fibre Loss		0.22 dB per km	
Total (Calculated loss for section)			dB

Typical Attenuation for Fibre Optic Components

Component	Loss
Connector (two connectors mated = one connection)	0.40 dB
Splice	0.05 dB
Fibre Loss (Single mode, 1550nm)	0.22 dB per km
Fibre Loss (Single mode, 1310nm)	0.22 dB per km

7.3 Connector types in use

	Lead connector	Card connector
COML/COSL	SC	SC
Telecoms interface	SC-APC	SC-APC
CTOS	ST	ST
FOA	ST	ST

8 SERVICE REPLACMENT COMPONENTS

8.1 Track Circuit Capacitor (TH)

The track circuit capacitor (TH) is fixed to a mounting plate that is secured to the rack with the plugboard's lower fixing screw.

Description	Type
Track Circuit Capacitor (TH) 2.2µF	Capacitor (ASF) N9502700225

Description	NRS Part Number
Mounting Plate	NRS 0050/000694

8.2 Field Adaption Unit

The original units have been discontinued. Equivalent units providing the same functionality are available under the following part numbers:

Old Part Number	New Part Number
MSC/11/00/00	FF05-000-SG-DRG000001
MSC/11/00/01	FF05-000-SG-DRG000002
MSC/11/00/02	FF05-000-SG-DRG000003
MSC/11/00/03	FF05-000-SG-DRG000004

Old Part Number	New Part Number
MSC/11/00/04	FF05-000-SG-DRG000005
MSC/11/00/05	FF05-000-SG-DRG000006
MSC/11/00/06	FF05-000-SG-DRG000007
MSC/11/00/07	FF05-000-SG-DRG000008
MSC/11/00/08	FF05-000-SG-DRG000009

8.3 POT Field Device Controllers

The firmware installed on the original POTs that interface the BR867 Track Feed Units and SD321 Main Signals to the Ansaldo ACC interlocking has been updated. The new unit is available under the following part number:

Old Part Number	New Part Number
FM9088300400	FM90883000402

8.4 CDEV Board

The surge arrestor has been removed from the CDEV board and a new part number allocated. The new board is available under the following part number:

Old Part Number	New Part Number
FM9088300903	CDEV-06 B22B.0100150

8.5 CTRC

The CTRC has been modified in compliance with the SHWW redesign. The version has been incremented but the existing part number has been retained. Some of the earlier boards may have been modified and labelled accordingly. If an early type board is not labelled it shall not be used and should be returned to the store or to your SM(S) so that it can be returned to the manufacturer for modification.

Version	Part Number
See wiring diagram	B2GB.000021

End

1. Road Traffic Light Signals

1.1 General Description

Early type traffic lights were fitted with 36-watt filament lamps and can often be identified by the high visibility white border on the periphery of the lamp backboard.

The later filament type is fitted with 50-watt Quartz Halogen (QH) lamps and can be identified by the high visibility red and white border on the periphery of the lamp backboard.

A new LED unit is now approved. The three types shall not be mixed at the same crossing.

Many older installations have been converted to use the 50-watt QH lamps to comply with the improved performance for road traffic light signals specified by BS505. On early conversions the high visibility red and white border was clamped on to the existing backboard.

The modified assemblies were fitted with a GEC identification label on the underside of the lamp bowl unit. The red lamp unit should be labelled LL5101 and the amber lamp unit LL5102.

1.2 Lens Orientation

It is important that the plastic lens (Red or Amber) is installed correctly and that the beam is concentrated downwards.

The plastic lens comprises a large number of small lenses arranged in rows on the rear face of the lens. The lens shall be installed with the arch of the small lenses upper most. Some lenses might have the word “TOP” embossed on the inner or outer face near the edge of the lens to indicate the correct orientation. See Figure 1.

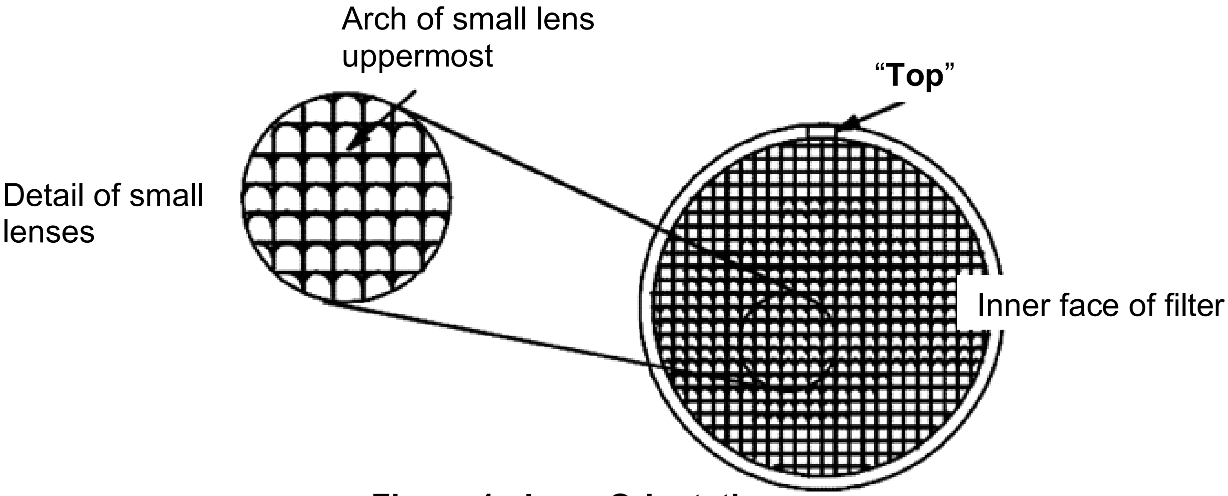


Figure 1 - Lens Orientation

The lens fitted to the QH type lamp assembly should have "TOP" moulded on a small raised block on the rim at the rear of the lens.

The latest type of traffic lights replacing the 50W QH lamps are LED based.

LED modules are NOT interchangeable with the current lamp assemblies and cannot be replaced individually, nor can they be mixed on the same crossing.

2. Booms

2.1 General Description

Booms may be constructed of wood, aluminium or glass reinforced plastic (GRP) e.g. Western Region type barrier.

The method of construction can also vary. Timber booms may be laminated or jointed lengths of solid timber.

Other types, such as boom gates, are constructed of marine ply to form a box section approximately 300 mm x 200 mm. The addition of vertical timbers creates the "gate like" assembly.

Some barrier machines are similar in design but are fitted with booms of different cross section. When replacing a damaged boom, it is essential for the continued correct operation of the barrier equipment that the replacement boom is the correct length and that the boom cross section is correct for the machine. See Figure 3 also Barrier out of Balance (Tip) Force.

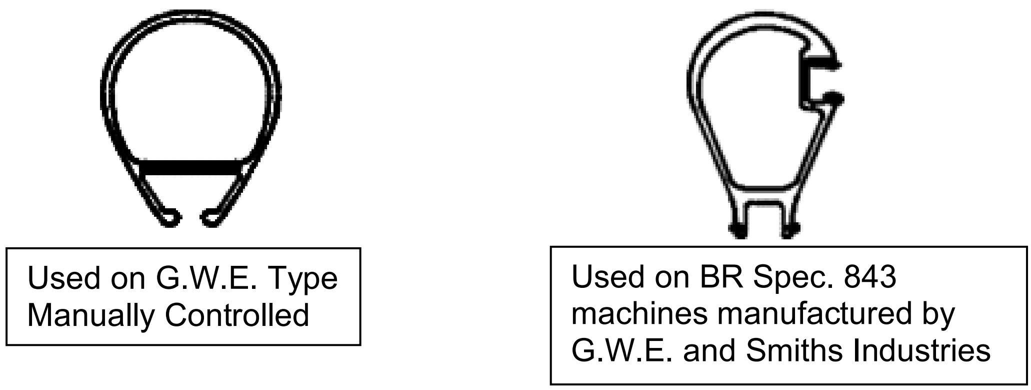


Figure 2 - Cross section of typical metal booms

SPX style booms shall be measured from the centre bolt of the side arm, older GWE's shall be from the end of the slot for the boom within the side arm, Penguins shall be from the centre pivot.

3. "Sangamo" or "Schlumberger" Time Switches

NOTE: *These time switches are no longer permitted and shall be replaced by the SELC electronic timer.*

3.1 Back-up Battery

The 110V supply cannot supply the peak pulse currents required by the time switch mechanism. These pulses are supplied from the internal back up battery which is also there to cover for power failures.

The backup battery is therefore essential to the correct operation of the time switch, such that a faulty battery can seriously affect the accuracy of the device.

As the purpose of the time switch is for controlling / muting the night time Yodalarm output, a slow time switch can eventually result in a muted Yodalarm during day time operation.

If a clock consistently loses time, arrangements shall be made to replace the time switch as soon as practicable.

Even if the time switch appears to be accurate the battery condition can be examined as follows:

- Remove the Cover
- Detach the timer dial by unscrewing the screw in the centre of the dial and easing it off. Do not turn the knurled Knob.

If the battery shows any sign of discharge or contamination, the complete unit should be considered as being defective and a replacement obtained.

The battery, which is incorporated in the printed circuit, cannot be replaced on site.

The battery should be examined when installing time switches as the battery condition can also deteriorate during storage.

NOTE: *The manufacturer recommends that the life expectancy of the backup battery with continuous use is approximately 10 years. However, prolonged storage in a discharged state may have an effect on the battery, limiting the life expectancy. It is recommended that the time switch is replaced at five-year intervals.*

3.2 Day Omit Device

The "Sangamo" or "Schlumberger" time switches may also incorporate a "Day Omit" option which is not required when they are used at level crossings. It is extremely important that this option is disabled. There are two methods by which this may be achieved.

The “Day Omit” option is controlled by seven arrows, one for each day. It is therefore extremely important that this option is disabled for each day of the week. Otherwise the volume of the “Yodalarm” will be muted during the daytime on those days not disabled.

Method 1

a) The position of the arrows on the “Day Omit” dial may be observed by carefully turning the “Day Omit” dial so that each arrow is just visible in turn at the edge of the main dial. The arrows on the face of the “Day Omit” dial shall be set to point towards the centre of the dial. See Figure 3. Take care not to rotate the timer dial.

b) To adjust the direction of an arrow, use a small flat bladed screw driver (blade approx. 3mm wide) and turn the arrow in an anti-clockwise direction until it points towards the centre of the “Day Omit” dial.

c) Check that the time setting is correct.

Method 2

Remove the central screw holding the timer dial and carefully lift it off. See Figure 3.

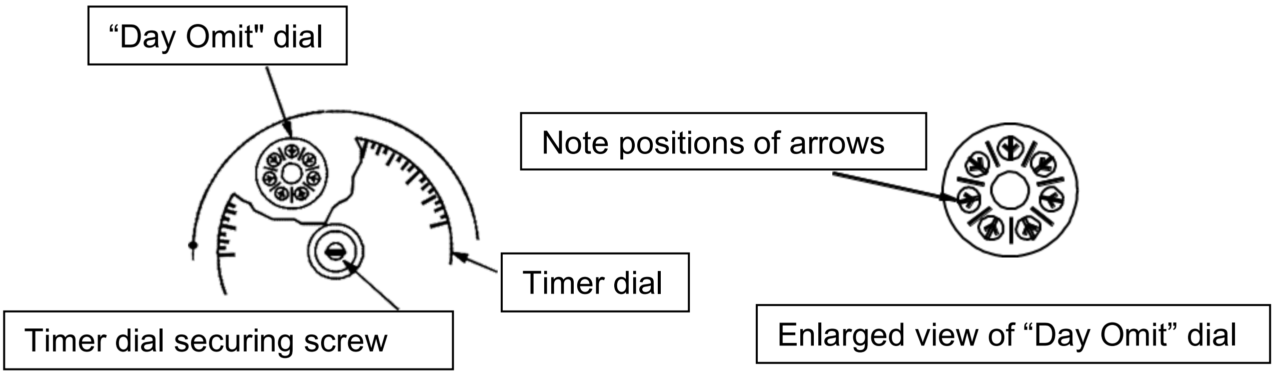


Figure 3 – Time Omit Device

Caution: Do not turn the knurled knob because the “ON” and “OFF” timing tappets will be loosened, and their relative time settings may be lost.

The arrows on the face of the “Day Omit” dial shall be set to point towards the centre of the dial.

To adjust the direction of an arrow, use a small flat bladed screw driver (blade approx. 3mm wide) and turn the arrow in an anti-clockwise direction until it points towards the centre of the “Day Omit” dial.

When all the arrows of the "Day Omit" device are set correctly, carefully replace the timer dial and secure with the centre screw.

Check that the time setting is correct.

3.3 Volume Control Adjustment

The times when the volume of the audible warning is to be reduced will be stipulated in the level crossing order or on the crossing layout drawing where an order does not exist. The timer "ON" and "OFF" tappets shall be set to correspond with these times.

The standard time clocks are supplied with pairs of "ON" and "OFF" tappets. The second tappet acting as a back-up for each type. The "ON" tappets switch the audible warning to the higher volume (Day setting) and the "OFF" tappets to the reduced volume (Night setting). i.e. "ON" days and "OFF" nights.

The first tappet of each type ("ON" or "OFF") should be set to the time specified in the Order or layout drawing. The second (back-up) tappet of the pair should be set to follow approximately one hour later.

The latest type of time switch made by a firm called SELC. It is electronically based, and it carries out the change to and from British Summer Time (BST) automatically. In early 2008 each area was supplied with a sufficient quantity of SELC timers to replace the previous mechanical type. These should be replaced at the NEXT maintenance visit or failing that at the earliest opportunity.

4. British Railways Board Automatic Half Barrier Crossing - Machines

4.1 General Description

The British Railways Board (BRB) Mk I and Mk II Automatic Half Barrier Crossing (AHBC) machines are often referred to as the "Penguin" type because of the bulbous shape of the concrete column.

The column tapers towards the top and may carry the road traffic light signals. At many crossings the road traffic light signals have been removed from the column and the typical post mounted road traffic light signal assembly has been installed adjacent to the machine.

The barrier operating equipment is housed in a steel frame mounted to the rear of the column. Robust moulded ABS plastic covers protect the equipment. The 'Y' barrier machine, contained the telephone and local controls.

Two doors were provided in the side of the top cover, one for public access to the telephone and the other for operator access to the Local Control Unit.

The operator's door is fitted with a locking device activated by a magnet bonded to the inner face of the machine cover adjacent to the door lock.

When the door is closed and locked, the magnet lifts a gravity-operated pawl at the rear of the lock permitting the key to be withdrawn.

At some installations the telephone has been removed. A cover without a telephone access door has been fitted to the machine.

This modified cover is necessary to prevent unauthorised access to the local control buttons via the adjacent unlocked telephone door.

The telephone is usually relocated in a weatherproof housing mounted on a post adjacent to the barrier machine. Similar arrangements may also apply to the local control unit.

The timber boom is mounted on boom carriers on either side of the machine. The boom lengths range from 3.98 m (13ft 1in) to 6.02 m (19ft 9ins) pivot to tip.

Boom lengths of 3.35 m (11ft 0ins) to 3.96 m (13ft 0ins) are available for special installations.

Two boom lamps are usually fitted, one of which is mounted approximately 150 mm (6 ins) from the tip of the boom.

The boom carriers on either side of the machine are fitted with moulded ABS plastic covers. These covers, often referred to as the anti-guillotine shields, shall be fitted securely to provide protection from the equipment as it operates. Arrangements shall be made to replace the shields if they are damaged or missing.

On early models, the main shaft on which the boom mechanism rotates, was carried on plain shell bearings. This main shaft / shell bearing assembly required frequent re- alignment following bearing renewal or if the boom was damaged.

During the 1970s the main shaft / bearing assembly of many machines were converted to a self-aligning bearing arrangement utilising special washers. An oil hole was also provided in the top of the bearing housing.

Many machines were subsequently fitted with PTFE coated bearings to produce a self-lubricating bearing, consequently an oil hole was not provided in the bearing housing.

PTFE coated bearings shall not be oiled as the oil can cause the coating to deteriorate.

4.2 Top Ram Pin Clamp

The hydraulic ram, which operates the barrier, is pivoted from a ram bracket fitted to the bottom of the steel frame attached to the rear of the concrete column.

The bottom pivot may be either a ram pin or bolt and nut assembly. The top of the ram is connected to the boom driving lug sub-assembly by a ram pin.

The ram pins are secured with split pins except where the modified top ram pin is fitted.

The ram journal rotates around the top ram pin as the ram extends and retracts to raise and lower the barrier.

If the pin is not lubricated it is prone to seizure and the barrier might fail in the raised position.

This is a potential Wrong Side Failure condition. However, oiling shall be done carefully to avoid surplus oil contaminating the “Metalastik” bush fitted to the ram journal.

A clamp has been developed to prevent the top ram pin turning in the driving lug sub- assembly.

The ram pin has been modified to incorporate a central hole and a grease nipple, which is fitted to one end of the pin. See Figure 4.

This arrangement makes the lubrication easier to apply and is delivered direct to the ram journal.

The clamp and modified top ram pin assembly can be fitted on site.

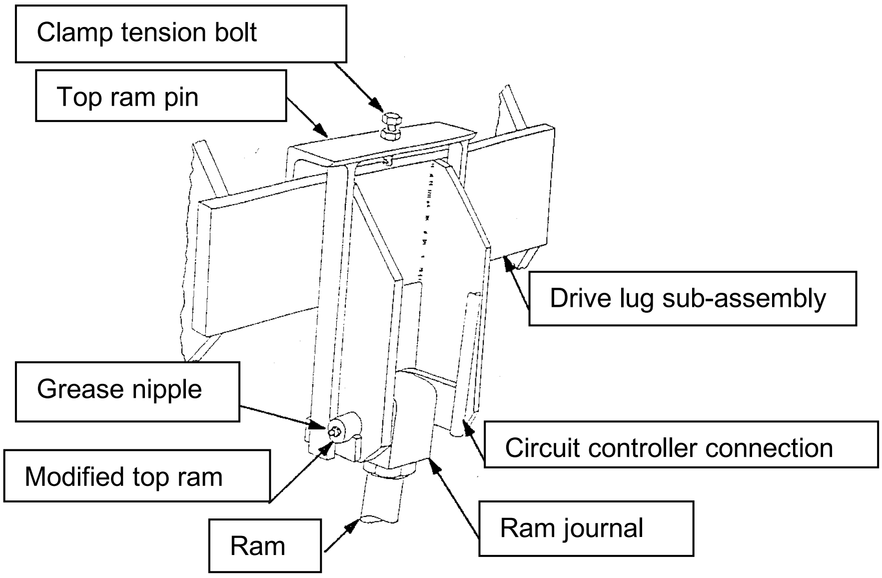


Figure 4 – Top Ram Pin Clamp Assembly

4.3 Local Control

The button switching mechanism is interlocked to check that only one button can be in the depressed position. When a button is depressed it is mechanically latched and is only released when another button is fully depressed and latched.

To check that the crossing is returned to automatic operation, the “Auto” button shall be depressed and the interlocking lever / cam assembly repositioned against the push button fascia.

The cam engages the aperture of the depressed “Auto” button verifying that the other buttons cannot be depressed. Unless this procedure is followed the access, door cannot be shut and locked.

The lever / cam assembly is an interlock and is not intended to force the “Auto” button into the latched position. The button shall remain latched until released by depression of another button.

Due to normal wear, free play might be present in the lever / cam assembly.

Therefore, it is very important that the “Auto” button remains latched irrespective of the position of the interlocking lever.

If the latching mechanism does not operate correctly, arrangements shall be made to replace the unit as soon as possible.

4.4 Barrier Out of Balance (Tip) Force

With the weights fitted and correctly adjusted, check the barrier is able to lower within the specified time. Incorrect setting can affect the lowering time.

The barrier might be slow to lower or prevented from lowering during windy conditions.

It is essential for the continued correct operation of the barrier machine that the correct boom is fitted, especially when a boom is replaced. If a boom of a different weight or of an incorrect length is fitted, the existing boom weights are likely to be incompatible and the out of balance force incorrect.

An incident occurred during strong windy conditions in which an incorrectly weighted boom was still lowering as the train passed over the crossing.

The boom eventually reached the lowered position, just within the time margin, allowing the crossing to normalise before the crossing indication time out period expired.

Consequently, the crossing operation was “normal” and the Signalman was unaware of the problem. A serious accident could have occurred.

Always check the replacement boom is a “like for like” replacement and that the out of balance (tip) force is correct even though the boom might appear to be identical.

NOTE: *Details of the out of balance tip force weights can be found in NR/SMS/PartZ/Z04 (Level Crossing – Reference Values).*

4.5 Hydraulic Unit (Removal)

a) Close the stop valve and manually raise the barrier to the fully raised position using the hand pump. See Figure 5.

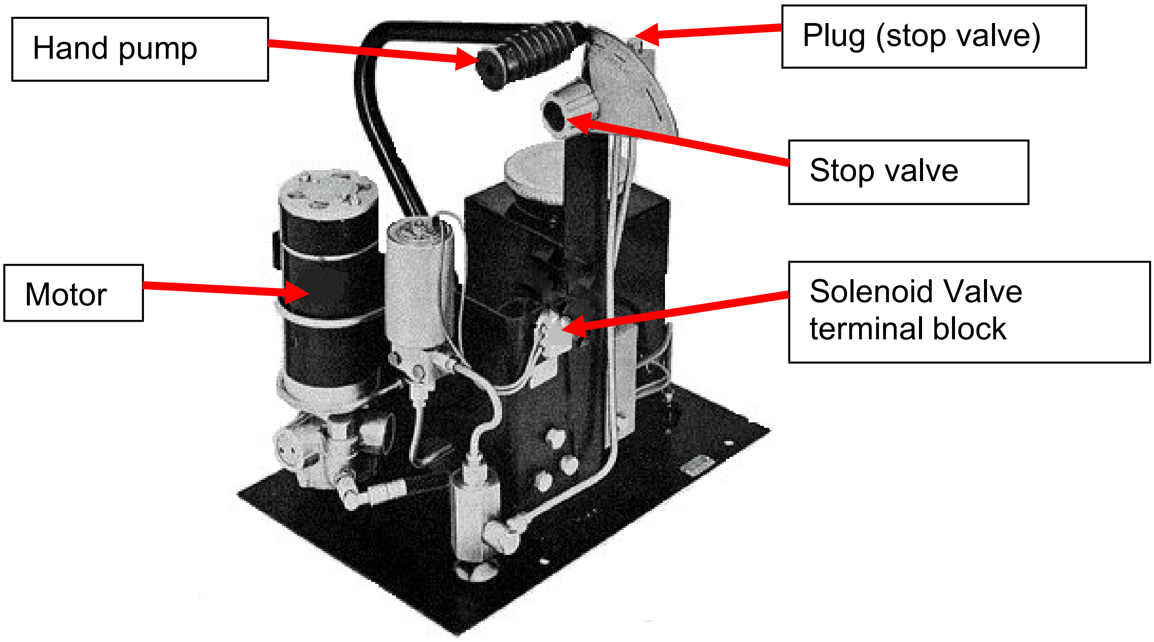


Figure 5 – Hydraulic Unit

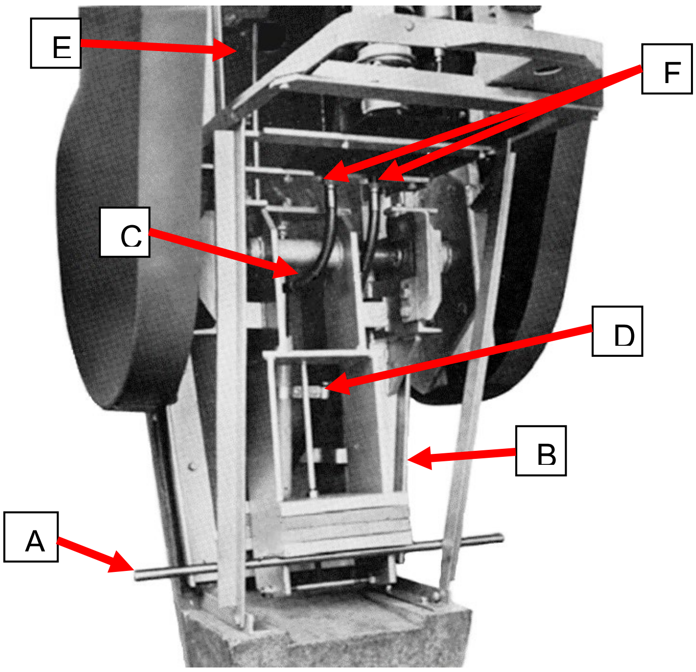


Figure 6 – Hydraulic Unit (Replacement)

b) Place a strong bar (A) between the machine frame and the counter balance weight carrier arm (B). See Figure 6.

c) Open the stop valve (1) to release the hydraulic pressure.

d) Disconnect the wires from the motor (3).

e) Disconnect the wires from the solenoid valve terminal block (4).

f) Carefully remove the plug (5) from the top of the stop valve body and connect the special drain pipe.

g) Close the stop valve (1). With a clean container held beneath the drain pipe, use the manual hand pump (2) to drain the reservoir (E).

h) Loosen the hose connections (F) at the bottom of the reservoir.

i) Remove a blanking plug from the connection at the bottom of the new unit.

j) Check the new unit is protected from contamination.

k) Disconnect one hose (C) and quickly fit the blanking plug to the connection (F) to prevent residual oil running out of the reservoir.

l) Temporarily tie the hose in an upright position to prevent loss of oil.

m) Repeat disconnection procedure for the other hose.

n) Remove the bolts securing the hydraulic unit to the machine frame.

o) Carefully remove the hydraulic unit from the machine frame.

4.6 Hydraulic Unit (Replacement)

a) Manoeuvre the hydraulic unit into the machine frame and bolt in position.

b) Reconnect the flexible hoses (C) to reservoir connections (F).

NOTE: *The hoses shall also be renewed at the time the pack is replaced as any contamination within the existing hoses can migrate back into the reservoir of the pack thus causing early ‘hunting’ problems of the new pack as the contamination takes effect.*

c) Check the bracket (D) securing the flexible hose to the ram body is secure.

d) Reconnect the wires to the solenoid valve terminal block (4).

e) Reconnect the wires to the motor terminals (3).

f) Fill the reservoir with clean approved hydraulic oil. Use the dipstick attached to the filler cap to determine the level. The reservoir capacity is approximately 2.3 litres (1/2 gallon).

g) Close the stop valve (1) and operate the hand pump.

h) With the boom manually supported carefully remove the locking bar (A).

i) Open the stop valve (1) and lower the boom.

j) Use the hand pump (2) to fully raise and lower the boom 3 times to bleed air from the system.

k) Restore the machine to power operation and raise and lower the boom 3 or 4 times and observe that the machine operates correctly.

l) Check the hydraulic system for leaks and rectify as necessary.

m) Check the level of the hydraulic oil and top up as necessary.

n) Replace the filler cap.

o) Check the operating time is correct.

RAISE TIME	4 to 5 seconds
LOWER TIME	6 to 8 seconds

p) Restore machine to automatic operation. See Restoring to Service.

5. G.W.E. Electro / Mechanical and Electro / Hydraulic Barrier Machine

5.1 Limit Switch

The 24-volt battery feed is housed in the pedestal of the Electro/Mechanical barrier machine

The limit switches fitted to the G.W.E. Electro/Mechanical and Electro/Hydraulic machines are manufactured by Crabtree.

The original switches were manufactured with the hole centres spaced at 30 mm x 80 mm and are identified by the Crabtree part number 24395. These dimensions were subsequently changed to 30 mm x 60 mm. The later type can be identified by the Crabtree part number 15045/2.

NOTE: *The original Crabtree switches are now obsolete. New Honeywell types are available but require the mounting plate changing at the same time.*

The Crabtree switches are not interchangeable and the whole mounting plate should be changed. When switches are changed it is essential that the mounting plate and switches are secure and the contact gap is correct.

The internal switch unit is secured within the metal housing by two screws. The housing is tapped to accept a conduit connection; however, when used in the barrier machine a plastic insert is fitted forming an open entry gland for the cable.

Drops of moisture can enter the switch unit through the open cable gland. The resulting contamination and corrosion could cause the switch to malfunction and could result in a Wrong Side Failure. It is therefore essential that the anti-condensation heaters and the thermostat operate correctly. The thermostat should be set to approximately 16°C (60°F).

A rubber grommet or similar cable gland sheath should prevent the ingress of moisture. Mastic sealant is not recommended as it might enter the switch and affect the operation of the contacts and could result in a Wrong Side Failure.

6. G.W.E. Electro/Mechanical Barrier Machine, Electro-Magnetic Clutch Mechanism Type

6.1 Barrier Damping Adjustment

The damper controls the lowering of the barrier and prevents the barrier end stop striking the road surface with excessive force, the result of which could damage the barrier and associated equipment. To check that the feature is operating correctly, proceed as follows:

a) Isolate the machine from power.

b) Observe the barrier as it descends.

The barrier should lower gently to the horizontal position and come to rest without bouncing.

If the damping is insufficient, turn the adjusting valve screw, if fitted, very slightly in a clockwise direction.

NOTE: *The damper adjusting screw is very sensitive and requires minimal adjustment to alter the damping effect. When the correct damping is obtained secure the screw with the locknut.*

If correct damping cannot be obtained by adjusting the screw, the barrier shall be re- balanced using the counter-weights. Moving the counter-weights can be used to increase their effective weight when the barrier is horizontal.

7. Lifting Barrier Machine to BR Spec 843

7.1 Main Shaft Weather Seals

When refurbishing the barrier machine, the seals and the exposed portions of the main shaft shall not be painted. (Else the seals can stick to the main shaft and are damaged when the barrier is operated. This can allow water to penetrate, which on freezing could prevent the barrier operating.

Seals that have been deformed, cut, or torn shall be replaced.

7.2 Main Shaft End Cap

Machines supplied with booms less than 7100 mm (pivot to tip) are not fitted with a support arm. An end cap should be fitted to the machine pedestal to cover the exposed end of the main shaft.

A mastic compound is used to provide a weatherproof seal between the end cap flange and the pedestal. The end cap shall be kept secure and the mastic seal in good condition to prevent the ingress of dirt and water which could freeze during the winter months.

Frozen grease and water caused both barriers at an AHB crossing to remain raised during the passage of a train. Grease expelled from the bearing during greasing could fill the end cap and extreme winter temperatures might cause it to freeze with similar results.

Packing the end cap with grease to prevent the ingress of water is not recommended for the same reason. The use of a frost resistance grease might be necessary during the winter months.

7.3 Boom Re-Fitting Procedure

a) Note the number and size of the weights on each side arm.

b) Remove the weights from the side arms.

c) Lift the side arm to the horizontal position and support.

d) Replace, if necessary, the displacement detection micro switch. See boom displacement detection micro switch re-fitting procedure.

e) Locate the boom adapter (pre-assembled to the boom) on to the two taper bushes fitted to the side arm. Check that the boom adapter is correctly seated in the side arm channel. See Figure 7.

f) Secure with two M12 x 70 bolts, each bolt to be complete with special thick washer (16 mm internal diameter) under the head of the bolt, M12 plain washer and an ordinary M12 hexagonal nut. See Figure 7.

g) Support the boom assembly at the tip.

h) Check that the boom and boom adapter fastenings are tight.

i) Fit and secure, if provided, the skirt linkage to the pedestal.

j) Fit and secure, if provided, support frame. See Support Frame Re-Fitting.

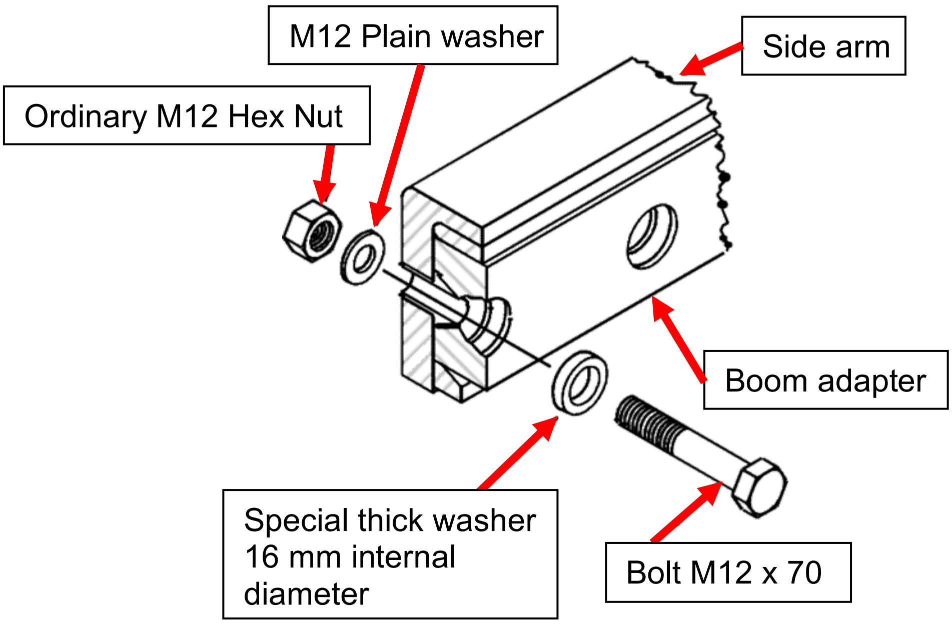


Figure 7 - Boom adapter to side arm - initial assembly

Assemble the Locating Pins with the Special Thick Washer (16 mm internal diameter), “E” Clip, and M6 Slotted Pan Head Screw. See Figure 8.

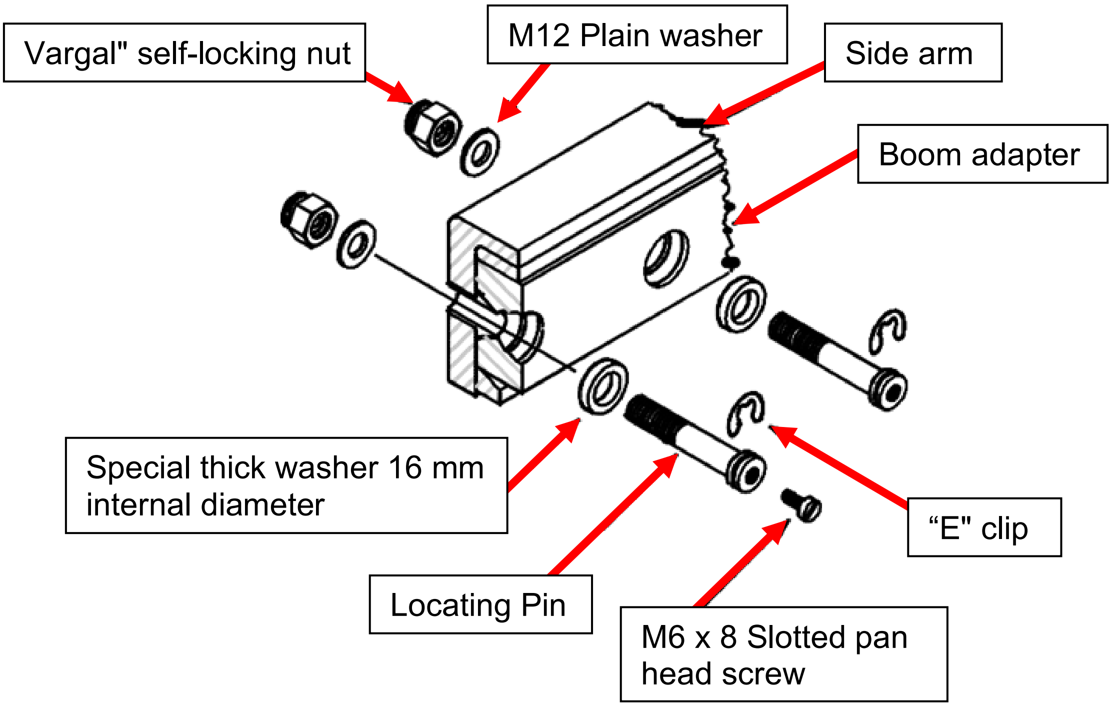


Figure 8 - Boom adapter to side arm fixing

k) Apply adhesive type grease to the locating pin assembly.

l) Remove one temporary M12 x 70 bolt assembly. Replace with a locating pin assembly complete with the special thick washer, M12 plain washer and "Vargal" self-locking nut.

NOTE: *The "Vargal" self-locking nut is designed to be re-used.*

m) Hold the locating pin assembly by inserting a screw driver into the slot of the M6 pan head screw. Tighten the "Vargal" self-locking nut to 16 Nm (12lbs. ft).

n) Remove the M6 pan head screw.

o) Repeat the procedure for the other temporary bolt assembly.

p) Pack the locating pin "E" clip cavity with adhesive type grease.

q) Fit the flexible conduit, which carries the boom light and displacement detection wires, over the fulcrum and then into the pedestal. Secure by means of the cable clips.

r) Route the boom light and displacement detection wires within the pedestal and fix into position. Check that the wires are supported clear of all moving parts and cannot become trapped when the door is closed or when the ram unit operates.

s) Remove the support from the side arm, fit, and secure the weights.

t) Fit, if provided, the strainer wire and adjust as necessary. See ‘7.6 Strainer Wire Re-Fitting’.

u) Terminate the boom light and displacement detection wires and check that the circuits operate correctly.

v) Measure the tip force and adjust the weights as necessary.

w) Operate the machine manually.

x) Power operate the barrier five times and observe that the operation is satisfactory.

y) Re-adjust the strainer wire, if necessary. See ‘7.7 Strainer Wire Tension’.

7.4 Assembly Bolts and Spare Locating Pins

It is good practice to keep the M20 x 70 bolts, nuts, washers, spare locating pins complete with “E” clips, M6 pan head screws, “Vargal” nuts and washers in a bag in the relay room or REB. The components are then readily available in the event of boom displacement or false indication.

Where the components have to be stored in the machine pedestal, check that they cannot interfere with the operation of the machine. Anti-rust protection may be necessary in some locations. Rusted or distorted “E” clips shall be replaced otherwise they might fail prematurely in service or during installation.

7.5 Support Frame Re-Fitting Procedure

NOTE: *The support frame shall not be fitted until the boom has been fitted.*

a) Slide the clamp plates into their approximate positions in the boom slot.

b) Fit and secure the support frame adapter to the support frame.

c) Position the Support Frame Adapter and using a 12 mm A/F Hex. Wrench Key screw the two M12 Taper Ended Screws so they protrude into the Side Arm. See Figure 9.

d) Commencing at the Pedestal End of the Support Frame, secure each Cross Member to a Clamp Plate with two M12 x 25 mm bolts and M12 washers. See Figure 10.

e) Check that the Cross-Member fastenings are tight.

f) Adjust the two M12 Taper Ended Screws so their taper ends protrude into the Side Arm by approximately 10 mm when measured from its outside face.

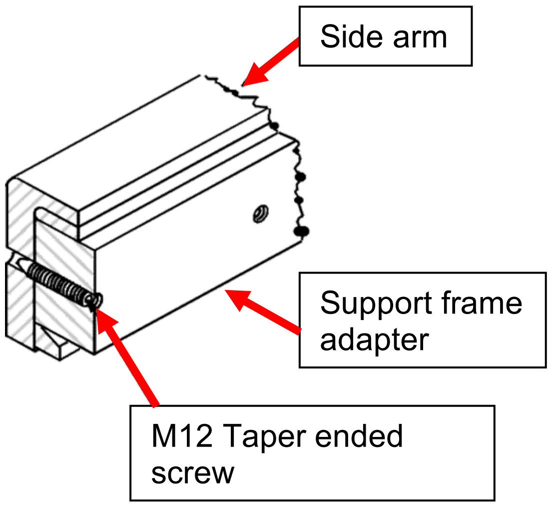


Figure 9 - Support frame adapter and side arm assembly

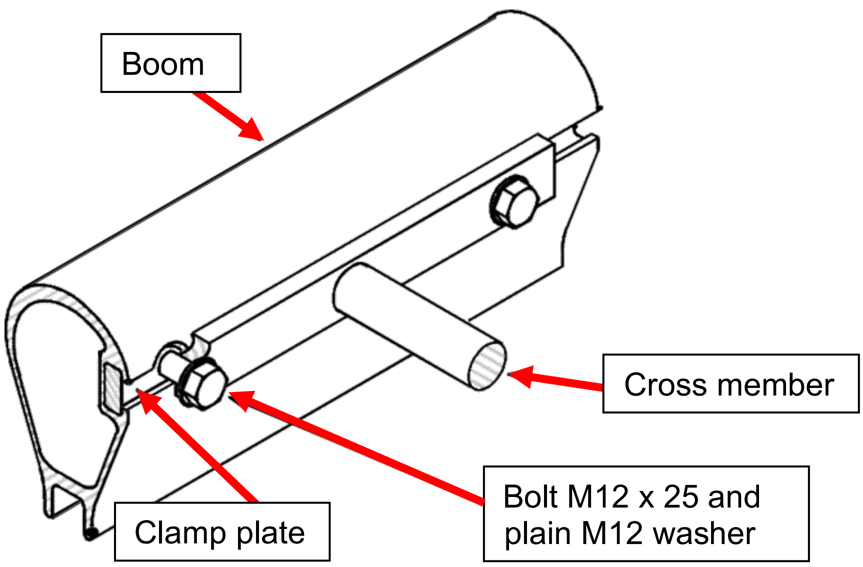


Figure 10 - Cross member to boom assembly

7.6 Strainer Wire Re-Fitting Procedure

a) Fit and secure the Strainer Wire Support and Rear Anchorage assemblies onto the Side Arm.

b) Check that the Boom Tip Eye Bolt assembly is secure.

c) Fit and secure the Strainer Wire.

d) Adjust the tension of the Strainer Wire so that the boom is straight throughout its length. See ‘7.7 Strainer Wire Tension’.

NOTE: *Only approved strainer wire shall be used.*

7.7 Strainer Wire Tension

If after carrying out the SMS process or replacing a strainer wire it requires to be tensioned the following process should be carried out.

With the barrier in the lowered position the strainer wire should maintain the boom in a straight alignment (i.e. minimum sag).

If a boom support is provided it should be removed temporarily before assessing the alignment of the boom or adjusting the tension of the strainer wire.

This is to check that enough tension is applied to the strainer wire to maintain the boom in straight alignment.

When the tension is correct, tighten the Rear Anchorage adjusting nuts.

Apply adhesive type grease to the exposed adjuster threads to protect the threads and make adjustment easier when required.

Refit the boom support, if provided.

7.8 Boom Displacement Detection Micro Switch Replacement Procedure

The micro switch assembly comprises a mounting bracket to which is fitted the micro switch and a short length of wiring harness encased in a flexible conduit. The micro switch assembly is fitted to the underside of the boom adapter. See Figures 11 and 12.

a) Remove the M6 x 15 screw.

b) Remove the M4 Dog point socket screw.

c) Loosen the M4 socket head screw securing the conduit clamp to the inner face of the side arm.

d) Disconnect the 4-pin connector. (Adjacent to the conduit clamp).

e) Remove the short length of skirt channel (complete with skirt rods, where fitted)

f) Disconnect the 2-pin connector. (Adjacent to the micro switch).

g) Loosen the M4 socket head screw securing the conduit clamp to the boom adapter.

h) Remove the two M4 pan head screws securing the micro switch mounting bracket to the boom adapter.

i) Remove the old micro switch assembly.

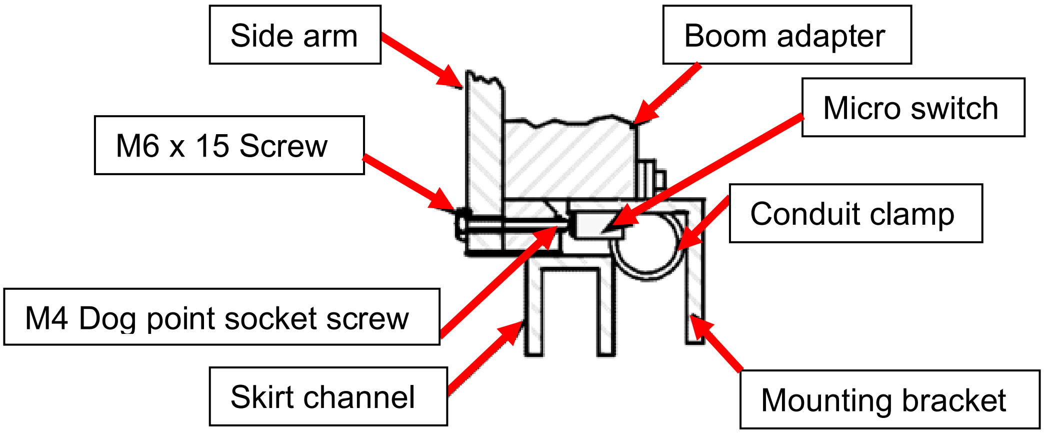


Figure 11 - Section through boom assembly looking towards the machine (cables and wires not shown)

j) Fit the new micro switch assembly and secure to the boom adapter.

k) Locate the flexible conduit in the conduit clamp.

l) Tighten the conduit clamp securing screw.

m) Reconnect the 2-pin connector.

n) Refit the short length of skirt channel (complete with skirt rods, where fitted).

o) Reconnect the 4-pin connector.

p) Tighten the conduit clamp securing screw.

q) Set the boom detection by carefully adjusting the M4 Dog point socket screw until the micro switch contacts just 'make'.

NOTE: *This should be undertaken using a multi-meter as over-tightening of the Dog Point socket screw can cause severe damage to the micro-switch assembly*

r) Turn the screw a further ½ turn (maximum).

s) Refit the M6 x 15 screw to protect the micro switch adjusting screw.

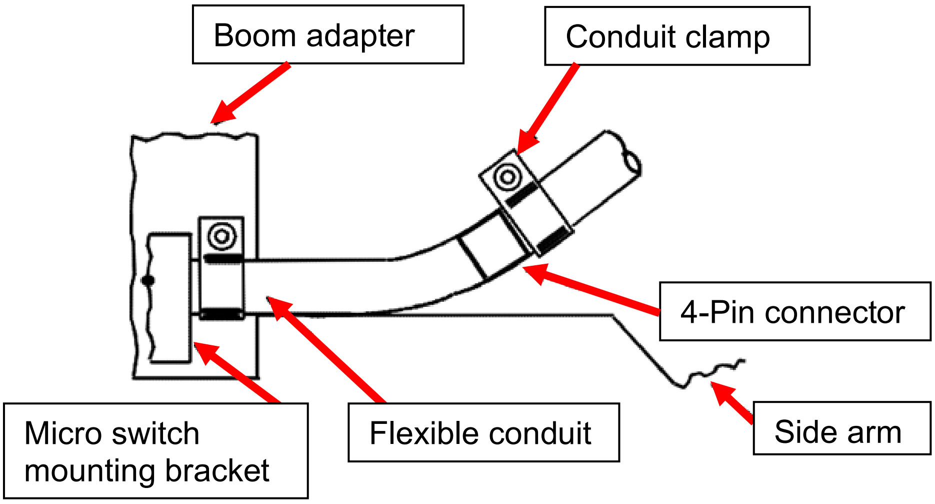


Figure 12 - Micro switch mounting

It is important that the 4-pin connector is located on the correct side of the side arm conduit clamp. Otherwise the connector might not pull apart when the boom is dislodged and the boom displacement detection could fail to operate. To prevent the cable being strained the clamps shall be secure and the conduit held firmly without damage.

7.9 False Indication of Boom Displacement

If false indications of boom displacement are reported, check the setting of the M4 Dog point socket screw that operates the micro switch.

This screw is located beneath the M6 x 15 mm screw fitted at the lower edge of the side arm. See Figure 11.

a) The M4 Dog point socket screw should be set so that the micro switch contacts just 'make'.

NOTE: *This should be undertaken using a multi-meter as over-tightening of the Dog Point socket screw can cause severe damage to the micro-switch assembly*

b) The screw should be turned a further 1/2 turn (maximum).

c) Refit the M6 x 15 screw to protect the micro switch adjusting screw.

If the setting was found to be correct, check that the boom adapter is securely fitted to the side arm. Any movement of the boom adapter might cause the micro switch to operate.

If movement of the boom adapter is suspected, do not try to secure it by tightening the nuts on the locating pins otherwise the “E” clips might be distorted or displaced.

Use the M12 x 70 bolt, washer, and nut assembly to tighten the boom adapter onto the side arm. See ‘7.3 Boom Re-fitting Procedure’.

7.10 Barrier Out of Balance (Tip) Force

With the weights fitted and correctly adjusted, check the barrier is able to lower within the specified time. Incorrect setting can affect the lowering time.

Incorrect setting could affect the lowering time or might prevent the barrier from lowering during windy conditions.

It is essential for the continued correct operation of the barrier machine that the correct type of boom is fitted, especially when a boom is replaced.

If a boom of a different weight or of an incorrect length is fitted, the existing boom weights are likely to be incompatible and the Out of Balance Force incorrect.

An incident occurred during strong windy conditions in which an incorrectly weighted boom was still lowering as the train passed over the crossing. The boom eventually reached the lowered position, just within the time margin, allowing the crossing to normalise before the crossing indication time out period expired.

Consequently, the crossing operation was “normal” and the Signaller was unaware of the problem. A serious accident could have occurred.

Always check the replacement boom is a “like for like” replacement and that the Out of Balance (Tip) Force is correct even though the boom might appear to be identical.

Correct setting of the Out of Balance (Tip) Force is especially important at Automatic Half Barrier Crossing (AHBC), Automatic Full Barrier Crossings Locally Monitored (AFBCL), Automatic Barrier Crossing Locally Monitored (ABCL) and Automatic Open Crossing Locally Monitored plus Barriers (AOCL+B) installations.

NOTE: *Details of the out of balance tip force weights can be found in NR/SMS/PartZ/Z04 (Level Crossing – Reference Values).*

7.11 Hydraulic Unit (Removal)

The power pack can be changed with the barrier either raised or lowered. If, due to local traffic conditions, the pack has to be changed with the barrier in the raised position check that it is safely secured.

NOTE: *Failure to do so results in the barrier crashing down.*

a) Lower the boom.

b) Isolate the machine from the power supply and disconnect the plug coupler on the top of the unit.

c) Remove the bolts from bottom bracket (3). See Figure 13

d) Check that the unit is supported in an upright position and remove the bolts from the top bracket (2).

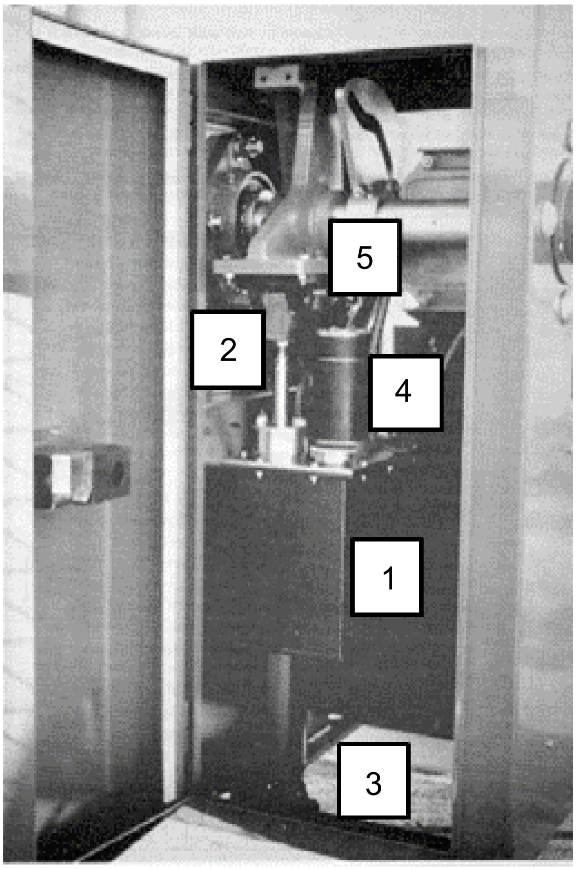
e) Note which holes in the operating arm were used as there are two fixing positions ‘Short Stroke’ and ‘Long Stroke’. The holes not used should have been fitted with nuts and bolts painted red during manufacture. (Arrange replacement if they are missing).

f) The “Long Stroke” position (bolt holes furthest from the pivot shaft) is used if the boom length is in excess of 7100 mm (pivot to tip).

g) Lift the hydraulic unit (3) remove from the barrier machine pedestal.

h) The hydraulic oil can be drained from the unit via the reservoir filler.

i) Replace the cap securely to prevent the ingress of dirt or water.



1 Hydraulic unit and reservoir.

2 Top pivot bracket (see note 2).

3 Bottom pivot bracket (see note 2).

4 Motor.

5 Ram-rod adjustment (see note 1).

Figure 13 – Barrier unit Internal components (front)

NOTE: *The PTFE lined pivot bearings shall not be lubricated.*

NOTE 2: *The length of the ram-rod is set during manufacture and shall not be altered as this affects the timings and damage the machine.*

7.12 Hydraulic Unit (Replacement)

NOTE: *It should be noted that there are two different types of power packs which can be fitted within a BR843 cabinet.*

The Grey units are fitted within AHB and MCB installations and fail in the lowered position if the solenoid feed is disconnected.

Blue coloured units are fitted within ABCL installations and require the solenoids to be energised for the barrier to lower. (i.e. they can fail in the raised position). It should be noted that some drive up drive down GWE units have been replaced with blue packs.

The correct type of power pack should be selected.

a) Remove the new unit from its transit box. Use box to return old unit.

b) Clean the pivot bracket fixing bolts, if necessary.

c) Hold the unit upright and carefully position the bottom pivot bracket (3) onto the mounting in the base of the pedestal and bolt in position.

d) With the unit supported in an upright position fill the reservoir (1) with clean approved hydraulic oil until it is visible in the strainer. The reservoir capacity is 10 litres (2.2 gallons).

e) Check the machine is isolated from the power supply and reconnect the plug coupler.

NOTE: *Current packs are self-bleeding. If the pack is not self-bleeding, the ram shall not be connected to the operating arm until the hydraulic system has been bled as follows:*

f) Keep the unit in the upright position and use the manual pump handle to fully extend the ram.

g) Continue to pump for another 5 full strokes of the manual pump handle.

h) Stow the manual pump handle and restore the power to the motor and solenoid valve.

i) Operate the motor for approximately ten seconds and then isolate the machine from the power supply.

j) Check that the ram top pivot bracket (2) is located in the same position on the operating arm as the original unit and bolt in position.

k) Top and bottom pivot securing bolts shall be fitted with TAB washers.

NOTE: *The dimension between the joint faces of the top and bottom pivot brackets is set at the factory to check that the boom should be horizontal when fully lowered.*

This dimension shall not be altered. Unauthorised adjustment of the ram-rod length might result in incorrect operating times and could damage the ram and associated equipment.

l) Using the hand pump, check that the machine operates correctly. Raise and lower the boom 2 or 3 times. Approximately 20 full strokes of the handle should be necessary to fully raise the boom.

m) Restore the machine to power and raise and lower the boom 3 or 4 times and observe that the machine operates correctly.

n) The barrier should rise smoothly without hesitation and should not oscillate excessively during the last few degrees of movement.

o) Check the operating time is correct.

Boom Length	Up to 7.3 m (24 ft)	Over 7.3 m (24 ft)
Raise Time	4 to 6 seconds	6 to 8 seconds
Lower Time	6 to 8 seconds	8 to 10 seconds

p) Power the boom to the fully raised position. Observe that the boom rises smoothly and remains in the fully raised position without any signs of lowering.

q) When the boom is released, it should lower smoothly and be damped during the last 10° of fall.

r) Set the Auto / Manual valve to the correct mode of operation and secure with the pin and wire seal. See Lock Down Feature Also Restoring to Service.

s) Check the level of the hydraulic oil, top up as necessary. The oil should be just visible in the filler strainer.

t) Replace the filler cap securely.

7.13 Operators Door Micro Switch

When the operators' door is closed and locked it is electrically proven by a micro switch operated by the movement of the lock tongue.

Problems have occurred when the door has been locked but not proven. To check correct operation of the lock and micro switch proceed as follows:

a) Check that the door is free of obstruction and fully closed.

b) Insert the "Allen" key and turn it clockwise ¼ of a turn to engage the door latch behind the door rebate. Remove the "Allen" key.

c) Turn the Yale key fully in the clockwise direction to verify the maximum extension of the lock tongue and the satisfactory operation of the micro switch via the spring-loaded plunger.

d) Turn the key anti-clockwise to the vertical position and withdraw it.

NOTE: *Unless the Yale key is turned to its fullest extent the door could be locked but not proven. If the door closed proving cannot be obtained on one door the plunger should be lubricated to make sure it moves freely.*

If the proving can still not be obtained then try another key. If both of these options do not work further fault finding should be undertaken. When the door is fully open the key should be removed to prevent it being damaged by the barrier back weight when lowering the barriers.

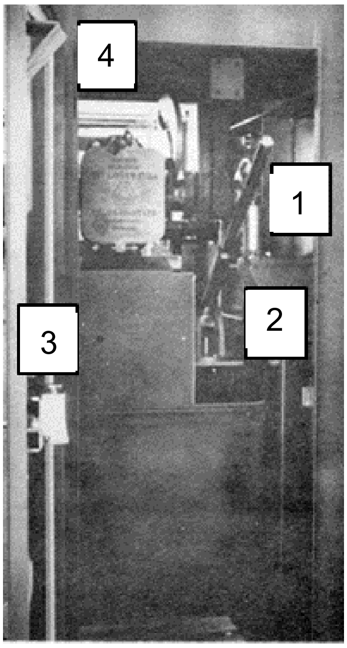
NOTE: *Do not force the key.*

7.14 Manual Pump Handle (Faulty Stowage)

The single acting telescopic manual pump handle is located in a casting bolted to the top of the reservoir.

When the handle is extended for manual operation it lowers into the pumping position. See Figure 14.

With the handle in this position it causes the hand lever stop (HLS) valve to close. Further downward movement operates the pump causing the barrier to rise.



1 Pump handle.

2 Pump handle casting bolted to top of reservoir.

3 Operators door.

4 Operators door pump handle check bracket.

Figure 14 - Barrier unit Internal components (rear)

The extended length of the handle is controlled by a spiral guide pin that protrudes through the slots in the lower shaft. When the handle is lifted, the spiral guide pin engages in guide slots in the pump handle casting.

The handle can then slide down into the stowed position causing the HLS valve to open and the barrier to lower. Unless the handle is in the stowed position the operators' door cannot be closed.

A potential wrong side failure condition was found during a routine test of an AHB crossing. The condition was created by the combination of a step at the bottom of the guide slot in the pump handle casting and a bent spiral guide pin. See Figures 15 and 16.

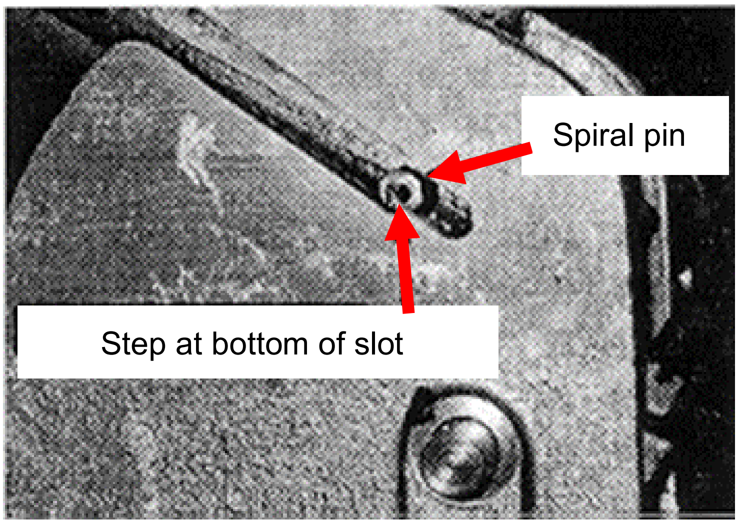


Figure 15 – Wrong side failure example

The step prevented the handle sliding fully home, whilst the bent spiral guide pin allowed the handle to be stowed sufficiently to enable the door to be closed with minimal force.

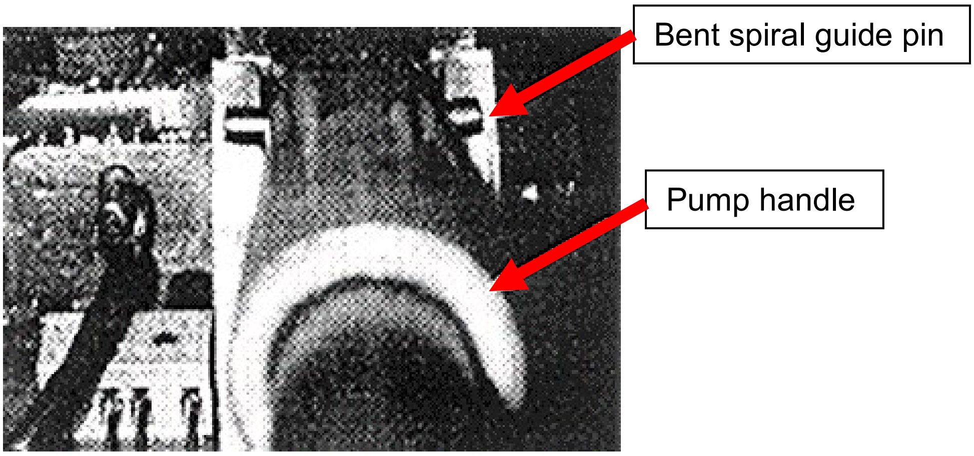


Figure 16 - Wrong side failure example

The closed door applied enough force to the pump handle to cause the spiral guide pin to ride up the step in the guide slot. The bent spiral guide pin allowed the handle to travel just far enough to open the HSL valve. The barrier commenced to lower as expected.

However, as the barrier lowered, the tilting movement of the power pack / ram assembly negated the force applied to the pump handle.

The spiral guide pin dropped down the step causing the HLS valve to close and the barrier stopped lowering.

Other castings have been inspected and found to have similar steps. However, the height of the step was not constant due to the machining tolerances and the width of the cast slot.

Excessive wear on the lower face of the machined slot could increase both the height of the step and the risk of the handle not fully seating at the bottom of the slot.

The machines most at risk are those fitted with booms in excess of 7600 mm (pivot to tip). In these cases, the long stroke coupling position is used which tilts the power pack further from the door check bracket.

In this position the clearance between the closed-door check bracket and the pump handle is increased comparative to that when the “short” stroke position is used.

7.15 Main Shaft Movement

A Wrong Side Failure occurred when a barrier remained in the raised position throughout the crossing sequence. The main shaft had moved through the bearings causing the machine components to come into contact with each other and obstruct the operation of the barrier.

In this case the probable cause was a severe blow to the end of the main shaft. However, the inspection revealed other potential failure conditions affecting BR Spec. 843 machines manufactured by both G.W.E. and Smiths Industries.

In a number of machines manufactured by G.W.E. the main shaft bearings were found to be loose. This made it possible for the rotating shaft to move through the bearings during the barrier operating cycle. The lateral movement would have caused the machine components to foul each other preventing the correct operation of the barrier.

Some machines manufactured by Smiths Industries were found to be slow in operation, which is a potential Wrong Side Failure condition. The cause was attributed to the main shaft bearings being over tightened during manufacture.

In both cases, personnel trained in the use of the special tools required undertook the rectification.

The above conditions should not re-occur. However, if movement of the main shaft is found or suspected, or the specified operating times cannot be achieved when the machine is set up correctly, the cause might be one of the above. It is stressed that adjustments shall not be undertaken locally unless the staff have been trained and the special tools are available.

7.16 Field & Grant Circuit Controller

The type TY 199 group 5 circuit controllers fitted to barrier machines during manufacture or supplied direct from the manufacturer as service replacements from 1996 are pre-set in compliance with BR Spec. 843 and do not require on-site coarse adjustment. However, fine adjustment might be necessary to compensate for local site variations such as site foundation levels, road profiles, or boom lengths.

Where site conditions require fine adjustment of the circuit controller proceed as follows:

a) Open the lid of the circuit controller.

b) Identify the band that requires adjustment.

c) Loosen the nut on the terminal stud just enough to allow the spring contact finger and its associated adjuster to be moved.

d) The adjuster is located into one of seven holes in the contact spring and is to be disengaged to permit the contact spring to be moved.

NOTE: *Very fine tuning can be achieved by moving the adjuster tip in the free space within the original hole in the contact spring. (particularly useful on long WR style booms).*

e) The contact spring has a slotted fixing hole and can be moved in the required direction to achieve the correct setting.

f) Re-engage the adjuster into the next available hole in the contact spring.

g) Carefully tighten the terminal nuts verifying that the contact spring and wire terminations are secure.

h) Test for correct operation.

i) Repeat the above procedure as necessary until the operation is correct.

j) Close and secure the circuit controller lid.

If the circuit controller springs are excessively worn, have lost tension are corroded or have fractured, replacement of the complete controller is recommended as good practice rather than changing the contact springs.

A heavily worn or grooved band is indicative of incorrect spring tension, maladjustment, or malformed springs.

The complete controller should be replaced.

The sleeve is an “Oilite” bearing which continually lubricates throughout the life of the unit. The cover of the modified units carried the letter “P” or “R” adjacent to the logo to aid identification.

The “R” type is fitted with larger spline collars which are coloured red instead of black. Labels with the legend “DO NOT OIL” are fitted to the bearing housings.

Although the type “R” is the latest version, either “P” or “R” types can be fitted.

For optimum performance, the “Oilite” type of bearing relies on 360° rotation of the shaft to distributed the lubricant evenly. However, in this design of circuit controller full rotation does not occur and can result in inadequate distribution of the lubricant and bearing failure.

The end of the bearing nearest the operating arm is also exposed to the atmosphere. In some instances, the lubricant has been found to dry up causing the bearing to seize on the shaft.

The dried lubricant / dirt contamination might appear as a black or brown film in the area of the bearing. However, this is not always visible until the unit is dismantled. If a faulty circuit controller is thought or found to be the cause of slow or faulty operation of the barrier equipment, a replacement controller is the only option.

It is stressed that the “Oilite” type of bearing shall not be lubricated, internally or externally otherwise the porous bearing material can become clogged.
A faulty bearing cannot be rejuvenated and a good bearing might fail prematurely.
“Elvolube” contact lubricant contains oil and has a similar affect, it is emphasised that excess lubricant or spillage shall be carefully removed.

7.17 Hydraulic Ram Failures

There have been instances where the hydraulic ram has broken at the upper trunnion block end.

This defect was “masked” by the barrier continuing to operate by driving along the inner face of the pedestal front door.

The fault only comes to light when the front door is opened with the boom in the raised position. Once the door is opened the hydraulic unit is free to fall forward and the barrier falls, uncontrolled, on to the person opening the door.

This issue was immediately addressed by labelling the front door instructing not to be opened with barrier raised.

Later hydraulic units have ram modifications to eliminate this mode of failure.

8. Rural Barriers

8.1 General Description

The rural barrier apparatus usually encountered on the railway was manufactured by Godwin Warren Engineering (G.W.E.). The G.W.E. rural barrier has now been superseded by a version of the Standard Lifting Barrier machine manufactured to BR Spec. 843 by Smiths Industries.

The level crossing barriers are normally in the lowered position and the crossing may also be protected by miniature warning lights or miniature stop lights.

Telephones connected direct to the adjacent signal box or other monitoring point are provided for the crossing user. Operating instructions are displayed on a sign fitted to the side of the machine housing on the approach side of the crossing.

The barriers are raised by the user applying a pumping action to the long handle on the exterior of the machine. Approximately 14 full strokes of the handle are required to produce enough hydraulic pressure to completely raise the barriers.

The BR Spec. 843 machine requires approximately 14 to 24 strokes.

Lifting a small lever on the opposite machine lowers the barriers. Operation of the lever releases a valve causing the hydraulic fluid to return to the reservoir ready for the next operation.

The crossing user is responsible for the correct operation of the equipment, their own safety, and that of others, by lowering the barriers after use.

If the barriers are left raised it might be thought that it is safe to cross and could result in an accident.

Instances of the barriers being left in the raised position, especially if it is a common occurrence at a particular crossing, shall be reported to your manager so that action can be instigated.

8.2 Faulty Operation

The hydraulic system of the G.W.E. rural barrier is a relatively simple design. However, for optimum operation of the system, the reservoirs should be at the same height and the return pipe run below the oil level of the reservoirs throughout its length.

If, due to the profile of the crossing area, the barrier machines are installed at different heights, the variation in reservoir height and associated fluid level can affect the rate of the return flow to the higher reservoir.

The problem could be accentuated when the barriers are repeatedly operated from the same side of the crossing without a significant time delay between operations. The length, gradient, and height of the return pipe can also affect the return cycle of the hydraulic oil.

The fault can self-rectify if enough time has elapsed and therefore the reported barrier malfunction can be difficult to trace.

In severe cases, the combination of excessive use from one side of the crossing and an air lock or restriction in the balance pipe might cause the hydraulic oil to overflow from the lower reservoir whilst starving the higher reservoir. See ‘8.3 Air in the System’.

8.3 Air in the System

Pump the barriers to the fully raised position usually 14 full strokes are required for the GWE type. The machine derived from the BR Spec. 843 machine needs approximately 40 full strokes.

Lower the barriers and note the lowering time (usually 6 seconds). Both barriers should lower together, although the barrier of the machine at which the lowering lever was operated might tend to lead the other barrier.

If the barriers of the GWE type machine lower slowly check that the bleed valve jet on the ram is clear.

8.4 Bleeding Air from the System (G.W.E. Type)

Hold down the lower release valve and pump air through into the reservoir. Repeat the procedure from the other barrier machine. Loosen the bleed valve at the top of the ram and allow any trapped air to bleed off. Repeat the procedure for the other barrier machine ram.

To check that air is expelled when refilling the system with hydraulic fluid it is necessary to pump through the main pressure feed pipe. To do this, disconnect the pipe from the master barrier and pump fluid through the slave.

When connecting the main pressure pipe hold down the lower release valve and pump the air through into the reservoir, as previously described.

8.5 Bleeding Air from the System (BR Spec. 843 Type)

The ram body incorporates an air bleed groove which allows any air trapped below the piston to escape to the reservoir when the ram is caused to over travel before installation in the pedestal.

If it becomes necessary to bleed the system, the ram top pivot bracket shall be disconnected from the operating arm to allow the ram to over travel and note which fixing holes are used. (Unused holes are usually blanked with bolts and nuts painted red).

a) Keep the unit in the upright position and use the manual pump handle to fully extend the ram. Continue the pumping action to cause the ram to over travel and the air to return to the reservoir.

b) Reconnect the ram top pivot bracket to the original holes in the operating arm.

c) Raise and lower the boom 2 or 3 times and check that the machine operates correctly.

d) The barrier should rise smoothly without hesitation and should not oscillate excessively during the last few degrees of travel.

e) Check the level of the hydraulic oil, top up as necessary. The oil should be just visible in the filter strainer.

f) Replace the filler cap securely.

g) Repeat the procedure for the other barrier machine.

9. Western Region Barrier

9.1 Hydraulic Ram Setting

The correct height at which the lowering barrier is damped is reliant on the dimension between the centres of the barrier pivot and the bottom ram pin. This dimension is 891 mm (2 ft 111/16 ins).

The dimension between the centres of the top and bottom ram pins is 1021 mm (3 ft 43/16 ins) and can be used for the initial setting. See Figure 17.

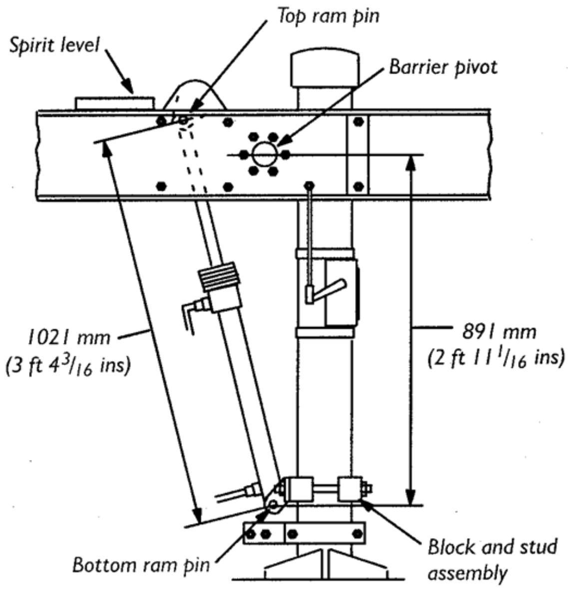


Figure 17 – Hydraulic Ram Setting

Checking this dimension is difficult due to the restricted working area. A simple gauge can be made from an old locking bar and the driving tips from two copper earth rods, See Figure 18.

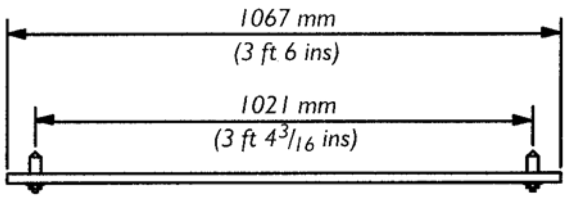


Figure 18 – Dimension Gauge

Cut the bar to length and carefully remove all burrs and sharp edges. Take great care when marking out the position for the two holes for the locating pins (driving tips).

Punch the hole centres and drill through with a sharp 9.5 mm (3/8 in) drill. Assemble the tips to the bar and secure with M10 nuts and washers.

With the barriers in the fully lowered position, check that the barrier is horizontal by placing a spirit level on the top of the side arm channel that carries the boom. See Figure 17.

Wipe each grease nipple and the end of each ram pin before removing the grease nipples. Check they are kept clean prior to refitting when the check is completed.

Check that the tip ends of the gauge are clean and free from dirt. Try to locate the tip ends into the grease nipple holes in the ram pins. If the dimension is correct, they should fit centrally in the holes. If not, adjustment could be required.

This can be achieved by moving the clamp blocks and bottom ram pin bracket assembly, as required. When the dimension is correct, secure the assembly, and re-check the dimension.

If still correct, check that the grease nipples are clean and re- fit them. Replenish the lost grease using a grease gun filled with lithium based grease.

Test the barrier to verify that it operates correctly. Operate the barrier several times to clear any air from the hydraulic system before finally checking the damping action as the barrier lowers.

The barrier should be damped when the tip is approximately 914 mm (3 ft 0 ins) from the road surface. If the damping is incorrect further adjustment may be necessary. Failure to achieve the correct setting may be due to movement of the clamp blocks. See ‘9.2 Bottom Clamp Block Movement’.

9.2 Bottom Clamp Block Movement

During 1977 the bottom clamp block and “U” bolt assembly which also secures the bottom ram pin bracket to the post was replaced with two blocks. The “U” bolt was replaced with two ¾ inch x 10½ inch studs with a ¾ Whitworth thread at either end. Each stud end was fitted with a plain washer, spring washer, and nut.

At some installations the clamp blocks and bottom ram pin assembly moved during operation of the barrier. The movement altered the setting of the ram length dimension and the position at which the barrier was damped as it lowered. The blocks were not securely clamped to the post due to insufficient length of thread on the studs. Although the nuts were fully tightened, they had only “bottomed” on the end of the thread.

If the correct clamping position cannot be maintained, movement of the clamp blocks could be the cause. Fitting additional washers may prove a temporary cure until the faulty studs can be replaced.

Some machines are fitted with a bar between one leg of the lower “U” bolt that secures the barrier pivot bracket to the top of the post and one of the studs that secures the clamp block and bottom ram pin assembly to the bottom of the post.

This was a local modification to address the problem of clamp block movement. However, the bar should not be necessary if the stud thread lengths are correct and a plain and spring washer is fitted beneath each nut.

9.3 Ram Pin Failure

An investigation into the failure of a Western Region type barrier revealed that the top ram pin had broken in half.

In this condition the retaining cotter pin was rendered ineffective allowing the broken ram pin to fall out. The hydraulic ram became detached from the drive lugs of the side arm cross member (rear strut).

This failure occurred with the barrier in the fully lowered position. If the pin had failed during the operating cycle only the counterbalance weights would have prevented the barrier falling without warning.

In high wind conditions the counterbalance forces might not be enough to prevent such an occurrence. Similarly, if the counterbalance weights are not at the optimum setting the result could be the same. In either case a serious accident or injury could occur.

9.4 Top Ram Pin

Lubricant is delivered to the bearing surface via a longitudinal hole drilled along the axis of the pin. A countersunk cross drilled hole connects this gallery with an annular groove at the centre of the pin. See Figure 19.

NOTE: *The following illustrations derived from drawing F1A2239/I5, have been exaggerated for clarity, and are not intended for manufacturing purposes.*

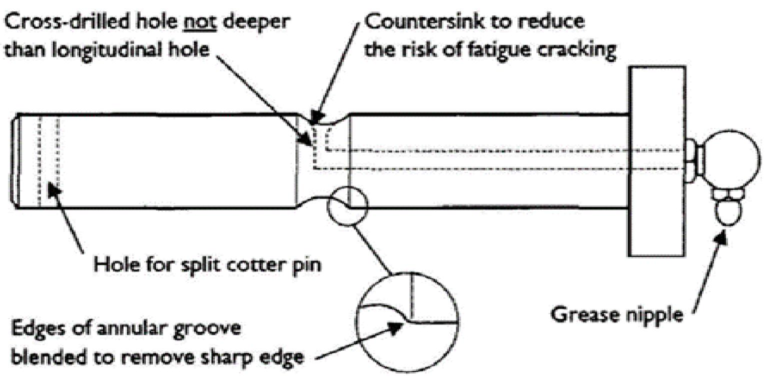


Figure 19 – Correctly manufactured ram pin

10. CLOSED CIRCUIT TELEVISION (CCTV)

10.1 Camera Column (Code of Practice)

The winch mechanisms and ropes used on camera columns should be inspected at regular intervals. This work is done by plant staff who work to NR/L2/ELP/27238 Appendix L.

END

General

Point rollers are designed to assist the movement of the switch rail during the operation of points by reducing the effects of friction. This leads to a reduction in the amount of drive force that is required to operate the points hence reducing the wear on the asset.

The point rollers are adjusted to achieve the minimum amount of lift of the switch rail as quickly as possible during the movement of the switch rail.

If the point rollers are set too high then the point operating equipment has to work harder to lift the switch rail higher than what is required, which leads to an increase in drive forces.

If the point rollers are set too low, then there will still be issues associated with the friction between the switch rail and the slide baseplates, also leading to an increase in drive forces.

Due to the condition of the switch rail i.e. hogging or differing track conditions, the rollers might require adjusting from their optimum setting in order to maintain reliable operation of the point operating equipment.

When the rollers are set to the correct height, it should be possible to slide a 1mm feeler gauge between the bottom of the switch rail and the slide baseplates.

If point rollers are set to a height to accommodate poor switch rail or poor track conditions, there will be a need to reset the position of the point rollers if any track improvement work is carried out (eg. tamping, stone blowing, or lifting and packing) as the relationship between the bottom of the switch rail and slide baseplates will be altered.

Point rollers might also need adjusting due to changes in track condition over time caused by the passage of trains.

Where points are fitted with Remote Condition Monitoring equipment, this should identify where the point rollers are not operating correctly. Also, it should be possible to compare current traces from before and after adjustment to make sure that the point roller adjustment has been effective.

Setting Up Point Rollers

Adjustment of the rollers should be done if they are out of position due to:

- Back Drive adjustment
- Manual Lift & Packaging
- Tamping or Stone Blowing

On Hy-Drive mk2 installations, the rear rollers might need to be lowered to allow manual pumping of the points due to the back of the switch starting to move before the toe leading to the lock arm jamming.

The height of the rollers can only be set when the switch rail is in the closed position.

1.1 Check to see that the switch is fitting up with the stock rail. If this is not the case then the back drive may need to be adjusted before the point rollers are set up.

For each roller assembly:

1.2 Clean the slide / base plates of dust and debris and remove the fixing bolts from the roller package.

It is good practice to grease the holes that are not used with lithium grease to prevent the threads from rusting (see figure 1).

Figure 1 – Grease Holes

1.3 Check the condition of the thread on the fixing bolts, replace them if necessary.

1.4 Place the fixing bolts back onto the roller package, before tightening lower the roller assembly to the lowest setting and slide the roller package horizontally underneath the rail.

1.5 Adjust the height of the roller so it comes into contact with the bottom of the switch rail (see figure 2); make a note of the height.

Figure 2 – Grease Holes

1.6 Slide the roller package out from under the switch rail and raise the roller assembly by 1mm.

1.7 By using a feeler gauge, measure the gap between the bottom of the switch rail and the slide plate (see figure 3), this distance will be known as 'X' mm during the following set up procedure.

Figure 3 - Gap

1.8 Slide the roller package horizontally underneath the switch rail allowing a gap equal to 1mm + 'X' mm to accommodate dynamic loading.

1.9 If a second roller is present, then set the second roller 1mm higher than the first.

1.10 Tighten the fixing bolts to 70NM by using the torque wrench, then recheck the height of the roller assembly as it may have moved in the tightening process.

1.11 Repeat the process for all roller packages throughout the closed switch.

1.12 Check the roller height settings (see figure 4). If they are approaching their maximum height setting, this should be reported to your supervisor as corrective maintenance such as lifting and packing might be required.

Grey roller packages provide a lift upto 6mm whereas blue packages provide a lift upto 4mm.

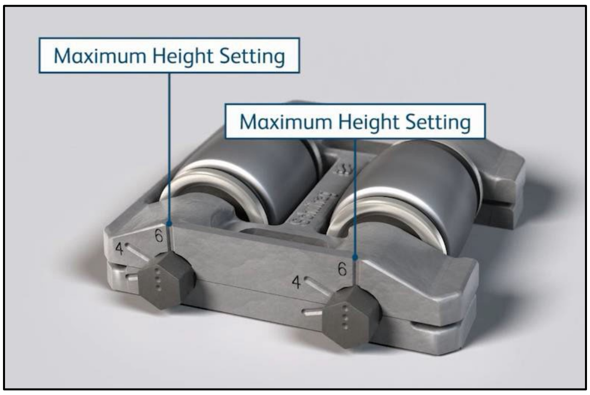


Figure 4 – Height setting

1.13 Operate the switch into the open position so the switch rail moves across the rollers.

1.14 Check the clearance between the bottom of the switch rail and slide baseplates through the switch lengths (see figure 5) . Ideally this gap should be between 1-3mm.

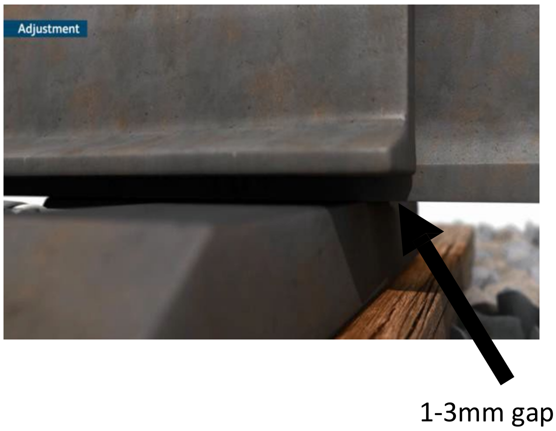


Figure 5 – Clearance check

1.15 If the 1mm clearance has not been achieved then raise the height of the roller, if the clearance is greater than 3mm then the height of the roller shall be reduced.

1.16 Recheck all slide plate clearances are within 1–3mm, if not then readjust.

1.17 Check that the kicking strap has a 6-9mm clearance from the stock rail.

1.18 Once all rollers have been set, operate the switch over and back a few times and assess the roller operation.

1.19 Check for signs of binding.
If the kicking strap is binding and this cannot be adjusted at the time of the roller setup, the front rollers can be lowered whilst arrangements are made to adjust the kicking strap. This should be reported as corrective maintenance.

1.20 Check the switch and rollers function normally after all work has been completed. Any issues that could not be rectified should be reported to a supervisor.

Further details of how to set up the rollers can be found in the standardised task video found on the Network Rail Intranet and How To app.

END

1. Mil Spec 5015 Plug Couplers, General

1.1 Mil Spec 5015 Plug Couplers (Figure 1) are defined in Network Rail standard NR/L2/SIG/30027 and consist of a plug and a receptacle which mechanically lock together via a reverse bayonet fitting.

Figure 1 - Mil Spec 5015 Plug Coupler. Male (left) and female (right)

1.2 Cables are supplied as pre-fitted "sealed units" with plugs/receptacles.

1.3 Maintainers shall not attempt to re-terminate plugs or receptacles.

1.4 A receptacle will typically be provided on lineside equipment by being mounted in the equipment's housing. Alternatively, the equipment can be fitted with a receptacle on a cable, which is then wired into terminals in the equipment.

1.5 5015 Plug Couplers are supplied with an environment cap to stop contamination of both pins and sockets. See Figure 2.

Figure 2 - Plug Coupler with (detached) environmental cap

2. General Maintenance

2.1 MIL 5015 connectors do not need scheduled maintenance and should not be disconnected during routine maintenance. Routine examination is limited to visual external inspection for signs of damage to the connector/cable boot and incorrect alignment/incomplete locking. It is not necessary to lift troughing etc to inspect inaccessible plug coupled joints.

2.2 Figure 3 shows the locking mechanism in both the locked and unlocked positions.

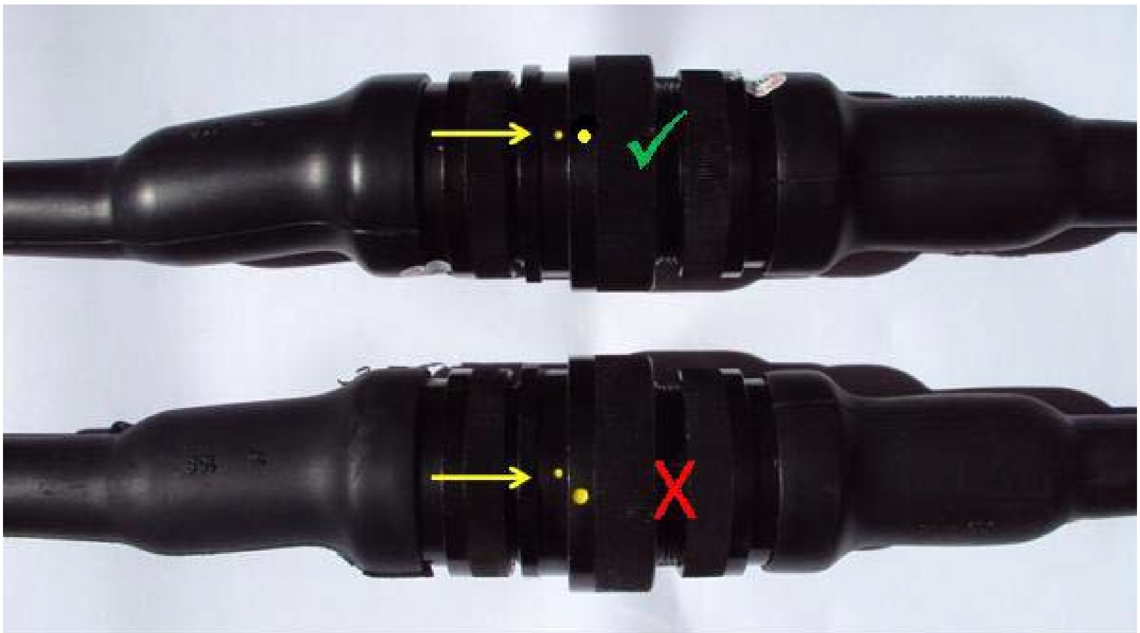


Figure 3 - Plug Couplers showing correct (top) and incorrect (bottom) mating. Note the position of the alignment dots

2.3 If required, disconnect the equipment using links at the location case where possible, not at a plug coupler.

3. Faulting

3.1 Where possible, plug coupled connections should not be opened and instead diagnostic testing should be done from accessible termination points such as Wago links in the location case/ REB. This will enable testing through the plug coupled connector.

3.2 When disconnecting plug coupled connectors, connect an environmental cap to both connectors except when connected to a break out box.

3.3 If environmental caps are not fitted to any exposed connectors i.e. plugs or receptacles, then NR/SMTH/Part04/CA06 (Renew a Plug Coupled Cable ("interconnect") with a Non Certified Replacement) testing shall be required following reconnection.

3.4 A Product Approved breakout box can be used to connect in-line across the plug coupled connections so that test terminals are available.

3.5 A pre-use test of the breakout box shall be carried out in conformance with the manufacturer's instructions.

This enables continuity and insulation resistance testing to be carried out on plug coupled equipment and cables.

3.6 Test Leads SHALL NOT BE INSERTED INTO MIL SPEC PLUG COUPLER PLUGS OR RECEPTACLES WHETHER MALE OR FEMALE UNDER ANY CIRCUMSTANCES.

They might damage the pins/sockets and potentially cause short circuits between cores. Damage inflicted in this way may not be visible to the naked eye.

3.7 Before (re)connecting plug coupled equipment, the Maintainer shall visually check that the plug coupler has not been damaged and that there is no water ingress. If there is, then the affected cable ("interconnect") or equipment shall be replaced.

END

GENERAL

DO NOT INSERT TEST LEADS INTO MIL SPEC PLUG COUPLER PLUGS OR RECEPTACLES WHETHER MALE OR FEMALE UNDER ANY CIRCUMSTANCES since these might damage the pins/sockets and potentially cause short circuits between cores.

INTRODUCTION

Where it is essential to record test measurements at the plug coupler then an approved break out box should be used. This enables continuity and insulation resistance testing to be carried out on plug coupled cables. Some break out boxes can also be inserted at an inline plug coupler so that ‘on load’ voltage can be measured across plug coupler pins.

There are currently a number of prototype break out boxes in service see Figure 1:

Figure 1 – Break Out Box

1. Signal Maintenance Testing

1.1 A product approved breakout box can be used to connect in-line across the plug coupled connections so that test terminals are available. However, if possible, testing should be done from accessible links to avoid the need to open the coupler.

2. Signal Works Testing

2.1 Where an approved break out box is required for testing it shall be stated in the relevant test specification. If it is not specifically identified, then authorisation for its use is referenced in the test instruments section of the test plan.

3. Before Use

3.1 Inspect that the break out box and its components are not damaged.

3.2 Check all end caps have been correctly fitted.

3.3 Remove each cap and inspect each connector to check that there is no damage visible to the pins or sockets.

See Figure 2 and Figure 3 for the type of damage that might be present:

1. Fig 2 a socket has pushed back into the housing.
2. Fig 3 three pins have been pulled forward. No pin shall stand proud of it housing for safety reasons:

Figure 2 – Socket pushed back

Figure 3 – Three pins pulled forward

3.4 Check that the unit has a valid certificate of conformance or an equivalent label attached.

Any deficiencies found shall be reported to the Tester in Charge or the SM(S).

4. Connecting the break out box

4.1 The break out box is configured in pairs of receptacles (R) and Plugs (P).

4.2 Each pair has a numerical ID e.g. R1 and P1.

Pair ID	Insert Arrangement	Number of cores	Plug Type	Receptacle Type
P1 / R1	32 - 013	12	Male	Female
P2 / R2	32 - 013	10	Male	Female
P3 / R3	24 - 2	7	Male	Female
P4 / R4	20 - 4	3	Male	Female
P5 / R5	20 - 4	3	Female	Male

Table 1 – Break out box 1

Pair ID	Insert Arrangement	Number of cores	Plug Type	Receptacle Type
P1 / R1	32 - 013	10	Male	Female
P2 / R2	20 - 23	2	Male	Female
P3 / R3	20 - 4	4	Male	Female
P4 / R4	20 - 4	4	Female	Male
P5 / R5	20 - 4	2	Male	Female

Table 2 – Break out box 2

4.3 Figures 4 shows the Break out Box with environmental covers in place, and Figure 5 shows Environmental covers removed and the Break out Box in use.

Figure 4 – Break Out Box with environmental covers in place

Figure 5 – Break Out Box in use

Insert arrangements are made of two numbers the first being the coupler size and the second being the pin configuration. When looking at the pin configuration blank or removed pins should be taken into consideration.

4.4 Identify the cable to be tested is correctly labelled, of the correct type and that the plug coupler is of the correct size.

4.5 Visually check plug coupler for signs of mechanical damage to connector shell/housing, contacts and that all contacts and filler plugs are inserted correctly.

A break out box shall not be inserted into a circuit until arrangements have been made with the Signaller to book the circuit out of use for testing purposes.

4.6 Check that the relevant arrangements are in place prior to disconnecting any operational equipment.

5. Voltage Check

5.1 For ‘on load’ voltage testing the plug coupled connection needs to be uncoupled and the male and female connections need to be connected either side of the breakout box using the relevant pair of connectors, as shown in Figure 6.

5.2 Check that both Mil 5015 connectors visually, mechanically and audibly secured.

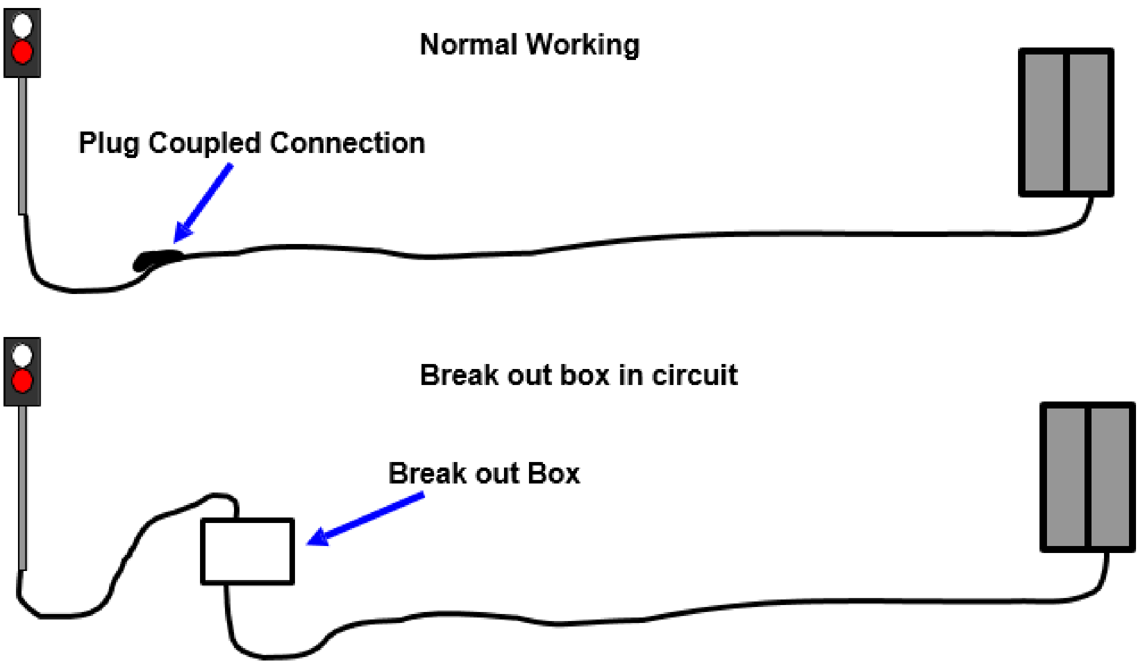


Figure 6 – Inserting a break out box for on load testing

5.3 At this point all of the cable cores are available for via the 4mm plug sockets mounted on the top of the breakout box. These should be used in the same way as if the interconnect was terminated on links. Multiple testing methods can now be employed.

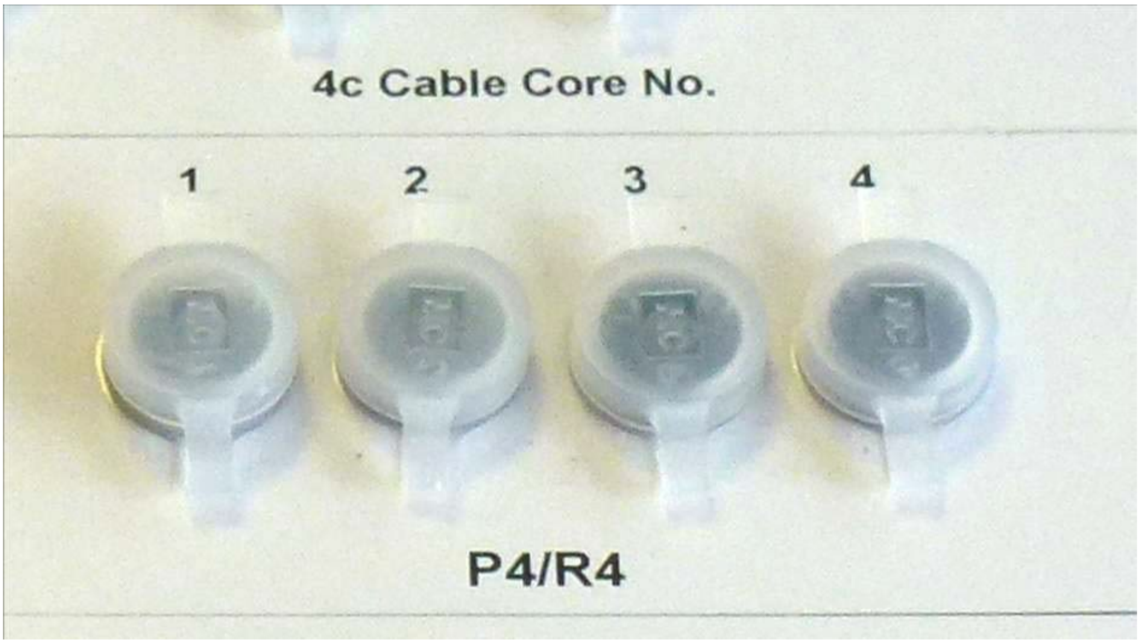


Figure 7 – Break out box sockets

5.4 An example of the 4mm sockets found on the Break out box, associated with a 4 core interconnect/cable, can be seen in Figure 7. Each of the four numbers relate directly to the cable core number.

5.5 By plugging a meter into the relevant test sockets voltages can be measured.

6. Testing for Current

6.1 This test can only be carried out on a two-core cable and would normally only be used to test an AWS.

6.2 On both break out boxes there is a facility to undertake a current reading.

6.3 Break out box 1 has the facility to test only one of the possible connector sizes whereas Break out box 2 caters for both sizes of connector.

6.4 The terminations for the two cored cables differ from all others by having two core one 4mm test sockets.

6.5 With the break out box in circuit and the meter set to read current, the meter leads should be plugged into the 2 terminations marked 1, see Figure 8.

Figure 8 – Current Testing

6.6 Check the circuit being tested is energised and when ready to take the current measurement press the green push button on the front panel.

6.7 Pushing this button inserts the meter into the circuit between the number 1 pins of the connected inline couplers, see Figure 9.

Figure 9 – Current Testing Push Button

6.8 Record readings as required then release the push button

7. Continuity and Insulation Tests

7.1 To carry out both of these tests, a break out box for each plug coupled interconnect end is required.

7.2 Where an interconnect is plugged into a wire receptacle which is then terminated directly onto disconnect able links it is acceptable to test through the interconnect as far as the links.

7.3 Both CONTINUITY TEST and INSULATION TEST shall be carried out as laid down in the defined tests.

8. After Use

8.1 Check that all the plastic test socket covers are correctly re-inserted.

8.2 Check that all the coupler caps are correctly reconnected.

8.3 Where provided, replace the break out box into the carry bag/case.

END

1. Frauscher Advanced Counter FAdC, General

The FAdC is used for safe monitoring of track sections. With the FAdC, the clear and occupied status can be generated by the track sections. The clear and occupied status is output by the software interface or by voltage-free relay contacts. One track section can consist up to 16 counting heads. A counting head consists of a wheel sensor (RSR123), an overvoltage protection unit (BSI005) and an evaluation board (AEB). Double or multiple usage of a counting head is possible.

The FAdC may either be connected to a CAN bus or decentralised across large distances using an Ethernet network.

2. Operating mode of the FAdC

At the start and end of each track section, there is a wheel sensor that acts as a counting head together with the BSI and the AEB. This detects all the axles of rolling stock travelling on this track and also their direction of travel, using two electronic wheel sensor systems. By comparing the counting result for the axles counted in with the result of those counted out, it is possible to make a statement regarding the status of the track section.

Each wheel sensor is connected with an AEB by a four-wire signal cable. This connection provides the power supply to the wheel sensor and transmits the axle information to the AEB. The AEB boards are linked with one another by means of a CAN bus.

An AEB correlates the axle information for all counting heads allocated to a track section into an overall result and uses this to create a clear or occupied indication for this track section.

The COM-AdC or the COM-WNC, which are also connected to the CAN bus, provide an Ethernet interface. Using this interface, the clear and occupied indications can be output via a vital protocol (COM-WNC), for any further processing required. Alternatively, the clear and occupied indications can also be output via voltage-free relay contacts from an IO-EXB connected to the AEB.

3. Test equipment

The following items are used to complete all the testing and maintenance activities on Frauscher Advanced Counter equipment:

- Testing plate PB200.
- Advanced Service Display ASD and Service Display Cable.
- Frauscher Diagnostic System FDS (optional).

- Multimeter, range 1000 mV DC, ± 0.5 % basic accuracy, internal resistance >> 1 kΩ.
- 2 leads with 2 mm male connectors.
- Non-conductive cord.
- Tape measure.

4. Wheel sensor RSR123

The wheel sensor RSR123 detects axles and consists of two sensor systems. Viewed from the plug side, wheel sensor system 1 is on the left hand side, wheel sensor system 2 is on the right hand side. Wheel sensor system 1 and 2 are symmetrically in design and are galvanically separated. Two wires are allocated to each wheel sensor system. On the wheel sensor there is a four-wire cable connected via a plug connection, with a standard length of 5, 10 or 25 m. It is recommended to use a protection tube for the cable.

Figure 2 - RSR123 Wheel Sensor

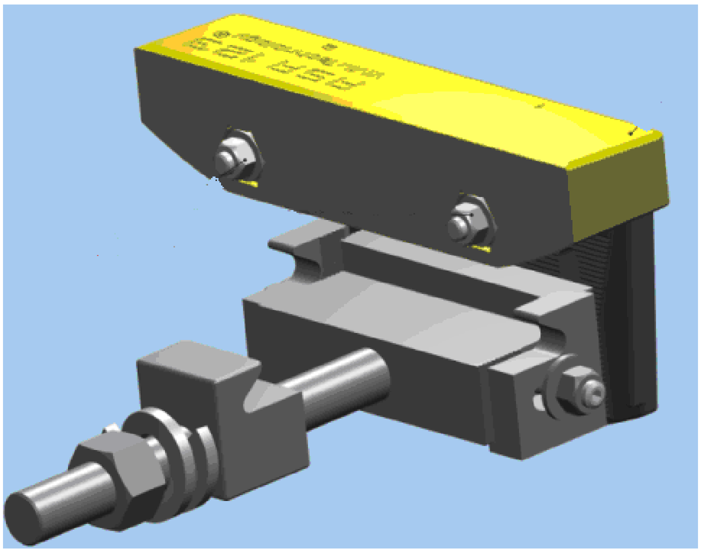


Figure 1 – RSR123 Wheel Sensor Bracket

5. Communication Boards COM-WNC/COM-AdC

The hardware of the COM-WNC is identical with the COM-AdC. In addition to the functionality of the COM-AdC (configuration server and data transmission within the FAdC) the COM- WNC can communicate with an interlocking via Ethernet.

The COM-WNC contains the protocol implementation for the interlocking specific protocol WNC. So, the COM-WNC enables to convert data of the FAdC with the protocol FSC to the protocol WNC of the interlocking and the data of interlocking with the protocol WNC to the protocol FSC of the FAdC.

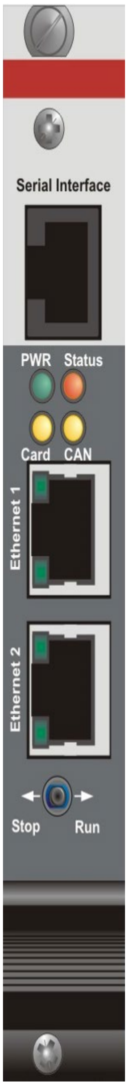


Figure 3 - COM-AdC Card

Indication/ Function	Meaning/Use
Serial Interface	Service Interface (for ASD)
PWR	Power supply
Status Card	Status display (flashing in the event of a fault).
CAN	Illuminated when CF card is present and ok, flashing in case of card access
	Illuminated when software-configuration is obtained, illuminated or flashing in the event of a fault
Ethernet 1	Connection to network 1
Upper LED	Illuminated when a connection to the network is present.
Lower LED	Flashes when data is transmitted or received
Ethernet 2	Connection to network 1 or 2
Upper LED	Illuminated when a connection to the network is present
Lower LED	Flashing when data is transmitted or received
Stop	No function at present
Run	No function at present
Type key (on the top of the hand grip):	
COM-AdCnnn	Board identification code starting with 001
xx...yy	Operating voltage range
GSzz	Version beginning with 01

6. DIP-switches of the COM-AdC / COM-xxx

The DIP-switches can be found on the left-hand side of the COM-AdC/COM-xxx.

There two dip switches for each of the channels.

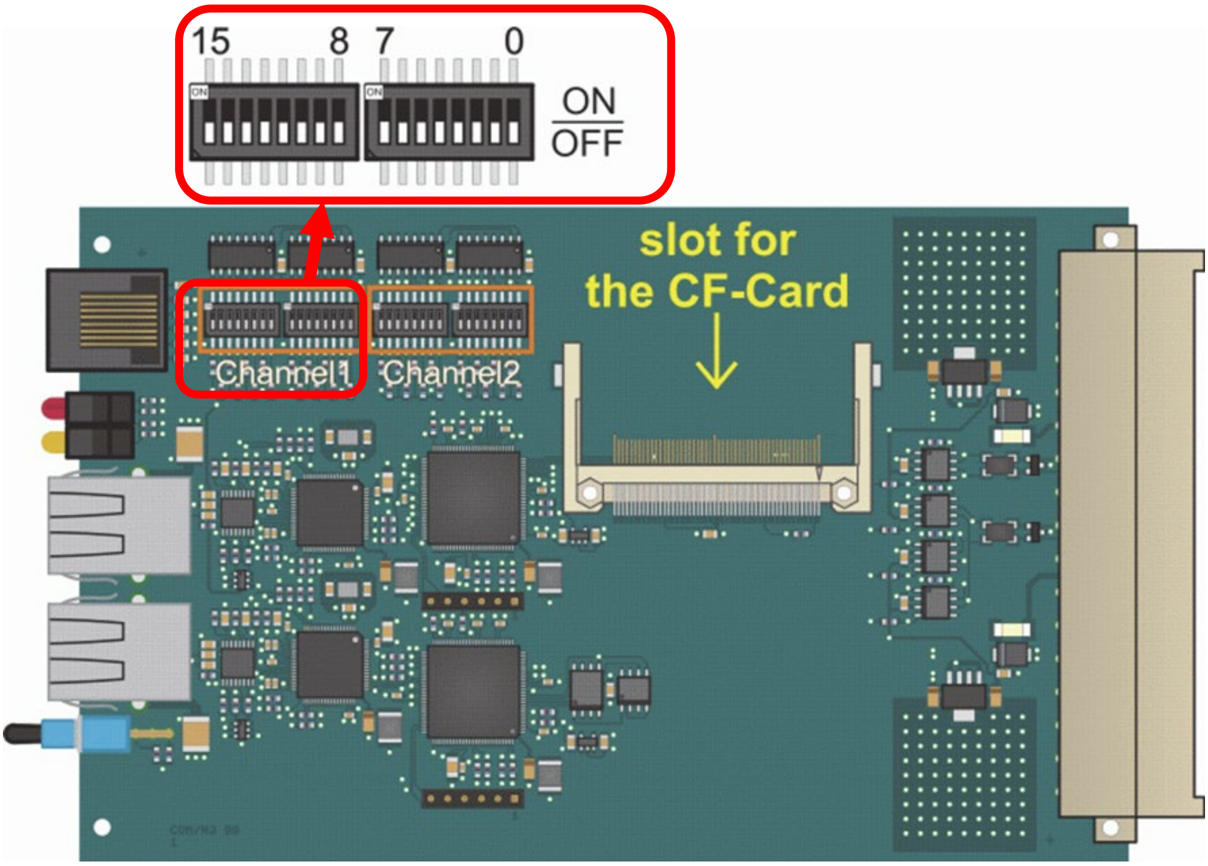


Figure 4 - COM-AdC Dip Switches

7. Advanced Evaluation Board AEB

The AEB is used to supply and evaluate a wheel sensor RSR123. The digital counting head information is output for further processing. Moreover, the AEB's tasks also include counting axles and generating failsafe clear and occupied indications for up to two track sections. An AEB can control up to 8 IO-EXB or 8 CO-EXB boards (the boards can also be used in combination).

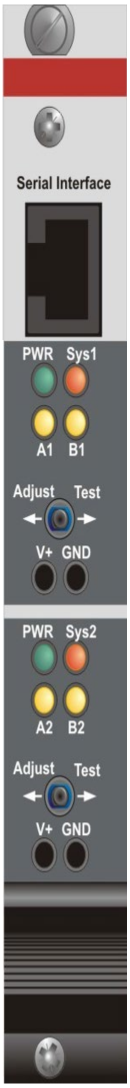


Figure 6 – AEB Card

Indication/ Function	Meaning/Use
Serial Interface	Service Interface (for ASD)
PWR	Power supply
Sys1	System 1 occupied (illuminated) or faulty (flashing).
A1	Indicates the clear and occupied status of track section 1 and/or displays counting head control
B1	The AEB obtains its software- configuration (illuminated) or data transfer interfered (illuminated/flashing)
Adjust	Adjust Is required to adjust the wheel sensor / AEB and to carry out a pre-Reset
Test	Simulates damping of system 1
V+/GND	2 mm test sockets, voltage corresponds to the analogue wheel sensor current via an 100 Ω Shunt
PWR	Power supply
Sys2	System 2 occupied (illuminated) or faulty (flashing).
A2	Indicates the clear and occupied status of track section 2 and/or displays counting head control
B2	The AEB obtains its software- configuration (illuminated) or data transfer interfered (illuminated/flashing)
Adjust	Adjust Is required to adjust the wheel sensor / AEB and to carry out a pre-Reset
Test	Simulates damping of system 2
V+/GND	2 mm test sockets, voltage corresponds to the analogue wheel sensor current via an 100 Ω Shunt.
Type key (on the top of the hand grip):	
AEBnnn-1/-3	Board identification code starting with 001, -1 for RSR180, -3 for RSR123
xx...yy	Operating voltage range
GSzz	Version beginning with 01

8. DIP-switches counting head outputs of the AEB

The DIP-switches counting head outputs can be found on the left-hand side of the AEB.

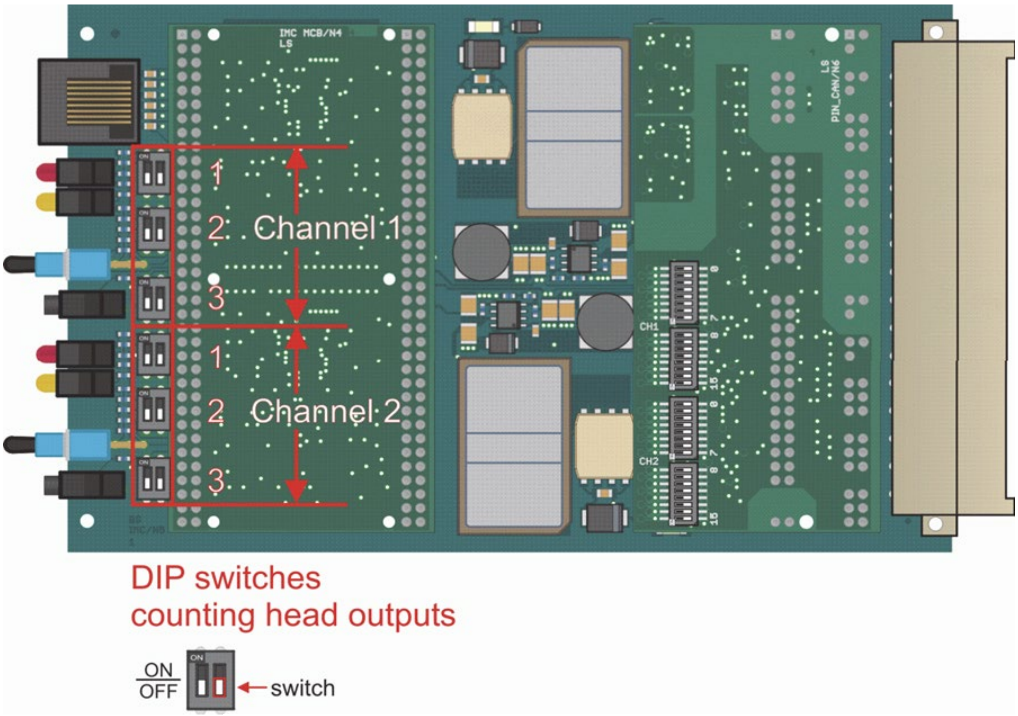


Figure 7 – DIP Switch Positions for Counting Head outputs on the AEB Card

9. DIP-switches ID of the AEB

The DIP-switches ID can be found on the right-hand side of the AEB.

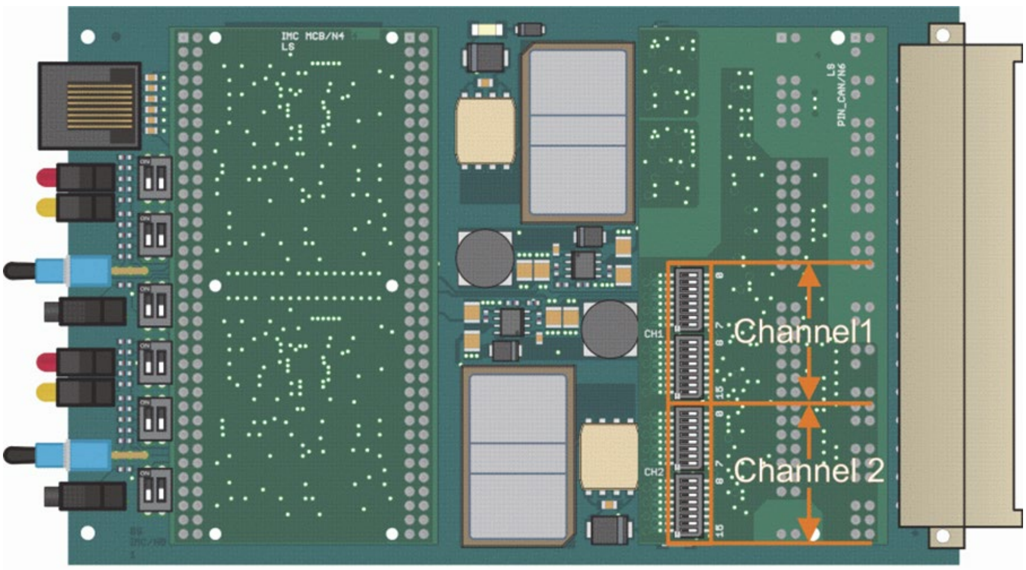


Figure 8 - DIP Switch Positions for the ID of the AEB Card

10. Input/Output Extension Board IO-EXB

The IO-EXB is used for failsafe output of the clear/occupied status for up to 2 track sections, via voltage-free relay contacts, and for output of error codes from the track section or the AEB. Alternatively, the IO-EXB can also be used to input and output failsafe and non-failsafe (depending on configuration) digital arguments (data transmission).

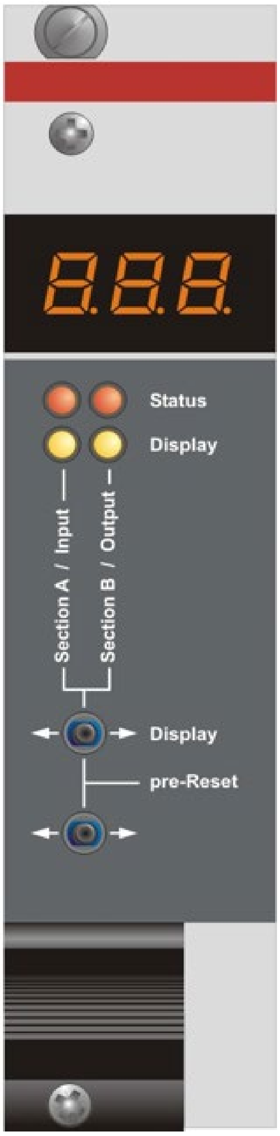


Figure 9 - IO-EXB Board

Indication/ Function	Meaning/Use
Display	Number of axles in a track section, Output of error code in the event of a fault, Output of the bit status as a HEX code (in the case of data transmission).
Status	Track section occupied (illuminated) or faulty (flashing). Output of the status of the inputs/outputs (flashing in the event of a fault, illuminated if no AEB is connected).
Display LED	Indicates the track section for which the information is valid, Track section 1 (= Section A) or track section 2(= Section B). These indicate which information (input or output) is currently valid on the display (in the case of data transmission).
Display button	Button to change the display between track section.
pre-Reset	Track section 1 and 2 or input and output Activated by pressing both buttons to the left (track section 1) or the right (track section 2) at the same time.
Type key (on the top of the hand grip):	
AEBnnn-1/-3	Board identification code starting with 001, -1 for RSR180, -3 for RSR123.
xx...yy	Operating voltage range
GSzz	Version beginning with 01.

11. Counting Head Control (CHC)

11.1 Counting Head Control (CHC) is a method of suppressing activation outputs of the RSR123 when no train is approaching.

Function:

a) CHC is active if both sections each side of the wheel sensor are indicating clear.

b) CHC is not active if one or both of the sections are indicating occupied (by a fault or a train) - any sensor activations will be passed to the signalling system.

Settings:

c) The number of outputs that can be suppressed is hard configured between 1 and 100, in a 1-minute period. After 1 minute the counter resets. If this count is exceeded the relevant sections will enter a failsafe state.

d) FAdC version R2 with AEB101 GS04 or later includes the facility to deactivate the CHC function. The method of deactivation/activation will be defined locally.

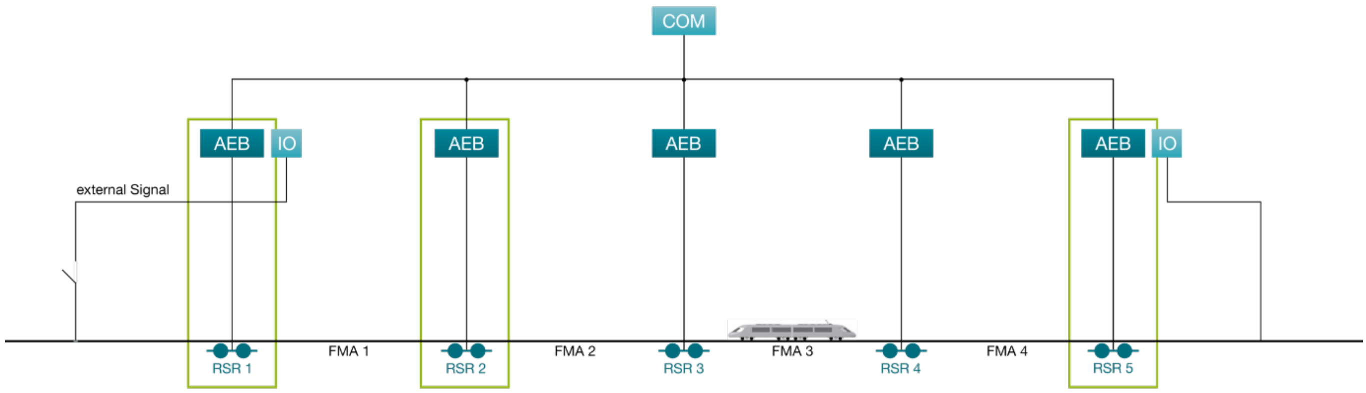


Figure 11 - Sensors with CHC active are highlighted in Green

12. Supervisor Track Section (STS)

12.1 A Supervisor Track Section STS is an additional track section covering two or more signalled track sections.

Function:

a) If the STS is clear, and one or both signalled sections are indicating occupied, then an automatic reset will be carried out on the signalled sections.

b) If both the signalled sections indicate clear, they are able to reset the STS.

Settings:

c) The type of reset is configurable (Unconditional/Conditional – with/without Sweep train).

d) The number of resets that can be carried out is hard configured between 1 and 100. The counter is reset with the successful traverse of a train. If this counter is exceeded a manual reset will be required.

e) FAdC version R2 with AEB101 GS04 or later includes the facility to deactivate the STS function. The method of deactivation/activation will be defined locally.

Occupancies of the signalled sections are highly likely to appear to the signalling systems before the reset is carried out.

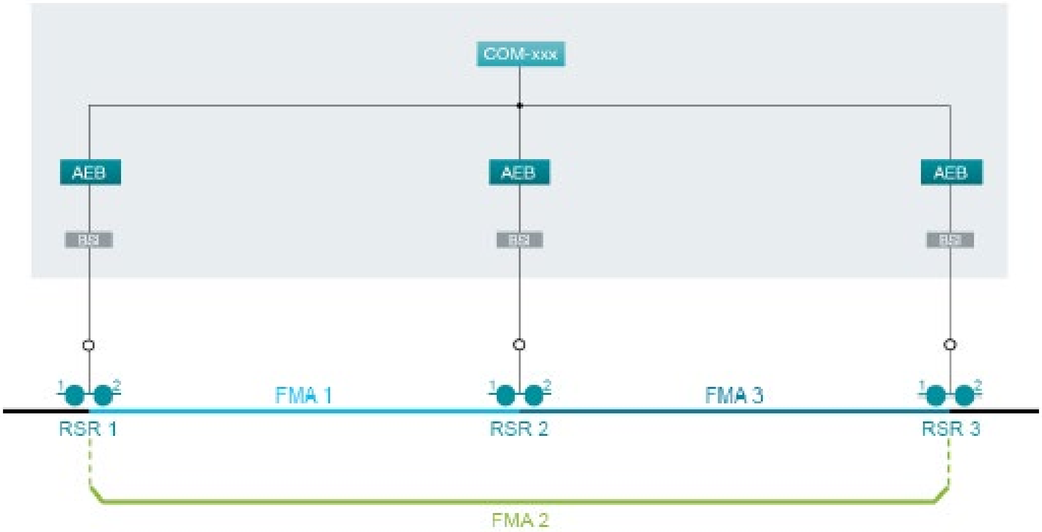


Figure 12 - FMA 2 is an STS covering signalled sections FMA 1 and FMA 3

13. Abbreviations Frauscher Advanced Counter

Abbreviation	Meaning
AEB	Advanced Evaluation Board
ASD	Advanced Service Display
BSI	Overvoltage Protection Unit
CAN	Controller Area Network
CF	Compact Flash
CHC	Counting Head Control
CO-EXB	Configuration Extension Board
COM-AdC	Communication Board for Advanced Counter
COM-WNC	Communication Board (specific implementation of COM-xxx communication board with implemented WNC protocol)
DIP	Dual in-line package
FadC 2.1.x.x-3	Frauscher Advanced Counter with the system number 2.1.x.x-3 (“x” is a free variable parameter for the specific name of the various
FadC	systems)
FDS	Frauscher Diagnostic System
FSC	Frauscher Safe CAN Protocol
IO-EXB	Input/Output Extension Board
PB	Testing plate
PSC	Power Supply with Crowbar
RSR123	Wheel sensor type RSR123
Sys	Sensor system of a wheel sensor
STS	Supervisor Track Section
Reset/pre-Reset	Reset inputs
Fault	An error that can be rectified with a configured Reset procedure, as long the FAdC is/was ready for operation.
Counting head	In functional terms, a counting head consists of a wheel sensor, a BSI and an AEB

END

Includes:	EBI Track 200 Audio Frequency Track Circuit
Excludes:	All other Track Circuits

General

UNDER NO CIRCUMSTANCES should the TX and RX tuning units of one-track circuit be disconnected from the rails at the same time as this can allow unwanted power to pass between the adjacent track circuits resulting in a possible wrong side failure of one of the abutting track circuits.

If an RX or TX is disconnected from its tuning unit, the terminals on that tuning unit to which the 2-core cable was attached should be short circuited, (i.e. terminals 1&2 for an RX or low power TX, terminals 4&5 for a standard power TX) this corrects the tuned zone readings.

A double rail EBI Track 200 track circuit should never be reconfigured as a single rail track circuit.

Before the removal of a Track relay, fed by an analogue RX, the RX should have its power removed to prevent the RX output stage becoming damaged.

The gain or sensitivity should not be increased or decreased where the clear track current (across the 1Ω resistor) has changed by more than 10% without consulting your Supervisor.

Any adjustment should only be to obtain the correct drop shunt, for that track circuit.

Tuned zones should be kept clear of all metallic objects including new or scrap lengths of rail for a distance of at least 1.25m (4ft). The tail cables from the TU to

the rails form part of the tuned circuit, because of this they should wherever possible be bound together, not allowed to form loops and not be run in parallel with the running rails. Failure to observe these items can result in the effectiveness of the tuned area being altered i.e. low or below specification readings.

1. EBI Track 200 Audio Track Circuit:

1.1 EBI Track 200 Layout Configurations

EBI Track 200 track circuits can be used in a number of configurations:

- Single rail configuration using ETUs or TCUs.
- Double rail configuration using TUs for jointless or ETU for jointed track circuits.

- Both single rail and double rail configurations can have multiple Receivers/Track Relays.

Low Power Configurations – Double Rail (ETU & TU)

For track circuits of between 50m (20m where ETUs are used) and 250m in length the EBI Track 200 is configured in a Low Power mode by connecting the TX to terminals 1 and 2 of the tuning unit.

Low Power Configurations - Single Rail

The ETU and SPETU can be used in low power or low power plus modes for tracks between 20m and 250m. Low power is configured by connecting the TX to terminals 1 and 2 of the ETU/SPETU.

Low power plus is configured by connecting the TX to terminals 2 and 5 and providing a strap between terminals 1 and 4of the ETU/SPETU.

Low power plus provides approximately an additional 5% launch voltage over low power tracks for use where single rail tracks are used through S&C.

Additionally, a single rail configuration can be used utilising TCUs which are inherently low power.

1.2 Power Supplies and Fusing

EBI Track 200 can utilise different types of 24VDC power supplies from Bombardier or other suppliers.

An Anti-surge fuse of the type - "Fuse cartridge 3A Anti-surge for PSU AC input, (Cooper Bussmann MDA-3-R Series, ¼" x 1¼")'. (086/043768)" should be used for both the 110VAC to the Power supply and 24VDC to the Tx/Rx equipment etc.

Relaxation of this requirement is permitted in accordance with the EBI Track 200 Standard NR/L2/SIG/11761.

1.3 SPETU Surge Protection and Fusing

The Surge Protected End Termination Unit is an ETU fitted with surge protection (GDT) and replaceable fuses for use in single rail applications, where protection is required to prevent damage to internal components from traction short circuits.

All applications of the SPETU on Network Rail infrastructure should use the Littelfuse 10Amp 600VAC fuse (KLK D 010, 086/043730). Some MOD states of the SPETU are factory fitted with 5A fuses. These should be replaced by the 10A fuse.

In the event of a SPETU fuse failure; both fuses should be replaced.

In addition, where the GDT is a separate Line Replaceable Unit in later SPETU builds, it should also be replaced by a 145VDC GDT (086/047392) as a precaution against the GDT being stressed and damaged during the original fuse blow event.

Early versions of the SPETU have been delivered with a 95VDC GDT. If the SPETU is reliable there is no need to change the GDT.

However, if the SPETU fuses fail or there is an opportunity to change the GDT, it should be replaced with the 145VDC version (086/047392).

1.4 Test Equipment

A frequency selective meter (FSM), or TI21 Test Meter (TTM), set to the frequency of the track circuit under test should be used for voltage measurements.

It is not acceptable to test EBI Track 200 without an FSM/TTM.

A rail current measuring device such as a Rocoil or Lemflex, used in conjunction with the TTM can be used to measure the TI current in the rail to locate a section of the track bed causing loss of TI power at the Receiver end.

Sleeper testing – The integrity of the Pads and Nylons can be tested using the Bombardier SIT.

1.5 Centre Fed and Cut Section Track Circuits

Each half of a centre fed track circuit or each cut section operates as an independent track circuit and should be tested as such and record cards kept for each part.

1.6 Impedance Bond Tuning

Any impedance bonds within the track circuit should be tuned with the correct resonating capacitor across the auxiliary coil or in the case of B3 3000 and B3 500 bonds (which have no auxiliary coil) the correct tuning module.

Each removable tuning capacitor / module is labelled with the style of bond it should be fitted to; where it is not removable this information appears on the bond itself.

If the earlier PCB type of tuner board (e.g. Howells or WH3 type) is used the correct links should be cut depending on the track circuit frequency.

1.7 Rail-to-Rail Voltage

With the track circuit not shunted by a train or train shunt the rail-to-rail voltage should fall approximately linearly from the TX to the RX end.

In exceptional circumstances (and with permission of the S&T Maintenance Engineer) it may be raised by intermediate tuning capacitors.

1.8 Rail Current

The EBI Track 200 rail current reading gives a more useful reading, than rail voltages, and should be virtually constant throughout the Track Circuit length. It should also be of similar values in both rails.

The Clear Track Current should be within the range defined in Appendix D Table 2.

If the Clear Track Current is outside these values, then the track condition should be investigated to determine the cause of the non-conforming readings.

The Supervisor may advise a higher drop shunt to improve reliability if the track records indicate this is appropriate.

Where impedance bonds, or intermediate tuning capacitors (Bucking Capacitors) have been fitted the current value will have a marked change.

Significant changes in track current indicate leakage faults between the rails which should be investigated and rectified.

It should be noted that PAN8 and Bullhead rail will inherently lose current because of the lack of pads and nylons.

1.9 Tuned Zone Ratios (Pole/Zero Ratios)

Pole – Track under test
Zero – Adjacent/abutting track

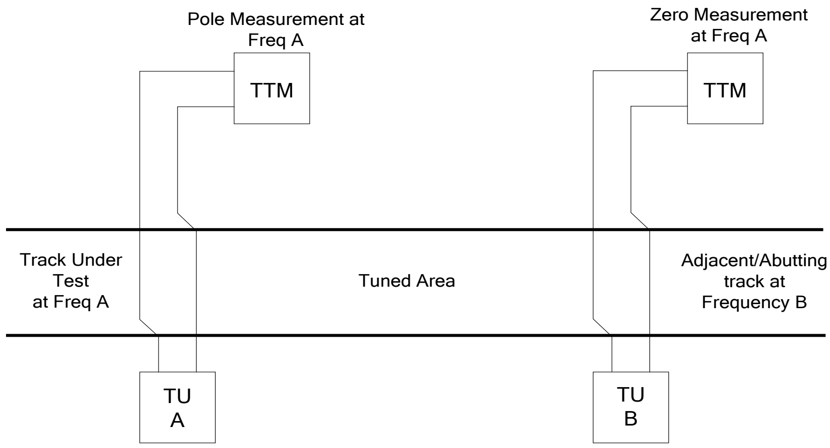


Figure 1 - Tuned Zone Ratios

The Pole voltage is the voltage across the rails at the TU of the track under test (TU A in drawing) at that track's frequency (Frequency A in drawing).

For the purpose of the test this TU can be called the 'Pole TU'.

The zero voltage is measured across the companion tuning unit's (TU B in the drawing) rail terminals at the track under test frequency (Frequency A in the drawing).

For the purpose of the test this TU can be called the 'Zero TU'.

Important points to note are:

- The pole/zero measurement will give no information about the quality of the pole.

  The pole is the property in the Tuning Unit which determines how much signal current is sent down the track to the RX at the other end.

- The pole/zero measurement will give a good measurement of the quality of the zero.

  The zero determines how much unwanted signal flows into the adjacent track.

- The quality of the zero is determined by the impedances caused by:
  - The components within the TU.
  - The tightness of the track and TU connections
  - The layout of the track cables.
  - The equipment (TX/RX) connected to the zero TU.

From the above statements, the following conclusions can be reached:

- Pole/zero ratios are a good method of monitoring the quality of the TU connections and track cable layout.

  As such, they provide evidence that good installation practice has been followed.

- If Pole/zero ratios are measured with an active TX connected to the zero TU, then the ratio will be degraded.

1.10 Mechanical and Electrical Connections

Good quality mechanical and electrical connections are important to obtain reliable operation of the EBI Track 200 equipment.

These connections should be made and maintained in accordance with the torque requirements defined in NR/SMS/PartZ/Z03.

The Advance Plate to Impedance Bond centre tap connection should use the spreader plates and associated installation procedure.

Existing installations should be changed to the updated process if the opportunity arises.

1.11 Spare/Scrap Rail Laid in the 4ft

Placing spare/scrap rail in the 4ft should not affect the operation of the track circuit.

Additionally, the constraint for not placing rail in the 4ft through a Tuned Zone should be complied with.

However, it is recognised that it is not always possible to comply with the TZ constraint. In which case there are some actions which will mitigate against unreliable operation or TC failure.

1.12 TU/ETU/SPETU hoods (Acoustic Jackets)

These should be fitted in areas close to residential property where noise might cause a nuisance.

1.13 Intermediate Tuning Capacitors

These are used to increase the gain at intermediate positions in the track circuit to overcome low ballast resistance caused by poor formation and/or rail fastenings.

They shall not be fitted without permission from the S&TME.

They also require individually specified drop shunt testing along the length of the track circuit at increased frequency

1.14 Receiver Current – Analogue

RX current is measured at the 1Ω resistor on the RX input terminals with a FSM or TTM.

This is the actual physical quantity that the track circuit uses to determine the presence of a train and so is a direct measure of the overall health of the circuit.

Clear track RX current is approximately twice the threshold at which the track relay drops (the threshold is determined by the gain strapping and can be found by reference to Appendix D Table 6.

1.15 Receiver Current – Digital

RX current is measured at the 1Ω resistor on the RX input terminals (TP1 and IPC) with an FSM or TTM or by using the display.

This is the actual physical quantity that the track circuit uses to determine the presence of a train and so is a direct measure of the overall health of the circuit.

Clear track RX current is approximately twice the threshold at which the track relay drops (the threshold is determined during the setup procedure in Appendix E.

1.16 Receiver Current – General

The RX current is affected by:

- The quality of the TX pole.
- The quality of the RX pole.
- Ballast resistance.
- Feed through from adjacent track circuits of the same frequency.

From the previous statements, the following conclusions can be reached:

- RX current is an excellent overall measure of the stability of the track circuit. Significant changes in current are due to either degradation in the TUs, or changes in the leakage current between the rails. e.g. impedance bonds, rail bonds, check rails etc.

A significant change should be determined by which is the greater of:

- a change of ±20% in the track current
- or a change of ±10mA in the track current.

These factors require investigation if fault-free operation is to be maintained’

1.17 Using the Digital Rx Mating Connector with adaptor for or Fork Terminals.

The Digital Rx Mating Connector is used to present the screw terminal connections for wiring purposes, using fork crimps, when an Analogue Rx is converted to a Digital Rx.

If the wrong wiring connections are made to the Receiver, the TC will become unreliable because the Clear Track Current in to the Receiver will be seen to be incorrect.

1.18 Tuned Zones

Pole/zero ratios are useful in monitoring installation standards.RX current is the most effective measure of track circuit performance and stability since it measures the effectiveness of the pole circuit and signal leakage effects.

1.19 Tuned Zones on Steel Sleepers

The following Special instructions for tuned zone installations should be followed:

- The tuned zone is 22m ± 0.5m
- All the sleepers within the zone, and for 3 bays either side, are of a Network Rail accepted steel type
- The tuned zone is not part of a TI 21/Aster hybrid interface
- Single Rail Application
- RX current can be affected by the quality of the rail connections, bonded out joints, IRJ's and S&C insulations (sole plates, stretcher bars etc).

FAULT FINDING GUIDELINES

2. General

Before starting work, all track connections should be checked for tightness as described in NR/SMS/PartC/TC16 (Track Circuit: EBI Track 200)

The Bombardier Hints and Tips document 'EBI Track 200 Track Circuit: Aid for Maintenance & Fault Finding' can be also referenced.

The health of a track circuit can be determined by the voltage measured across the 1Ω resistor.

Any changes to the TX output level, the TX or RX ETU, TU or TCU the track bed or associated tuned zone equipment will affect the receiver input current.

The track relay voltage will indicate the correct functioning of the RX and that the relay coil is not damaged. If the relay coil voltage is low, it will indicate a failing RX unit.

The relay end 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.

A low rail voltage will indicate a faulty TU/ETU/TCU or a faulty connection at any part of the track.

If two adjacent track circuits fail simultaneously, the fault is most likely where the two tracks adjoin. Check the tuning units and associated connections and other shared equipment like the PSU.

For centre fed track circuits any problem within 30 metres of the centre feed will affect both sections.

If low ballast resistance is suspected see if the problem can be localised. On concrete sleepered track Check the pads and clip insulations.

On timber sleepered track Check for poor ballast drainage and P8 type rail fastenings.

If the problem can be isolated, spot replacement of rail insulations or replacement of P8 fastenings with P14 should be considered. (if you are in doubt about the type of fastenings, ask your SM(S)

Checking obtained readings against those on the Record Card and investigating those that have significantly changed can reveal the source of the fault.

Using an FSM/TTM the measurement of the rail-to-rail voltage at regular intervals from TX to RX should show a gradual decrease of the voltage.

The rail current reading gives a more valued reading than track voltage and typical current readings are:

- Normal power = 1.0 - 1.5 Amp
- Low power = 0.5 - 0.75 Amp
- Low power plus = 0.55 - 0.8 Amp

Within a tuned zone

- Each RX =5 Amp, each TX = 10 amp (5 if low power or low power plus) per frequency

3. Feed (Transmitter) End

3.1 Measure the PSU output voltage and current. If the readings are within the specified limits Measure the TX output using TTM. If the voltage is outside its specified limits

3.2 Check the PSU input tapings are set to P5 and P115. If not, adjust the tapping settings.

3.3 Measure the voltage on the 110V signalling supply to the PSU. If the supply is over 115VAC, adjust the PSU output tapings to give between 25V and 27V DC.

Otherwise, adjust the PSU output tapings to give ideally 24V - 26V DC.

If the current drawn by the TX is outside its specified limits, the PSU, TX or TU/ETU/TCU shall be replaced.

3.4 Measure the AC Ripple on the 24V DC from the PSU.

Values exceeding 1V shall be investigated to eliminate the cause or the PSU replaced.

3.5 Check that the TX is emitting a regular warbling noise. If the tone is fixed rather than warbling, this indicates that the unit is not modulating.

In this case, first Check that the mod pin is not connected to B24 or N24. If it is not warbling, or the sound is unusual or irregular, remove the 24V supply fuse and replace it after a couple of minutes.

If this activates the unit, it shall be replaced as it could fail again. If the warbling does not start, also replace the TX.

3.6 Measure the rail voltage between the TX rail connections, if they are outside the specified limits check all the associated TU/ETU/TCU connections (including equipment in the location housing) and then test the units themselves and replace as necessary.

3.7 If the TX is at a tuned zone calculate the tuned zone ratio (Appendix B). If a low ratio is found Check all associated TU/ETU/TCU connections (including equipment in the location housing) and then Test the units themselves and replace as necessary. If the fault has cleared move to 3.9.

3.8 Place a short circuit between terminals T1 and T2 on the adjoining TU/ETU (this will cause the track circuit to show occupied) and Measure the rail voltage at the TX.

It should not have altered from the previous reading in 3.6

If it is not the same, check all the associated TU/ETU/TCU connections (including equipment in the location housing) and then Test the units themselves and replace as necessary.

Remove the short circuit and re-calculate the tuned zone ratio (Appendix B).

3.9 Measure the rail voltage at the TX.

3.10 Connect a shunt set at 1Ω across the rails at the TU/ETU connections and measure the rail voltage again. The rail voltage should decrease by 50%.

3.11 Remove the shunt and the voltage should rise immediately to the first reading. If this is the case then it can be assumed that all the TX equipment is working correctly.

Impedance Bonds (Where Fitted)

Before checking the impedance bond(s) the TX equipment shall first be proved to be operating correctly.

3.12 Check that no corrosion, dirt oil or water is present in the terminal box and/or connection points.

3.13 Measure the voltage across the auxiliary coil or tuning module (NOT applicable to B3 3000 and B3 500 bonds), check it is in the correct ratio with the rail-to-rail voltage (Appendix C).

If it is correct the bond should be operating correctly, if it is incorrect proceed with the next step.

3.14 Check the tuning capacitor/module is correct for the style of bond and the track circuit frequency. Apply a short circuit across the tuning capacitor/module and

3.15 Measure the voltage. Remove the short circuit and Check the voltage rises.

If there is not a dramatic rise in voltage replace the tuning capacitor/module.

If this still does not improve matters consider replacing the bond.

Near ETU units this tuning capacitor/module test might not work.

For Intermediate Bonds Only

3.16 Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the TTM (= amps, I1).

3.17 Repeat the measurement 1 metre from the bond on the RX side (I2)

3.18 Subtract I2 from I1 thus obtaining the current through the bond at the EBI Track 200 frequency.

3.19 Measure the rail to rail voltage (V) across the impedance bond.

3.20 Divide the voltage (V) by the current calculated from 2.3.6 thus giving the impedance (Z), Z= V / (I1-I2).

This value should be greater than 8Ω.

If less than 8Ω, check for traction imbalance before remedial action is taken with the impedance bond. (The Manufacturers specification is 12Ω when measured at the Capacitor frequency)

It is possible to verify the Impedance Bond is within the manufacturers specification by measuring the Bond inductance without the tuning capacitor connected.

The value should be between 27.8 to 28.2 μHenries.

The value between the rail connections and the centre tap will be half these values.

4. Relay (Receiver) End

4.1 Observe the track relay. If energised, Check the line circuits as the fault is between the relay and the signallers 'Occupied' indication.

4.2 Measure the DC voltage across the track relay coils.

- 40V to 75V DC for the analogue RX
- 40V to 44V DC for the digital RX MOD 1 & 2
- 48V to 52V DC for the digital RX MOD 3

If it is within the specified limits remove the receiver 24V supply fuse and replace the relay. Replace the supply fuse on completion.

4.3 Measure the RX 24V DC supply voltage.

- 22.5V to 30.5V DC

4.4 Measure the AC Ripple on the 24V DC from the PSU. It should not exceed 1V. Values above this level should be investigated to eliminate the cause or the PSU replaced.

If the voltages are within the specified limits go to move to Step 4.7.

4.5 Measure using a FSM/TTM the rail voltage at the RX rail connections. If they are within the specified limits go to Step 4.6.

If they are not attention should be given to a track circuit examination and testing at the TX end.

Low rail volts could be due to ballast or other track equipment, as well as a fault at the TX end of the track

4.6 Calculate the tuned zone ratio (Appendix B). If this ratio is lower than the specified limits test all the TU/ETUs and their connections replacing where necessary. If the ratio is within the specified limits and the fault still remains, replace the adjoining TU.

4.7 Measure the Receiver input voltage, using a TTM, and the frequency, using a multimeter, across the surge arrestors.

4.8 At the Transmitter place a shorting link on the B24 and mod transmitter terminals, and note the values at the RX end.

This causes the TX to transmit the upper sideband frequency (USB)

4.9 At the Transmitter remove the B24 – Mod short strap and place the shorting link on the N24 and mod transmitter terminals, and note the values at the RX end.

This causes the TX to transmit the lower sidebands frequency (LSB)

4.10 The USB and LSB frequencies recorded should be within ±4Hz of the figures in Appendix G. If not, then the Transmitter is off frequency and should be replaced.

If the voltages noted at the RX end give a sideband imbalance ratio greater than 1.6:1 for TU, ETU & SPETU or 1.8:1 for TCU ratio, then at least one of the TUs/ETUs/TCUs for that track circuit are out of specification.

If so, then repeat this test at the TX TU/ETU/TCU to determine whether the RX TU/ETU/TCU is at fault or the TX TU/ETU/TCU.

4.11 Remove shorting strap on completion of the steps 4.8 and 4.9.

4.12 Measure the voltage and current supplied by the PSU. If they are not within the specified limits check the PSU tapping and/or replace the PSU.

4.13 Measure the voltage across the 1Ω resistor; compare this reading against the Record Card.

If the obtained reading is not within 10% of the Commissioning reading or last Set-up reading on the Record Card, the reason for the discrepancy should be investigated.

Appendix D Table D2 can be also consulted if the track has a history of poor performance.

If adjustment is required, the initial setting for an analogue RX should be selected from Appendix D table 5 using the voltage across the 1Ω resistor, followed by a drop shunt test. For digital RX, an auto-set routine should be performed.

The gain should only be altered to obtain the correct drop shunt.

5. Interference Test

To check the traction interference levels on the track the following test are carried out on T1-T2 terminals of the ETU/TU or the TCU surge arrestors.

For traction areas only:

5.1 Remove the B24 fuse to the TX and Check the correct track relay drops.

5.2 Measure the voltage across the track using a TTM set to AC 200mV range.

5.3 Measure the frequency across the track using a multimeter.

Record both the voltage and frequency readings.

Readings greater than 100mV are un-acceptable, the track circuit should be investigated and your SM(S) informed.

If there is a problem, this test can be repeated with the Traction supply OFF as this can help to identify the source of the interference.

5.4 If all the readings appear to be correct but the track circuit remains failed then recheck all items above and check there are no problems arising from Spare / Scrap rail laid in the 4ft. See Steps 6.1 and 6.2.

6. Spare/Scrap Rail Laid in the 4ft

Placing spare/scrap rail in the 4ft should not affect the operation of the TC.

Additionally, the constraint for not placing rail in the 4ft through a Tuned Zone should be complied with.

However, it is recognised that it is not always possible to comply with the TZ constraint.

In which case there are some actions which will mitigate against unreliable operation or TC failure.

6.1 Measure the current flowing in the rail laid in the 4ft using a Rocoil. This should be Zero.

If current is found to be flowing in the rail, then there is likely to be physical contact between the running rails and the spare rail. This should be rectified.

6.2 Check the TZR before and after the rail is laid in the 4ft.

If the change in TZR is less than 10%, there should not be any further problems. This check should be repeated when the rail is removed from the 4ft.

7. Using the Digital Rx Mating Connector with adaptor for or Fork Terminals.

The Digital Rx Mating Connector is used to present the screw terminal connections for wiring purposes, using fork crimps, when an Analogue Rx is converted to a Digital Rx.

If the wrong wiring connections are made to the Receiver, the TC will become unreliable because the Clear Track Current in to the Receiver will be seen to be incorrect.

7.1 Check the wiring for the rail connections which should be connected to IP1 and IPC (See figure).

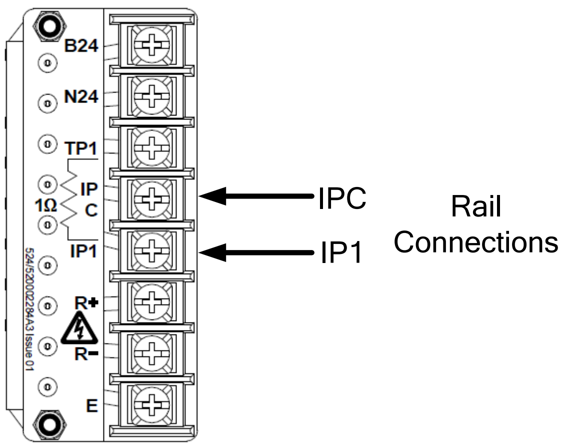


Figure 2 – Rail Connections

In later versions of the Mating Connector with adaptor for Fork Terminals, the screw in TP1 is removed

7.2 Check the Average Current is within 10% of the 1Ω Value from the Record Card.

If the Average Current is approximately 50% of the 1Ω Value from the Record Card, check that the rail connections are not erroneously connected to IP1 and TP1.

If the Average Current is approximately 1% of the 1Ω Value from the Record Card, check that the rail connections are not erroneously connected to IPC and TP1.

APPENDIX A - Typical Rail-to-Rail Voltages (Vp)

Operation	Track Length (m)	TX End Volts Freq ACEG	RX End Volts Freq ACEG
Low Power	20	0.5V – 0.7V	0.6V – 0.7V
	50	0.6V - 0.7V	0.6V – 0.7V
	150	0.9V - 1.1V	0.4V – 0.7V
	250	1.1V - 1.3V	0.3V – 0.5V
Low Power Plus	50	0.6V - 0.8V	0.6V – 0.8V
	150	1.1V – 1.5V	0.4V – 0.7V
	200	1.2V – 1.5V	0.4V – 0.7V
	250	1.3V – 1.5V	0.3V – 0.6V
Normal Power	200	4.5V – 5.3V	1.1V – 2.6V
	400	4.2V – 6.0V	0.5V – 1.0V
	600	4.2V – 6.1V	0.3V – 1.0V
	900	4.2V – 6.2V	0.2V – 0.7V
	1100	4.2V – 6.2V	0.1V – 0.5V

Table 1 – Rail Voltage's for Frequencies A C E and G

Operation	Track Length (m)	TX End Volts Freq BDFH	RX End Volts Freq BDFH
Low Power	20	0.9V – 1.1V	0.9V – 1.1V
	50	1.0V – 1.2V	0.8V – 1.1V
	150	1.4V - 1.7V	0.6V – 0.8V
	250	1.6V – 2.0V	0.5V – 0.6V
Low Power Plus	50	1.0V – 1.3V	0.8V – 1.2V
	150	1.7V – 2.2V	0.6V – 0.8V
	200	1.8V – 2.2V	0.6V – 0.9V
	250	1.9V – 2.3V	0.5V – 0.7V
Normal Power	200	5.8V – 7.1V	1.9V – 2.8V
	400	6.1V – 7.5V	0.9V – 1.6V
	600	6.0V – 7.6V	0.6V – 1.1V
	900	6.0V – 7.7V	0.3V – 0.7V
	1100	6.0V – 7.7V	0.2V – 0.6V

Table 2 - Rail Voltage's for Frequencies B D F and H

APPENDIX B - Tuned Zone Ratios

These ratios are the absolute MINIMUM values acceptable. The table below takes into account the latest installation standards and cable types.

If the Tuned Zone Ratio is not achievable, check the quality of the installation.

Pole	Frequency	Zero	Frequency	Ratio
Tx	ACG	Rx	BDH	12:1
Tx	ACG	Tx	BDH	11:1
Rx	ACG	Tx	BDH	12:1
Rx	ACG	Rx	BDH	12:1
Tx	BDFG	Rx	ACEG	18:1
Tx	BDFG	Tx	ACEG	15:1
Rx	BDFG	Tx	ACEG	18:1
Rx	BDFG	Rx	ACEG	18:1
Tx	E	Rx	F	9:1
Tx	E	Tx	F	8:1
Rx	E	Tx	F	9:1
Rx	E	Rx	F	9:1

Table 3 – Tuned Zone Ratios

APPENDIX C - Impedance Bond Voltage Ratios

Impedance Bond Style	Voltage Ratio
DE	40:1
MR	56:1
P3	45:1
S	56:1
WH3	56:1
B3 500	Not applicable
B3 3000	Not applicable

Table 4 - Impedance Bond Voltage Ratios

APPENDIX D - Analogue RX

Gain	Drop Across 1Ω Resistor (mV)	Input 1	Input 2 Strap (Note D)	Strap 1	Strap 2
1	390	1H	1L		
2	195	3L	1L	1H-3H	
3	134	3H	3L		
4	98	1H	3L	1L-3H	
5	78	3L	9L	1H-9H	1L-3H
6	65	3L	9L	3H-9H	
7	56	3L	9L	1H-3H	1L-9H
8	50	1L	9L	1H-9H	
9	45	9H	9L		
10	39	1H	9L	1L-9H	
11	35.4	3H	9L	1L-3L	1H-9H
12	32.4	3H	9L	3L-9H	
13	30	1H	9L	1L-3H	3L-9H

Table 5 - Receiver Gain Connections

The voltage measured across the 1Ω resistor is the clear track current.

A Strap 1 and Strap 2 refer to wire positions not labels.

B When no straps are listed in the table, they are not required.

C Input 1 and Input 2 can be either of the pair of cores from the tuner unit.

D Input 2 is always taken to the bottom of the 1Ω resistor; its associated strap is always taken from the top of the 1Ω resistor to the terminal shown.

E The drop across the 1Ω resistor is used with this table to set the initial gain, the final setting is made by placing a shunt box across the rails at the RX tuning unit and adjusting the tapping to obtain an optimum shunt value.

	Clear Track Receiver Current (mA)			
Track Length	**Normal Power**		**Low Power or Low Power Plus**	
(m)	**Min**	**Max**	**Min**	**Max**
20 – 100	-	-	43	106
100 – 150	-	-	38	90
150 – 200	-	-	33	76
200 – 250	130	251	28	66
250 – 300	110	213	-	-
300 – 400	81	184	-	-
400 – 500	62	143	-	-
500 – 600	48	116	-	-
600 – 700	38	98	-	-
700 – 800	31	84	-	-
800 – 900	25	74	-	-
900 – 1000	24	66	-	-
1000 – 1100	24	60	-	-

Table 6 - Expected Range of Track Currents against Track Circuit Lengths

This table provides a reference for Operational tracks to give guidance on the expected Clear Track Receiver Current depending on the track length.

NOTE: *This table is not required for setting up the track.*

Where Transmitter circuits use LMUs, the line losses become insignificant and therefore the table also applies.

However, where long TX to TU/ETU cables are in use without LMUs, then the table does not apply due to the losses in the cable.

Typical Gain Setting figures for single rail using TCUs

The Table shows the initial sensitivity setting at the Receiver for the combination of track circuit lengths and combined rail-to-TCU cable lengths. The combined rail-to-TCU cable length is the length of the transmitter TCU-to-rail feed cable plus the length of the receiver TCU-to rail feed cable.

		Total TX + RX Rail-to-TCU Cable Length			
		0 to 70m	**70 to 130m**	**130 to 200m**	**200-350m**
Track	**0 to 70m**	60mA	55mA	50mA	35mA
	70 to 130m	75mA	60mA	55mA	35mA
	130 to 200m	90mA	65mA	55mA	35mA

Table 7 - Digital Rx

		Total TX + RX Rail-to-TCU Cable Length			
		0 to 70m	**70 to 130m**	**130 to 200m**	**200-350m**
Track	**0 to 70m**	6 – 7	7	8	11
	70 to 130m	5 – 6	6 - 7	7 - 8	11 – 12
	130 to 200m	4 - 5	6	7	12

Table 8 - Analogue Rx

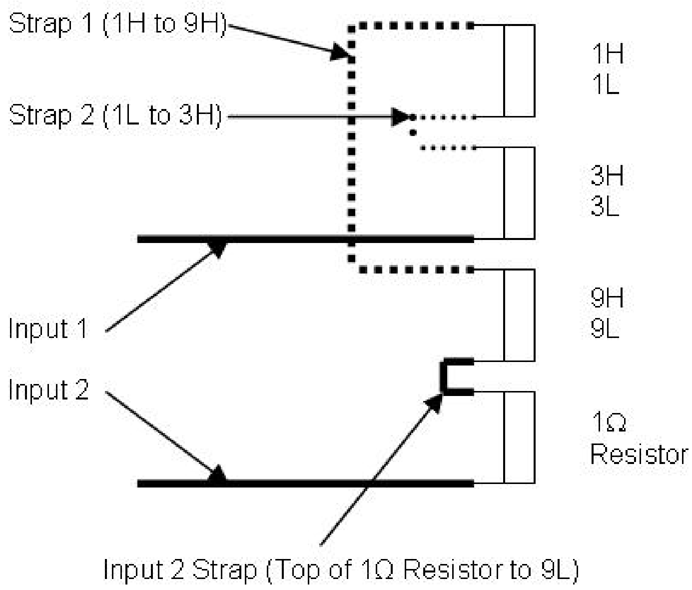


Figure 3 – An Example of the Strapping of an Analogue Receiver

Figure 3 shows the connections and strapping require to set the receiver gain to setting 5

- Input 1 from TU/ETU to 3L
- Input 2 from TU/ETU to bottom of 1Ω resistor
- Input 2 strap from top of 1Ω resistor to 9L
- Strap 1 from 1H to 9H
- Strap 2 from 1L to 3H

APPENDIX E - DIGITAL RX Set up procedure for the Digital Receiver

This procedure shall be completed regardless of whether the unit has been previously used or not.

If safe track access is possible then this process. If not, then the follow the set-up procedure shown in Appendix G can be used.

1. Power up the Receiver. The display will respond with ‘KEY?’. Fit the correct frequency key for the track circuit under test.

2. The display will echo back the frequency in the format, for example ‘200A’ for frequency A, and then display ‘NewK’.

A previously set up Receiver will display the relay state (‘PICK’ or ‘drop’).

3. Confirm that RX has a supply voltage within the range 24V to 26V.

<u>On the Receiver</u>

Press OK then ‘NEXT’ until ‘Vpsu’

Press OK this displays the PSU Voltage

Note this Value

4. Confirm the track circuit has a Sideband imbalance ratio less than:

- 1.6:1 for TU/ETU/SPETU
- 1.8:1 for TCU

On the Receiver

Press OK then 'NEXT' until 'INOW'

Note this Value

Press OK then Next Until 'USB'

Press OK and note the value.

Press 'BACK' then 'NEXT' until 'LSB'

Press OK and note the value.

Calculate and record sideband imbalance by dividing the larger value by the smaller value.

Note this Value

NOTE: *If the sideband imbalance exceeds the ratio values above, the track circuit should be investigated to ascertain the cause of the imbalance. Carry out steps 4.7 to 4.11.*

5. Confirm Average current seen by the RX.

On the Receiver

Press OK then 'NEXT' until 'INOW'

Press OK then Next Until 'AV'

Press OK this displays the average current seen by the Unit.

Note this Value

For existing installations:

6. Using the Average Current value from the test above, confirm that it is the same as that recorded on the track Record Card or within 10% of that value.

If the clear track current is more than 10% below the expected level, or is pulsing this indicates that the track circuit is losing current and is not a receiver problem.

In this case the cause of the current loss should be determined and rectified otherwise the safety margin of the circuit can be eroded.

<u>For new digital receiver Installations (Projects or Maintenance replacement)</u>

7. Refer to Table 6 (Typical Track Currents against Track Circuit Lengths) and confirm that the value noted in 5A above is within 20% of the expected value from the table.

8. Determine the ratio between the TX end and RX end rail currents as described below.

9. Using a TI21 Test Meter (TTM) and a Rocoil rail current Transducer (or functional equivalent);

   Measure the signal current at the meter points shown in figure 4.

   Compare I1a with I1b and discard the lower value.

   Compare I2a with I2b and discard the higher value.

   Obtain the ratio IRail by dividing the RX end current (lowest I2) by the TX end value (highest I1).

   Record this value on the record card.

   NOTE: *In points tracks, where multiple receivers are used, then a current measurement must be taken adjacent to each receiver and the values added together to obtain the I2 value for use in Tables 9 to 14.*

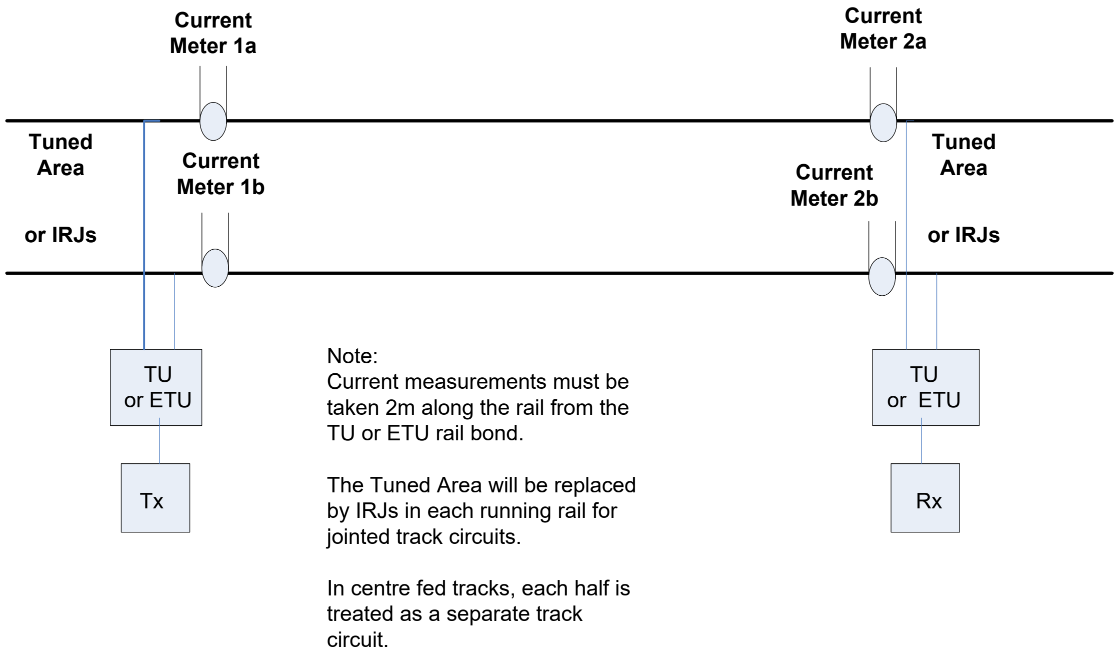


Figure 4 - Measurement Points for IRail Ratio Determination

10. Determine the value of ballast impedance by inspection of the Tables 9 to 14 (check that the table appropriate to the frequency and low power / normal power setting of the track circuit is used).

Record this value on the record card.

Determination of Ballast Impedance from Irail ratio % for Various Track Lengths

Track Length (m)	Ballast Impedance Ωkm									
	2	3	4	5	6	8	10	15	20	200
200-249	89	92	94	95	96	97	98	98	99	99
250-349	81	87	90	92	93	95	96	97	98	100
350-449	73	81	86	88	90	93	94	96	97	100
450-549	63	74	80	84	87	90	92	95	96	100
550-649	54	66	74	79	82	87	89	93	95	100
650-749	44	58	67	73	77	83	86	91	94	100
750-849	36	50	59	66	71	78	83	89	92	100
850-949	29	42	52	60	65	74	79	86	90	100
950-1049	24	36	45	53	59	68	74	83	88	100
1050-1100	19	30	39	47	53	63	70	80	86	100

Table 9 - Normal Power Frequencies A and E

Track Length (m)	Ballast Impedance Ωkm									
	2	3	4	5	6	8	10	15	20	200
200-249	85	90	92	94	95	96	97	98	98	100
250-349	76	83	87	90	91	93	95	97	97	100
350-449	65	75	81	85	87	91	92	95	96	100
450-549	54	66	74	79	82	87	90	93	95	100
550-649	43	57	66	72	77	83	86	91	94	100
650-749	34	48	57	65	70	77	82	89	92	100
750-849	27	39	49	57	63	72	77	86	90	100
850-949	21	32	42	50	56	66	72	82	87	100
950-1049	17	27	35	43	49	59	67	78	84	100
1050-1100	13	22	30	37	43	53	61	74	81	100

Table 10 - Normal Power Frequencies B, C, F and G

Track Length (m)	Ballast Impedance Ωkm									
	2	3	4	5	6	8	10	15	20	200
200-249	81	87	90	92	93	95	96	97	98	100
250-349	71	80	84	87	89	92	94	96	97	100
350-449	60	71	78	82	85	88	91	94	96	100
450-549	48	61	70	75	79	84	88	92	94	100
550-649	38	52	61	68	73	79	84	89	92	100
650-749	30	43	53	60	66	74	79	86	90	100
750-849	23	35	44	52	58	68	74	83	88	100
850-949	18	28	37	45	51	61	68	79	85	100
950-1049	14	23	31	38	45	55	62	75	82	100
1050-1100	11	19	26	33	39	49	57	70	78	100

Table 11 - Normal Power Frequencies D and H

Track Length (m)	Ballast Impedance Ωkm									
	2	3	4	5	6	8	10	15	20	200
20-74	I_{Rail} Ratio measurement not required									
75-124	95	96	97	98	98	99	99	99	99	100
125-174	92	94	96	97	97	98	98	99	99	100
175-224	89	92	94	95	96	97	98	98	99	100
225-250	85	90	92	94	95	96	97	98	98	100

Table 12 - Low Power Frequencies A and E

Track Length (m)	Ballast Impedance Ωkm									
	2	3	4	5	6	8	10	15	20	200
20-74	I_{Rail} Ratio measurement not required									
75-124	93	95	96	97	97	98	98	99	99	100
125-174	89	92	94	95	96	97	98	98	99	101
175-224	85	90	92	94	95	96	97	98	98	100
225-250	80	86	90	92	93	95	96	97	98	100

Table 13 - Low Power Frequencies B, C, F and G

Track Length (m)	Ballast Impedance Ωkm									
	2	**3**	**4**	**5**	**6**	**8**	**10**	**15**	**20**	**200**
20-74	I_{Rail} Ratio measurement not required									
75-124	91	94	95	96	97	98	98	99	99	100
125-174	86	90	93	94	95	96	97	98	98	100
175-224	81	87	90	92	93	95	96	97	98	100
225-250	76	83	87	90	91	93	95	97	97	100

Table 14 - Low Power Frequencies D and H

11. Determine the set-up shunt to be used by inspection of Tables 15 and 16 (use appropriate Low Power / Normal Power table).

If the set-up shunt is given as ‘Special’ this indicates that the ballast is in a very poor condition.

As an interim measure, until the ballast can be rectified, track circuits should be set up at 3Ω.

Affected track circuits should be monitored weekly for changes in Rx clear track current (Inow on the Rx display).

If Inow changes by more than 10% from the value at set up, then the track shal be re-set. Record the set-up shunt value on the record card.

If the ballast measurement of a track circuit in special measures does not return to normal levels and can be shown to be stable over several months, then a case can be made for reducing the set-up shunt.

NOTE: *If the IRail ratio measurement requires the use of higher shunt values, and the track is not very wet, then this indicates that there is severe loss of current down the track which should be investigated and corrected.*

Determination of Set Up Shunt from Ballast Impedance for Various Track Lengths

Track Length (m)	Ballast Impedance Ωkm							
	2	3	4	5	6	8	10	15 and above
200-249	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
250-349	1.2	1.2	1.0	1.0	1.0	1.0	1.0	1.0
350-449	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0
450-549	1.4	1.2	1.2	1.2	1.0	1.0	1.0	1.0
550-649	1.6	1.4	1.2	1.2	1.2	1.0	1.0	1.0
650-749	2.0	1.4	1.2	1.2	1.2	1.0	1.0	1.0
750-849	2.4	1.6	1.4	1.2	1.2	1.2	1.0	1.0
850-949	Special	1.8	1.4	1.4	1.2	1.2	1.0	1.0
950-1050	Special	2.2	1.6	1.4	1.2	1.2	1.0	1.0
1050-1100	Special	2.8	1.8	1.6	1.4	1.2	1.2	1.0

Table 15 - Set Up Shunt (Ω) for Normal Power All Frequencies

Track Length (m)	Ballast Impedance Ωkm				
	2	3	4	5	6 and above
20-74	1.5	1.5	1.5	1.5	1.5
75-124	1.7	1.5	1.5	1.5	1.5
125-174	1.7	1.7	1.7	1.5	1.5
175-250	1.9	1.7	1.7	1.7	1.5

Table 16 - Set Up Shunt (Ω) for Low Power All Frequencies

An example set-up shunt determination:

- Frequency B track circuit, 757m long.
- I1a = 1.012A I1b = 1.023 Use 1.023A
- I2a = 757mA I1a = 782mA Use 757mA
- IRail Ratio = 757/1023 = 0.74 = 74%
- Ballast (Table E1.b) = 8Ω
- Set Up Shunt (Table E1.g) = 1.2Ω

12. Connect a shunt box across the rails at the receiver TU or ETU track connections.

    Set the drop shunt to the value determined in step 11.

    Check that clear track current has fallen to less than 80% of the value before the shunt box was connected.

13. Replace the frequency key with the set-up key.

    The display will respond with ‘SET?’

    Press the ‘OK’ button to begin the automatic set-up process

    NOTE: *If the set up key is left in place for more than 1 minute, then the set up function will time out and the threshold will be set to zero.*

14. The condition monitoring display will show the legend ‘WAIT’, followed by ‘PASS’ or ‘FAIL’.

    ‘PASS’ indicates that set-up has been successful, and the new gain settings have been locked into the unit.

    ‘FAIL’ indicates that set-up was unsuccessful because, for example, the wrong frequency key has been used, or the track current is too low.

    In this case, ‘FAIL’ will cycle with the reason for failure shown as a code. (See APPENDIX H)

    The track circuit should be investigated, and faults corrected before set-up is attempted again.

    NOTE: *If the set up fails, then the threshold will be set to zero.*

15. Leaving the Shunt box applied. Replace the set-up key with the frequency key.

16. Check that clear track current is still below 80% of the value without the shunt box connected.

17. Remove the shunt box and check that the current recovers to the value noted in step 4.

    If step 17 is positive then release the shunt push button and confirm that the track relay picks.

18. Connect a shunt box, set to 0.7Ω, across the rails at the transmit end TU / ETU track connections and check that the track circuit drops.

19. Record the threshold level on the track circuit record card and confirm that the clear track current is correctly recorded.

20. Carry out a full test of the track circuit and record all values as required in the track Record Card

This completes the receiver set up.

NOTE: *Where Low Power or Low Power Plus tracks are used, the appropriate 'Low Power' or 'Low Power Plus' labels are required for the TX, RX and TUs / ETUs / SPETUs*

APPENDIX F - An alternative method for setting up the track circuit after a failed Transmitter LMU-TX, LMU-TU or TU/ETU

The SM(S) should risk assess the ability to gain safe site access and the competence of Maintenance staff attending the track circuit equipment and should satisfy themselves that the use of the procedure is appropriate and authorise its use.

A full test should be carried out as soon as practically possible.

Deferral of testing, up to a limit of 48 hours, can be permitted on the basis of safety if this setup procedure is used.

1. Remove the faulty unit and replace with the new one.

2. Note the clear track and threshold current values recorded on the track circuit record card.

3. Check that the threshold value on the receiver (Ith) is the same as that entered on the record card.

   For track circuits with multiple receivers, all thresholds shall be checked.

   If the thresholds have not changed then proceed to Step 9

4. Check that the clear track current is within ±20% of the original value.

   If the clear track current is more than ±20% of the original value proceed to Step 7 unless track access is not available to perform drop shunt testing, in which case proceed to Step 9.

5. Check that all receivers drop with 0.8Ω across their rail connections, and that 0.7Ω at the transmitter rail connections drops all receivers in the track circuit.

If the drop shunt tests fail proceed to Step 9.

6. Fill in the record card. Set up completed. Do not carry out steps 7, 8 or 9

7. Check that all receivers drop with 0.8Ω across their rail connections, and that 0.7Ω at the transmitter rail connections drops all receivers in the track circuit.
If the drop shunt tests fail proceed to step 9.

8. Complete the record card.

The setup has been completed. Do not proceed to step 9.

9. The criteria for using the shortened set up procedure have not been met. A Full Test shall be performed.

A full Set-Up procedure (APPENDIX E) should be carried out as soon as practically possible.

Deferral of Setting Up and Testing, up to a limit of 48 hours, might be permitted on the basis of safety if this setup procedure is used.

This completes the track set up using this process.

NOTE: *Where Low Power or Low Power Plus tracks are used, the appropriate 'Low Power' or 'Low Power Plus' labels are required on the TX, RX and TUs / ETUs / SPETUs*

APPENDIX G - An alternative method for setting up the Receiver after a failed Receiver or failed Set-up Key

The SM(S) should risk assess the ability to gain safe site access and the competence of Maintenance staff attending the track circuit equipment and should satisfy themselves that the use of the procedure is appropriate and authorise its use.

A full test shall be carried out as soon as practically possible.

Deferral of testing, up to a limit of 48 hours, may be permitted on the basis of safety if this setup procedure is used.

This procedure is to be completed regardless of whether the unit has been previously used or not.

1. Power up the Receiver. The display will respond with 'KEY?'.

2. Fit the correct frequency key for the track circuit under test.

The display will echo back the frequency in the format, for example '200A' for frequency A, and then display the relay state ('PICK' or 'drop') or can display 'NewK'.

3. Confirm that RX has a supply voltage within the range 24V to 26V

On the Receiver

Press OK then 'NEXT' until 'Vpsu'

Press OK this displays the PSU Voltage

Note this Value

4. Confirm Average current seen by the RX.

On the Receiver

Press OK then 'NEXT' until 'INOW'

Press OK then Next Until 'AV'

Press OK this displays the average current seen by the Unit.

Note this Value

5. Confirm the track circuit has a Sideband imbalance ratio less than:

- 1.6:1 for TU/ETU/SPETU
- 1.8:1 for TCU

On The Receiver

Press OK then 'NEXT' until 'INOW'

Press OK then Next Until 'USB'

Press OK and note the value.

Press 'BACK' then 'NEXT' until 'LSB'

Press OK and note the value.

Calculate and record sideband imbalance by dividing the larger value by the smaller value.

NOTE: *If the sideband imbalance exceeds the ratio values above, the track circuit should be investigated to ascertain the cause of the imbalance. Carry out steps 4.7 to 4.11.*

6. Using the Average Current value from the test above, confirm that it is the same as that recorded on the track Record Card or within 20% of that value.

If the clear track current is more than 20% outside the required level, or is pulsing this indicates that the track circuit is losing current and is not a receiver problem.

In this case the cause of the current loss should be determined and rectified otherwise the safety margin of the circuit can be eroded.

NOTE: *Items such as Ballast or Equipment degradation and Environmental Conditions (Temperature Extremes, Heavy Rainfall) etc. should all be considered.*

Variations are permitted under exceptional circumstances depending on ballast and environmental conditions.

7. Using the 2mm test lead adaptors, attach a Shunt Box across the IPC and IP1 terminals, or at the equivalent point on the surge arrestor terminals.

Adjust the shunt resistance so that the average track current reads the same as the threshold current value recorded on the test record card.

8. Leaving the Shunt Box in place, remove the frequency key and replace it with the set-up key.

The display will respond with ‘SET?’.

Press the ‘OK’ button to begin the automatic set-up process.

9. The condition monitoring display will show the legend ‘WAIT’, followed by ‘PASS’ or ‘FAIL’.

‘PASS’ indicates that set-up has been successful, and the new gain settings have been locked into the unit.

‘FAIL’ indicates that set-up was unsuccessful because, for example, the wrong frequency key has been used, or the track current is too low.

In this case, ‘FAIL’ will cycle with the reason for failure shown as a code. (See APPENDIX E)

The track circuit should be investigated, and faults corrected before set-up is attempted again.

10. Leaving the Shunt box applied. Remove the Set-up key and replace with the Frequency Key. Confirm that the INOW AV current is the same as the Record Card Ith.

    If not, then the set-up procedure needs to be repeated.

11. If Step 10 is positive then release the shunt push button and confirm that the track relay picks.

12. Check that the clear track current is within ±20% of the original value. If this is the case, then proceed to step 12C.

    If the clear track current is more than ±20% of the original value a Full Test is required.

13. Check that all receivers drop with 0.8Ω across their connections which go out to the rails, and that 0.7 Ω at the transmitter connections which go out to the rails, drops all receivers in the track circuit.

    If the drop shunt tests pass, then proceed to 13C.

14. Record all values as required in the track Record Card.

    A full Set-Up procedure (APPENDIX E) should be carried out as soon as practically possible.

    Deferral of Setting Up and Testing, up to a limit of 48 hours, might be permitted on the basis of safety if this setup procedure is used.

This completes the RX set up.

NOTE: *Where Low Power or Low Power Plus tracks are used, the appropriate ‘Low Power’ or ‘Low Power Plus’ labels are required on the TX, RX and TUs / ETUs / SPETUs*

APPENDIX H - Digital Receiver Set Up Error codes

The automatic set-up failure code consists of 4 letters which are designed to focus the fault investigation:

- “M” indicates that the modulation rate is in error, e.g. mod pin stuck on high sideband.
- “S” indicates that the sideband imbalance is too great (exceeds 100%) suggesting a TU fault.

- “H” indicates that the input signal is too high suggesting the track should be moved to ‘Low Power’ or ‘Low Power Plus’.
- “L” indicates that the input signal is too low suggesting open circuits / poor connections.

Message	Meaning of Code	Field Examples
L	Input signal low.	Over-long TC. Poorly set-up tuned area. Loose connections.
H	Input signal high	TC too short.
HL	Input signal high and low	Internal RX fault.
S	Sideband imbalance high	Failed TU.
SL	Sideband imbalance high and signal low	
SH	Sideband imbalance high and signal high	
SHL	Sideband imbalance high, signal high and low	Internal RX fault.
M	Mod rate incorrect	Faulty TX.
ML	Mod rate incorrect and signal low	Open circuit in TC. Wrong frequency TX or RX key.
MH	Mod rate incorrect and signal high	
MHL	Mod rate incorrect and signal high and low	Internal RX fault.
MS	Mod rate incorrect and sideband imbalance high	MOD pin tied on TX or TX MOD fault.
MSL	Mod rate incorrect, sideband imbalance high and signal low	Incorrect frequency key used.
MSH	Mod rate incorrect, sideband imbalance high and signal high	Unlikely to occur
MSHL	All signals incorrect	Internal RX fault.
Thld Tol	A-B mismatch between thresholds.	High level traction interference signal present.
Time Out	-	During the set up process when the set-up key is inserted - if ‘OK’ is not pressed within 60 seconds, the set up process will time out and the Threshold set to Zero.
Key Wrte	-	Faulty key or process corrupted.
WRNG	-	Set-up key inserted before frequency key or incorrect frequency key inserted to finish the process.

Table 17 - Typical Automatic Set-up Failure Codes

APPENDIX I - Error Codes

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
0	Internal Circuit Fault	Circuit monitoring tests failed. This test has highest priority	‘ERR’ cycling with ‘PICK’ or ‘drop’ On pressing <OK> display routes to ‘Stat’ then pressing <OK> routes to ‘INT’	Replace digital RX
1	Temperature	Error raised if internal temperature outside the range -30°C to +100°C	‘ERR’ cycling with ‘PICK’ or ‘drop’ On <OK> display routes to ‘Temp’	Check Internal temperature of enclosure. If within temp. range then consider replacing digital RX
2	PSU Voltage	Error raised if PSU voltage outside the range +22V to +31V	‘ERR’ cycling with ‘PICK’ or ‘drop’ On <OK> display routes to ‘Vpsu’	Check PSU setup.
3	Relay Current Note: Only relevant to MOD State 1 Dig RX.	Error raised if Relay Current exceeds 100mA.	‘ERR’ cycling with ‘PICK’ or ‘drop’ On <OK> display routes to ‘Iout’	Check wiring and if no fault found replace digital RX
4	Relay Voltage	Error raised if Relay Voltage below 10V and output is ON.	‘ERR’ cycling with ‘PICK’ On <OK> display routes to ‘Vout’	Check for a fault in the TR wiring, if no fault found change the Digital Rx
5	Relay State	Error raised if relay voltage > 10V and relay state = drop.	‘ERR’ cycling with ‘drop’ On <OK> display routes to ‘Vout’	Check for a fault in the TR wiring, if no fault found change the Digital Rx
6	Modulation Frequency	Modulation Frequency out of range : 3.4Hz to 6.2Hz	‘ERR’ cycling with ‘PICK’ or ‘drop’ On <OK> display routes to ‘Stat’ then <OK> routes to ‘MOD’	Check TC installation, however this is likely to be a TX fault. Change the TX.
7	Sideband Imbalance	Sideband imbalance out of specification. SB ratio exceeds 2:1.	‘ERR’ cycling with ‘PICK’ or ‘drop’ On <OK> display routes to ‘Stat’ then <OK> routes to ‘SB’	Check TC installation, specifically TU/ETU, as this is not likely to be a digital RX fault. Carry out tests 1.16 to 1.19

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
8	Over-range Signal	Input current exceeds 500mA	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'OVR'	Check TC installation as this is not likely to be a digital RX fault. Check TU/ETU setting is on correct power mode.
9	Power Up			Not an error code. Timestamp of last power up.
10	Relay Current Trip Note: Only relevant to MOD State 1 Dig RX.	Relay current exceeds 110mA	'ERR' cycling with 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'TRIP'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
10	Relay Power Trip MOD State 2 MOD State 3 Dig RX onwards	Relay power exceeds 2.4W 6.25W	'ERR' cycling with 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'TRIP'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
11	FPGA Fail	One or both FPGA test flags are clear.	'ERR' cycling with 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'INT'	Replace digital RX
12	Auto set	An auto set has successfully occurred.		Not an error code. Time stamp of that last Auto set.
13	Relay Power Note: Only relevant for MOD State 2 Dig RX.	Error raised if Relay Power exceeds 2.2W.	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Pout'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
13	Relay Current Applies to MOD State 3 Dig RX onwards	Error raised if Relay Current exceeds 260mA.	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Iout'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
None	Assertion error	An assertion error occurs during normal operation.	'ErSW' displayed (Note: this error is not logged).	Replace the key as it could be a latent logging problem and cycle the unit's power. If ErSW appears again replace the unit and carry out an Autoset.

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
None	Corrupt Key	Error raised if a corrupt key is detected upon initial insertion.	BADK	Replace frequency key and carry out an Auto set

These errors are not latched, i.e. if the quantity causing the error returns to normal, the ‘ERR’ display will be cleared and the fault relay energised. Note that the error is recorded in the error log.

The errors have a priority, 0 being the highest. If multiple errors exist then the only the highest priority error is shown. When it is cleared the next highest priority, error is shown.

The last error generated will be stored and made available as one of the data items over the serial link.

APPENDIX J - EBI Track 200 Frequencies

	Nominal	Lower Sideband	Upper Sideband
A	1699 Hz	1682 Hz	1716 Hz
B	2296 Hz	2279 Hz	2313 Hz
C	1996 Hz	1979 Hz	2013 Hz
D	2593 Hz	2576 Hz	2610 Hz
E	1549 Hz	1532 Hz	1566 Hz
F	2146 Hz	2129 Hz	2163 Hz
G	1848 Hz	1831 Hz	1865 Hz
H	2445 Hz	2428 Hz	2462 Hz

Table 18 - EBI Track 200 Frequencies

APPENDIX K - EBI Track 200 B3 3000 Impedance Bond Information

Frequency	Capacitance µF	Tolerance
A	308.23µF	± 1.5%
B	167.22µF	± 1.5%
C	222.07µF	± 1.5%
D	130.79µF	± 1.5%
E	373.41µF	± 1.5%
F	191.80µF	± 1.5%
G	259.76µF	± 1.5%

H	147.29µF	± 1.5%

Table 19 - Capacitor Box capacitance values

The Inductor in the Impedance Bond should be between 27.8µH – 28.2µH

END

1. General

The EBI Gate 200 Level Crossing System is an overlay system for use at footpaths, bridleways and UWC crossings. The system can be powered from a 110v/240v AC. supply or a solar/wind 24v DC. Supply.

The system can be configured for use on single or dual lines and has bi-directional capability.

Each line has two block sections and the system uses Frauscher RSR123 Wheel Sensors for train detection.

The distance of the normal direction strike-in (NDI) and the opposite direction strike-in (XDI) from the crossing varies depending on line speed and other design factors.

The wheel sensor at the crossing (NDO) on each line performs the input to one block section and the output to the adjacent block section.

Each wheel sensor is connected to an overvoltage protection unit (BSI005) in the EBI Gate 200 master unit by a 2 pair cable.

Each overvoltage protection unit is connected to a Frauscher ACS 2000 Evaluation Board (IMC).

The status of each block section is monitored by a Frauscher ACS 2000 Axle Counter Board (ACB).

The output of the Frauscher axle counter system (block section status) is used as the input to the safety rated PLC (programmable logic controller) architecture that determines the occupancy of the crossing approach block section.

The PLC drives the crossing user lights, audible warnings via safety rated IO Modules, it also provides auto-dial fault reporting and data logging capabilities.

Each crossing comprises of two EBI Gate units designated as master and slave. Both units contain Red/Green lights, audible warning units and the On-Demand mode push buttons (where required).

In addition, the master unit contains the PLC, IO modules, Battery backup/UPS, Frauscher axle counter units and power supply unit. The two units are connected by a 10 pair Plug Coupler cable.

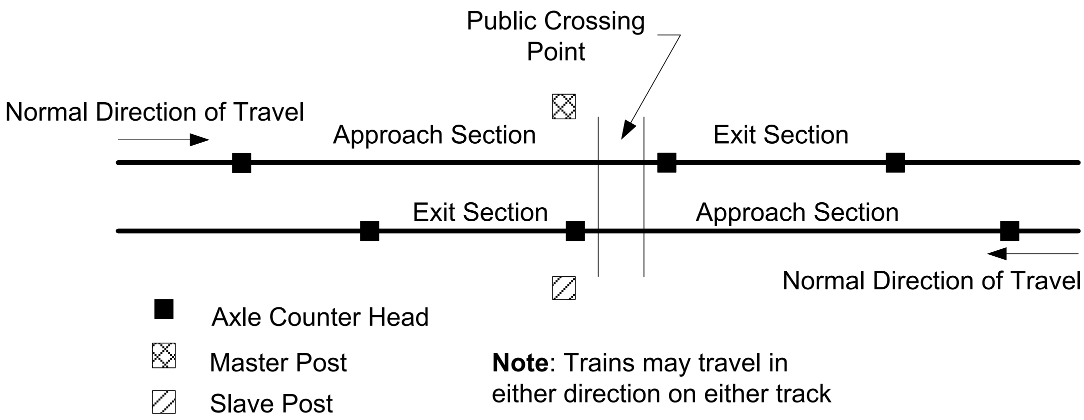


Figure 1 - A typical dual track system schematic

2. Operating Modes

The EBI Gate 200 Level Crossing System can be used in two modes.

a) Automatic.

b) On Demand.

In automatic mode the system operates as for a standard miniature red/green MSL crossing.

In On-Demand mode the user pushes a button located below the Red/Green lights on the EBI Gate 200 unit which when activated it displays a Green light if the crossing is available.

However, if the crossing is not available (train in section) at the time the button is activated then a Red light is displayed, and audible warning is given.

In “On-Demand” mode, when the button is pushed, and a Green or Red light is displayed. The system reverts to “energy saving” mode after a period of 5 minutes.

The EBI Gate 200 Level Crossing System gives another train warning tone and verbal warning on multi-track lines.

The EBI Gate 200 Level Crossing System has an inbuilt auto-restore facility and automatically sends a failure message followed by a system restored message to the designated monitoring point.

In the event that the system cannot restore itself the system sends a failed message to the monitoring point.

3. Test Equipment

The following items are used to complete all the testing and maintenance activities on Frauscher Advanced Counter equipment:

- Testing plate PB200.
- Test Box AMB100.
- Multi-meter, range 1000 mV DC, ± 0.5 % basic accuracy, internal resistance > 1 kΩ.
- 2 leads with 2 mm male connectors at both ends.
- Non-conductive cord (Plumb Line).
- Screwdriver (Flat-Headed Electrical Type).
- Tape measure.
- 30mm Spanner .
- 2.5mm Allan Key.
- Cord line and stepped treadle gauge.
- SD Card reading device (Laptop PC).

4. Wheel sensor RSR123

The wheel sensor RSR123 detects axles and consists of two sensor systems.

Viewed from the plug side, wheel sensor system 1 is on the left-hand side, wheel sensor system 2 is on the right-hand side.

Wheel sensor system 1 and 2 are symmetrically in design and are galvanically separated.

Two wires are allocated to each wheel sensor system. On the wheel sensor there is a four-wire cable connected via a plug connection, with a standard length of 5, 10 or 25 m. It is recommended to use a protection tube for the cable.

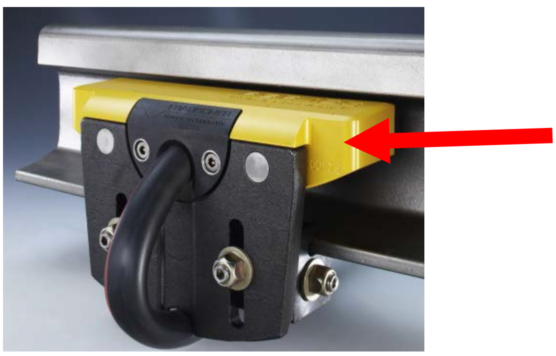


Figure 2 - Serial Number Location

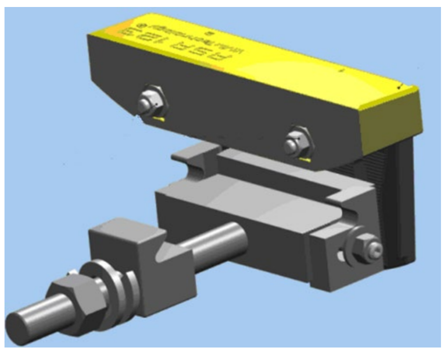
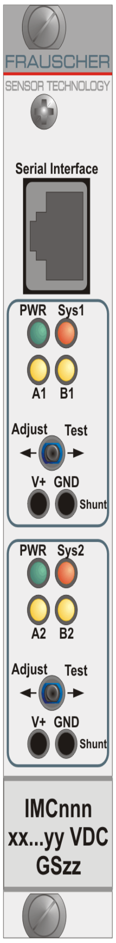


Figure 3 – General View

5. Axle Counter Evaluation Board (IMC)

The evaluation board is used to power and evaluate a wheel sensor with two sensor systems. The output switching signals are transmitted to the Axle Counting Board (ACB) via the Axle counting Back Plane (ABP).

Key to Board Image



Indication / Function	Meaning / Use
Serial Interface	Socket for diagnostic link
PWR	Supply voltage channel
Sys1	Illuminated - Illuminates when a wheel passes over Sys 1 sensor. This appears to flicker as each wheel passes over the sensor due to the speed of train. If A1 is permanently lit there is a cable fault.
A1	**Slow Flashing –** Cable or adjustment errors: Sys1 is either incorrectly connected, faulty, not adjusted, has a short circuit or an interruption in the supply line.
	Fast Flashing – Internal or operating error: The adjustment process was terminated; an invalid operation sequence was triggered (flash duration 2s) or an internal malfunction of the module has occurred. Turn the power supply of the IMC module off and on again!
	Short Flash – Wheel Sensor fault in Sys1: The life signal is lacking or there is an impermissible quiescent current drift.
B1	Illuminated - indicating switching its output when wheel detected.
A2	**Slow Flashing –** Cable or adjustment errors: Sys2 is either incorrectly connected, faulty, not adjusted, has a short circuit or an interruption in the supply line.
	Fast Flashing – Internal or operating error: The adjustment process was terminated; an invalid operation sequence was triggered (flash duration 2s) or an internal malfunction of the module has occurred. Turn the power supply of the IMC module off and on again!
	Short Flash – Wheel Sensor fault in Sys2: The life signal is lacking or there is an impermissible quiescent current drift.
	Slow Flashing – Cable or adjustment errors: Sys2 of the wheel sensor is either incorrectly connected, faulty, not adjusted, has a short circuit or an interruption in the supply line.
B2	Illuminated - indicating switching its output when wheel detected.
Adjust...	Is required to adjust the wheel sensor /IMC and to carry out a pre-Reset
Test	Damping of system 1
V+/GND	2 mm test sockets, voltage corresponds to the analogue wheel sensor current via a 100 Ω Shunt
nnn	Board identification code (IMC039)
xx…..yy	Month and Year of Manufacture
VDC	Operating voltage range (19 -72 volts DC)
ZZ	Version, beginning with 03

6. Axle Counter Board (ACB)

The ACB processes the counting head data supplied by the evaluation boards. Based on the data of the evaluation boards, the clear track or occupied track status of the track section to be controlled is determined and transmitted to the "clear/occupied" interface using direct output relays (potential-free).

Key to Board Image

Indication / Function	Meaning / Use
5v	Power supply
Occupied	Track section clear (not illuminated), track section occupied (illuminated) track section faulty (flashing).
Display	Number of axles in a track section, status information (error).
pre-Reset	Activated by pressing both buttons to the left at the same time to pre-reset the A/C heads.
Serial Interface	Socket for diagnostic link
nnn	Board identification code (ACB120)
xx…..yy	Month and Year of Manufacture
VDC	Operating voltage range (19 -72 volts DC)
ZZ	Version, beginning with 04

7. Fuse Board (SIC)

The SIC is used as supply voltage protection for ACS2000.

Indication / Function	Meaning / Use
Si1	Fuse for supply voltage at channel 1
Si2	Fuse for supply voltage at channel 2
nnn	Board identification code (SIC006)
xx…..yy	Month and Year of Manufacture
VDC	Operating voltage range (19 -72 volts DC)
ZZ	Version, beginning with 01

8. Axle Counter Board (ACB) Power Up Sequence Indications

Code				Meaning
L	R	N	0	No processor initialized, show for approximately 5 seconds
*	*	*	*	Flashing (successful initialization), show for approximately 10 seconds
-	1	0	9	The display alternates between the two codes indicating the ACB does not know the status of the axle counter section. At least one axle shall be correctly counted in and counted out.
-	2	0	9	
			0	Display status after axle in / axle out simulated.
/	/	/	/	If during power up a wheel sensor assigned to a track section is occupied
/	*	*	*	If a wheel sensor assigned to a track section is occupied during a serious or minor error.
S	C	I		A serial connection or communication has been interrupted / disrupted after power up but before reset. This can indicate a defective modem
B	O	O	T	This indicates a defective display processing unit. The ACB board should be
*	*	*	*	Not Flashing shown after power up and an axle count in or out.

9. Axle Counter Board (ACB) Diagnostic Indications

The ACB has a four-digit alphanumeric display. This is used to show the section axle count and also to show coded error/fault messages.

Codes that can be shown in display position 1**:**

Code				Meaning
-				Minor error or axle counted out
+				Minor error or axle counted in
/				One or more systems occupied
*				Steady, serious error
*				Flashing, error after reset

Codes that can be shown in display position 2:

Code				Meaning
	1			Channel 1 / System 1
	2			Channel 2 / System 2
	3			Channel 1 / System 1 of second axle counting board (second subsystem)
	4			Channel 2 / System 2 of second axle counting board (second subsystem)

10. Minor Error Codes, causes and actions Codes 00 to 7F (Hex)

Some of the codes that can be shown in display positions 3 and 4**:**

Code				Brief Description	Cause	Action
		0	0	No fault is present	fault-free operation	
		0	1	Another subsystem is reporting a minor error	see error code of the other subsystem	
		0	2	Another subsystem is not responding to the applied Reset	serial communication has been temporarily interrupted or disrupted (component error of a board)	repeat Reset, check the transmission medium, if necessary, replace the board
		0	3	Partial traversing on another subsystem	see error code of the other subsystem	
		0	4	Waiting for clearing of track after Reset (modem operation)	At least one axle shall be correctly counted in and out again, whereby one counting process shall take place on each subsystem (a train shall traverse from one subsystem to the other).	
		0	5	Occupied / clear comparison faulty in transmission mode.	EMC-interference (Hardware error)	Carry out a reset; if the error occurs again, replace the affected ACB.
		0	6	Negative axle in (modem operation)	For errors 21 to 26, if the serial communication is interrupted or disrupted.	Carry out a reset; if the error occurs again, replace the affected ACB.
		0	7	Pre-Reset carried out in (modem operation)	reset restriction removed through pre-Reset operation; the code is displayed after successful execution as confirmation.	
		0	8	Results of the counting logic and hardware evaluation	EMC-interference (Hardware error)	
		0	9	Waiting for clearing of track after Reset (isolated	At least one axle shall be correctly counted in and out again. This counting in and out process can be carried out at each counting head	
		0	A	Comparison of channel 1 and 2 faulty	overcurrent due to e.g. wire break, short circuit or interference on the wheel sensor cabling evaluation board has been removed or is not adjusted correctly Short circuit or interruption in double usage wiring evaluation board defective D|P-switches different wheel sensor has dropped off the track wheel sensor poles are reversed	
		0	B	Comparison of hardware evaluation 1 and 2 does not match		
		0	C	Negative axle in isolated operation	The same causes as with errors 21 to 26; display of this error code, if the serial communication is interrupted or disrupted.	

Code				Brief Description	Cause	Action
		0	E	Pre-Reset carried out in isolated operation	If a reset restriction has been removed with a pre-Reset operation, this code is displayed as confirmation after successful execution.	
		0	F	Failure of the serial communication	Serial communication (modem connection) is out of action for longer than 30 days.	Establish connection again; reverse the axle counting system by carrying out a simple reset.
		1	1	Partial traversing at the 1ST evaluation board.	Partial traversing e.g. during shunting works Very small wheel Check wheel sensor mounting (mounted too deep)	
		1	2	Partial traversing at the 2ND evaluation board.		
		1	3	Partial traversing at the 3RD evaluation board.		
		1	4	Partial traversing at the 4TH evaluation board.		
		1	5	Partial traversing at the 5TH evaluation board.		
		1	6	Partial traversing at the 6TH evaluation board.		
		2	1	Negative axle at the 1ST evaluation board.	System reset, with at least one axle in the track section Very small wheel Check wheel sensor mounting (mounted too deep)	
		2	2	Negative axle at the 2ND evaluation board.		
		2	3	Negative axle at the 3RD evaluation board.		
		2	4	Negative axle at the 4TH evaluation board.		
		2	5	Negative axle at the 5TH evaluation board.		
		2	6	Negative axle at the 6TH evaluation board.		
		3	1	System pulse of the 1ST evaluation board too short.	EMC-Interference Interference on the double usage wiring Evaluation board defective	If this error occurs with increasing frequency, the evaluation board affected should be replaced.
		3	2	System pulse of the 2ND evaluation board too short.		
		3	3	System pulse of the 3RD evaluation board too short.		

Code				Brief Description	Cause	Action
		3	4	System pulse of the 4TH evaluation board too short.		
		3	5	System pulse of the 5TH evaluation board too short.		
		3	6	System pulse of the 6TH evaluation board too short.		
		4	1	System 1 and 2 simultaneously on the 1st evaluation board	- Very large wheel - Wiring short circuit on the wheel sensor cabling - EMC-interference on the wheel sensor cabling - interference on the double usage wiring - check wheel sensor mounting (mounted too deep)	
		4	2	System 1 and 2 simultaneously on the 2nd evaluation board		
		4	3	System 1 and 2 simultaneously on the 3rd evaluation board		
		4	4	System 1 and 2 simultaneously on the 4th evaluation board		
		4	5	System 1 and 2 simultaneously on the 5th evaluation board		
		4	6	System 1 and 2 simultaneously on the 6th evaluation board		
		5	1	Pulse edge sequence not correct, too many edges at the 1st evaluation board	- EMC-interference - Very large wheel - Wiring short circuit on the wheel sensor cabling - EMC-interference on the wheel sensor cabling - interference on the double usage wiring	
		5	2	Pulse edge sequence not correct, too many edges at the 2nd evaluation board		
		5	3	Pulse edge sequence not correct, too many edges at the 3rd evaluation board		
		5	4	Pulse edge sequence not correct, too many edges at the 4th evaluation board		
		5	5	Pulse edge sequence not correct, too many edges at the 5th evaluation board		
		5	6	Pulse edge sequence not correct, too many edges at the 6th evaluation board		

Code				**Brief Description**	**Cause**	**Action**
		6	0	Relay Test	- Relay test active	unplug/plug relay
		6	1	The other subsystem is reporting clearing of track	- See error code of the other Subsystem	
		6	2	occupancy at the wrong time	- Defective wheel sensor - Defective evaluation board	
		7	1	Relay feedback faulty #1	An overcurrent due to e.g. wire break, short circuit or interference on the wheel sensor cabling short circuit or interruption in double usage wiring evaluation board defective - DIP-switches different relay contacts oxidised relay activation defective relay defective fault on the readback wire wheel sensor has dropped off the track wheel sensor poles are reversed	if this error occurs, troubleshooting should be executed in the sequence opposite (cause column); if necessary, the voltage supply should be interrupted and a reset should be carried out; if the fault occurs again, the affected ACB should be replaced.
		7	2	Relay feedback faulty #1		
		7	3	Relay feedback faulty #1		

#1. Detection of error during change from the clear to the occupied status or from the occupied to the clear status.

11. Serious Error Codes, causes and actions

Code				**Brief Description**	**Cause**	**Action**
		8	2	Power up, 4 asterisks are shown on the display.	Status after application of the supply voltage.	Reset required.
		8	3	Pre-Reset and Reset actuated at the simultaneously	- Pre-reset and Reset actuated at the simultaneously - Short circuit between the pre-reset and reset inputs	.
		8	4	DIP-switches changed during operation	- DIP-switches changed during operation.	Check diagrams for correct settings.
		9	0	Another sub-system is reporting a serious error	See error code on other sub- systems.	

Code				Brief Description	Cause	Action
		A	4	Relay feedback faulty #1	Relay contacts oxidized Relay activation defective Relay defective Fault on readback wire	If this error occurs the supply voltage should be interrupted, and a reset carried out. If it occurs again replace the affected ACB board.
		A	5			
		A	6			
		A	7			
		A	9			
		A	A			
		A	B			
		A	C			
		A	D			
		A	E			
		A	F			
		B	1			
		B	2			
		B	3			
		B	4			
		B	5			
		B	6			
		B	7			
		B	9			
		B	A			
		B	B			
		B	C			
		B	D			
		B	E			
		B	F			
		C	1			
		C	2			
		C	3			
		C	4			
		C	5			
		C	6			
		C	7			
		C	9			
		C	A			
		C	B			
		C	C			
		C	D			
		C	E			
		C	F			

#1 Detection of error during change from the clear to the occupied status or from the occupied to the clear status.

Code				Brief Description	Cause	Action
		D	0	Error in the program code test #2	- Program code faulty - EMC - interference	If this error occurs the supply voltage should be interrupted, and a reset carried out. If it occurs again replace the affected ACB board.
		D	1	Error in the data storage test #2	- SRAM faulty - EMC-interference	
		D	2	Error in the register test #2	- Register faulty - EMC-interference	
		D	3	Error in the Watch Dog Timer test #2	- Watch Dog Timer faulty - EMC-interference	
		D	4			
		D	5			
		D	6	Error in the overvoltage test #2	- Overvoltage Monitoring faulty - EMC-interference	
		D	7			
		D	8			
		D	9			
		D	A	Error in the read back input 2	- ACB faulty - EMC-interference	
		D	B			

#2. Detection of error during a power-up or caused by cyclical tests.

12. EBI Gate 200 System Messages

Message	Meaning
DAY LOG STATUS	System Periodic Test Ok This message sent on Power up and at 12:00 GMT every day.
RED DARK MODE ON	This message is sent if the crossing has entered Dark Mode and a successful reset has not occurred after 45 minutes. It continues to be sent every 45 minutes until the crossing has been restored.
GREEN SYSTEM RESTORED	This message is sent once the system is available to the user to display a red/green signal.
POWER FAILURE	This message sent on power failure

13. EBI Gate Abbreviations

Abbreviation	Meaning
ABP	Axle Counter Back Plane
ACB	Axle Counter Board
AMB100	Test Box
BSI	Overvoltage Protection Unit
IMC	Axle Counter Evaluation Board

Abbreviation	Meaning
NDI	Crossing Strike-in head in the normal direction of running
NDO	Crossing Strike-out head for both normal direction of running and bi-directional running
PB 200	Testing plate
RSR123	Wheel sensor type RSR123
Sys	Sensor system of a wheel sensor
SIP	Crossing Strike-in point
XDI	Crossing Strike-in head bi-directional running

14. Interpretation of the DataLog Files

In order to assist with the interpretation of the details shown in the columns of the DayLog this section contains expanded explanations of the details, grouped by column.

Column A - Date and Time

Date/Time	Explanation
01/02/70-00:00:15	Time/Date Stamp, DD/MM/YY-HH:MM:SS

Column B – Event

Event Description	Trigger
No Description	
1 Minute Check	Current Minute <> Last Log Minute
System Periodic Test OK	Logged on Power up and Mid-Day Only
Frauscher Reset	Frauscher Block Sections Reset after a “Self-Reset” or “Power Up”
AMBER Awaiting Train Reset	System has Initialised
GREEN System Restored	System Restored
Green Aspect On	The GREEN aspects have been illuminated on the posts
Green Aspect Off	The GREEN aspects have been switched off
Red Aspect On	The RED aspects have been illuminated on the posts
Red Aspect Off	The RED aspects have been switched off
RED Dark Mode On	Entering Dark Mode
Energy Save On	The Energy Save mode has activated
Demand Press	The “On-Demand” button has been pressed on either post
Manual Reset	Manual Reset has been carried out using the “Reset” Switch

Event Description	Trigger
Test Activated	System Test has been activated using the “Test” Switch
Audio 1 On	Audio 1 has been activated
Audio 1 Off	Audio 1 has been turned off
Audio 2 On	Audio 2 has been activated
Audio 2 Off	Audio 2 has been turned off
Open /Replace <file>	A file is open
Created: <File>	A new file is created
Train Update	Train Movement
Power Failure	Systems Power Lost
SMS Power Failure	Power failure Text Message
SMS Power Restored	Power Restored Text Message
Hardware Fault	System has entered an irrecoverable fault
Door open	Enclosure door open (Future Use)
Door Closed	Enclosure door Closed (Future Use)

Column D – Inputs

Block Input Message	Description
F	Sensor Fault
O	Transition State
FM	Block Clear
P	Block Occupied
DB	Demand Button Pressed
MR	Manual Reset

Inputs	Explanation
FM,--,--,--,--,--,--,--,	Block Section 1 Clear
P,--,--,--,--,--,--,--,	Block Section 1 Occupied
--,FM,--,--,--,--,--,--,	Block Section 2 Clear
--,P,--,--,--,--,--,--,	Block Section 2 Occupied
--,--,FM,--,--,--,--,--,	Block Section 3 Clear
--,--,P,--,--,--,--,--,	Block Section 3 Occupied
--,--,--,FM,--,--,--,--,	Block Section 4 Clear

Inputs	Explanation
--,--,--,P,--,--,--,--,	Block Section 4 Occupied
FM,FM,FM,FM,--,--,--,--,	All 4 Block Sections Clear
P,P,P,P,--,--,--,--,	All 4 Block Sections Occupied
DB,DB,DB,BD,--,--,--,--,	"On Demand" Button Pressed
MR,MR,MR,MR,--,--,--,--,	"Reset" Button Pressed

Column E - Block Status

Block Section Status	Description
CL	Block Section Clear
Oc	Occupied
WC	Waiting to Clear
I	Initialising
D1	Sensor Fail Timer
D2	Direction Timer Fail
RF	Red Fail Timer
GF	Green Fail Timer
HF	Hardware Fault
DM	Dark Mode
E	Energy Save Mode
--	Transition State

Inputs	Explanation
Cl,--,--,--,--,--,--,--,	Block Section 1 Clear
Oc,--,--,--,--,--,--,--,	Block Section 1 Occupied
WC,--,--,--,--,--,--,--,	Block Section 1 Waiting to Clear
I,--,--,--,--,--,--,--,	Block Section 1 In Initialization State
D1,--,--,--,--,--,--,--,	Block Section 1 Illegal Move Detected
D2--,--,--,--,--,--,--,	Block Section 1 Sensor Fail Timer

Inputs	Explanation
RF--,--,--,--,--,--,--,	Block Section 1 Direction Timer Fail
GF--,--,--,--,--,--,--,	Block Section 1 Red Fail Timer
HF--,--,--,--,--,--,--,	Block Section 1 Green Fail Timer
DM--,--,--,--,--,--,--,	Block Section 1 Hardware Fault
E--,--,--,--,--,--,--,	Block Section 1 Dark Mode

Column F - Status of Displayed Aspects

Aspect	Explanation
G,G,G,G,--,--,--,--,	GREEN Aspect Displayed
R,G,G,G,--,--,--,--,	RED Aspect Displayed Due to Block Section 1 Occupied
G,R,G,G,--,--,--,--,	RED Aspect Displayed Due to Block Section 2 Occupied
G,G,R,G,--,--,--,--,	RED Aspect Displayed Due to Block Section 3 Occupied
G,G,G,R,--,--,--,--,	RED Aspect Displayed Due to Block Section 4 Occupied
E,E,E,E,--,--,--,--,	Energy Save Mode. No Aspects Illuminated
--,--,--,--,--,--,--,--,	Aspect States During Initialization

15. Data Scenarios

To further improve the interpretation of the details the following DayLog extracts show the normal data sequences recorded for a number of scenarios.

Scenario 01- Up Road Train Normal Direction

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
47	01/11/13-00:36:34	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
48	01/11/13-00:37:35	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
49	01/11/13-00:38:36	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
50	01/11/13-00:39:36	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
51	01/11/13-00:40:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
52	01/11/13-00:41:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
53	01/11/13-00:41:50	Train Update	P,FM,FM ,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G,G,G ,--,--,--,--,	Block Section 1 is occupied by train
54	01/11/13-00:41:50	Green Aspect Off	P,FM,FM ,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G,G,G ,--,--,--,--,	Green aspect turns off as Block Section 1 is occupied by train
55	01/11/13-00:41:50	Red Aspect On	P,FM,FM ,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G,G,G ,--,--,--,--,	Red aspect turns on as Block Section 1 is
56	01/11/13-00:41:50	Audio 1 On	P,FM,FM ,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G,G,G ,--,--,--,--,	Audio 1 turns on as Block Section 1 is occupied by train
57	01/11/13-00:42:18	Train Update	P,P,FM,FM ,--,--,--,--,	Oc,WC,Cl,Cl,--,--,--,--	R ,R ,G ,G ,--,--,--,--,	Train transitions the crossing, Block Section 1 and Block Section 2 is occupied by train
58	01/11/13-00:42:18	Train Update	FM,P,FM,FM ,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--	G ,G ,G ,G ,--,--,--,--,	Green aspect turns on as train clears the crossing, Block Section 1 clears, and Block Section 2 is occupied by train
59	01/11/13-00:42:18	Green Aspect On	FM,P,FM,FM ,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green aspect turns on as train clears the crossing, Block Section 1 clears, and Block Section 2 is occupied by train
60	01/11/13-00:42:18	Red Aspect Off	FM,P,FM,FM ,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 1 clears, and Block Section 2 is occupied by train
61	01/11/13-00:42:18	Audio 1 Off	FM,P,FM,FM ,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 1 turns off as train clears the crossing, Block Section 1 clears, and Block Section 2 is occupied by train
62	01/11/13-00:42:39	Train Update	FM,P,FM,FM ,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Train clears Block Section 2.
63	01/11/13-00:43:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing Block Section 2 clears. 1 Min Checks resume.
64	01/11/13-00:44:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
65	01/11/13-00:45:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
66	01/11/13-00:46:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Checks occurring as expected.
67	01/11/13-00:47:21	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
68	01/11/13-00:48:21	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Scenario 02- Up Road Train Wrong Direction

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
50	01/11/13-00:39:36	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
51	01/11/13-00:40:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
52	01/11/13-00:41:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
53	01/11/13-00:41:50	Train Update	FM,**P** ,FM,FM,--,--,--,--,	Cl,Oc,Cl,Cl,--,--,--,--,	G ,R ,G ,G,--,--,--,--,	Block Section 2 is occupied by train
54	01/11/13-00:41:50	Green Aspect Off	FM,**P** ,FM,FM,--,--,--,--,	Cl,Oc,Cl,Cl,--,--,--,--,	G ,R ,G ,G,--,--,--,--,	Green aspect turns off as Block Section 2 is occupied by train
55	01/11/13-00:41:50	Red Aspect On	FM,**P** ,FM,FM,--,--,--,--,	Cl,Oc,Cl,Cl,--,--,--,--,	G ,R ,G ,G,--,--,--,--,	Red aspect turns on as Block Section 2 is occupied by train
56	01/11/13-00:41:50	Audio 1 On	FM,**P** ,FM,FM,--,--,--,--,	Cl,Oc,Cl,Cl,--,--,--,--,	G ,R ,G ,G,--,--,--,--,	Audio 1 turns on as Block Section 2 is occupied by train
57	01/11/13-00:42:18	Train Update	P,FM,FM,FM ,--,--,--,--,	WC, Oc,Cl,Cl,--,--,--,--,	G ,R ,G ,G ,--,--,--,--,	Train tansitioning from Block Section 2 to Block Section 1
58	01/11/13-00:42:18	Train Update	P,FM,FM,FM ,--,--,--,--,	WC,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Train clears the crossing, Block Section 2 clears and Block Section 1 is occupied by train
59	01/11/13-00:42:18	Green Aspect On	P,FM,FM,FM ,--,--,--,--,	WC,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green aspect turns on as train clears the crossing, Block Section 2 clears and Block Section 1 is occupied by train
60	01/11/13-00:42:18	Red Aspect Off	P,FM,FM,FM ,--,--,--,--,	WC,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 2 clears and Block Section 1 is occupied by train

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
61	01/11/13-00:42:18	Audio 1 Off	P,FM,FM,FM ,--,--,--,--,	WC,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 1 turns off as train clears the crossing, Block Section 2 clears and Block Section 1 is occupied by train
62	01/11/13-00:43:19	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing are, Block Section 1 clears..
63	01/11/13-00:43:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Min Checks resume.
64	01/11/13-00:44:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min
65	01/11/13-00:45:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1-minute Checks occurring as expected.
66	01/11/13-00:46:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
67	01/11/13-00:47:21	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Scenario 03 - Down Road Train Normal Direction

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
50	01/11/13-00:39:36	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1-minute time Checks occurring as expected.
51	01/11/13-00:40:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
52	01/11/13-00:41:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
53	01/11/13-00:41:50	Train Update	FM,FM,FM,P,--,--,--,--,	Cl,Cl,CL,Oc,--,--,--,--,	G,G ,G ,R ,--,--,--,--,	Block Section 4 is occupied by train
54	01/11/13-00:41:50	Green Aspect Off	FM,FM,FM,P,--,--,--,--,	Cl,Cl,CL,Oc,--,--,--,--,	G,G ,G ,R ,--,--,--,--,	Green aspect turns off as Block Section 4 is occupied by train
55	01/11/13-00:41:50	Red Aspect On	FM,FM,FM,P,--,--,--,--,	Cl,Cl,CL,Ocl--,--,--,--,	G,G ,G ,R ,--,--,--,--,	Red aspect turns on as Block Section 4 is occupied by train
56	01/11/13-00:41:50	Audio 1 On	FM,FM,FM,P,--,--,--,--,	Cl,Cl,CL,Oc,--,--,--,--,	G,G ,G ,R ,--,--,--,--,	Audio 1 turns on as Block Section 4 is occupied by train
57	01/11/13-00:42:16	Train Update	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Train Transitioning from Block Section 4 to Block Section 3

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
58	01/11/13-00:42:18	Train Update	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Train clears Block Section 4 and Block Section 3 is occupied by train
59	01/11/13-00:42:18	Green Aspect On	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green aspect turns on as train clears the crossing, Block Section 4 clears and Block Section 3 is occupied by train
60	01/11/13-00:42:18	Red Aspect Off	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 4 clears and Block Section 3 is occupied by train
61	01/11/13-00:42:18	Audio 1 Off	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 1 turns off as train clears the crossing; Block Section 4 clears and Block Section 3 is occupied by train
62	01/11/13-00:43:19	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing area, Block Section 3 clears.
63	01/11/13-00:43:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing area, Block Section 3 clears. 1 Min Checks resume.
64	01/11/13-00:44:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
65	01/11/13-00:45:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
66	01/11/13-00:46:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Scenario 04 - Down Road Train Wrong Direction

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
51	01/11/13-00:40:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
52	01/11/13-00:41:37	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
53	01/11/13-00:41:50	Train Update	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,Cl,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Block Section 4 is occupied by train

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
54	01/11/13-00:41:50	Green Aspect Off	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,Cl,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Green aspect turns off as Block Section 4 is occupied by train
55	01/11/13-00:41:50	Red Aspect On	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,Cl,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Red aspect turns on as Block Section 4 is occupied by train
56	01/11/13-00:41:50	Audio 1 On	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,Cl,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Audio 1 turns on as Block Section 3 is occupied by train
57	01/11/13-00:42:16	Train Update	FM,FM,P ,FM,--,--,--,--,	Cl,Cl,WC,Oc,--,--,--,--,	G ,G ,G ,R ,--,--,--,--,	Train Transitioning from Block Section 4 to Block Section 3
58	01/11/13-00:42:18	Train Update	FM,FM,FM,P ,--,--,--,--,	Cl,Cl,Oc,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Block Section 4 clears and Block Section 3 is occupied by train
59	01/11/13-00:42:18	Green Aspect On	FM,FM,FM,P ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green aspect turns on as train clears the crossing, Block Section 4 clears and Block Section 3 is occupied by train
60	01/11/13-00:42:18	Red Aspect Off	FM,FM,FM,**P** ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 4 clears and Block Section 3 is occupied by train
61	01/11/13-00:42:18	Audio 1 Off	FM,FM,FM,P ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 1 turns off as train clears the crossing, Block Section 4 clears and Block Section 3 is occupied by train
61	01/11/13-00:43:19	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing are, Block Section 3 clears.
63	01/11/13-00:43:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing are, Block Section 3 clears. 1 Min Checks resume.
64	01/11/13-00:44:19	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
65	01/11/13-00:45:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
66	01/11/13-00:46:20	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Scenario 05 - Up Road Train Normal Direction then a Down Road Train Normal Direction ATC

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
672	01/11/13-08:53:52	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
673	01/11/13-08:54:52	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
674	01/11/13-08:55:53	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
675	01/11/13-08:56:34	Train Update	P,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Block Section 1 is occupied by train
676	01/11/13-08:56:34	Green Aspect Off	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Green aspect turns off as Block Section 1 is occupied by train
677	01/11/13-08:56:34	Red Aspect On	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Red aspect turns on as Block Section 1 is occupied by train
678	01/11/13-08:56:34	Audio 1 On	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Audio 1 turns on as Block Section 1 is occupied by train
679	01/11/13-08:56:53	Train Update	P ,FM ,P ,FM,--,--,--,--,	Oc,Cl,Oc,Cl,--,--,--,--,	R ,G ,R ,G ,--,--,--,--,	Down Road Train Strikes into Block Section
680	01/11/13-08:56:55	Train Update	P ,P ,P ,FM,--,--,--,--,	Oc,WC,Oc,Cl,--,--,--,--,	R ,G ,R ,G ,--,--,--,--,	Up Road Train Transitions Block Section 1 to Block Section 2
681	01/11/13-08:56:55	Audio 2 On	P ,P ,P ,FM,--,--,--,--,	Oc,WC,Oc,Cl,--,--,--,--,	R ,G ,R ,G ,--,--,--,--,	Audio 2 turns on as a Down Road Train Strikes into Block Section 3 and the Up-Road Train transitions Block 1 to 2
680	01/11/13-08:56:57	Train Update	FM ,P ,P ,FM,--,--,--,--,	Cl,WC,Oc,Cl,--,--,--,--,	G ,G ,R ,G ,--,--,--,--,	Up Road Train clears Block Section 1 and occupies Block Section 2
681	01/11/13-08:57:10	Train Update	FM ,FM ,P ,FM,--,--,--,--,	Cl,Cl,Oc,Cl,--,--,--,--,	G ,G ,R ,G ,--,--,--,--,	Up Road Train clears Block Section 2
682	01/11/13-08:57:18	Train Update	FM ,FM ,P ,FM,--,--,--,--,	Cl,Cl,Oc,WC,--,--,--,--,	G ,G ,R ,G ,--,--,--,--,	Down Road Train Transitions Block Section 3 to Block Section 4

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
683	01/11/13-08:57:22	Train Update	FM,FM,FM,FM ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Down Road Train clears the crossing, Block Section 3 clears, and Block Section 4 is occupied by train
684	01/11/13-08:57:22	Red Aspect Off	FM,FM,FM,P ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 3 clears, and Block Section 4 is occupied by train
685	01/11/13-08:57:22	Audio 1 Off	FM,FM,FM,P ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 1 turns off as train clears the crossing, Block Section 3 clears, and Block Section 4 is occupied by train
686	01/11/13-08:57:22	Audio 2 Off	FM,FM,FM,**P** ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio 2 turns off as train clears the crossing, Block Section 3 clears, and Block Section 4 is occupied by train
687	01/11/13-08:57:23	Green Aspect On	FM,FM,FM,**P** ,--,--,--,--,	Cl,Cl,Cl,WC,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect turns off as train clears the crossing, Block Section 3 clears, and Block Section 4 is occupied by train
688	01/11/13-08:58:23	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	The train leaves the crossing area, Block Section 4 clears. 1 Min Checks resume.
689	01/11/13-08:59:24	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	No trains in the crossing area. 1 Min Checks occurring as expected.
690	01/11/13-09:00:24	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	
691	01/11/13-09:01:25	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	

Scenario 06 - Start Up Sequence

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
1370	21/07/16-09:38:48	Train Update	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,--,--,--,--,--,--,	Updates as Power Turned On
1371	21/07/16-09:38:48	Power Restored	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Power Restore Detected
1372	21/07/16-09:38:48	Door Closed	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Door Contacts Detected
1373	21/07/16-09:38:48	Frauscher Reset	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Axle Counters Reset
1374	21/07/16-09:38:48	AMBER Awaiting Train Reset	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	SMS Message Sent

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
1375	21/07/16-09:38:49	Green Aspect Off	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Green Aspect Output Off
1376	21/07/16-09:38:49	Red Aspect Off	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Red Aspect Output Off
1377	21/07/16-09:38:49	Audio 1 Off	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Audio 1 Output Off
1378	21/07/16-09:38:49	Audio 2 Off	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Audio 2 Output Off
1379	21/07/16-09:39:19	System Periodic Test OK	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Periodic Test
1380	21/07/16-09:40:00	1 Min Check	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	1 Minute Self Check
1381	21/07/16-09:40:47	Train Update	MR,MR,MR,MR,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Manual Reset Operated
1382	21/07/16-09:40:47	Manual Reset	MR,MR,MR,MR,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Manual Reset Operated
1383	21/07/16-09:40:47	Train Update	P ,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Block Section State Change
1384	21/07/16-09:40:49	Train Update	P ,P ,FM,FM,--,--,--,--,	I ,I ,GF,GF,--,--,--,--,	--,--,--,--,--,--,--,--,	GF Registered as 2 minutes from startup
1385	21/07/16-09:40:50	Frauscher Reset	P ,P ,FM,FM,--,--,--,--,	I ,I ,GF,GF,--,--,--,--,	--,--,--,--,--,--,--,--,	Axle Counters Reset
1386	21/07/16-09:40:55	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,GF,GF,--,--,--,--,	G ,G ,--,--,--,--,--,--,	Block Section State Change
1387	21/07/16-09:40:55	Train Update	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Block Section State Change. All Blocks Clear
1388	21/07/16-09:40:55	GREEN System restored	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	SMS Message Sent
1389	21/07/16-09:40:55	Green Aspect On	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green Aspect Output On
1390	21/07/16-09:41:00	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Minute Self Check
1391	21/07/16-09:42:00	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Minute Self Check
1392	21/07/16-09:42:52	GREEN System restored	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	SMS Message Sent
1393	21/07/16-09:43:00	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Minute Self Check
1394	21/07/16-09:44:00	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Minute Self Check
1395	21/07/16-09:45:00	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	1 Minute Self Check
1396	21/07/16-09:45:52	Energy Save On	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	E ,E ,E ,E ,--,--,--,--,	Energy Save after 5 Minutes
1397	21/07/16-09:45:52	Green Aspect Off	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	E ,E ,E ,E ,--,--,--,--,	Energy Save after 5 Minutes

Scenario 07 - Typical Dark Mode / Auto Reset Sequence

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
1246	21/05/14-15:23:23	Train Update	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Block Section 1 occupied
1247	21/05/14-15:23:23	Audio 1 On	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	Section 1 occupied and AWD on

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
1248	21/05/14-15:23:23	Green Aspect Off	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	green off due to occupancy of section 1
1249	21/05/14-15:23:23	Red Aspect On	P ,FM,FM,FM,--,--,--,--,	Oc,Cl,Cl,Cl,--,--,--,--,	R ,G ,G ,G ,--,--,--,--,	red aspect on due to occupancy of section 1
1250	21/05/14-15:23:28	Train Update	FM,P ,FM,FM,--,--,--,--,	Oc,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Train Transitioning from Block Section 1 to Block Section 2 lit
1251	21/05/14-15:23:31	Train Update	FM,P ,FM,FM,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Section 1 clear, section 2 occupied, green aspect lit
1252	21/05/14-15:23:31	Green Aspect On	FM,P ,FM,FM,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Section 1 clear, section 2 occupied, green aspect lit
1253	21/05/14-15:23:31	Red Aspect Off	FM,P ,FM,FM,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Red aspect off due to section 1 clear
1254	21/05/14-15:23:31	Audio 1 Off	FM,P ,FM,FM,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Audio off due to section 1 clear
1255	21/05/14-15:24:32	1 Min Check	FM,P ,FM,FM,--,--,--,--,	Cl,WC,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Standard 1 minute cyclical input check
1256	21/05/14-15:25:31	Train Update	FM,P ,FM,FM,--,--,--,--,	GF,GF,GF,GF,--,--,--,--	--,--,--,--,--,--,--,--,	Green Aspect Failure Registered
1257	21/05/14-15:25:31	Green Aspect Off	FM,P ,FM,FM,--,--,--,--,	GF,GF,GF,GF,--,--,--,--	--,--,--,--,--,--,--,--,	Green aspect off due to 120 second timer being exceeded
1258	21/05/14-15:25:31	Dark Mode On	FM,P ,FM,FM,--,--,--,--,	GF,GF,GF,GF,--,--,--,--	--,--,--,--,--,--,--,--,	Dark mode on
1259	21/05/14-15:25:41	Train Update	FM,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	
1260	21/05/14-15:25:41	Frauscher Reset	FM,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Internal reset within Frauscher system
1261	21/05/14-15:25:45	System Initialised	FM,P ,FM,FM,--,--,--,--,	I ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	internal reset within Frauscher system

Record	Date/Time	Event	Inputs	BlockStatus	Aspect	Explanation
1262	21/05/14-15:26:11	Train Update	P,P ,FM,FM,--,--,--,--,	Oc ,I ,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Block Section 1 occupied
1263	21/05/14-15:26:55	Train Update	P,P ,FM,FM,--,--,--,--,	Oc,Oc,Cl,Cl,--,--,--,--,	--,--,G ,G ,--,--,--,--,	Train Transitioning from Block Section 1 to Block Section 2
1264	21/05/14-15:26:55	Train Update	P,P ,FM,FM,--,--,--,--,	Cl,Oc,Cl,Cl,--,--,--,--,	G,--,G ,G ,--,--,--,--,	Block Section 1 clear, Block section 2 occupied
1265	21/05/14-15:27:12	Train Update	P,P ,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G,G,G ,G ,--,--,--,--,	Block Section 2 Clears
1266	21/05/14-15:27:12	GREEN System restored	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Train has passed through section correctly and system has restored
1267	21/05/14-15:27:12	Green Aspect On	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	Green aspect on due to all sections clear
1268	21/05/14-15:27:12	GREEN System restored	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	SMS Message Sent
1269	21/05/14-15:28:12	1 Min Check	FM,FM,FM,FM,--,--,--,--,	Cl,Cl,Cl,Cl,--,--,--,--,	G ,G ,G ,G ,--,--,--,--,	standard 1 minute cyclical input check

END

Includes:	EBI Track 400 Audio Frequency Track Circuit
Excludes:	All other Track Circuits

1. EBI Track 400 Audio Track Circuit: GENERAL

This document provides technical information for the setting up, faulting and maintenance of EBI Track 400 track circuits.

Under no circumstances shall the TX and RX tuning units of one track circuit be disconnected from the rails at the same time.

This can allow unwanted power to pass between the adjacent track circuits resulting in a possible failure of an abutting track circuit.

The TU cables form part of the tuned circuit, because of this they should wherever possible be bound together, not allowed to form loops and not be run in parallel with the running rails. Failure to observe these items can result in the effectiveness of the tuned area being altered i.e. low or below specification readings.

Numerous parameters are usually accessible via Remote Condition Monitoring and can be used to assist with fault investigations.

1.1. EBI Track 400 Layout Configurations

EBI Track 400 track circuits can be used in a number of configurations:

a) Double rail configuration using TUs for jointless or ETUs for jointed track circuits using Open Line frequencies.

b) Double rail configuration using SATUs for jointless or CUs for jointed track circuits using Station Area frequencies.

c) Single rail configuration using ETUs, SPETUs.

d) Both single rail and double rail configurations can have multiple Receivers/Track Relays.

1.2. Warning:

If an RX or TX is disconnected from its tuning unit, the terminals on that tuning unit to which the 2-core cable was attached shall be short circuited.

A double rail EBI Track 400 track circuit shall never be reconfigured as a single rail track circuit.

1.3. Caution:

The gain or sensitivity shall not be increased or decreased where the clear track current (across IPC-IP1 OL, IPC-IP2 SA.) has changed by more than 10% without consulting your S(MS).

Any adjustment should only be to obtain the correct drop shunt, for that track circuit.

Tuned zones shall be kept clear of all metallic objects including new or scrap lengths of rail for a distance of at least 1.25m (4ft). The tail cables from the TU to the rails form part of the tuned circuit, because of this they should wherever possible be bound together, not allowed to form loops and not be run in parallel with the running rails. Failure to observe these items can result in the effectiveness of the tuned area being altered i.e. low or below specification readings.

1.4. Power Supplies and Fusing

EBI Track 400 utilises PULS power supplies which provide a stabilised 48VDC. The 110VAC supply to the power supplies are fused with 5A BS88 Joint Services Fuse. The 48VDC supply to Transmitters use 5A and 7A BS88 Joint Services Fuse depending on the feed lengths and Receivers use a 3A BS88 Joint Services Fuse. BS88 fuses are mandated for reliability.

1.5. Test Equipment

A TI21 Test Meter (TTM), TI21-M Test Meter (MTM) or EBI Track Track Circuit Meter (ETTCM) set to the frequency of the track circuit under test shall be used for voltage measurements. It is not acceptable to test EBI Track 400 without a TTM, MTM or ETTCM.

A Rail current measuring devices such as a Rocoil or Lemflex, used in conjunction with the TTM/MTM/ETTCM, can be used to measure the EBI Track 400 current in the rail to locate a section of the track bed causing loss of power at the Receiver end.

1.6. Centre Fed and Cut Section Track Circuits

Each half of a centre fed track circuit or each cut section operates as an independent track circuit and shall be tested as such and record cards kept for each part.

1.7. Impedance Bond Tuning

Any impedance bonds within the track circuit shall be tuned with the correct resonating capacitor across the auxiliary coil or in the case of B3 3000 and B3 500 bonds (which have no auxiliary coil) the correct tuning module.

Each removable tuning capacitor / module is labelled with the style of bond it should be fitted to. Where it is not removable this information appears on the bond itself.

If the earlier PCB type of tuner board (e.g. Howells or WH3 type) is used, the correct links shall be cut depending on the track circuit frequency.

1.8. Rail to Rail Voltage

With the track circuit not shunted by a train or train shunt the rail-to-rail voltage should fall approximately linearly from the TX to the RX end. In exceptional circumstances (and with permission of the S&T Maintenance Engineer) it may be raised by intermediate tuning capacitors.

1.9. Rail Current

The EBI Track 400 rail current reading gives a more useful reading, than rail voltages, and should be virtually constant throughout the track circuit length. It should also be of similar values in both rails.

Where impedance bonds, or intermediate tuning capacitors (Bucking Capacitors) have been fitted the current value will have a marked change. Significant changes in track current indicate leakage faults between the rails which should be investigated and rectified.

It should be noted that PAN 8 and Bullhead rail will inherently lose current because of the lack of pads and nylons.

1.10. Tuned Zone Ratios (Pole/Zero Ratios)

Pole – Track under test
Zero – Adjacent/abutting track

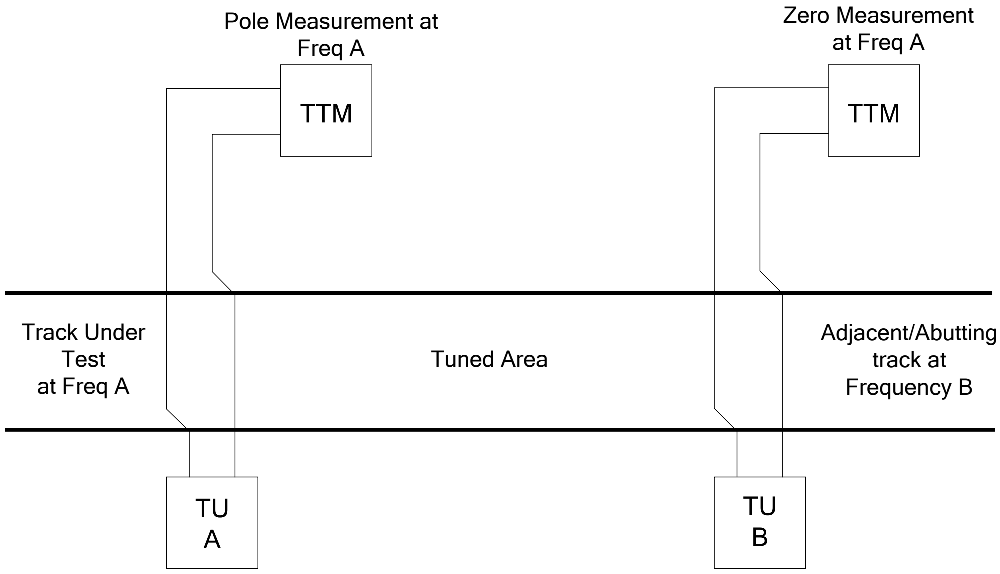


Figure 1 – Tuned Zone Ratio Pole Zero Positions

The Pole voltage is the voltage across the rails at the TU of the track under test (TU A in drawing) at that track's frequency (Frequency A in Figure 1). For the purpose of the test this TU can be called the 'Pole TU'.

The zero voltage is measured across the companion tuning unit's (TU B in the drawing) rail terminals at the track under test frequency (Frequency A in the drawing). For the purpose of the test this TU can be called the 'Zero TU'.

Important points to note are:

a) The pole/zero measurement gives no information about the quality of the pole. The pole is the property in the tuning unit which determines how much signal current is sent down the track to the RX at the other end.

b) The pole/zero measurement will give a good measurement of the quality of the zero. The zero determines how much unwanted signal flows into the adjacent track.

c) The quality of the zero is determined by the impedances caused by:

- The components within the TU.
- The tightness of the track and TU connections.
- The layout of the track cables.
- The equipment (TX/RX) connected to the zero TU.

From the above statements, the following conclusions can be reached:

a) Pole/zero ratios are a good method of monitoring the quality of the TU connections and track cable layout. As such, they provide evidence that good installation practice has been followed.

b) If pole/zero ratios are measured with an active TX connected to the zero TU, then the ratio will be degraded.

1.11. Mechanical and Electrical Connections

Good quality mechanical and electrical connections are important to obtain reliable operation of the EBI Track 400 equipment.

These connections shall be made and maintained in accordance with the torque requirements defined in Appendix G.

1.12. Spare/Scrap Rail Laid in the 4ft

Placing spare/scrap rail in the 4ft should not affect the operation of the track circuit.

However, if placing spare/scrap rail through a Tuned Zone is unavoidable, the following actions will mitigate against unreliable operation:

a) Measure the current flowing in the rail laid in the 4ft using a Rocoil. This should be Zero.

If current is found to be flowing in the rail, then there is likely to be physical contact between the running rails and the spare rail. This should be rectified.

b) Check the TZR before and after the rail is laid in the 4ft. If the change in TZR is less than 10%, there should not be any further problems. This check should be repeated when the rail is removed from the 4ft.

1.13. TU/ETU/SPETU hoods (Acoustic Jackets)

These should be fitted in areas close to residential property where noise might cause a nuisance.

1.14. Intermediate Tuning Capacitors

These are used to increase the gain at intermediate positions in the track circuit to overcome low ballast resistance caused by poor formation and/or rail fastenings.

They shall not be fitted or removed without permission from the S&T Maintenance Engineer.

They require individually specified drop shunt testing along the length of the track circuit at increased frequency.

1.15. Transmitter and OM3 Failures

Transmitter and OM3 failures will generally result in a hard failure of the track causing it to show occupied. If these items are replaced, either individually or both at the same time, and the OM3 set up in accordance with the switch setting information from the record card and provided the receiver is not changed; then a check of the clear track current will determine how much testing is required before the track is returned to operational service.

If, after the equipment is replaced, the clear track current is within 10% of the clear track current recorded, **at Commissioning**, on the record card then a full test shall be carried out in accordance with the defined procedures.

If the clear track current has changed by more than 10% then the receivers shall be set up again followed by carrying out a full test in accordance with the defined procedures.

1.16. Receiver Current

RX current is measured at the RX input terminals (IP1 & IPC for Open Line tracks, IP2 & IPC for Station Area tracks) with a TTM, MTM, ETTCM or by using the display. This is the actual physical quantity that the track circuit uses to determine the presence/absence of a train and so is a direct measure of the overall health of the track circuit.

1.17. Receiver Current – General

The RX current is affected by:

a) The quality of the TX pole.
b) The quality of the RX pole.
c) Ballast resistance.
d) Feed through from adjacent track circuits of the same frequency.

From the previous statements, the following conclusions can be reached:

RX current is an excellent overall measure of the stability of the track circuit. Significant changes in current are due to either degradation in the TUs, or changes in the leakage current between the rails. e.g. impedance bonds, rail bonds, check rails etc.

A significant deviation is indicated if the change of track current is greater than:

±20% OR

±10mA.

These factors require investigation if fault-free operation is to be maintained'.

1.18. Tuned Zones

Pole/zero ratios are useful in monitoring installation standards.

RX current is the most effective measure of track circuit performance and stability since it measures the effectiveness of the pole circuit and signal leakage effects.

1.19. Tuned Zones on Steel Sleepers

Special instructions for tuned zone installations shall be followed:

a) Open Line Tuned zone is 22m ± 0.5m.
b) Station Area Tuned Zone is 5m ± 0.1m.
c) All the sleepers within the zone, and for 3 bays either side, are of a Network Rail accepted steel type.

There have been instances of re-railing where concrete/timber sleepers have been replaced by steel sleepers and the tuned zone has not been changed accordingly.

Where an EBI Track 400 Tuned Zone on steel sleepers is found to be not installed to 22m+/-0.5m, it shall be reported as corrective maintenance.

1.20. Single Rail Application

RX current can be affected by the quality of the rail connections, bonded out joints, IRJ's and S&C insulations (sole plates, stretcher bars etc).

1.21. Testing for Crosstalk / Feed through

Where it is required to test and check for crosstalk / feed through values, the procedure below is to be performed:

Check that all track circuits which can cause interference to the track circuit being tested are operational, including:

(a) The next track circuits of the same frequency.
(b) Track circuits connected to the track circuit under test by cross bonding.

Switch off the transmitter associated with the tack circuit under test, and check that the track relay de-energises.

Using the Receivers Condition Monitoring display, record the value 'Inow (AV)' on the track circuit record card as part of the record for the test and check for permitted values against Table 1.

Track Circuit Configuration	**Crosstalk / Feed Through Max (mA)**
Double Rail Open Line frequency Track Circuits	8mA
Single Rail Open Line frequency Track Circuits (with 30m Bonding/Cross Bonding)	3mA
Double Rail Station Area frequency Track Circuits	Less than 10% of Ith or 20mA whichever is the lower

Table 1 – Crosstalk / Feed Through values

Where a SR track circuit is identified as not having the 30m bonding/cross bonding:

- The crosstalk / feed through could be higher than 3mA. A crosstalk / feed through value of greater than 8ma should be investigated for corrective action.

- The track circuit should be reported for corrective action to apply the 30m bonding/cross bonding.

A current higher than the stated maximum values should be investigated. Look for disconnected or incorrect bonding, tuning unit failure, etc.

2. Fault Finding - Guidelines

2.1. General

Before starting work, all track connections shall be checked for tightness as described in NR/SMS/PartC/TC17 (Track Circuits: EBI Track 400).

The generic EBI Track 400 Bombardier Manuals can be also referenced.

The health of a track circuit can be determined by the voltage measured across IPC-IP1 OL, IPC-IP2 SA . Any changes to the TX/OM3 output level, the TX or RX ETU, SPETU, TU, SATU or CU the track bed or associated tuned zone equipment will affect the receiver input current.

The track relay voltage will indicate the correct functioning of the RX and that the relay coil is not damaged. If the relay coil voltage is low, it will indicate a failing RX unit.

The relay end 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. A low rail voltage will indicate a faulty TU/ETU/SPETU/SATU/CU or a faulty connection at any part of the track.

If two adjacent track circuits fail simultaneously, the fault is most likely where the two tracks adjoin. Check the tuning units and associated connections and other shared equipment like the PSU.

For centre fed track circuits any problem within 30 metres of the centre feed will affect both sections.

If low ballast resistance is suspected see if the problem can be localised. On concrete sleepered track check the pads and clip insulations. On timber sleepered track check for poor ballast drainage and P8 type rail fastenings. If the problem can be isolated, spot replacement of rail insulations or replacement of P8 fastenings with P14 shall be considered. (if you are in doubt about the type of fastenings, ask your Supervisor).

Checking obtained readings against those on the Record Card and investigating those that have significantly changed can reveal the source of the fault.

Using a TTM/MTM/ETTCM a measurement of the rail-to-rail voltage at regular intervals from TX to RX should show a gradual decrease of the voltage.

Rail current readings give a more valued reading than track voltage.

2.2. Open Line Frequency Tracks

2.2.1. OL Track Circuit Tests – General

WARNING

High voltages can be present at the EBI Track 400 Transmitter Output Module terminals, line matching unit terminals and at receiver output terminals.

Before fitting or removing these units, power shall be removed from the associated transmitter or receiver. Personnel delegated to work on these units while in operation, shall be suitably competent.

Do not allow the output of the Output Module to become short-circuited.

The OM3 resistor shall remain switched to the 0R position in “Open Line” operation.

If the OM3 resistor is found not switched to the 0R position, this shall only be corrected with permission from the S&T Maintenance Engineer.

Observe all safety procedures that are in force for track possession, and for working on or near the track.

NOTE: *High voltages can be present at rail connections due to traction currents.*

IMPORTANT

Before disconnecting any Tuning Unit rail connections, both track circuits adjacent to the affected track are switched off. This is because the disconnected TU can have formed the short circuit that prevented energy from one adjacent track feeding through to the other. There is a danger of false feeding a track circuit and causing a wrong side failure if this precaution is not observed and another Tuning Unit were to become disconnected.

Short circuiting connections to a TU or disconnecting a transmitter or receiver from a TU can cause a right side failure by dropping the companion track circuit (the track circuit that shares the tuned area being tested with the track that is under investigation).

Measurements of voltage and current of the EBI Track 400 frequency signal for a track can be corrupted by signals from the companion track and other AC sources. To overcome this problem, a TTM/ETTCM, set to the frequency of the track circuit under test, should be used for all readings. If a TTM/ETTCM is not available, to reduce the problem, the Transmitter of the companion track should be switched off as follows:

(1) Always switch off the companion Transmitter if it shares the tuned area being tested. Switch off by removing a power supply fuse - do not disconnect the Transmitter from the Tuning Unit as this will upset the "pole" tuning.

(2) When signal levels less than or equal to receive end rail voltages are being measured, switch off the companion Transmitter even if it is remote from the tuned area being tested.

Unless a TTM/ETTCM is used, there is always a danger that interference from other tracks or 50 Hz mains can reduce the accuracy of measurements. In electrified areas measurements should not be made when a train is nearby on any line in case harmonics in the traction current at EBI Track 400 frequencies corrupt the readings. A TTM/ETTCM will not satisfactorily filter out other signals within 30 Hz of that selected for measurement.

The TTM/ETTCM could be influenced by strong magnetic fields. Consequently it is advisable that a TTM/ETTCM is not placed directly onto traction current carrying components, such as running rails, impedance bonds, traction return cables, etc. Also, on some schemes with concrete track beds there is the possibility of stray currents flowing in concrete reinforcements of the track bed.

2.2.2. Open Line Tests – Track Circuits with TUs / ETUs

Confirmation of the source of the fault can be achieved by use of the track circuit tests next described. Some measurements can be made by using the Condition Monitoring System (CMS).

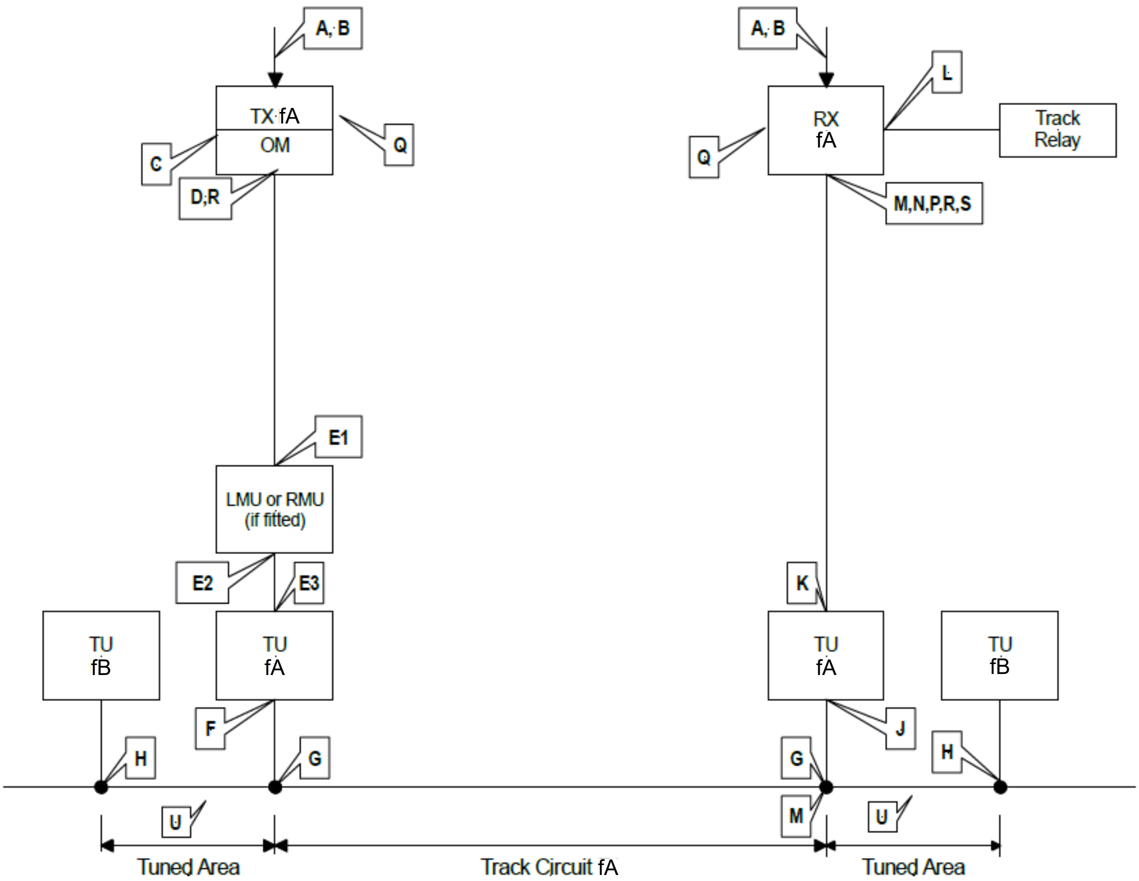


Figure 2 – Summary of Tests for track Circuits with TUs / ETUs

The Table 2 indicates the acceptable limits for each of the parameters measured at the above test points “A” to” H”.

Measurements can be taken by alternative methods as indicated.

- CMD= Condition Monitoring Display on Tx or Rx.
- DVM= Digital Multimeter.
- TTM = TI21 Track Circuit Meter.
- ETTCM = EBI Track Track Circuit Meter.

Test	Measurement	CMD	TTM or ETTCM	DVM	Normal Range
A	Tx 48V input current.	-	-	√	Depends on track and feed cable length, see Appendix C - Transmitter Current Consumption (Max).
A	Rx 48V input current. Relay down	-	-	√	Approx. 50mA DC
A	Rx 48V input current. Relay up	-	-	√	100mA to 150mA DC

Test	Measurement	CMD	TTM or ETTCM	DVM	Normal Range
B	Tx & Rx Power Supply Input voltage	"Vpsu"	-	√	47.5V to 48.5V DC
C	Tx Voltage out.		√	√ see note 1a	32V to 34V rms
D	Output Module output voltage	"Vout"	-	√ see note 1b	OM3 depends on switch setting see Appendix D - Output Module (OM3) Output Level v Step Setting. **0R switch shall be set to 0R**
	Output Module output power	"Pout"	-	-	"Pout" should be greater than 1.5W indicating that the Tx is supplying power to the line. "Pout" rises with Tx-to-track distances and track length up to a maximum of 200W.
E1	LMU(TU) Input Voltage	-	-	√ see note 1b	50V to 148V RMS (increases with Tx to TU feed length)
E2	LMU(TU) Output Voltage	-	√	√ see note 1a	0.6V to 15 V rms
E3	TU/ETU Input Voltage. Terminals 4 & 5	-	√	√ see note 1a	20m – 250m: 0.6V to 2.0V 250m – 1100m: 5V to 15V rms
F	TU Output Voltage	-	√	√ see note 1a	Values should be 5% to 10% Higher than Test G
G	Tx End Rail to Rail Voltage	-	√	√ see note 1a	Values should meet Appendix A - Typical Rail-to-Rail Voltages.
H	Tuned Area Voltage ratios. (see note 3)	-	√	-	Minimal acceptable ratios indicated in Appendix B. (See note 2).
J	Rx TU Input Voltage. Terminals T1 & T2	-	√	-	Values should meet Appendix A - Typical Rail-to-Rail Voltages.
K	Rx TU Output Voltage. Terminals 1 & 2	-	√	-	Lower than Test J. (See note 2).

Test	Measurement	CMD	TTM or ETTCM	DVM	Normal Range
L	Receiver output Voltage to Relay	√ "Vout"	√	√	50V relay version: 48 to 52VDC (Mod state 2 and later) 40 to 44VDC (Mod state 1) 24V relay version: 23 to 27VDC (Mod state 2 and later) 19 to 22VDC (Mod state 1)
M	Rx Drop Shunt at Rx end of TC. TC length > 250m	-	-	-	0.8 Ohm to 1.2 Ohm (see note 4.)
M	Rx Drop Shunt at Rx end of TC. TC length < 250m	-	-	-	1.3 Ohm to 1.7 Ohm (see note 4.)
N	Rx Input current	√ "Inow"	√	-	30-380mA. Value should be within ±20% of value recorded at last set up. See note 5.
P	Cross-talk and Feed-through test	√ "Inow"	√	-	Less than 8mA. (see note 6.)
Q	Earth Connection continuity	-	-	-	See note 7
R	Check that surge arrestor line terminals are isolated from earth.	-	-	√	>100kΩ
S	Total Wide-band current (3Hz-33kHz)	"ITot"	-	-	This level should be noted as it can be used to ascertain the bleed through and cross talk of the tuned zone. It shall be less than 500mA
T	Impedance Bond Test	-	√	-	The impedance of an impedance bond can be checked by measuring the voltage across the bond and the current through it at the track circuit frequency. To take the current measurements use a Rocoil connected to a TTM/ETTCM. • Check all rail connections and bonding are tightened to the correct torque. • Check the security and the fixing of the tuning module. • Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the TTM/ETTCM (= amps, I_1). • Repeat the measurement 1 metre from the bond on the RX side (= amps, I_2).

Test	Measurement	CMD	TTM or ETTCM	DVM	Normal Range
					• Subtract I_2 from I_1 thus obtaining the current through the bond at the EBI Track 400 frequency. • If an ETU is connected directly to the bond, then a current clamp able to wrap around the ETU lead and feed into the TTM/ETTCM (eg a Fluke i3000s Flex-24) shall be used as follows. Place the current clamp around the ETU lead and note the reading on the TTM/ETTCM (= amps, I_3). This value will be subtracted from the previously calculated current, thus obtaining the current through the bond at the EBI Track 400 frequency. • Measure the rail to rail voltage (V) across the impedance bond. • Divide the voltage (V) by the current calculated above thus giving the impedance (Z), Z= V / (I_1-I_2). This value shall be greater than 8 Ω. If this is not the case, check that the correct tuning module has been fitted.
U	Spare Rail in the Tuned Zone Test	-	√	-	Measure the current flowing in the rail laid in the 4ft using a Rocoil. This should be Zero. If current is found to be flowing in the rail, then there is likely to be physical contact between the running rails and the spare rail. This should be rectified. Check the Tuned Zone Ratio (Test H) before and after the rail is laid in the 4ft. If the change in Ratio is less than 10%, there should not be any further problems. This check should be repeated when the rail is removed from the 4ft.

Table 2 – Summary of Tests for track circuits with TUs / ETUs

These notes and Test Letter references in Sections 2.2.3 to 2.2.6 to be read in conjunction with the Table above.

Note 1a. Use a TTM/ETTCM set to the appropriate voltage range and TC frequency. If a TTM/ETTCM is not available use a DVM that is suitable for measuring true rms voltages at frequencies up to 3kHz.

Note 1b. Use a DVM that is suitable for measuring true rms voltages at frequencies up to 3kHz or a ETTCM. Do not use a TTM. Do not allow the Output Module's output to become short-circuited.

Note 2. To measure receive end voltage, the TU output terminals 1 and 2 shall be connected to the Receiver or short circuited - do not leave them open circuit.

Note 3. The voltage measured across the rail connections of the companion, or "Zero", Tuning Unit should be lower than that across the "Pole" Tuning Unit of area. All measurements are taken at the 'Pole' frequency. The voltage ratio is calculated as voltage at G divided by voltage at H.

Note 4. It is only necessary to carry out a drop shunt test at the receive end Tuning Unit rail connections since similar or higher values will be found elsewhere in the TC except within the tuned area which is a special case.

Under no circumstances shall a TC be left with a drop shunt less than 0.5 Ohm in the main part of the track circuit.

Note 5. As a cross check on the CMD measurement, the value of Receiver input current can also be measured by checking, with a TTM/ETTCM, the voltage developed across the 1Ω resistor (which is connected in series with the input of the Receiver). One mV so measured equates to One mA.

The minimum value of input current (the Threshold Current) necessary for an Rx to pick up its Track Relay can be read directly from the Rx display by accessing the quantity "Ith" since this is the value locked into the Rx during the automatic set-up process.

Note 6. Check that all track circuits which can cause interference to the TC under test are operational, including:

a) The next TC of the same frequency.
b) TCs connected to the TC under test by cross bonding.

Switch off the Tx associated with the TC under test and check that the Track Relay de-energises and that the Receiver input current is less than 8mA. An Rx input current higher than 8mA shall be investigated

Note 7. Confirm by continuity checks that the Tx, Rx and PSU cases are connected to the local earth. Also confirm that all lightning protection earth terminals are connected to earth. The earth connection resistance must not be greater than 50Ω.

WARNING

Do not use a TTM to measure the output from an Output Module and its corresponding LMU(TU) input (ETTCM can be used). Beware that the voltages on these units can exceed 150V RMS.

NOTE: *The 2mm Test leads have a rated maximum operating voltage of 30VAC and 60VDC.*

This voltage is high enough to endanger life; before fitting or removing these units, power shall be removed from the associated EBI Track 400 Transmitter.

2.2.3. OL Fault Finding - General

If adjacent track circuits fail together, then items common to them - power supplies, Tuning Units or interconnections - should be checked first.

The most vulnerable parts of the track circuit are the TU / ETU-to-rail and impedance bond-to-rail connections. It is prudent to check the integrity of these before beginning a systematic test through the circuit from the transmit end. It is also advisable to check that there is no fault in the wiring between the receiver output, track relay and the panel indication before proceeding to the trackside

Full details of the tests are given in Section 2.2.2. It is important not to simply overcome a fault by adjusting the receiver gain; the reason for a change in drop shunt value should be ascertained by performing the tests given in this section. The results of each test can be compared with the measurements taken at the last test / commissioning / setting-up that were logged on the record card; any major differences can be a guide to the possible fault area. Although the tests are presented to start from the transmit end of the track circuit, sometimes it can be more convenient to start from the receive end.

2.2.4. OL Fault Finding - Transmitter End

1. Check that the Transmitter and Tuning Unit / End Termination Unit are making a 'singing' noise (The volume of this will vary depending on cable and track length).

   Use the Condition Monitor to ascertain that the Tx and OM3 output are correct (i.e. display does not show ‘ERR’). If the Transmitter is showing ‘ERR’ then press ‘OK’ and follow the CM menu structure to find the cause of the error.

   a) If the Transmitter is not ‘singing’ and the Tx Status indicates an internal or frequency fault, then the Transmitter is faulty and should be changed.

   b) If the Transmitter is not ‘singing’ and ‘’Vout’ is zero, or very low then check the connections between the Output Module and the Tx. If these are OK, then the Transmitter is faulty and should be changed.

   c) If ‘Vout’ is in range but ‘Pout’ is zero, or very low, then this indicates that the Output Module is disconnected from its TU/ETU.

2. Test the integrity of the Tx to rail path by connecting a 1.0Ω shunt across the Transmitter TU rail connections. This should reduce the rail-to-rail voltage by approximately half if the transmit end is working properly. If this test is successful then the remainder of the Transmitter tests need not then be carried out.

3. Test the +48 power supply voltage and current to the Transmitter (Tests A and B), and the Transmitter and Output Module output voltage (Tests C and D). Results from these tests outside the normal range show that the power supply unit, Transmitter or Tuning Unit / End Termination Unit can be faulty. Further tests will help to indicate which has failed but only replacement of the most suspect unit can finally establish which is faulty.

4. Tuning Unit input and output voltages (Tests E3 and G) will show whether the interconnections are OK.

5. The results of Test D and E1 will indicate whether the inter-wiring between Tx/LMU(TU) is serviceable.

WARNING

Do not use a TTM to measure the output from an Output Module and its corresponding LMU(TU) input. ETTCM can be used. Beware that the voltages on these units can exceed 150V RMS.

NOTE: *The 2mm Test leads have a rated maximum operating voltage of 30VAC and 60VDC.*

This voltage is high enough to endanger life; before fitting or removing these units, power shall be removed from the associated EBI Track 400 Transmitter.

6. If the rail-to-rail voltage (Test G, step 4 above) is wrong, then either of the TUs, or the rail connections can be faulty.

   The companion TU voltage should be tested (Test H). If incorrect, then the companion TU can be faulty. The companion TU will be confirmed as faulty if the rail-to-rail voltage at the TU of the failed track becomes correct when terminal T1 is shorted to terminal T2 on the companion TU.

   If the transmit end appears to work normally, walk through the track checking bonds and insulation pads, and look for any metal debris that can be shorting it out.

   The rail current should fall only very slowly between the Transmitter and Receiver ends. During the walk through, it should be checked every 20m, or 50m if a long track, and the difference between any two consecutive readings should be about the same. Any sharp falls in current indicate a problem with the track itself. The place where the irregularity occurs can be used as a guide to the location of the track fault.

   See section 2.2.6 for further information on track faults.

2.2.5. OL Fault Finding - Receiver End

1. Check the voltage at the Tuning Unit rail connections (Test J). A low reading indicates that either TU can be faulty or that a connection has failed.
2. The voltage at the companion TU should be tested (Test H). If incorrect, then the companion TU can be faulty. The companion TU will be confirmed as faulty if the rail-to-rail voltage at the TU of the failed track becomes correct when terminal T1 is shorted to terminal T2 on the companion TU.

3. Measure the Receiver input current (Test N). If this is significantly lower than the clear track current recorded on the record sheet, i.e. more than 20% less, the Receiver TU is faulty. If it is adequate but there is insufficient relay supply voltage (Test L) with a satisfactory power supply (Tests A and B), then change the Receiver.

4. Check the connections to the relay, and that the voltage is available on the coil terminals. Change the relay if necessary.

2.2.6. OL Fault Finding - Track Related problems

If all the standard tests detailed in sections 2.2.3 to 2.2.5 do not reveal a fault and problems persist, then the fault is probably due to excessive leakage of track circuit signal current. The causes of leakage fall into three main groups:

Individual sleeper leakage paths	Chair bolts touching reinforcing in concrete sleeper and either no or failed insulation system (pads & biscuits between rail and chairs).
Localised. leakage paths	Track running through a 'wet bed' or over a road crossing where contamination has occurred (e.g. lorries carrying coal or minerals).
General 'background' leakage	Old track on wooden sleepers without insulation system between rails and chairs

In the case of localised leakage and individual sleeper problems, the most effective means of identifying the problem area is by use of a Rocoil Rail Current Transducer and TTM/ETTCM using the following method;

The Rail Current Transducer is connected to the TTM/ETTCM and the meter switched to the correct frequency for the track circuit under investigation. Current flowing onto the track circuit from the End Termination Unit should first be measured.

The current level in each rail should be the same; this should be checked since a difference of more than about 10% should be investigated. Differences in current between the two rails indicate that there is a third path through which some of the feed or return current is flowing. This could be a path through the ground (or ballast), but is more likely to be via traction bonding or other rails or tracks. Such paths should be eliminated as far as possible since they can only reduce the sensitivity of the track circuit to train shunts by providing alternative paths that are not shunted.

Areas where current can be significantly different in each rail are in points and crossings. It is sometimes the case that one rail splits to form two parallel paths, e.g. via the diamond of a crossing. In this case about half of the track circuit current will flow in each path, and it will not be possible to change this.

In areas of plain line, assuming the current in both rails is the same, it is not normally necessary to continue measuring in both rails. The current in the rail should be measured at convenient intervals, say 20m to 50m, until a larger than normal decrease is noted. The poor ballast area or shorting sleeper will be within this area. Further readings can now be taken to narrow down the precise area of leakage, or the shorting sleeper.

2.3. Station Area Frequency Tracks with SATU/CU

2.3.1. SA Track Circuit Tests - General

WARNING

High voltages can be present at the EBI Track 400 Transmitter Output Module terminals, tuning unit terminals and at Receiver output terminals. Before fitting or removing these units, power shall be removed from the associated Transmitter or Receiver. Personnel delegated to work on these units while in operation, shall be suitably competent.

Do not allow the output of the Output Module to become short-circuited.

Observe all Safety Procedures that are in force for track possession, and for working on or near the track. Note that high voltages can be present at rail connections due to traction currents.

IMPORTANT

It is important that, before disconnecting any tuning unit rail connections, both track circuits adjacent to the affected track are switched off. This is because the disconnected SATU could have formed the short circuit that prevented energy from one adjacent track feeding through to the other. There is a danger of false feeding a Track Circuit and causing a wrong side failure if this precaution is not observed and another tuning unit were to become disconnected.

Beware, also, that short circuiting connections to a SATU or disconnecting a Transmitter or Receiver from a SATU can cause a right side failure by dropping the companion track circuit.

Measurements of voltage and current of the EBI Track 400 frequency signal for a track can be corrupted by signals from the companion track and other AC sources. To overcome this problem, a MTM/ETTCM, set to the frequency of the Track Circuit under test, should be used for all readings. If a MTM/ETTCM is not available, to reduce the problem, the Transmitter of the companion track should be switched off as follows:

(1) Always switch off the companion Transmitter if it shares the tuned area being tested. Switch off by removing a power supply fuse, or dis-engage the TX frequency key - do not disconnect the Transmitter from the Tuning Unit as this will upset the "pole" tuning.

(2) When signal levels less than or equal to receive end rail voltages are being measured, switch off the companion Transmitter even if it is remote from the tuned area being tested.

Unless an MTM/EETCM is used, there is always a danger that interference from other tracks or 50 Hz mains can reduce the accuracy of measurements. In electrified areas measurements should not be made when a train is nearby on any line lest harmonics in the traction current at EBI Track 400 frequencies corrupt the readings. An MTM/ETTCM will not satisfactorily filter out other signals within ±100 Hz of that selected for measurement.

Note that the MTM/ETTCM could be influenced by strong magnetic fields. Consequently it is advisable that an MTM/ETTCM is not placed directly onto traction current carrying components, such as running rails, impedance bonds, traction return cables, etc. Also, on some schemes with concrete track beds there is the possibility of stray currents flowing in concrete reinforcements of the track bed.

2.3.2. SA Tests – Track Circuits with SATUs / CUs

Problems with Track Circuit operation can be indicated in a number of ways. The most common is nuisance dropping of the track relay when trains are not present. Some faults, e.g. Tx frequency out of specification, low power supply voltage or an internal logic fault in the Tx or Rx, are indicated directly on the Transmitter or Receiver Condition Monitoring Displays (CMD). Other problems require the source of the fault to be discovered by use of the Track Circuit tests in Figure 3.

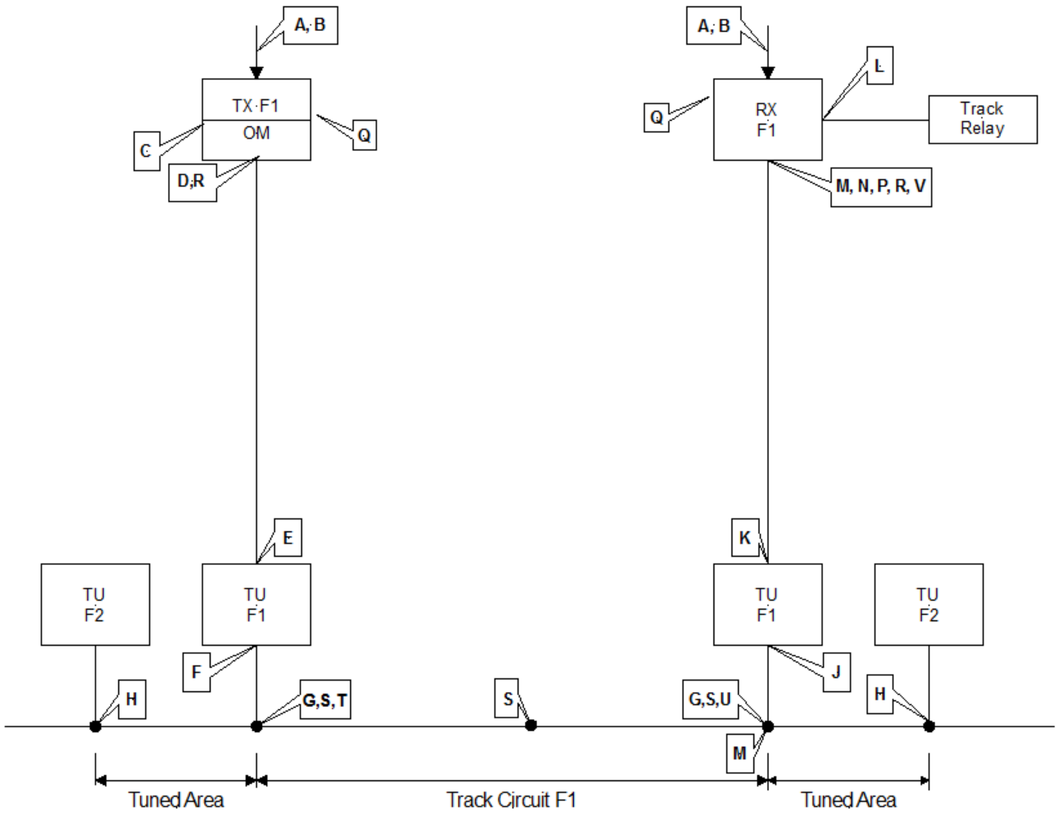


Figure 3 – Summary of Tests for track Circuits with SATUs / CUs

The Table 3 indicates the acceptable limits for each of the parameters measured at the above test points “A” to” H”.

Measurements can be taken by alternative methods as indicated.

- CMD= Condition Monitoring Display on Tx or Rx.
- DVM= Digital Multimeter.
- MTM =TI21-M Track Circuit Meter.
- ETTCM = EBI Track Track Circuit Meter.

Test	Measurement	CMD	MTM or ETTCM	DVM	Normal Range
A	Tx 48V input current.	-	-	√	1.5A to 6A DC
A	Rx 48V input current. Relay down	-	-	√	Approx. 50mA DC
A	Rx 48V input current. Relay up	-	-	√	100mA to 150mA DC
B	Tx & Rx Power Supply Input voltage	“Vpsu”	-	√	47.5V to 48.5V DC

Test	Measurement	CMD	MTM or ETTCM	DVM	Normal Range
C	Tx Voltage out.		√	√ see note 1a	33V AC rms
D	Output Module output voltage	"Vout"	-	√ see note 1b	If resistor switch set to 0R; The OM3 output voltage depends on switch setting, see Appendix D - Output Module (OM3) Output Level v Step Setting. If resistor switch set to 48R; Resistor switch shall be set to 48R when a SATU or CU is used with a feed length less than 750m. The OM drive level shall be 13 or lower and the open circuit output voltage shall be less than 95V.
	Output Module output power	"Pout"	-	-	"Pout" should be greater than 1.5W indicating that the Tx is supplying power to the line. "Pout" rises with Tx-to-track distances and track length until the maximum SATU/CU input voltage is reached. The maximum SATU/CU input voltage shall be no more than $95V_{RMS}$.
E	SATU/CU Input Voltage at terminals LINE 1 & 2.	-	√	√ see note 1b	Line losses mean that this figure will be less than that measured in D. Voltage will rise with Tx-to-track distances and track length until the maximum level of 95V is reached. This level shall not be exceeded.
F	SATU/CU Output Voltage	-	√	√ see note 1a	Values should be 5% to 10% Higher than Test G (see note 4)
G	Tx End Rail to Rail Voltage	-	√	√ see note 1a	Values should meet Appendix A.
H	Tuned Area Voltage ratios. (see note 3)	-	√	-	Minimal acceptable ratios 3:1 for F1, F3, F4 & F5 5:1 for F2, F4, F6 & F8 (See note 2 & 4)
J	Rx SATU/CU Input Voltage at terminals T1 & T2	-	√	-	Record value for use in test K.

Test	Measurement	CMD	MTM or ETTCM	DVM	Normal Range
K	Rx SATU/CU Output Voltage. Terminals LINE 1 & 2	-	√	-	30% lower than Test J. (See note 2 & 4).
L	Receiver output Voltage to Relay	√ "Vout"	√	√	50V relay version: 48 to 52VDC (Mod state 2 and later) 40 to 44VDC (Mod state 1) 24V relay version: 23 to 27VDC (Mod state 2 and later) 19 to 22VDC (Mod state 1)
M	Rx Drop Shunt at Rx end of TC.	-	-	-	1.0Ω to 3.0Ω
N	Rx Input current	√ "Inow"	√	-	Should be within 25% of the Rx I/P current recorded during last set-up. See note 5.
P	Cross-talk and Feed-through test	√ "Inow"	√	-	Less than 10% of 'Ith' or 20mA whichever is the lower. A higher level shall be investigated (look for disconnected cable screens, SATU failure, etc). (See note 6)
Q	Earth Connection continuity.	-	-	-	See note 7
R	Check that surge arrestor line terminals are isolated from earth.	-	-	√	>100kΩ
S	Set a shunt box to 0.2Ω and carry out a shunt test at the following points in the track circuit: Tx pole, Mid-point, Rx pole and At the end of the deviation of a points track.	√ "Inow"	-	-	Track shall drop. Record Rx current at each point with the shunt in place.

Test	Measurement	CMD	MTM or ETTCM	DVM	Normal Range
T	Calculate the Tx TZ impedance: $TZimp = \left(\frac{CT}{Ish} - 1\right) xRsh$ CT = Receiver input current (Iav) Measured when track is clear Ish =Receiver input current (Iav) measured when a 1Ω shunt has been applied at the Tx end rail connections.	√ "Inow"	-	-	TZimp shall be >0.4Ω
U	Calculate the Rx TZ impedance: $TZimp = \left(\frac{CT}{Ish} - 1\right) x\ 1.5$ CT = Receiver input current (Iav) Measured when track is clear Ish = Receiver input current (Iav) measured when a 1Ω shunt has been applied at the Rx end rail connections.	√ "Inow"	-	-	TZimp shall be >0.4Ω
V	Total Wide-band current (3Hz to 33kHz)	"ITot"	-	-	"ITot" shall be less than 500mA. This level should be noted as it can be used to ascertain the bleed through and cross talk of the tuned zone.
Y	Impedance Bond Test	-	√		The impedance of an impedance bond can be checked by measuring the voltage across the bond and the current through it at the track circuit frequency. To take the current measurements use a Rocoil connected to a MTM/ ETTCM.

Test	Measurement	CMD	MTM or ETTCM	DVM	Normal Range
					• Check all rail connections and bonds are tightened to the correct torque. • Check the security and the fixing of the tuning module. • Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the MTM/ETTCM (= amps, I_1). • Repeat the measurement 1 metre from the bond on the RX side. • Subtract I_2 from I_1 thus obtaining the current through the bond at the *EBI* Track 400 SA frequency. • If an CU is connected directly to the bond, then a current clamp able to wrap around the CU lead and feed into the MTM/ETTCM (eg a Fluke i3000s Flex-24) shall be used as follows. Place the current clamp around the CU lead and note the reading on the MTM/ETTCM (= amps, I_3). This value will be subtracted from the previously calculated current, thus obtaining the current through the bond at the *EBI* Track 400 SA frequency. • Measure the rail to rail voltage (V) across the impedance bond. Divide the voltage (V) by the current calculated above thus giving the impedance (Z), Z= V / (I1-I2). This value shall be greater than 8 Ω. If this is not the case, check that the correct tuning module has been fitted.

Table 3 - Summary of Tests for track Circuits with SATUs / CUs

These notes and Test Letter references in Sections 2.3.3 to 2.3.6 be read in conjunction with the Table above.

Note 1a. Use an MTM/ETTCM set to the appropriate voltage range and TC frequency. If an MTM/ETTCM is not available use a DVM that is suitable for measuring true rms voltages at frequencies up to 10kHz.

Note 1b. Use a DVM that is suitable for measuring true rms voltages at frequencies up to 10kHz. Do not use a MTM/ETTCM. Do not allow the Output Module's output to become shot-circuited.

Note 2. To measure receive end voltage, the SATU/CU LINE 1 & 2 shall be connected to the Receiver or short circuited-do not leave the open circuit.

Note 3. The voltage measured across the rail connections of the companion, or "Zero", Tuning Unit should be lower than that across the "Pole" Tuning Unit of area. All measurements are taken at the 'Pole' frequency. The voltage ratio is calculated as voltage at G divided by voltage at H.

Note 4. When taking test measurements at SATU terminals that have been coated with contact treatment grease, check that a good contact is made, if necessary clean the relevant terminals with a suitable cleaning agent and apply further grease after the measurements have been taken.

Note 5. As a cross check on the CMD measurement, the value of Receiver input current can also be measured by checking, with an MTM/ETTCM, the voltage developed across the 1 Ohm resistor (which is connected in series with the input of the Receiver). One mV so measured equates to one mA.

The minimum value of input current (the Threshold Current) necessary for an Rx to pick up its Track Relay can be read directly from the Rx display by accessing the quantity "Ith" since this is the value locked into the Rx during the automatic set-up process.

Note 6. Check that all track circuits which can cause interference to the TC under test are operational, including:

(a) the next TC of the same frequency.
(b) TCs connected to the TC under test by cross bonding.

Switch off the Tx associated with the TC under test and check that the Track Relay de-energises. The only suitable meter for this test is an MTM/ETTCM. A general purpose DVM shall not be used.

Note 7. Confirm by continuity checks that the Tx, Rx and PSU cases are connected to the local earth. Also confirm that all lightning protection earth terminals are connected to earth. The earth connection resistance must not be greater than 50Ω.

WARNING

Do not use an MTM/ETTCM to measure the output from an Output Module and its corresponding SATU or CU input. Beware that the voltages on these units can exceed 150V RMS.

This voltage is high enough to endanger life; before fitting or removing these units, power shall be removed from the associated EBI Track 400 Transmitter.

Do not allow the output of the OM3 to become short circuited.

2.3.3. SA Fault Finding – General

If adjacent track circuits fail together, then items common to them - power supplies, tuning units or interconnections - should be checked first.

The most vulnerable parts of the track circuit are the SATU / CU-to-rail and impedance bond-to-rail connections. It is prudent to check the integrity of these before beginning a systematic test through the circuit from the transmit end. It is also advisable to check that there is no fault in the wiring between the receiver output, track relay and the panel indication before proceeding to the trackside.

Full details of the tests are given in Section 2.3.2. It is important not to simply overcome a fault by adjusting the receiver gain; the reason for a change in drop shunt value should be ascertained by performing the tests given in this section. The results of each test can be compared with the measurements taken at the last test / commissioning / setting-up that were logged on the Record card; any major differences can be a guide to the possible fault area. Although the tests are presented to start from the transmit end of the track circuit, sometimes it can be more convenient to start from the receive end.

2.3.4. SA Fault Finding - Transmitter End

1. Check that the Transmitter and SATU / CU are making a 'singing' noise (the volume of this will vary depending on cable and track length).

   Use the Condition Monitor to ascertain that the Tx and OM3 output are correct (i.e. display does not show 'ERR'). If the Transmitter is showing 'ERR' then press 'OK' and follow the CM menu structure to find the cause of the error.

   - If the Transmitter is not 'singing' and the Tx Status indicates an internal or frequency fault, then the Transmitter is faulty and should be changed.
   - If the Transmitter is not 'singing' and ''Vout' is zero, or very low then check the connections between the output module and the Tx. If these are OK, then the Transmitter is faulty and should be changed.
   - If 'Vout' is in range but 'Pout' is zero, or very low, then this indicates that the output module is disconnected from its SATU/CU.

2. Test the integrity of the Tx to rail path by connecting a 2.0Ω shunt across the Transmitter SATU rail connections. This should reduce the rail-to-rail voltage by approximately 25% if the transmit end is working properly. If this test is successful then the remainder of the Transmitter tests need not then be carried out.

3. Test the +48 power supply voltage and current to the Transmitter (Tests A and B), and the Transmitter and Output Module output voltage (Test C and D). Results from these tests outside the normal range show that the power supply unit, Transmitter or Tuning Unit / Coupling Unit can be faulty. Further tests will help to indicate which has failed but only replacement of the most suspect unit can finally establish which is faulty.

4. Tuning Unit input and output voltages (Tests E and F) will show whether the interconnections are OK.

WARNING

Do not use an MTM/ETTCM to measure the output from an Output Module and its corresponding SATU or CU input. Beware that the voltages on these units can exceed 150V RMS.

This voltage is high enough to endanger life; before fitting or removing these units, power shall be removed from the associated EBI Track 400 Transmitter.

5. If the rail-to-rail voltage (Test G) is wrong, then either of the SATU/CU, or the rail connections can be faulty.

   The companion SATU voltage should be tested (Test H). If incorrect, then the companion SATU can be faulty. The companion SATU will be confirmed as faulty if the rail-to-rail voltage at the SATU of the failed track becomes correct when terminal T1 is shorted to terminal T2 on the companion SATU.

   If the transmit end appears to work normally, walk through the track checking bonds and insulation pads, and looking for any metal debris that can be shorting it out.

   The rail current should fall only very slowly between the Transmitter and Receiver ends. During the walk through, it should be checked every 20m or 50m and the difference between any two consecutive readings should be about the same. Any sharp falls in current indicate a problem with the track itself. The place where the irregularity occurs can be used as a guide to the location of the track fault.

   See Section 2.3.6 for further information on track faults.

2.3.5. SA Fault Finding - Receiver End

1. Check the voltage at the tuning unit rail connections (Test F). A low reading indicates that either SATU can be faulty or that a connection has failed.

2. The voltage at the companion SATU should be tested (Test H). If incorrect, then the companion SATU can be faulty. The companion SATU will be confirmed as faulty if the rail-to-rail voltage at the SATU of the failed track becomes correct when terminal T1 is shorted to terminal T2 on the companion SATU.

3. Measure the Receiver input current (Test N). If this is significantly lower than the clear track Rx input current recorded on the record sheet, i.e. reduced by more than 20%, the Receiver SATU is faulty. If it is adequate but there is insufficient relay supply voltage (Test L) with a satisfactory power supply (Tests A and B), then change the Receiver.

4. Check the connections to the relay, and that the voltage is available on the coil terminals. Change the relay if necessary.

2.3.6. SA Fault Finding - Track Related problems

If all the standard tests detailed in sections 2.3.3 to 2.3.5 do not reveal a fault and problems persist, then the fault is probably due to excessive leakage of Track Circuit signal current. The causes of leakage fall into three main groups:

Individual sleeper leakage paths	Chair bolts touching reinforcing in concrete sleeper and either no or failed insulation system (pads & biscuits between rail and chairs).
Localised. leakage paths	Track running through a 'wet bed' or over a road crossing where contamination has occurred (e.g. lorries carrying coal or minerals).
General 'background' leakage	Old track on wooden sleepers without insulation system between rails and chairs

In the case of localised leakage and individual sleeper problems, the most effective means of identifying the problem area is by use of a Rail Current Transducer and MTM/ETTCM using the following method.

The Rail Current Transducer (e.g.Rocoil) is connected to the MTM/ETTCM and the meter switched to the correct frequency for the Track Circuit under investigation. Current flowing onto the Track Circuit from the Coupling Unit should first be measured.

The current level in each rail should be the same; this should be checked since a difference of more than about 10% should be investigated. Differences in current between the two rails indicate that there is a third path through which some of the feed or return current is flowing. This could be a path through the ground (or ballast), but is more likely to be via traction bonding or other rails or tracks. Such paths should be eliminated as far as possible since they can only reduce the sensitivity of the Track Circuit to train shunts by providing alternative paths that are not shunted.

Areas where current can be significantly different in each rail are in points and crossings. It is sometimes the case that one rail splits to form two parallel paths, e.g. via the diamond of a crossing. In this case about half of the Track Circuit current will flow in each path, and it will not be possible to change this.

In areas of plain line, assuming the current in both rails is the same, it is not normally necessary to continue measuring in both rails. The current in the rail should be measured at convenient intervals, say 20m to 50m, until a larger than normal decrease is noted. The poor ballast area or shorting sleeper will be within this area. Further readings can now be taken to narrow down the precise area of leakage, or the shorting sleeper.

2.4. Impedance Bonds (Where Fitted)

Before checking the impedance bond(s) the TX equipment shall first be proved to be operating correctly.

1. Check that no corrosion, dirt oil or water is present in the terminal box and/or connection points.

2. Check the Advance plate to Centre Tap connection has be made using the bolted spreader plates in accordance with the Network Rail defined procedures.

3. Check the Impedance Bond has been installed and sitting on a rubber Conformance Pad.

4. Check the Impedance Bond has been installed with the appropriate insulating covers depending on the Impedance Bond type.

5. Measure the voltage across the auxiliary coil or tuning module (NOT applicable to B3 3000 and B3 500 bonds), check it is in the correct ratio with the rail-to-rail voltage (Appendix C). If it is correct the bond should be operating correctly, if it is incorrect proceed with the next step.

6. Check the tuning capacitor/module is correct for the style of bond and the track circuit frequency. Apply a short circuit across the tuning capacitor/module and measure the voltage.

7. Remove the short circuit and check the voltage rises. If there is not a dramatic rise in voltage replace the tuning capacitor/module. If it still does not improve matters consider replacing the bond.

Near ETU units this tuning capacitor/module test might not work.

For intermediate bonds only - the impedance of any impedance bond can be checked by following steps 7 to 11.

8. Place the Rocoil over the rail 1 metre before the Bond (TX side) and note the reading on the TTM/ETTCM (= amps, I1).

9. Repeat the measurement 1 metre from the bond on the RX side (I2).

10. Subtract I2 from I1 thus obtaining the current through the bond at the EBI Track frequency.

11. Measure the rail to rail voltage (V) across the impedance bond.

12. Divide the voltage (V) by the current calculated from step 9 above thus giving the impedance (Z),

$$Z = V / (I1 - I2)$$

This value should be greater than 8Ω. If less than 8Ω, check for traction imbalance before remedial action is taken with the impedance bond. (The Manufacturers specification is 12Ω when measured at the Capacitor frequency).

It is possible to verify the Impedance Bond is within the manufacturers specification by measuring the Bond inductance without the tuning capacitor connected. The value should be between 27.8 to 28.2 μHenries.

The value between the rail connections and the centre tap will be half these values.

2.5. Interference Test

To check the traction interference levels on the track the following tests are carried out on T1-T2 terminals of the ETU/TU/SATU/CU.

For traction areas only:

1. Remove the B24 fuse to the TX and check the correct track relay drops.

2. Measure the voltage across the track using a TTM/ETTCM set to AC 200mV range. Measure the frequency across the track using a multimeter.

3. Record both the voltage and frequency readings.

4. Readings greater than 100mV are un-acceptable, the track circuit shall be investigated and your SM(S) informed.

If there is a problem, this test can be repeated with the traction supply OFF as this can help to identify the source of the interference.

If all the readings appear to be correct but the track circuit remains failed then recheck all items above and check there are no problems arising from spare / scrap rail laid in the 4ft.

3. Appendix A - Typical Rail-to-Rail Voltages

TRACK LENGTH (m)	Tx to TRACK LENGTH (km)	MAX Tx END VOLTAGE (V)		MAX Rx END VOLTAGE (V)	
		A, C, E, G	B, D, F, H	A, C, E, G	B, D, F, H
100	<2	3.0	4.5	1.0	1.6
100	6	2.0	2.8	0.4	0.5
200	<2	4.0	6.0	1.0	1.6
200	6	2.6	3.6	0.4	0.5
400	<2	5.0	7.0	1.0	1.6
400	6	3.2	4.5	0.4	0.5
1000	<2	5.5	7.5	0.4	0.5
1000	6	-	-	-	-
Note: this table provides guidance only, intermediate distances shall be interpolated.					

Table 4 - Open Line Frequencies : Maximum TX and RX End Rail to Rail Voltages for Various Track and Feed Lengths

Track Circuit	Volts (F1)	Volts (F2)	Volts (F3)	Volts (F4)	Volts (F5)	Volts (F6)	Volts (F7)	Volts (F8)
Length (m)	Max	Max	Max	Max	Max	Max	Max	Max
<100	2.9	3.6	3.3	4	2.6	3.5	3.1	3.9
100 - 150	3.4	4.3	3.9	4.6	3.1	4.0	3.6	4.4
151 - 200	4.3	5.4	4.8	5.9	3.9	5.0	4.5	5.5
201- 250	5.1	6.5	5.9	7.1	4.8	6.1	5.5	6.8
251- 300	6.3	8	7.1	8.8	5.8	7.5	6.8	8.4

Table 5 - Station Area Frequencies : Maximum TX End Rail to Rail Voltages for Various Track Lengths

4. Appendix B - Tuned Zone Ratios

These ratios are the absolute **MINIMUM** values acceptable. The table below takes into account the latest installation standards and cable types.

If the Tuned Zone Ratio is not achievable, check the quality of the installation.

Tuned Area				
Pole	Frequency	Zero	Frequency	Ratio
Primary Frequencies				
Tx	AC	Rx	BD	12:1
Rx	AC	Tx	BD	12:1
Tx	AC	Tx	BD	11.1
Rx	AC	Rx	BD	12:1
Tx	BD	Rx	AC	18:1
Rx	BD	Tx	AC	18:1
Tx	BD	Tx	AC	15:1
Rx	BD	Rx	AC	18:1
Secondary Frequencies				
Tx	EG	Rx	FH	9:1
Rx	EG	Tx	FH	9:1
Tx	EG	Tx	FH	8:1
Rx	EG	Rx	FH	9:1
Tx	FH	Rx	EG	18:1
Rx	FH	Tx	EG	18:1
Tx	FH	Tx	EG	15:1
Rx	FH	Rx	EG	18:1

Table 6 - Tuned Zone Ratios : Open Line Frequencies

Ratio figures are calculated with voltages measured at the frequency of the POLE Tuning Unit, using a TTM/ETTCM.

Frequency	Ratio
F1, F3, F5, F7	3:1
F2, F4, F6, F8	5:1

Table 7 - Tuned Zone Ratios : Station Area Frequencies

Ratio figures are calculated with voltages measured at the frequency of the POLE Tuning Unit, using an MTM/ETTCM.

5. Appendix C - Transmitter Current Consumption (Max)

Tx to TU/ETUCable Length	Track Circuit Length			
	<250m	250m – 499m	500m – 749m	750m – 1000m
<1km	0.5A	1.8A	3.5A	4.65A
1km – 1.99km	0.75A	2.8A	4.65A	5A
2km – 3.99km	1A	3A	5A	5A
4km – 6km	1.5A	5A	5A	N/A

Table 8 - Transmitter Current Consumption (Max)

6. Appendix D - Output Module (OM3) Output Level v Step Setting

Step	Output Level (V)	Step	Output Level (V)	Step	Output Level (V)
1	30.40	10	73.60	19	116.80
2	35.20	11	78.40	20	121.60
3	40.00	12	83.20	21	126.40
4	44.80	13	88.00	22	131.20
5	49.60	14	92.80	23	136.00
6	54.40	15	97.60	24	140.80
7	59.20	16	102.40	25	145.60
8	64.00	17	107.20	26	150.40
9	68.80	18	112.00	27	155.20

Table 9 - Output Module (OM3) Output Level v Step Setting

7. Appendix E - Open Line Frequencies – Double Rail - Setup Configuration Routine

7.1. Open Line Frequencies Setup : Initial Configuration

Step	Transmitter	Receiver
0	Transmitter with no key inserted. Transmitter key of the correct frequency available for use. This key contains a unique code for any market area. The key colour shall be the correct one for the market area - blue With no key in place the display indicates "KEY?"	Receiver key starts off programmed for frequency only. The key colour shall be the correct one for the market area – blue. With no key in place the display indicates "KEY?" If an un-coded Rx key is inserted in the Rx the Rx will respond with BLNK
1	Adjust the Output Module to step 1 and the resistor to 0R. **Note The Resistor shall remain in the 0R position and is not be used to adjust the output level.**	
2	Configuration process starts by inserting the Tx key in the Tx. This configures Tx for code and frequency. The display will first confirm key frequency as"400X" for 1 second, where "X" = one of eight frequencies A to H, followed by the key serial no. for 1 second and "RUN" when fully active and emitting signals	
3	If Rx keys are required to be programmed, then remove Tx key. Display will again indicate "KEY?"	

Step	Transmitter	Receiver
4	Insert the Rx key to be coded (shall be the same frequency as the Tx key being copied)" The display will respond by indicating "CPY?" Press the "OK" pushbutton. Display responds "TxK?" Remove Rx key and replace with Tx key. Display responds with "RxK?" Remove Tx key and replace with Rx key. The display will change to "PASS" which indicates that the Rx key has been successfully programmed with the correct code.	
5	Repeat item 4 with subsequent Rx keys if multiple Rx are used.	
6	Remove last Rx key and re-fit the Tx code and frequency key. The display will first confirm key frequency as "400X" for 1 second where "X" = one of eight frequencies A to H, followed by "KEY S/N" for 1 second and "RUN" when fully active and emitting signals.	
7		Insert a programmed Rx key in Rx. The display will first confirm key frequency as"400X" for 1 second where "X" = one of eight frequencies A to H, followed by "KEY S/N" for 1 second and "NewK" when fully active. Rx can display "drop" or "PICK" when fully active if the Rx key was programmed and used for the track circuit previously. Rx now active and ready for set up.

Step	Transmitter	Receiver
8		Perform the TC set up routine as per section 7.2 - Open Line Frequencies Setup : Set-up Routine
Fault indications during the Initial Configuration Routine. If at any step of the initial configuration routine the Transmitter or Receiver displays differ from those indicated above then the table below shows the likely reasons.		
Note: Tx keys cannot be reprogrammed to a new code or frequency. Rx keys can be programmed to a new code, but cannot be reprogrammed to a new frequency.		

Table 10 - Open Line Frequencies Setup : Initial Configuration

Tx or Rx Display	Fault
Rx display “ERR” cycling with “drop” Tx display “ERR” cycling with “stop” On OK display changes to “STAT” On OK display changes to “INT”	Internal circuit fault with unit. See Note 1
Rx display “ERR” cycling with “PICK” or “drop” Tx display “ERR” cycling with “RUN” On OK display changes to ”TEMP”	Temperature has exceeded the temperature range -30°C to + 100°C. See Note 1
Rx display “ERR” cycling with “PICK” or “drop” Tx display “ERR” cycling with “RUN” or “stop” Display depends on the level at which the voltage is out of specification . On OK display changes to “Vpsu”.	PSU outside the specified voltage range. See Note 1
Tx / Rx display “WRNG”	Incorrect key inserted.
Tx / Rx display “BADK”	Corrupt key (Replace Key)
Tx / Rx display “BLNK”	Rx frequency key has not been coded with any Tx code

Table 11 – Initial Configuration Routine Fault Indications

NOTE 1: *If there are multiple faults then the fault which occurs first will be displayed first. The additional errors will then be displayed in turn.*

7.2. Open Line Frequencies Setup : Set-up Routine

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
0	Switch on the Tx PSU. Check that the Transmitter is configured and emitting signals. Display indicates "RUN" Check that the Output Module is set to step 1 and the resistor is set to 0R. **Note The Resistor shall remain in the 0R position and is not be used to adjust the output level levels**			Switch on the Rx PSU. Check that the receiver has been configured and is displaying 'NewK'. Confirm that the DC supply voltage is within the range 46V to 50V by use of the display (Vpsu) or a TTM/ETTCM.
1	Confirm that the DC supply voltage is within the range 46V to 50V by means of the display (Vpsu) or a TTM/ETTCM. Adjust the OM drive level as described in Rx column.	After completing adjustment of the OM step setting, check that the rail voltage at the Tx end, is not more than the maximum stated in Table 2. If the rail voltage cannot be set up, do not proceed until cause of error is corrected.		Adjust the OM drive level to achieve an Rx input current of 50mA on the receiver display (IAV). Long tracks might not achieve 50mA, but shall achieve more than 30mA. In the case of short feed cables and short track circuit length, Rx input current can be more than 50mA with an OM step setting of 1. In this case Rx input current should be less than 380mA. In the case of tracks with more than 1 Rx the set up should done monitoring the Rx on the longest section of track. See **Note 1** below.

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
2a		If the Tx and/or Rx end of the track circuit is part of a mixed tuned zone, the set up shunt is fixed at 1.5Ω. Adjust a Shunt Box, to 1.5Ω, and connect it across the rail connections of the Rx end TU/ETU then proceed to step 4. Do not perform steps 2b, 3a and 3b. If not, proceed to step 2b.		
2b		Measure rail currents at Tx end (I_{1a} and I_{1b}) as shown in Section 7.3 - Open Line Frequencies Setup : Irail Determination and Calculation. Select the highest value (I_1) and discard the other.	Measure rail currents at Rx end (I_{2a} and I_{2b}) as shown in Section 7.3 - Open Line Frequencies Setup : Irail Determination and Calculation. Select the lowest value (I_2) and discard the other.	
3a			Calculate the I_{Rail} Ratio in % by dividing I_2 x 100 by I_1. Look up the value of ballast impedance in the Section 7.3 Table 11 to Table 13 (use the correct table for the frequency of the track circuit is used). If the set up shunt is given as ‘Special’, then follow the **special measures** process described immediately below Section 7.3 Table 14.	

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
3b			Using the value of ballast impedance, look up the value of set up shunt in Section 7.3 Table 14. Adjust a Shunt Box, to the value of the set up shunt, and connect it across the rail connections of the Rx end TU/ETU.	
WARNING	**If the I_{Rail} ratio measurement requires the use of higher shunt values, and the track is not very wet, then this indicates that there is severe loss of current down the track which should be investigated and correct**			
4				Replace frequency key with a set-up key. Display will respond with 'SET?' Press the 'OK' button to begin the automatic set up process.

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
5				Display will show the legend 'WAIT', followed by 'PASS' or 'FAIL'. 'PASS' indicates that set up has been successful, and the new threshold setting has been locked into the unit. 'FAIL' cycling with "X", where "X" is the error code, indicates that set up was unsuccessful. See Section 10 - Appendix H - Receiver Set Up Error codes for interpretation of the error code. Faults shall be corrected before another set up is attempted. See **Note 2** below.
6				Rx will display threshold level "Ith", followed by key frequency as"400X" where "X" = one of eight frequencies A to H, followed by "KEY S/N" for 1 second and "drop".
7			Remove Shunt Box.	Check that Receiver display shows 'Pick'
8a			Replace Shunt Box, set to 0.7Ω, across the rails	Check that Receiver display shows 'drop'
8b		Connect Shunt Box, set to 0.7Ω, across the rails		Check that Receiver display shows 'drop'
9			Remove Shunt Box	
10	Carry out a Full Test			

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
11	Using the record cards – examples shown in Sections 18, 19 & 20 - record track clear current and threshold level current and drop shunt on the record card. Also carry out and record the additional measurements since these can be valuable fault-finding aids. Finally, verify that the clear track current is approximately twice the threshold. This validates that the correct drop shunt was used to set up the track.			

Table 12 – Open Line Frequencies Setup : Set-up Routine

NOTE 1: *If the clear track current is less than 30mA then the track circuit is losing current and the cause of the current loss shall be determined and rectified otherwise the safety margin of the circuit can be eroded.*

NOTE 2: *The set-up failure code consists of 4 letters which are designed to focus the fault investigation. Two examples are:*

- H indicates that the input signal is too high suggesting the OM step should be reduced.
- L indicates that the input signal is too low suggesting open circuits / poor connections, or a wrong frequency.

Examples of fault codes are given in Section 10.

7.3. Open Line Frequencies Setup : Irail Determination and Calculation

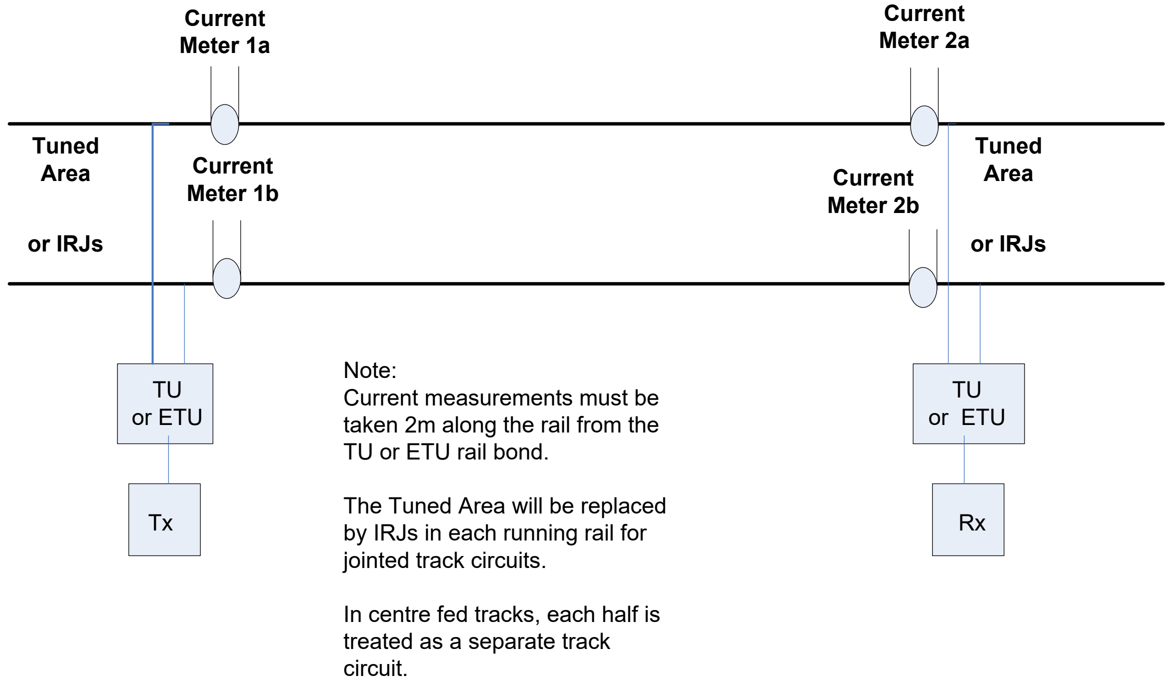


Figure 4 – Measurement Points for IRail Determination

7.3.1. Determination of Ballast Impedance from Irail ratio % for Various Track Lengths

When reading the Ballast Impedence from the Irail ratio %, the lower value shall be used. For example a 500m track length with a Irail ratio % of 77%, the Ballast Impedance is 3 Ωkm.

Track Length	Frequencies A and E Ballast Impedance Ωkm									
m	2	3	4	5	6	8	10	15	20	200
200-249	89	92	94	95	96	97	98	98	99	99
250-349	81	87	90	92	93	95	96	97	98	100
350-449	73	81	86	88	90	93	94	96	97	100
450-549	63	74	80	84	87	90	92	95	96	100
550-649	54	66	74	79	82	87	89	93	95	100
650-749	44	58	67	73	77	83	86	91	94	100
750-849	36	50	59	66	71	78	83	89	92	100
850-949	29	42	52	60	65	74	79	86	90	100
950-1049	24	36	45	53	59	68	74	83	88	100
1050-1100	19	30	39	47	53	63	70	80	86	100

Table 13 – Frequencies A and E, Ballast Impedance Ωkm

Track Length	Frequencies B, C, F and G Ballast Impedance Ωkm									
m	2	3	4	5	6	8	10	15	20	200
200-249	85	90	92	94	95	96	97	98	98	100
250-349	76	83	87	90	91	93	95	97	97	100
350-449	65	75	81	85	87	91	92	95	96	100
450-549	54	66	74	79	82	87	90	93	95	100
550-649	43	57	66	72	77	83	86	91	94	100
650-749	34	48	57	65	70	77	82	89	92	100
750-849	27	39	49	57	63	72	77	86	90	100
850-949	21	32	42	50	56	66	72	82	87	100
950-1049	17	27	35	43	49	59	67	78	84	100
1050-1100	13	22	30	37	43	53	61	74	81	100

Table 14– Frequencies B, C, F and G, Ballast Impedance Ωkm

Track Length	Frequencies D and H Ballast Impedance Ωkm									
m	2	3	4	5	6	8	10	15	20	200
200-249	81	87	90	92	93	95	96	97	98	100
250-349	71	80	84	87	89	92	94	96	97	100
350-449	60	71	78	82	85	88	91	94	96	100
450-549	48	61	70	75	79	84	88	92	94	100
550-649	38	52	61	68	73	79	84	89	92	100
650-749	30	43	53	60	66	74	79	86	90	100
750-849	23	35	44	52	58	68	74	83	88	100
850-949	18	28	37	45	51	61	68	79	85	100
950-1049	14	23	31	38	45	55	62	75	82	100
1050-1100	11	19	26	33	39	49	57	70	78	100

Table 15 – Frequencies D and H, Ballast Impedance Ωkm

7.3.2. Determination of Set Up Shunt from Ballast Impedance for Various Track Lengths

Track Length	**Set Up Shunt (Ω) for Normal Power All Frequencies Ballast Impedance Ωkm**							
m	**2**	**3**	**4**	**5**	**6**	**8**	**10**	**15 and above**
20 175	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
176-200	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
201-249	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
250-349	1.2	1.2	1.0	1.0	1.0	1.0	1.0	1.0
350-449	1.2	1.2	1.2	1.0	1.0	1.0	1.0	1.0
450-549	1.4	1.2	1.2	1.2	1.0	1.0	1.0	1.0
550-649	1.6	1.4	1.2	1.2	1.2	1.0	1.0	1.0
650-749	2.0	1.4	1.2	1.2	1.2	1.0	1.0	1.0
750-849	2.4	1.6	1.4	1.2	1.2	1.2	1.0	1.0
850-949	Special	1.8	1.4	1.4	1.2	1.2	1.0	1.0
950-1050	Special	2.2	1.6	1.4	1.2	1.2	1.0	1.0
1050-1100	Special	2.8	1.8	1.6	1.4	1.2	1.2	1.0

Table 16 – Set Up Shunt from Ballast Impedance for Various Track Lengths

Special Measures

If the set up shunt is given as 'Special' this indicates that the ballast is in a very poor condition. As an interim measure, until the ballast can be rectified, track circuits shall be set up at 3Ω. Affected track circuits shall be monitored weekly for increases in Rx clear track current (Inow on the Rx display). If Inow increases by more than 10% from the value at set up, then the track shall be re-set. If the ballast measurement of a track circuit in special measures does not return to normal levels and can be shown to be stable over several months, then a case can be made for reducing the set up shunt.

Example Set Up Shunt Determination

Frequency B track circuit, 757m long.
I1a = 1.012A   I1b = 1.023   Use 1.023A
I2a = 757mA   I2b = 782mA   Use 757mA
IRail Ratio = 757/1023 = 0.74 = 74%
Ballast (Table 12) = 8Ω   (See Grey Cell – using the lower value)
Set Up Shunt (Table 16) = 1.2Ω   (See Grey Cell)

8. Appendix F - Open Line Frequencies – Single Rail - Setup Configuration Routine

The Open Line commissioning procedure in Section 7 - Appendix E - Open Line Frequencies – Double Rail - Setup Configuration Routine can be used without alteration except that steps 0 and 1 of section 7.2 - Open Line Frequencies Setup : Set-up Routine is altered as shown below.

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
0	Switch on the Tx PSU and confirm that the DC supply voltage is within the range 46V to 50V by means of the display (Vpsu) or a TTM/ETTCM. Display indicates "RUN" Check that the Output Module is set to step 1 and the resistor is set to 0R. **Note The Resistor shall remain in the 0R position and is not used to adjust the output level levels.**			Switch on the Rx PSU. Check that the receiver has been configured and is displaying 'NewK'. Confirm that the DC supply voltage is within the range 46V to 50V by use of the display or a TTM/ETTCM.
1	Adjust the OM drive level as described in Rx column	After completing adjustment of the OM step setting, check that the rail voltage at the Tx end, is not more than 2.3V. If the rail voltage cannot be set up, do not proceed until cause of		Adjust the OM drive level to achieve an Rx input current of 50mA on the receiver display (IAV). In the case of short feed cables and short track circuit length, Rx input current can be more than 50mA with an OM step setting of

Step	Transmitter	Transmitter TU/ETU	Receiver TU/ETU	Receiver
		error is corrected.		1. In this case Rx input current should be less than 380mA. In the case of tracks with more than 1 Rx, the set up should done monitoring the Rx on the longest section of track. See **Note 1** below.

Table 17 – Open Line Frequencies – Single Rail : Setup Configuration Routine

NOTE 1: *If the clear track current is less than 30mA then the track circuit is losing current and the cause of the current loss should be determined and rectified otherwise the safety margin of the circuit can be eroded.*

9. Appendix G – Station Area Frequencies – Setup Configuration Routine

9.1. Station Area Frequencies Setup : Initial Configuration

Step	Transmitter	Receiver
0	Transmitter with no key inserted. Transmitter key of the correct frequency available for use. This key contains a unique code for any market area. The key colour shall be the correct one for the market area - blue. With no key in place the display indicates “KEY?”	Receiver key starts off programmed for frequency only. The key colour shall be the correct one for the market area - blue. With no key in place the display indicates “KEY?” If an un-coded RX key is inserted in the Rx the Rx will respond with “BLNK”
1	The Output Module should be set to an initial drive level of 1. The resistor switch shall be set to 48R if the feed cable length is less than 750m, otherwise it shall be set to 0R position.	
2	Configuration process starts by inserting the Tx key in the Tx. This configures Tx for code and frequency. The display will first confirm key frequency as”400X” for 1 second where “X” = one of eight frequencies F1 to F8, followed by “KEY S/N” for 1 second and “RUN” when fully active and emitting signals.	
3	If Rx keys are required to be programmed, then remove Tx key. Display will again indicate “KEY?”	
4	Insert blank Rx key. The display will respond by indicating “CPY?” Press the “OK” pushbutton. Display responds “TxK?”	

Step	Transmitter	Receiver
	Remove Rx key and replace with Tx key. Display responds with “RxK?” Remove Tx key and replace with Rx key. After 1 second the display will change to “PASS” which indicates that the Rx key has been successfully programmed with the correct code.	
5	Repeat with subsequent Rx keys if multiple Rx used.	
6	Remove last Rx key and re-fit the Tx frequency key. The display will first confirm key frequency as”400X” for 1 second where “X” = one of eight frequencies F1 to F8, followed by “KEY S/N” for 1 second and “RUN” when fully active and emitting signals.	
7		Programmed Rx key inserted in Rx. The display will first confirm key frequency as”400X” for 1 second where “X” = one of eight frequencies F1 to F8, followed by “KEY S/N” for 1 second and “NewK” when fully active. Rx can display “drop” or “PICK” when fully active if the Rx key was programmed and used for the track circuit previously. Rx now active and ready for set up.
8		Perform the TC set up routine as per Section 9.2 - Station Area Frequencies : Track Circuit Set-up Routine.
Fault indications during the Initial Configuration Routine.		

Step	Transmitter	Receiver
If at any step of the initial configuration routine the Transmitter or Receiver displays differ from those indicated above then the table below shows the likely reasons.		
Note: Tx keys cannot be reprogrammed to a new code or frequency. Rx keys can be programmed to a new code, but cannot be reprogrammed to a new frequency.		

Table 18 – Station Area Frequencies Setup : Initial Configuration

Tx or Rx Display	Fault
Rx display "ERR" cycling with "drop" Tx display "ERR" cycling with "stop" On OK display changes to "STAT" On OK display changes to "INT"	Internal circuit fault with unit. See Note 1
Rx display "ERR" cycling with "PICK" or "drop" Tx display "ERR" cycling with "RUN" On OK display changes to "TEMP"	Temperature has exceeded the temperature range -30°C to + 100°C. See Note 1
Rx display "ERR" cycling with "PICK" or "drop" Tx display "ERR" cycling with "RUN" or "stop" Display depends on the level at which the voltage is out of specification. On OK display changes to "Vpsu"	PSU outside the voltage range. See Note 1
Tx / Rx display "WRNG"	Incorrect key inserted.
Tx / Rx display "BADK"	Corrupt key (Replace Key)
Tx / Rx display "BLNK"	RX frequency key has not been coded with any TX code

Table 19 – Initial Configuration Routine Fault Indications

***NOTE 1:** If there are multiple faults then the fault which occurs first will be displayed first. The additional errors will then be displayed in turn.*

9.2. Station Area Frequencies : Track Circuit Set-up Routine

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
0	Transmitter configured and emitting signals. Display indicates “RUN”. Confirm that the DC supply voltage is within the range 46V to 50V by use of the display or an MTM/ETTCM.			Receiver configured and displaying ‘NewK’. Confirm that the DC supply voltage is within the range 46V to 50V by use of the display or an MTM/ETTCM.
1	Adjust the Output Module drive level to achieve an Rx input current of between 15 and 25mA while not exceeding 120W on the Tx output power ‘Pout’ reading[1]. The current should be set as close to 25mA as the ‘Pout’ and TU/CU voltage limit allows. If the track circuit is short, Rx input current may be more than 25mA with OM drive level 1. In this case RX input current should be less than 250mA.	Using a DVM/ETTCM on the AC range, check that the input voltage to the TU or CU does not exceed 95V RMS.		Read the Receiver current (IAV) on the Receiver display.

[1] Where these limits cannot be achieved, i.e. for long tracks and long Tx-to-track distances, the output power can be increased until 15mA is achieved, but a Tx end 0Ω shunt test must be carried out and the output power (’Pout’) must be less than 180W with the shunt in place.

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
	If the 48R resistor is in circuit, then than drive level must not exceed 13. Validate that the drive level does not exceed 13 by open circuiting the Output Module output (eg by opening the 6A track fuse) and checking that the output voltage is less than 95V.			
2		Measure the rail-to-rail voltage at the Tx tuning unit or coupling unit (pole). Using Table 3 - check that the correct rail voltage is obtained at the Tx end. If voltage is incorrect, do not proceed until cause of error is corrected. Typical causes are poor ballast, incorrect traction bonding, faulty impedance bonds (e.g. wrong tuning module for track frequency), or infrastructure faults.		
3		Measure the rail-to-rail voltage at		

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
		companion tuning unit (zero) of the Tx tuned area. If the Tx is connected to a coupling unit or a mixed tuned zone omit this test. Divide the pole voltage (step 2) by this zero voltage (step 3) to determine the pole/zero ratio. Check that the ratio is in the correct range: 3 for F1, F3, F5 & F7. 5 for F2, F4, F6 & F8. If the ratio is lower than shown, then check that tuned area connections and the cable layout are in accordance with the installation drawings		
4			Using a shunt box, place a 1Ω shunt across the rails on the rail connections.	Replace the frequency key with a set-up key. Display will respond with 'SET?' Press the 'OK' button to begin the automatic set up process.
5				Display will show the legend 'WAIT',

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
				followed by 'PASS' or 'FAIL'. 'PASS' indicates that set up has been successful, and the new threshold setting has been locked into the unit. 'FAIL' cycling with "X", where "X" is the error code, indicates that set up was unsuccessful. Faults must be corrected before set up is attempted again. See Note 1 below.
6				Replace set-up key with frequency key. Rx will display threshold level "Ith", followed by key frequency as"400X" where "X" = one of eight frequencies F1 to F8, followed by "KEY S/N" for 1 second and "drop".
7			Remove shunt box.	Check that Receiver display shows 'PICK' Verify that the clear track Rx input current is approximately 1.5 times the threshold level current (Ith). This validates that the correct drop shunt was used to set up the track.

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
8			Connect a shunt box across the rails and determine the value at which the Receiver display shows 'drop' The shunt value must be ≥0.9Ω.	Check that Receiver display 'drop'
9			Remove shunt box	Check that Receiver display 'PICK'
10		Connect a shunt box across the rails and determine the value at which the Receiver display shows 'drop' The shunt value must be ≥0.9Ω.		Check that the Receiver displays 'drop'
11		Remove shunt box		Check that Receiver display shows 'PICK'
12a		Calculate Tx TZ Impedance as described in Test T. Tx TZ shall be more than 0.4Ω See Note 2 below		
12b			Calculate Rx TZ Impedance as described in Test U. Rx TZ Impedance shall be more than 0.4Ω.	

Step	Transmitter	Transmitter TU/CU	Receiver TU/CU	Receiver
			See Note 2 below.	
13	Set a shunt box to 0.2Ω and carry out a shunt test at the extremities of any points tracks which are not terminated by Receivers. In each case, ensure that the Track Relay drops and record the Rx input signal current			
14	Measure, and record, the supply voltage and current to the Transmitter and Receiver .*Use a suitable current clamp meter that has a 10A DC current range.*			
15	Using the record card in section 9, record the listed parameters on record card (see Note 2)			

Table 20 – Station Area Frequencies : Track Circuit Set-up Routine

NOTE 1: *The set-up failure code consists of 4 letters which are designed to focus the fault investigation. Two examples are:*

- H indicates that the input signal is too high suggesting that the OM setting should be reduced.
- L indicates that the input signal is too low suggesting open circuits / poor connections.

NOTE 2: *If the Tx end drop shunt or the TZ (Tuned Zone) impedance requirements are not met, then the TZ installation shall be thoroughly examined for compliance with the installation requirements. Rectification of installation deficiencies will correct these issues.*

10. Appendix H - Receiver Set Up Error codes

The automatic set-up failure code consists of 4 letters which are designed to focus the fault investigation:

- "H" indicates that the input signal is too high suggesting the Output Module is driving too much power.

- "L" indicates that the input signal is too low suggesting open circuits / poor connections.

Typical examples of fault codes are given in the following tables.

Typical Automatic Set-up Failure Codes

Message	Meaning of Code	Field Examples
C	Code does not match	Incorrect key or interference.
LC	Code does not match	Incorrect key or interference.
HC	Code does not match	Incorrect key or interference.
L	Input signal low.	Over-long TC. Poorly set-up tuned area. Loose connections.
H	Input signal high	TC too short.
HL	Input signal high and low	Internal Rx fault.
MSHL	All signals incorrect	Internal Rx fault.
Thld Tol	A-B mismatch between thresholds.	High level traction interference signal present.
Time Out	-	'OK' not pressed within 60 seconds.
Key Wrte	-	Faulty key or process corrupted.
WRNG	-	Set up key inserted before frequency key or incorrect frequency key inserted to finish the process.
BLNK		Rx frequency key has not been coded with any Tx code

Table 21 – Typical Automatic Set-up Failure Codes

11. Appendix I - Transmitter Operational Error Codes

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
0	Internal Circuit Fault	Circuit monitoring tests failed. This test has highest priority	'ERR' cycling with 'RUN or stop' On 'OK' display routes to 'Stat' then 'OK' routes to 'INT'	Replace TX
1	Temperature	Error raised if the TFET is outside the range -30°C to +100°C *OR* The Transmitter is running *AND* the TTRN is outside the range -30°C to +100°C	'ERR' cycling with 'RUN' On 'OK' display routes to 'Temp'	Check Internal temperature of enclosure. If within temp. range then consider replacing TX
2	PSU Voltage	Error raised if PSU voltage outside the range 46V to 50V	'ERR' cycling with 'RUN or stop' On 'OK' display routes to 'Vpsu'	Check PSU setup.
3-8	Not used			
9	Power Up		Not an error as such, used to make a log entry.	Not an error code. Timestamp of last power up.
10-13	Not used			
14	Output Power	Error raised if Output Power exceeds 200W.	'ERR' cycling with 'RUN' On 'OK' display routes to 'Pout'	Check TX wiring, if no fault found check the OM3 is correctly set for tail cable length & track length. Otherwise change TX &/or OM3.
15	IR Comms Failure	Error raised if no comms with Output Module.	'ERR' cycling with 'RUN' On 'OK' display routes to 'Stat' then 'OK' routes to 'COMM'	Check the IR port between the TX and OM has not become obstructed. Otherwise change TX &/or OM3.

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
17	Checksum	Error raised if config memory checksum error.	'ERR' cycling with 'PICK' or 'drop' On 'OK' display routes to 'Stat' then 'OK' routes to 'INT'	Replace TX
-	Corrupt Key	Corrupt key detected upon initial insertion.	BADK	Replace TX frequency key, copy the CODE to RX keys and carry out an Autoset
-	Assertion Error	Assertion Error occurs during normal operation	ErSW (Note: this error is not logged)	Replace the TX key as it could be a latent logging problem and cycle the unit's power. It will be necessary to copy the CODE to RX keys and carry out an Autoset If ErSW appears again replace the unit and carry out an Autoset.

Table 22 – Transmitter Operational Error Codes

These errors are not latched, i.e. if the quantity causing the error returns to normal, the 'ERR' display will be cleared and the fault relay energised. Note that the error is recorded in the error log.

The errors have a priority, 0 being the highest. If multiple errors exist then the only the highest priority error is shown. When it is cleared the next highest priority error is shown.

The last error generated will be stored and made available as one of the data items over the serial link.

12. Appendix J - Receiver Operational Error Codes

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
0	Internal Circuit Fault	Circuit monitoring tests failed. This test has highest priority	'ERR' cycling with 'PICK' or 'drop' On pressing <OK> display routes to 'Stat' then pressing <OK> routes to 'INT'	Replace digital RX
1	Temperature	Error raised if internal temperature outside the range -30°C to +100°C	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Temp'	Check Internal temperature of enclosure. If within temp. range then consider replacing digital RX
2	PSU Voltage	Error raised if PSU voltage outside the range +22V to +50V	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Vpsu'	Check PSU setup.
3	Not used			
4	Relay Voltage	Error raised if Relay Voltage below 10V and output is ON.	'ERR' cycling with 'PICK' On <OK> display routes to 'Vout'	Check for a fault in the TR wiring, if no fault found change the Digital Rx
5	Relay State	Error raised if relay voltage > 10V and relay state = drop.	'ERR' cycling with 'drop' On <OK> display routes to 'Vout'	Check for a fault in the TR wiring, if no fault found change the Digital Rx
6	Code Error	Error when QUAL < 90%	'ERR' cycling with 'PICK' or 'drop' On 'OK' display routes to 'Stat' then 'OK' routes to 'CODE'	Check TC installation
7	Not used			

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
8	Over-range Signal	Input current exceeds 500mA	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'OVR'	Check TC installation as this is not likely to be a digital RX fault. Check TU/ETU setting is on correct power mode.
9	Power Up			Not an error code. Timestamp of last power up.
10	Relay Power Trip	Relay power exceeds 6.25W	'ERR' cycling with 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'TRIP'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
11	FPGA Fail	One or both FPGA test flags are clear.	'ERR' cycling with 'drop' On <OK> display routes to 'Stat' then <OK> routes to 'INT'	Replace digital RX
12	Autoset	An Autoset has successfully occurred.		Not an error code. Time stamp of that last Autoset.
13	Relay Current	Error raised if Relay Current exceeds 260mA.	'ERR' cycling with 'PICK' or 'drop' On <OK> display routes to 'Pout'	Check TR wiring, if no fault found and TR is operating correctly, change the Digital RX.
17	Checksum	Error raised if config memory checksum error.	'ERR' cycling with 'PICK' or 'drop' On 'OK' display routes to 'Stat' then 'OK' routes to 'INT'	Replace digital RX
18	Logging fail	Error raised if logging has been disabled.	'ERR' cycling with 'PICK' or 'drop' On 'OK' display routes to 'Ekey'	Cycle the unit's power. If the Logging Fail error persists, Replace the RX

Error Code	Quantity / Error Code	Test	Display	Mtce. Action Required
None	Corrupt Key	Error raised if a corrupt key is detected upon initial insertion.	BADK	Replace frequency key and carry out an Autoset
None	Assertion error	An assertion error occurs during normal operation.	'ErSW' displayed (Note: this error is not logged).	Replace the key as it could be a latent logging problem and cycle the unit's power. If ErSW appears again replace the unit and carry out an Autoset.

Table 23 – Receiver Operational Error Codes

These errors are not latched, i.e. if the quantity causing the error returns to normal, the 'ERR' display will be cleared and the fault relay energised. Note that the error is recorded in the error log.

The errors have a priority, 0 being the highest. If multiple errors exist then the only the highest priority error is shown. When it is cleared the next highest priority error is shown. The last error generated will be stored and made available as one of the data items over the serial link.

13. Appendix K - Torque Settings

New or loose connections shall be Torqued to the install value defined in this Appendix. Where an existing connection is checked using the Check Torque value it is critical the fixing does not move when the Check Torque is applied.

Where a loose connection is identified or the fixing moves when checked to a "Check Torque" value; Slacken and check the components and then retighten to the Installation torque.

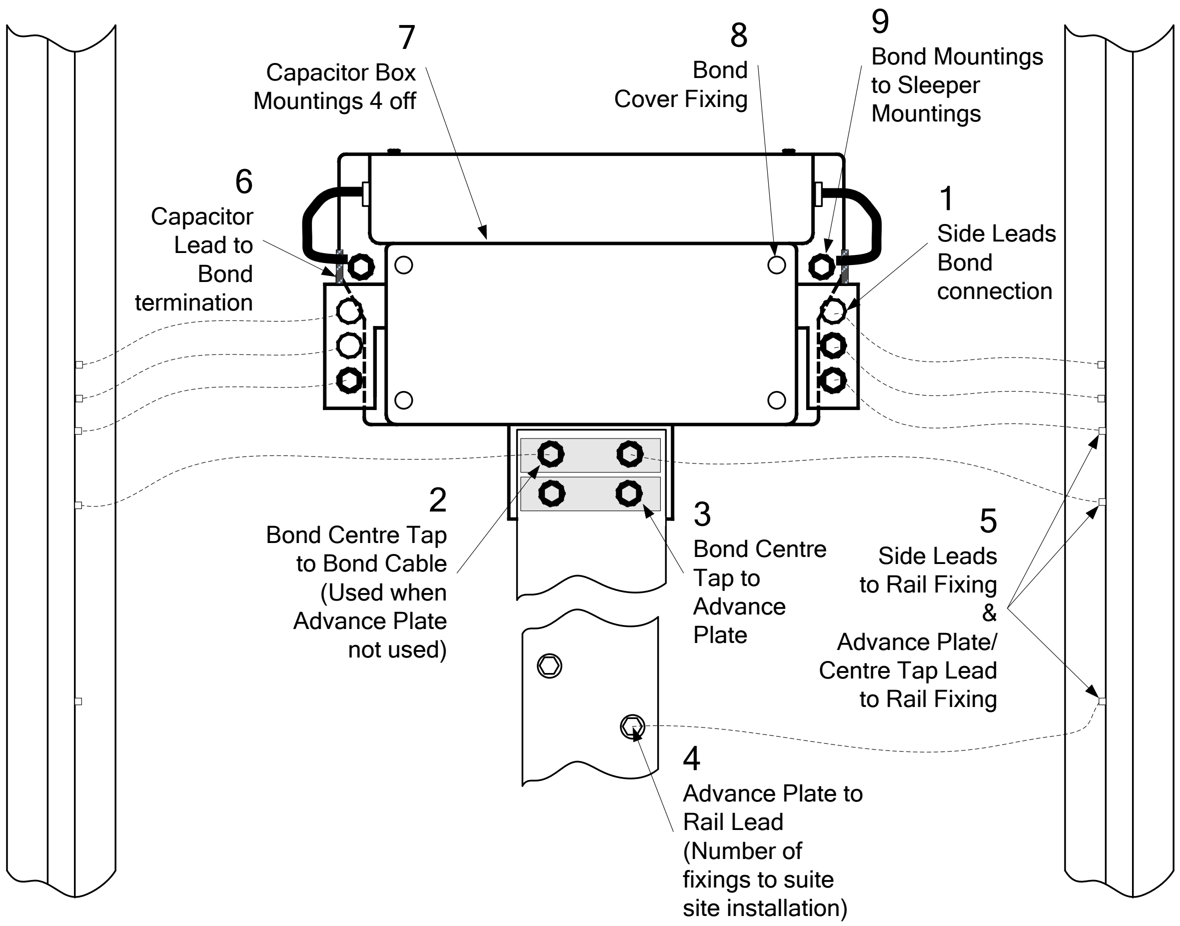


Figure 5 – Installation Positions requiring Torque settings

Equipment	Reference	Fixing Size	Torque Nm
Impedance Bond	Side Leads Bond connection (Copper crimps) Ref 1	M16	Install : 110 Check : 90
	Side Leads Bond connection (Aluminium crimps) Ref 1	M16	Install : 90 Check : 70
	Bond Centre Tap to Bond cable (Copper Crimp) Ref 2	M16	Install : 110 Check : 90
	Bond Centre Tap to Bond cable (Aluminium Crimp) Ref 2	M16	Install : 90 Check : 70
	Bond Centre Tap to Advance Plate (Aluminium) Ref 3 Note the correct installation procedure shall be used incorporating the spreader plates for all new installations.	M16	Install : 115 Check : 90
	Bond Centre Tap to Advance Plate (Aluminium) Ref 3 Non-Preferred Solution	M16	Install : 90 Check : 70
	Capacitor Box Mountings 4 off Ref 7	M6	7
	Capacitor Lead to Bond termination (Copper crimp) Ref 6	M10	Install : 35 Check : 25
	Advance Plate to Rail Lead Connection (Copper crimp) Ref 4	M16	Install : 90 Check : 70
	Advance Plate to Rail Lead Connection (Aluminium crimp) Ref 4	M16	Install : 90 Check : 70
	Advance Plate to Rail Lead Connection (Copper crimp) Ref 4	M12	Install : 72 Check : 60
	Advance Plate to Rail Lead Connection (Aluminium crimp) Ref 4	M12	Install : 72 Check : 60

Equipment	Reference	Fixing Size	Torque Nm
	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Copper crimp) Ref 5	M12 Uses Cembre or Glenaire rail fixings	Install : 72 Check : 60
	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Aluminium crimp) Ref 5	M12 Uses Cembre or Glenaire rail fixings	Install : 72 Check : 60
	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Copper crimp) Ref 5	Bolt	Install : 110 Check : 90
	Bond Cover Fixing (Uses lifting bolt holes) Ref 8	M10	Tighten manually using best judgement
Impedance Bond	Bond to concrete sleeper fixing including Bond Bottom Packing Covers. Ref 9	M16	110 Nm to fix bolt. 80 Nm to fix Bond #1
	Bond to timber sleeper fixing including Bond Bottom Packing Covers. Ref 9	M16 / $^5/_8$ inch coach screw with gimlet point.	60 #2
	Bond to steel sleeper including Bond Bottom Packing Covers. Ref 9	M12 Blind Bolt #3, Jam nut, Philidas nut	Jam Nut 17 Nm Philidas nut 50Nm
TU / ETU / SPETU	T1 & T2 (Copper crimp)	M10	Install : 25 Check : 20
	Rail connections (Cembre, Glenair or Hilti Stud, copper crimp)	M6	10
	Terminal block (Brass)	2BA (as supplied)	4.5 #4
	TU/ETU/SPETU to track mounted adapter plate or to mounting stake	M8 (as supplied)	24

Equipment	Reference	Fixing Size	Torque Nm
	Track mounted adapter plate to concrete sleeper (if used)	M16 Expanding bolt	120
	Track mounted adapter plate to timber sleeper (if used)	M16 / $^5/_8$ inch coach screw with gimlet point	60
	Track mounted adapter plate to steel sleeper (if used)	M10 Hilti stud	10
	Track mounted TU/ETU/SPETU protection cover.	M8	24
SATU / CU / Z Bond	T1 & T2 (Copper crimp)	M10	Install : 35 Check : 25
	Rail Connections (Cembre or Glenair, Copper Crimp)	M12 Rail Bonds	Install : 80 Check : 70
	Terminals Block	2BA	4.5 #4
	SATU/CU to Adaptor Plate / mounting unit or to mounting stake	2 x M8 min	24
	Adaptor plate to concrete sleeper (if used)	2 x M8 expanding or chemically locked bolt.	24
TX / OM / RX / PSU	Mounting	2BA / M5 (as supplied)	6 #4
LMU-TU	Terminals (Brass)	2BA	4.5 #4

Table 24 – Installation Torque Values

Traction Bonding connections are not covered in this table.

#1 M16 bolt or stud. Expanding metal sleeve type e.g. Expanding Hilti, RawlBolt.

Expanding bolt/stud shall be fixed to sleeper using following procedure:

- Fix bolt/stud to sleeper with torque of 110 Nm.
- Remove nut/washer, install bond/ Bond Bottom Packing Covers and replace with new Face Washer / Spring Washer / Full Depth Nut.
- Torque Full Depth Nut to 80 Nm.

#2 Use special M16 (5/8”) coach screws with gimlet point.
Intermediate Bond Cover bottom packing covers shall be installed between sleeper and Bond.

#3 Supplied by The Blind Bolt Company or accepted equivalent.

#4 If not able to torque, tighten manually using best judgement

14. Appendix L - EBI Track 400 Frequencies

Track	Open Line Track Circuits		Station Area Track Circuits	
	Frequency Identifier	Nominal Frequency	Frequency Identifier	Nominal Frequency
1	A	1699Hz	F1	6100Hz
	B	2296Hz	F2	7700Hz
2	C	1996Hz	F5	5700Hz
	D	2593Hz	F6	7300Hz
3	E	1549Hz	F3	6900Hz
	F	2146Hz	F4	8500Hz
4	G	1848Hz	F7	6500Hz
	H	2445Hz	F8	8100Hz

Table 25 – EBI Track 400 Frequencies

15. Appendix M - Impedance Bond Voltage Ratios

Impedance Bond Style	Voltage Ratio
DE	40:1
MR	56:1
P3	45:1
S	56:1
WH3	56:1
B3 500	Not applicable
B3 3000	Not applicable

Table 26 – Impedance Bond Voltage Ratios

16. Appendix N - EBI Track 400 B3 3000 Impedance Bond Information

Frequency	Capacitance µF	Tolerance
A	308.23µF	± 1.5%
B	167.22µF	± 1.5%
C	222.07µF	± 1.5%
D	130.79µF	± 1.5%
E	373.41µF	± 1.5%
F	191.80µF	± 1.5%
G	259.76µF	± 1.5%
H	147.29µF	± 1.5%
F1	23.90µF	± 1.5%
F2	15.00µF	± 1.5%
F3	18.70µF	± 1.5%
F4	12.30µF	± 1.5%
F5	27.40µF	± 1.5%
F6	16.70µF	± 1.5%
F7	21.00µF	± 1.5%
F8	13.50µF	± 1.5%

Table 27 – Capacitor Box capacitance values

The Inductor in the Impedance Bond should be between 27.8µH – 28.2µH

17. Appendix O - EBI Track 400 Mixed Tuned Zone : Open Line Tuned Area Capacitor values

Frequency	Capacitance µF
A	129.6 – 133.6 µF
B	70.8 – 73.0 µF
C	90.7 – 93.5 µF
D	61.1 – 63.0 µF
E	150.8 – 155.6 µF
F	79.3 – 81.9 µF
G	106.1 – 109.3 µF
H	62.4 – 64.4 µF

Table 28 – Mixed Tuned Zone Open Line Tuned Area Capacitor values

18. Appendix P - An alternative method for setting up the track circuit after a failed Transmitter, LMU-TU, OM or TU/ETU/SPETU/SATU/CU

The SM(S) should risk assess the ability to gain safe site access and the competence of Maintenance staff attending the track circuit equipment and should satisfy themselves that the use of the procedure is appropriate and authorise its use.

A full test shall be carried out as soon as practicable.

Deferral of testing, up to a limit of 48 hours, can be permitted on the basis of safety if this setup procedure is used.

1. Remove the faulty unit and replace with the new one.

   For an OM this shall be installed with the same settings as the failed unit. The settings shall also match the last settings on the record card. If they do not proceed to Step 8.

2. Note the clear track and threshold current values recorded on the track circuit record card.

3. Check that the threshold value on the receiver (Ith) is the same as that entered on the record card.

   For track circuits with multiple receivers, all thresholds shall be checked.
   If the thresholds have changed then proceed to Step 8.

4. Check that the clear track current is within ±10% of the original value.

   If the clear track current is not within ±10% of the original value proceed to Step 6 unless track access is not available to perform drop shunt testing, in which case proceed to Step 8.

   If the clear track current is not within ±20% of the original value proceed to Step 8.

5. Fill in the record card noting alternative setup procedure used. Set up completed. Do not carry out steps 6, 7 or 8.

6. Check that all receivers drop with 0.8Ω across their rail connections, and that 0.8Ω at the transmitter rail connections drops all receivers in the track circuit. If the drop shunt tests fail proceed to Step 8.

7. Complete the record card noting alternative setup procedure used.

   The setup has been completed. Do not proceed to Step 8.

8. The criteria for using this alternative set up procedure have not been met. A Full Test shall be performed before the equipment is handed back.

19. Appendix Q - An alternative method for setting up the Receiver after a Failed Transmitter Key, Failed Reciever or Failed Reciever Key

The SM(S) should risk assess the ability to gain safe site access and the competence of Maintenance staff attending the track circuit equipment and should satisfy themselves that the use of the procedure is appropriate and authorise its use.

A full test shall be carried out as soon as practicable.

Deferral of testing, up to a limit of 48 hours, may be permitted on the basis of safety if this setup procedure is used.

This procedure is to be completed regardless of whether the unit has been previously used or not.

1. If the Transmitter (TX) Key is not being replaced, start at Step 2.

   Replace the TX Key. The Reciever(RX) Key will now need to be programmed to the new TX Key. Refer to the initial configuration in this appendix for instructions to complete this and return here to complete the test.

   NOTE: If the track has multiple RXs then each RX Key needs to be re-coded.

   If the TX Key has been replaced and Step 1 completed, go to Step 4.

2. Power up the Receiver. The display will respond with ‘KEY?’.

3. Fit the correct frequency key for the track circuit under test.

   The display will echo back the frequency in the format, for example ‘400A’ for frequency A, and then display the relay state (‘PICK’ or ‘drop’) or ‘NewK’.

4. Confirm that the RX has a supply voltage within the range 47V to 49V.

5. Check the *Inow AV* current displayed on the RX.

   Note this value.

6. Using the Average Current value (*Inow AV*) from the test above, confirm that it is the same as recorded on the track record card or within ±10% of that value.

   If the clear track current is more than ±10% outside the required level, or is fluctuating by more than 5mA. This indicates that the track circuit is losing current and is not a receiver problem.

   In this case the cause of the current loss should be determined and rectified otherwise the safety margin of the circuit can be eroded.

   NOTE: *Items such as Ballast or Equipment degradation and Environmental Conditions (Temperature Extremes, Heavy Rainfall) etc. should all be considered.*

   Variations are permitted under exceptional circumstances depending on ballast and environmental conditions.

7. Using the 2mm test lead adaptors, attach a Shunt Box across the IPC and IP1 (Open Line) or IPC and IP2(Station Area) terminals, or at the equivalent point on the surge arrestor terminals.

   Adjust the shunt resistance so that the average track current reads as close as possible to the threshold current value recorded on the test record card.

8. Leaving the Shunt Box in place, remove the frequency key and replace it with the set-up key.

   The display will respond with ‘SET?’.

   Press the ‘OK’ button to begin the automatic set-up process.

   The condition monitoring display will show the legend ‘WAIT’, followed by ‘PASS’ or ‘FAIL’.

   ‘PASS’ indicates that set-up has been successful, and the new gain settings have been locked into the unit.

   ‘FAIL’ indicates that set-up was unsuccessful.

9. In the case of ‘FAIL’, the display will cycle with the reason for failure shown as a code. The track circuit shall be investigated, and any faults corrected before the set-up is attempted again.

10. Leaving the shunt box applied. Remove the set-up key and replace with the frequency key. Confirm that the INOW AV current is the same as Step 7.

    If not, then the set-up procedure needs to be repeated.

11. If Step 10 passes then remove the shunt and confirm that the track relay picks.

12. Check that the clear track current is within ±10% of the original value. If this is the case, then proceed to Step 13.

    If the clear track current is more than ±10% of the original value a Full Test is required.

13. Check the Inow QUAL is 100%.

    If it is not, this shall be investigated and corrected and the process re-started from Step 5.

14. Check that all receivers drop with 0.8Ω across their connections which go out to the rails, and that 0.8 Ω at the transmitter connections which go out to the rails, drops all receivers in the track circuit.

    If the drop shunt tests pass, then proceed to Step 15.

15. Record all values as required on the track record card, noting the alternative setup used.

16. Where there are multiple RXs and a TX Key has been replaced, repeat Steps 4 to 15 for each RX.

END

Introduction

This appendix contains additional information relating to the Westlock Interlocking system. It contains the following sections:

1. Westlock and WTS Healthy Indicators.
2. Periodic Task 01.
3. Periodic Task 02.
4. Periodic Task 03.
5. Equipment Replacement Processes.

1. WESTLOCK and WTS Healthy Indicators

Technicians' Workstation or Control System Gateway (where fitted) Compact PCI based equipment.

The System `healthy' indicators are illuminated as shown as follows:

Card	Indication	Status
Processor Card	Run LED	Green steady
PMC Card	Power LED	Green steady
PSUs	Status LED	Green steady

<u>WESTLOCK Cubicle</u>

The **CIP** system 'healthy' indicators are illuminated as shown as follows:

Unit	Indication	Normal State
MP modules	Pass	Green steady
	Fault	Off
	Active	Green flashing
CM modules	Pass	Green steady
	Fault	Off
	Active	Green steady
DI modules	Pass	Green steady
	Fault	Off
	Active	Green steady if on- line, off if on standby
	Field Power	Off

The **TIF** system `healthy' indicators are illuminated as shown as follows:

Unit	Indication	Normal State
MP modules	Pass	Green steady
	Fault	Off
	Active	Green flashing
CM modules	Pass	Green steady
	Fault	Off
	Active	Green steady
SCM modules	Pass	Green steady
	Fault	Off
	Active	Green steady
	Ext Alarm	Off
DLM	Power	Red steady
LDT	Power	Red steady
	System	Red steady
	PCM Tx Clock	Red steady
	PCM Rx Clock	Red steady
	PCM Rx Line	Red steady
	Data From SSI	Red steady
	Data To SSI	Red steady
	Data To PCM	Red steady

NOTE: *Depending on which variant the TIF is, it is fitted with either DLMs or LDTs.*

The **FEP** system `healthy' indicators are illuminated as follows:

Indication	Active PM	Inactive PM
24V	Green steady	Green steady
Active	Green flashing	Off
Standby OK	Green steady	Green steady
Fault	Off	Off
Alphanumeric Display	Off	Off
SMB A, B, C & D	Off (not used)	Off (not used)
Processor A Run	Green flashing	Green flashing
Processor B Run	Green flashing	Green flashing
Processor D Run	Green flashing	Green flashing
Processor A Ready	Green steady	Green steady
Processor B Ready	Green steady	Green steady
Processor D Ready	Off (not used)	Off (not used)
Processor A PM-PM	Green steady	Green steady
Processor B PM-PM	Green steady	Green steady
Processor A PM-PM	Yellow flashing	Yellow flashing
Processor B PM-PM	Yellow flashing	Yellow flashing
Ethernet A Link	Green steady	Green steady
Ethernet B Link	Green steady	Green steady
Ethernet A Activity	Yellow flashing	Yellow flashing
Ethernet B Activity	Yellow flashing	Yellow flashing

The shared **Ethernet and Power Supply** ‘healthy’ indicators are illuminated as follows. For single CIP or TIF cubicles these are:

Unit	Indication	Normal State
Ethernet Switches	DC1	Green steady
	DC2	Green steady
	ON	Green steady
	1 to 8	Flash (used ports only) to show
PSUs	DC-ON	Green steady

For Du**al Cubicles (managed)** these are:

Unit	Indication	Normal State
Ethernet Switches	DC-A	Green steady
	DC-B	Green steady
	SYS	Green steady
	Ports	Flash (used ports only) to show
PSUs	DC-ON	Green steady

For **Dual Cubicles (unmanaged)** these are:

Unit	Indication	Normal State
Ethernet Switches	PWR1	Green steady
	PWR2	Green steady

The **RSA** system 'healthy' indicators are illuminated as follows:

Indication	RSA A	RSA B
24V	Green steady	Green steady
Active	Green flashing	Green flashing
Fault	Off	Off
Alphanumeric Display	Off	Off
SMB A	Green flashing	Off (not used)
SMB B	Off (not used)	Green flashing
SMB C & D	Off (not used)	Off (not used)
Ethernet A Link	Green steady	Green steady
Ethernet B Link	Green steady	Green steady
Ethernet A Activity	Yellow flashing	Off (not used)
Ethernet B Activity	Off (not used)	Yellow flashing

The **SOM110** system 'healthy' indicators are illuminated as follows:

Common Indications	State
24V	Green steady
Fault	Off
SMB A	Green flashing
SMB B	Green flashing

The state of other indications on each SOM110 might vary with the state of the railway.

2. Periodic Task 1

<u>2 Year Maintenance - TF or CSG (where fitted) BlueChip PC based equipment</u>

BlueChip PC based TFs and CSGs - Replacing a Lithium Battery

Removal

1. Isolate the power from the PC.
2. Unscrew the thumb screw on the front of the PC and lower the access door.
3. Unscrew the two thumb screws securing the fan assembly and carefully pull the fan assembly clear of the PC casing, see Figure 1.
4. Carefully pull the battery holder out of the retaining clip.
5. Remove the old battery.

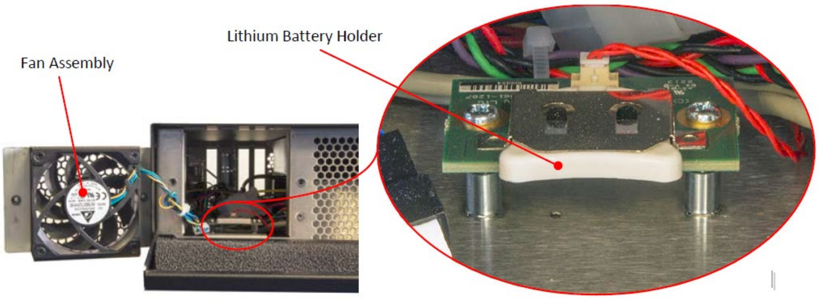


Figure 1 – Lithium Battery Location

Replacement

1. Check the new battery is the same type as the one removed.
2. Insert the new battery, + side up into the holder.
3. Carefully insert the holder into the retaining clip, see Figure 2.

Figure 2 – Lithium Battery Holder

4. Insert the fan into the PC and secure with the two thumb screws.
5. Close the access door and secure using the thumb screw.
6. Reapply power to the PC.
7. Reset the BIOS as detailed below.

Setting TF BIOS

When a TF-S or TF-R PC is replaced, or the lithium battery is replaced the PC's BIOS shall be set as follows:

1. Reset to Default Setting

To set the BIOS to the default settings.

a) During boot-up, press the <Delete> key to enter the BIOS menu.

b) Press the <F3> key to select Optimal Defaults and select the OK.

c) On main screen set Date and Time.

2. Power On Self-Test/Power Button Configuration

To set the PC to perform a full range of self-tests when powered up, to enable the BIOS output to be visible on the console and to configure the power button to perform a delayed power down.

a) Select the Advanced tab.

b) Select Boot Feature.

c) Set value of Quiet Boot to Disabled.

d) Set Value of Power Button Function to 4 Seconds Override.

e) Press the <Esc> key to return to the main BIOS screen.

3. Disable Intel AMT

The Intel AMT technology is disabled on the PC motherboard. To prevent hardware conflicts the AMT shall be disabled in the BIOS as follows:

a) Select the Advanced tab.

b) Select AMT Configuration.

c) Set value of AMT Support to Disabled.

d) Press the <Esc> key to return to the main BIOS screen.

4. Enable All Graphic Adaptors

All graphic adaptors fitted shall be enabled as follows:

a) Select the Advanced tab.

b) Select Chipset Configuration.

c) Select System Agent Configuration.

d) Set value of Initial Graphic Adaptor to IGD.

e) Set value of IGD Multi-Monitor to Enable.

f) Press the <Esc> key twice to return to the main BIOS screen.

5. Set SATA to Windows Mode

__NOTE:__ Windows does not configure itself to load the AHCI driver upon boot if the SATA-drive controller was in IDE mode and not in AHCI mode at the time of OS installation. So, the PC does not boot up if the SATA controller is later switched to AHCI mode or the OS image was installed in IDE mode. The drive controller should be changed to AHCI before installing the operating system".

The SATA Mode shall be set to operate with Windows as follows:

a) Select the Advanced tab.

b) Select IDE/SATA Configuration.

c) Set value of SATA Mode to IDE Mode or AHCI Mode.

d) Press the <Esc> key to return to the main BIOS screen.

6. Super I/O Configurations

As Port 3 and Port 4 are not used, these ports need to be disabled as follows:

a) Select the Advanced tab.

b) Select Super I/O Configuration.

c) Set value of Serial Port 3 to Disabled.

d) Set value of Serial Port 4 to Disabled.

e) Press the <Esc> key to return to the main BIOS screen.

7. Boot Option Priority

Configure the PC to boot off the correct drive as follows:

a) Select Boot tab.

b) Select Boot Options Priority.

c) Set value of Boot Option 1 to STAT: WDC xxxxxxxxxx (see note below).

d) Set value of Boot Option 2 to Disabled.

e) Press the <F4> key to save and exit, the PC continues to boot.

3. Periodic Task 2

10 Year Maintenance - TW or CSG (where fitted) Compact PCI based equipment

Failure to replace the battery periodically can result in the loss of BIOS parameters in the event of a computer black start. This results in increased start up time due to loss of BIOS parameters and can also cause reduced or incorrect operation while operating.

1. To replace a RAM battery:

   a) Re-boot computer and press F2 to enter BIOS Setup when prompted on VDU.

   b) Using the arrow keys and the help menu to navigate the screens and menu items, note all parameters for all menu items on all screens.

   c) Remove Processor module.

   d) Replace coin cell BR 2032 and check correct polarity.

   e) Replace Processor module.

   f) Turn on computer power and press F2 when prompted on the VDU to enter BIOS set up.

   g) Check all screens and menu items are set as noted in step 3 above.

   h) When BIOS set up complete, Press F4 to save and exit BIOS set up.

   i) Select 'Yes' to confirm BIOS settings on the confirmation screen.

The computer now reboots, load and run the program without further operator intervention.

It is recommended to prolong battery life that batteries are only fitted to spare modules immediately prior to being put into service. The shelf life of a battery in its original packing is in excess of 10 years. When fitted it is considerably shorter.

4. Periodic Task 3

14 Year Maintenance - WESTLOCK CIP and TIF Main Processors

The CIP, TIF and SIF Main Processors (MPs) contain a Lithium battery which shall be replaced periodically to maintain the MP's backup memory. Each MP has a label showing the date of manufacture; use this information to calculate service date. The format of the serial number is shown as yy.ww.nnnn, where yy is the year and ww is the week of manufacturer.

All MPs held as spares shall be serviced as above.

To prevent any interruption to service, it is recommended to replace only one MP at a time with a serviceable spare.

These batteries are not user serviceable, and the MP shall be returned to the factory for servicing, including all spares.

5. Equipment Replacement Processes

5.1 Replace a WESTLOCK Interlocking Module

a) On the WESTLOCK module to be removed, rotate the Lock lever counter clockwise through 270° until the module ejects from the baseplate.

b) Insert the replacement WESTLOCK module with the lock lever in the 6 o'clock position and rotate the lock lever clockwise to draw the module into the baseplate.

c) Continue rotating the Lock lever until it is in the 3 o'clock position. This might require firm pressure.

d) Check the lock indicator (red LED) is Off. If the indicator is on, the module is incorrectly seated.

5.2 Replace a WESTLOCK Ethernet Switch

a) Remove the input supply from the switch by unplugging the screw terminal block from the top of the switch.

b) Note the positions of the data cables connected to the switch ports. Check the cables and wires are correctly labelled.

c) Unplug the data cables from the switch ports.

d) Unclip the switch from the DIN rail and label it.

e) Fit the replacement switch onto the DIN rail.

f) Connect the cables to the switch ports in the positions noted at c.

g) Plug the input supply screw terminal into the socket on the top plate of the switch.

h) On the front panel of the switch, check that DC1, DC2 and On LEDs are lit.

i) After a short pause, check the port activity indicators begin flashing (used ports only).

j) At the TW(L), check the fault list to confirm correct operation of the network.

5.3 Replace a WESTLOCK Power Supply Unit (PSU)

a) Positively identify the power supply unit to be removed. The front panel of the PSU has a DC on status indicator, lit when the output is present.

NOTE: *If one power supply unit is faulty, powering down the remaining PSU removes the DC supply from the cubicle equipment.*

b) Positively identify the input and output power fuses for the PSU to be removed.

c) Remove the fuses and check on the PSU input terminals that the 110V AC is absent.

d) Note the positions of the input and output wires on the PSU terminals. Check the cables and wires are correctly labelled.

e) Remove the wires from the PSU terminals, insulating them using insulating tape.

f) Remove the PSU from the DIN rail and label it.

g) Fit the serviceable replacement PSU onto the DIN rail, in the same position as the original PSU.

h) Connect the input and output wires in the positions noted at step d. If in doubt, refer to the site records.

i) Re-fit the fuses removed at step b.

j) On the front panel of the PSU, check the DC On status indicator is lit.

k) At the TW(L), check the fault list to confirm correct operation of the PSU.

5.4 Replace a WESTLOCK CSG or TW(L) Module

a) At the rear of the housing, set the input power switches for both PSUs to the off (O) position.

b) Disconnect any data cables from the card.

c) Undo the single securing screw at the left and right of the card.

d) Release the card from the backplane connector by pressing the left and right card handles apart.

e) Carefully slide the card from the housing and place it in an anti-static bag.

f) At the rear of the housing, set the power input switch supplying the failed PSU to the off (O) position.

g) At the front of the housing, undo the screws securing the PSU to the housing and remove the PSU.

h) Isolate power to the KVM by disconnecting the mains cable feeding the KVM power supply. Check cables are correctly labelled.

i) Disconnect the connectors from the rear of the KVM unit.

j) Unscrew the four screws securing the KVM to the rack and withdraw the complete KVM.

k) Check the replacement card is correct type (the same type as the one removed and has been supplied by WRSL specifically for this type of installation).

l) Insert the card into its correct position and secure using the two front panel screws.

m) Reconnect the data cables as necessary, check each cable is fitted into the correct connector. If in doubt, refer to the site records.

n) Set the input power switches to on (I). Wait for the processor to boot up.

o) If the replaced card was a Rear Transition Module (which contains the hard disk drive), load the operating program.

p) Only competent personnel shall perform this task by inserting a USB memory stick containing the correct version and application, then selecting the application (TW(L), CSG 'A' or CSG 'B') using the keyboard/VDU field (input) fault and a module fault, resolve the field fault first.

q) Check all indications are correct and the equipment works correctly.

r) Check the replacement PSU is correct type (the same type as that removed).

s) Check the PSU is the correct way up, and then carefully align the PSU with the guides within the housing before sliding the PSU fully into the housing.

t) Apply firm pressure on the PSU front panel to fully insert the PSU into the housing.

u) Secure the PSU with the front panel screws.

v) Restore the mains input supply and check the Status indicator on the front panel illuminates.

w) Check that the replacement KVM unit is correct type (the same type as the one removed).

x) Slide the KVM housing into the rack and secure with the four screws.

y) Reconnect the cables at the rear of the KVM housing.

z) Restore power to the KVM.

aa) Test for correct operation.

5.5 Replace a WESTLOCK Baseplate

a) At the baseplate to be replaced, remove the modules. For each module, rotate the lock lever counterclockwise through 270° until the module ejects from the baseplate.

b) Disconnect any cables or wires from the baseplate. Note that on the DI baseplate the complete connector might be unplugged.

c) At the top and bottom of the baseplate to be removed, identify the crosshead screws securing the interconnect assemblies (4 screws) or cover assembly (2 screws) to the baseplate. Undo the securing screws and remove the interconnect / cover assemblies.

d) Undo and remove the four crosshead screws and associated lock washers securing the baseplate to the rear panel of the cubicle. Retain the screws and washers.

e) Carefully withdraw the baseplate from the cubicle.

f) Remove the address plug from the baseplate and plug it into the replacement baseplate.

g) Check the replacement baseplate is correct type (same type as the one removed and has been supplied by WRSL).

h) Fit the replacement baseplate into its correct position and secure using the four crosshead screws and associated lock washers.

i) Visually Check the interconnect assemblies for damaged connector pins. If damaged pins are present, replace the interconnect assembly.

j) Fit the interconnect assemblies / cover assembly and secure by tightening the four crosshead screws (interconnect assembly) or two crosshead screws (cover assembly).

k) Reconnect the cables or wires as necessary, check each cable is fitted into the correct connector. If in doubt, refer to the site records.

l) Insert each module into the baseplate with the lock lever in the 6 o'clock position and rotate the lock lever clockwise to draw the module into the baseplate. Continue rotating the lock lever until it is in the 3 o'clock position. This might require firm pressure.

5.6 Removal of CIP or TIF Module

a) If CIP or TIF module is to be removed, rotate the Lock lever counterclockwise through 270° until the module ejects from the baseplate (it is recommended to use a screwdriver).

b) Insert the replacement CIP or TIF module with the lock lever in the 6 o'clock position and rotate the lock lever clockwise to draw the module into the baseplate.

c) Continue rotating the Lock lever until it is in the 3 o'clock position. This might require firm pressure (it is recommended to use screwdriver).

d) Check the lock indicator (red LED) is Off. If the indicator is on, the module is incorrectly seated.

Removal of an PM from a FEP

a) Loosen the captive lock screw in each handle at the top and bottom of the module.

b) Press the red button in the lower handle. This shuts down the module and releases the lower handle.

c) Wait one second after depressing the red button to allow the module to shut down. This prevents damage to module components and proves the integrity of the backplane supply voltage during removal.

d) Swing both handles outwards to release the module and slide the module out of the housing along its guides.

e) Align the rails on the left top and bottom edge of the replacement module with the tracks at the top and bottom of the slot.

f) Push the module in until the levers start to engage.

g) Do not use excessive force: it's possible to bend terminals or break polarising pegs if the connectors and sockets are misaligned, or if the module is of the wrong type.

h) Pull up on the bottom lever and press down on the top lever at the same time to ease the module into the backplane, until the red power switch in the bottom lever clicks into place.

i) Tighten captive screws.

5.7 Replacing Westermo Lynx L106 and Cisco IE2000 and Amplicon EX43008-00-1-A

a) Power down the affected Ethernet switch by opening the fuse carriers on the power distribution rail. Note that there are two power supplies to each switch.

b) Unplug the screw terminal connector block or blocks from the switch. (Westermo Lynx L106 switches have one connector block. Cisco IE2000 switches have two connector blocks, one for each power supply).

c) Note the positions of the cables before unplugging from the switch ports.

d) Unclip the switch from the DIN rail by pulling down on the movable tab at the bottom of the unit then label it.

e) Fit the replacement switch onto the DIN rail.

f) Connect the cables to the switch ports in the positions noted at Step c).

g) Plug the input supply screw terminal connector block(s) into the switch.

5.8 Replace MP, CM, DI and SCM Baseplates

a) At the baseplate to be replaced, remove the modules. For each module, rotate the lock lever counterclockwise through 270° until the module ejects from the baseplate.

b) Disconnect any cables or wires from the baseplate. Note that on the DI baseplate the complete connector might be unplugged.

c) At the top and bottom of the baseplate to be removed, identify the crosshead screws securing the interconnect assemblies (4 screws) or cover assembly (2 screws) to the baseplate. Undo the securing screws and remove the interconnect / cover assemblies.

d) Undo and remove the four crosshead screws and associated lock washers securing the baseplate to the rear panel of the cubicle. Retain the screws and washers.

e) Carefully withdraw the baseplate from the cubicle.

f) Remove the address plug from the baseplate and plug it into the replacement baseplate.

g) Fit the replacement baseplate into its correct position and secure using the four crosshead screws and associated lock washers removed at Step c).

h) Visually check the interconnect assemblies (removed at step b) for damaged connector pins. If damaged pins are present, replace the interconnect assembly.

i) Fit the interconnect assemblies / cover assembly removed at Step b). and secure by tightening the four crosshead screws (interconnect assembly) or two crosshead screws (cover assembly).

j) Reconnect the cables or wires as necessary.

k) Insert each module into the baseplate with the lock lever in the 6 o'clock position and rotate the lock lever clockwise to draw the module into the baseplate. Continue rotating the lock lever until it is in the 3 o'clock position. This might require firm pressure.

5.9 Replace a WESTLOCK FEP Housing Backplane

a) Remove the two PMs from the FEP housing following the procedure in NR/SMTH/Part04/WL01 (Replace a WESTLOCK Interlocking Module).

b) Disconnect the four Ethernet cables and two power connections from the front panel of the FEP housing.

c) Disconnect the earth strap connecting the housing to the rear panel of the cubicle.

d) On each side of the FEP housing to be removed, identify and remove the crosshead screws securing the housing to the rear panel of the cubicle. Retain the screws and washers.

e) Carefully withdraw the housing from the cubicle.

f) Remove the panel in front of the Addressing Plug from the front of the housing to improve access to the Addressing Plug.

g) Remove the seals covering the Addressing Plug retaining screws, release the two screws and pull the Addressing Plug forward and out of the housing.

h) Disconnect the power connectors from the connections labelled 24V-A and 24V-B on the rear of the housing.

i) Remove the six SMB terminators from the SMB connections on the rear of the housing.

j) Remove and retain the six screws from the top and bottom of the cover plate and remove the cover.

k) Carefully mark the position of the backplane on the housing to check the connectors on replacement backplane align correctly with the rails supporting the processor modules.

l) Remove and retain the remaining four screws holding the backplane on to the housing and remove the backplane.

m) Align the backplane to the alignment marks made.

n) Note the position of the four slots in the protective cover and attach the backplane to the housing using the screws removed at Step j) so that the screws align with the slots in the protective cover.

o) Fit the protective cover plate using the six screws removed.

p) Re-fit the six SMB terminators to the SMB connectors.

q) Visually check cables for damaged connector pins. If necessary, replace the cable with a serviceable spare.

r) Reconnect the power connections.

s) Check wiring and cables are replaced as labelled.

t) WIRE COUNT replacement unit to diagram.

u) Fit the Addressing Plug removed from the failed backplane into the replacement backplane and secure it using the retained fixings.

v) Fit new red seals covering the retaining screws on the Addressing Plug.

w) Place the removed backplane in the transit packaging and return it to Siemens Rail Automation for repair.

x) Fit the housing into its correct position and secure using the four crosshead screws and associated lock washers removed.

y) Visually check cables for damaged connector pins. If damaged pins are present, replace the cable with a serviceable spare.

z) Reconnect the Ethernet cables and power connections, checking each cable is fitted into the correct connector.

aa) Insert each Processor Module (PM) into the housing following the procedure in NR/SMTH/Part04/WL01 (Replace a WESTLOCK Interlocking Module).

5.10 Replace a Siemens Zone Controller module

a) Loosen the captive lock screw in each handle at the top and bottom of the module.

b) Press the red button in the lower handle. This shuts down the module and releases the lower handle.

c) Wait one second after depressing the red button to allow the module to shut down. This prevents damage to module components and maintains the integrity of the backplane supply voltage during removal.

d) If the module to be replaced is a MAU, disconnect the optical fibre connections from the front of the MAU taking care to protect the ends.

e) Swing the handles outwards to release the module and slide the module out of the housing along its guides.

f) Align the rails on the left top and bottom edge of the module with the tracks at the top and bottom of the slot.

g) Push the module in until the levers start to engage.

h) Do not use excessive force: it’s possible to bend terminals or break polarising pegs if the connectors and sockets are misaligned, or if the module is of the wrong type.

i) If the module being replaced is a MAU, connect the optical fibre connections removed at Step d).

j) Pull up on the bottom lever and press down on the top lever at the same time to ease the module into the backplane, until the red power switch in the bottom lever clicks into place.

k) Tighten the captive lock screw in each handle at the top and bottom of the module.

5.11 Replace a Siemens Zone Controller Housing Backplane

a) Disconnect the power connectors from the connections labelled 24V-A and 24V-B on the rear of the housing.

b) Remove the panel in front of the Addressing Plug from the front of the housing to improve access to the Addressing Plug. It might be necessary to remove one or more modules or blanking plates to improve access.

c) Remove the seals covering the Addressing Plug retaining screws, release the two screws and pull the Addressing Plug forward and out of the housing.

d) Remove the six SMB cables or terminators from the SMB connections on the rear of the housing.

e) Remove and retain the eight screws from the top and bottom of the cover plate and remove the cover.

f) Carefully mark the position of the backplane on the housing to check the connectors on the replacement backplane align correctly with the rails supporting the modules.

g) Remove and retain the remaining twelve screws holding the backplane on to the housing and remove the backplane.

h) Check the replacement 10-Slot plus Addressing Plug backplane is the same type as the one removed.

i) Align the backplane to the alignment marks made in Step f).

j) Note the position of the slots in the protective cover and attach the backplane to the housing using the twelve screws removed at Step g) so that the screws align with the slots in the protective cover.

k) Fit the protective cover plate using the eight screws removed in Step e).

l) Visually check the cables removed for damaged connector pins. If necessary, replace the cable with a serviceable spare.

m) Re-fit the SMB cables and terminators to the SMB connectors.

n) Reconnect the power connections and SMB connections, checking each cable is fitted to the correct connector. If in doubt, refer to the site records.

o) Fit the Addressing Plug removed from the failed backplane into the replacement backplane and secure it using the retained fixings.

p) Fit new red seals covering the retaining screws on the Addressing Plug.

q) Replace any modules removed.

5.12 Replace a Siemens Zone Controller PM Backplane

a) Power down the RSA which is plugged into the affected backplane by pressing the red button in the lower handle.

b) Disconnect the Ethernet cable and loopback connector from the connections labelled Ethernet A and Ethernet B.

c) Remove and retain the three screws from the top and bottom of the cover plate and remove the cover.

d) Carefully mark the position of the backplane on the housing so that the connectors on replacement backplane align correctly with the rails supporting the RSA modules.

e) Remove and retain the remaining three screws holding the backplane on to the housing and remove the backplane.

f) Two solder links are provided on the PM backplane to select if the PM is the Primary or Secondary PM. These are not used by the RSA and can be left open.

g) Align the backplane to the alignment marks made in Step d).

h) Note the position of the slots in the protective cover and attach the backplane to the housing using the three screws removed at Step e) so that the screws align with the slots in the protective cover.

i) Fit the protective cover plate using the three screws removed in Step c).

j) Visually check the Ethernet cable and loopback connector for damaged connector pins. If damaged pins are present, replace the cable or loopback connector with a serviceable spare.

k) Reconnect the Ethernet cable and loopback connector, checking they are in the correct socket. Refer to the site records.

5.13 Replace a Siemens Zone Controller Surge Interface Board

a) Power down the SOM110 which is plugged into the affected interface board by pressing the red button in the lower handle.

b) Disconnect the I/O connection cable at the back of the housing from the affected interface board.

c) Remove and retain the four screws and washers from the top and bottom of the cover on the lower half of the interface board and remove the cover.

d) Carefully mark the position of the interface board on the housing so that the connectors on the replacement interface board align correctly with the rails supporting the modules.

e) Remove and retain the socket head screws holding the connector spacers and interface board on to the housing and remove the spacers and interface board. Spacers for 16HP width modules retained with six screws. Spacers for 8HP width modules retained using four screws.

f) Check the replacement interface board is the same type as the one removed.

g) Align the backplane to the alignment marks made in Step d).

h) Attach the backplane to the housing using the screws and spacers removed at step e. The screws pass through the top half of the upper spacer and through the bottom half of the lower spacer.

i) Fit the protective cover plate to the bottom half of the interface board using the four screws and washers removed in Step c).

j) Visually check the I/O connection cable for damaged connector pins. If damaged pins are present, replace the cable with a serviceable spare.

k) Reconnect the interface cable.

Replace a WESTLOCK FEP PM Backplane

a) Remove the two PMs from the FEP housing following the procedure in NR/SMTH/Part04/WL01 (Replace a WESTLOCK Interlocking Module).

b) Disconnect the four Ethernet cables and two power connections from the front panel of the FEP housing.

c) Disconnect the earth strap connecting the housing to the rear panel of the cubicle.

d) On each side of the FEP housing to be removed, identify and remove the crosshead screws securing the housing to the rear panel of the cubicle. Retain the screws and washers.

e) Carefully withdraw the housing from the cubicle.

f) Disconnect the Ethernet cables from the connections labelled Ethernet A and Ethernet B.

g) Disconnect the PM-PM Data Cable and PM-PM Status Cable connecting the two PM backplanes.

h) Remove and retain the screws from the top and bottom of the cover plate and remove the cover.

i) Carefully mark the position of the backplane on the housing to check the connectors on replacement backplane align correctly with the rails supporting the processor modules.

j) Remove and retain the remaining screws holding the backplane on to the housing and remove the backplane.

NOTE: *Two solder links are provided on the PM backplane to select if the PM is the Primary or Secondary PM.*

- The PM Backplane fitted to Slot 1 has LK1 closed and LK2 open.
- The PM Backplane fitted to Slot 2 has LK1 open and LK2 open.

k) Check the solder links on the new backplane are set correctly.

l) Align the backplane to the alignment marks made in Step i).

m) Note the position of the slots in the protective cover and attach the backplane to the housing using the three screws removed at Step j) so that the screws align with the slots in the protective cover.

n) Fit the protective cover plate.

o) Visually check the cables for damaged connector pins. If damaged pins are present, replace the cable with a serviceable spare.

p) Reconnect the Ethernet cables and status connections to the two PM backplanes.

q) Check each cable is fitted into the correct connector and replaced as labelled.

r) Fit the housing into its correct position and secure using the four crosshead screws and associated lock washers removed in Step d).

s) Visually check cables (removed at Step b) for damaged connector pins. If damaged pins are present, replace the cable with a serviceable spare.

t) Reconnect the Ethernet cables and power connections to the front of the FEP Housing, checking each cable is fitted into the correct connector. If in doubt, refer to the site records.

u) Insert each processor module into the housing following the procedure in NR/SMTH/Part04/WL01 (Replace a WESTLOCK Interlocking Module).

5.14 Replace a Siemens FEP/ZC Addressing Plug

a) Disconnect the power connectors from the connections labelled 24V-A and 24V-B on the rear of the housing.

b) Remove the panel in front of the Addressing Plug from the front of the housing to improve access to the Addressing Plug. It might be necessary to remove one or more modules or blanking plates to improve access.

c) Remove the seals covering the Addressing Plug retaining screws, release the two screws and pull the Addressing Plug forward and out of the housing.

d) Check the replacement Addressing Plug is the same type as the one removed.

5.15 Configuring an Addressing Plug

If a pre-configured spare Addressing Plug has been supplied for the Housing, move to Step 5.16).

a) Dismantle the new Addressing Plug by removing and retaining the four screws from the top and bottom and remove the cover.

b) All links in the new Addressing Plug are made. Links are cut to set the Housing and Installation addresses and configure the SMB communications.

c) Identify the links to be removed by reference to the drawing in the site-specific documentation.

d) Cut each link to be removed at both ends. Check all cut ends are removed from the module.

e) Re-check the Addressing Plug against the drawing.

f) Re-assemble the Addressing Plug.

g) Fit red seals to the Addressing Plug and apply the correct labelling.

5.16 Installing a new Addressing Plug

a) Fit the Addressing Plug into the FEP/ZC and secure it using the retained fixings.

b) Fit new red seals covering the retaining screws on the Addressing Plug.

c) Replace any front panels or modules.

d) Place the removed Addressing Plug in the transit packaging.

5.17 Replace a Siemens FEP/ZC Power Supply Module

a) Disconnect the plug couplers on the rear of the Power supply module (at the rear of the housing).

b) Release the four captive screws retaining the Power supply module located on the front panel.

c) Using the handles, slide the Power supply module out of the housing.

d) Slide the new Power supply module into the rack (checking correct orientation).

e) Locate and tighten the four cassette retaining screws.

f) Replace the plug couplers on the rear of the cassette (plug couplers are physically different and only plugs into one place).

5.18 Replace a Siemens Zone Controller Power Buffer Unit

a) Disconnect the Buffer Unit plug coupler on the rear of the power supply module.

b) Extract the Buffer Unit cable from any cable management.

c) Mark the Buffer Unit's position on the DIN rail.

d) Detach the Buffer Unit from the DIN rail. The release mechanism is located underneath the buffer unit and is operated with a flat blade screwdriver.

e) Attach the new Buffer Unit to the DIN rail in the same position as the previous one.

f) Route the buffer cable via the cable management.

g) Plug the buffer unit plug coupler into the rear of the power supply module.

5.19 Replace a Siemens Zone Controller TPWS Circuit Breaker

a) Disconnect the wires from the faulty circuit breaker.

b) Remove the circuit breaker fixings.

c) Remove the finger guard and faulty circuit breaker.

d) Align the replacement circuit breaker and finger guard to the fixing holes in the plate.

e) Refit the circuit breaker retaining fixings.

f) Check the new circuit breaker lever operates correctly, before returning it to the off position.

g) Reconnect the wires to the circuit breaker.

h) Refit finger guard.

5.20 Replace a Siemens Ethernet Switch Power Supply

a) Disconnect the wires from the Power Supply Unit.

b) Mark the Power Supplies position on the DIN rail.

c) Detach the Power Supply from the DIN rail. The release mechanism is located underneath the unit and is operated with a flat blade screwdriver.

d) Attach the new Power Supply to the DIN rail in the same position as the previous one.

e) Connect the wiring.

5.21 Replace a Siemens Ethernet Switch Power Buffer Unit

a) Disconnect the Buffer Unit from the Power Supply Unit.

b) Disconnect the output from the buffer unit one wire at a time to check the two wires cannot short the capacitors as they are withdrawn.

c) Mark the Buffer Unit’s position on the DIN rail.

d) Detach the Buffer Unit from the DIN rail. The release mechanism is located underneath the buffer unit and is operated with a flat blade screwdriver.

e) Attach the new Buffer Unit to the DIN rail in the same position as the previous one.

f) Connect the output from the buffer unit one wire at a time to checking the two output wires do not short the capacitors.

g) Connect the buffer unit to the power supply.

5.22 Replace a Siemens AMI-SRA Modular Technicians Facility PC

a) Isolate the power supply using the MCB.

b) Unplug the cables from the PC.

c) Remove and retain the Removable Drives and compact flash card (if used).

d) Remove and retain the fixing securing the PC to the bracket and withdraw the PC.

e) Insert the retained Removable Drives and compact flash card (if used) into the replacement PC.

f) Secure the PC in position using the retained fixings.

g) Check the cables are in the correct position and then re-connect.

h) Re-apply the power supply using the associated MCB.

5.23 Replace a Siemens Zone Controller MAU Backplane

a) Disconnect the power connectors from the connections labelled 24V-A and 24V-B on the existing MAU backplane on the rear of the housing.

b) Remove the two SMB cables or terminators from the SMB connections on the MAU backplane.

c) Remove and retain the four screws from the top and bottom of the cover plate and remove the cover.

d) Carefully mark the position of the backplane on the housing so the connectors on replacement backplane align correctly with the rails supporting the modules.

e) Remove and retain the remaining four screws holding the backplane on to the housing and remove the backplane.

f) Check the replacement WESTRACE MAU backplane is the same type as the one removed and has been supplied by Siemens Rail Automation.

g) Align the backplane to the alignment marks made in Step d).

h) Note the position of the slots in the protective cover and attach the backplane to the housing using the four screws removed at Step e) so that the screws align with the slots in the protective cover.

i) Fit the protective cover plate using the four screws removed in Step c).

j) Visually check the cables or terminators (removed at Step b) for damaged connector pins. If necessary, replace the cable with a serviceable spare.

k) Reconnect the power connections, SMB connections and terminators, checking each cable is fitted to the correct connector. If in doubt, refer to the site records.

l) Place the removed backplane in the transit packaging and return it to Siemens Rail Automation for repair.

5.24 Replace a Siemens Zone Controller Housing

a) Power down the modules in the housing by pressing the red button in the lower handle on each module.

b) Disconnect the power connectors from the connections labelled 24V-A and 24V-B on the rear of the housing.

c) Remove the six SMB cables or terminators from the SMB connections on the rear of the housing.

d) If an RSA is fitted to the housing, disconnect the Ethernet cable and loopback connector from the connections labelled Ethernet A and Ethernet B.

e) If a MAU is fitted, disconnect the optical fibre connections from the front of the MAU taking care to protect the ends.

f) Disconnect the I/O connection cable at the back of the housing from each interface board.

g) To reduce the weight of the housing, remove the modules by swinging the handles outwards and slide the module out of the housing along the guides.

h) Remove the panel in front of the Addressing Plug from the front of the housing to improve access to the Addressing Plug.

i) Remove the seals covering the Addressing Plug retaining screws, release the two screws and pull the Addressing Plug forward and out of the housing.

j) Remove and retain the eight screws holding the housing into the rack located on the front of the housing.

k) Using the handles, slide the housing out of the rack (the housing is supported by runners).

l) Slide the new housing into the rack (checking correct orientation).

m) Refit the four housing retaining screws.

n) Fit the modules to the new housing and check the backplanes are fitted in the correct position behind the modules.

o) Remove the housing backplane from the redundant housing and fit it to the new housing following the procedure in NR/SMTH/Part04/WL08 (Replace a Siemens Zone Controller Housing Backplane).

p) Remove any PM backplanes from the redundant housing and fit them to the new housing following the procedure in NR/SMTH/Part04/WL09 (Replace a Siemens Zone Controller PM Backplane).

q) Remove the Surge Interface Boards from the redundant housing and fit them to the new housing following the procedure in NR/SMTH/Part04/WL10 (Replace a Siemens Zone Controller Surge Interface Board).

r) Remove any MAU backplanes from the redundant housing and fit them to the new housing following the procedure in NR/SMTH/Part04/WL11 (Replace a Siemens Zone Controller MAU Backplane).

s) Fit the Addressing Plug removed from the redundant housing into the new housing and secure it using the retained fixings. It might be necessary to remove one or more modules to improve access.

t) Fit new red seals covering the retaining screws on the Addressing Plug.

u) Replace any front panels or modules.

v) Press the red button in the lower handle of each RSA, MAU and LOM110 or SOM110 module to check the modules are switched off.

w) Re-connect the cables.

5.25 Replace a Siemens Zone Controller Power Distribution Housing

a) Disconnect the plug couplers on the rear of the Power Cassettes (at the rear of the housing).

b) Remove and retain the four screws holding the housing into the rack located on the front of the housing.

c) Using the handles, slide the housing out of the rack (the housing is supported by runners).

d) Slide the new housing into the rack (checking correct orientation).

e) Refit the four housing retaining screws removed at Step b).

f) Replace the plug couplers on the rear of the cassettes (plug couplers are physically different and only plugs into one place within a cassette).

g) Turn on the upstream circuit breakers.

h) Turn on each circuit breaker on the front panel of the cassettes.

i) If the Power Cassette is a 24VDC cassette part number C52986/1, verify the green “DC Ok” status indicator on the front of the Power Cassette illuminates.

5.26 Replace a Siemens Zone Controller I/O Cable

a) Power down the IOM which is plugged into the affected I/O Connection Cable by pressing the red button in the lower handle.

b) Disconnect the I/O Connection Cable from the back of the housing from the affected interface board.

c) Extract the I/O Connection Cable from any cable management.

d) Disconnect the I/O Connection Cable from the Wago terminals.

e) Route the new I/O Connection Cable via the cable management.

f) Connect the new I/O Connection Cable to the Wago terminals according to the site-specific documentation.

g) Connect the new I/O Connection Cable to the back of the housing.

END

1. GENERAL

1.1 A BR Western Region coded track circuits fundamentally differ from a conventional steady energy DC track circuit in that the voltage, supplied to both rails at the feed end, is broken up into a code comprising alternate periods of positive and negative impulses (Figure 1).

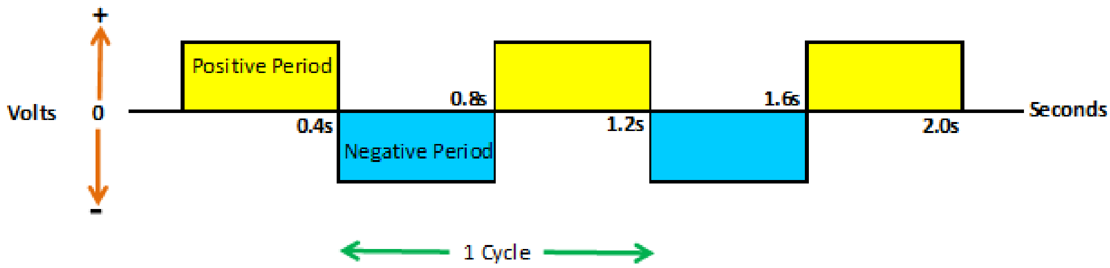


Figure 1 – 75 CPM Code

1.2 The code is produced by a coded transmitter (CT). It's oscillating contacts interrupt and alternate, a 2v Lead Acid battery supply at the feed end of the track circuit.

1.3 At the relay end of the track circuit the code is received by a 2 ohm Polar Biased code following relay (CFR). When working correctly, the CFR follows exactly the alternate code produced by the CT, and this produces the distinctive "tick-tock" at the CFR, at a rate of 75 cycles per minute.

The advantages arising from the use of DC Coded Tracks are:

a) Longer track circuits can be operated for a minimum ballast resistance.

b) The track cannot be falsely energised by an extraneous DC source.

c) There is no "battery storage effect" in poor ballast conditions.

1.4 Due to the DC coded track circuits alternating polarities, in order to interface with the signalling and provide contacts for signalling control and TPRs etc, a slow-release DC neutral shelf type relay is employed.

1.5 Under track clear conditions the TR is maintained in a steady energised state by means of a decoding transformer (DT). As long as the correct 75 cycles per minute are received by the CFR, the DT will provide a unidirectional current through the TR.

Any interruption or distortion of the 75 CPM code will not only cause the CFR to stop oscillating, but also the TR to be de-energised. It is the TR contacts that are then used in the conventional manner.

1.6 Although the relay is called the TR it is NOT the TR that is shunted as it has no direct connection to the rails, and the independent power supply via the DT. It is the CFR that is tested. (Figure 2)

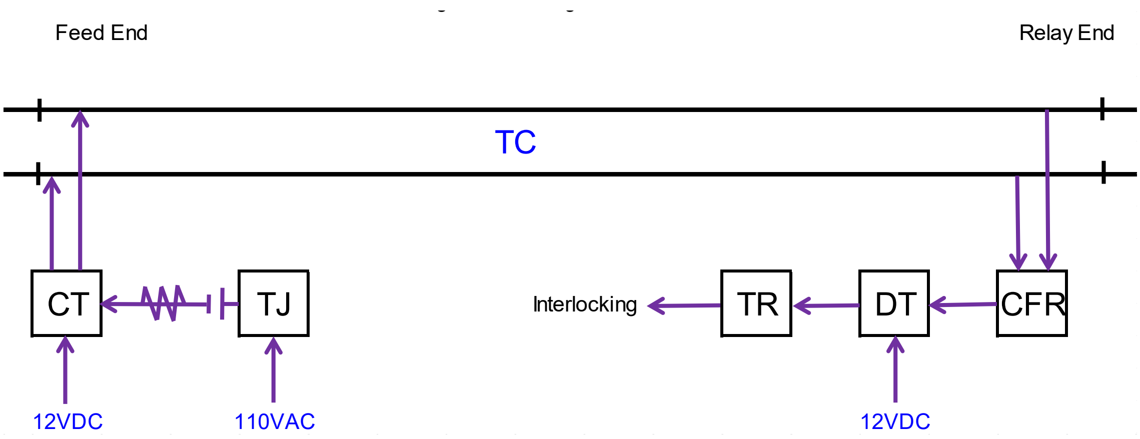


Figure 2 – Block Diagram

END

Includes:	Siemens ACM100 System
Excludes:	All other Axle counter systems

Abbreviation	Meaning
AC	Alternate current
ACM	Axle Counting Module
COM	Communication
DC	Direct Current
DIS	Connection box
RA	Reset acknowledgement
RR	Reset restriction
RST	Reset button
RST-RR1	Reset button for reset restriction 1
RST-RR2	Reset button for reset restriction 2
SRI	Safety related information
TVDS	Track Vacancy Detection System
WDME	Wheel Detection Monitoring Error
WSD	Wheel sensor double

Table 1 – List of Abbreviations

Track Vacancy Detection with an Axle Counting System

The ACM100 system (figure 1) is used for automatic monitoring of open-line and station tracks. Clear and occupied indications are transmitted to the interlocking or to subsystems for track sections and points. The ACM100 system consists of two sets of equipment, Trackside and Indoor equipment.

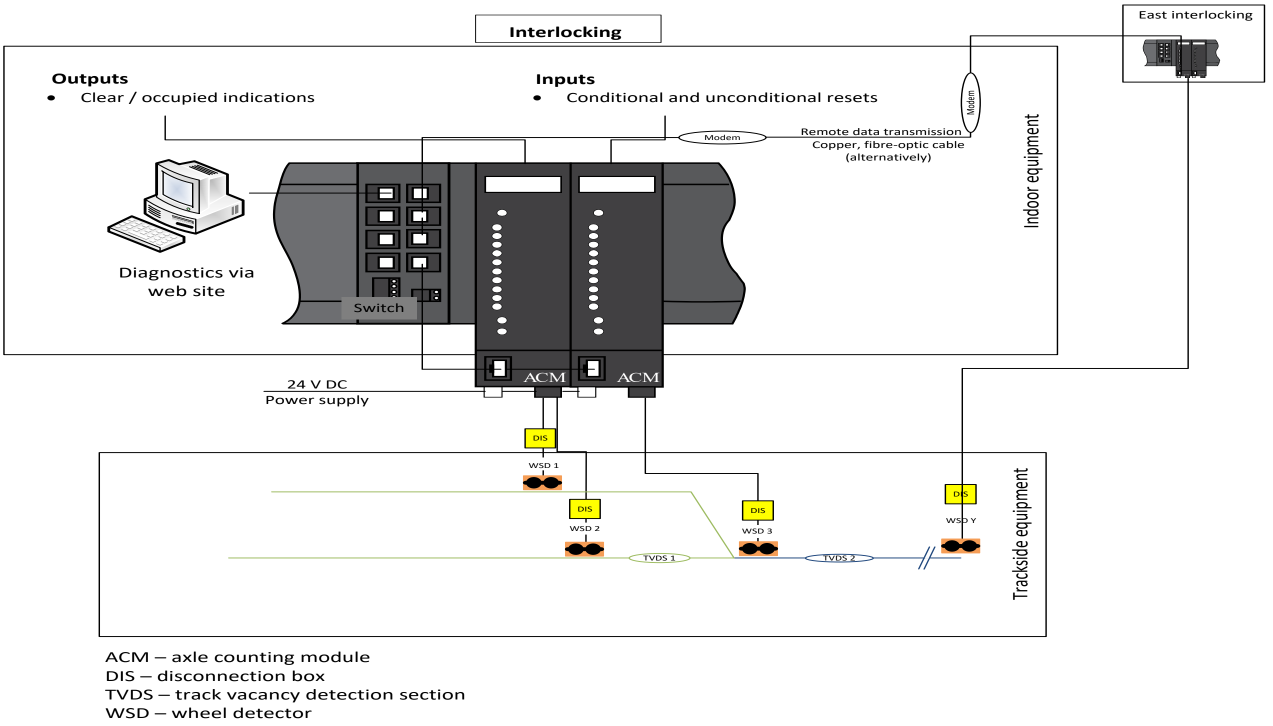


Figure 1 – ACM100 overview

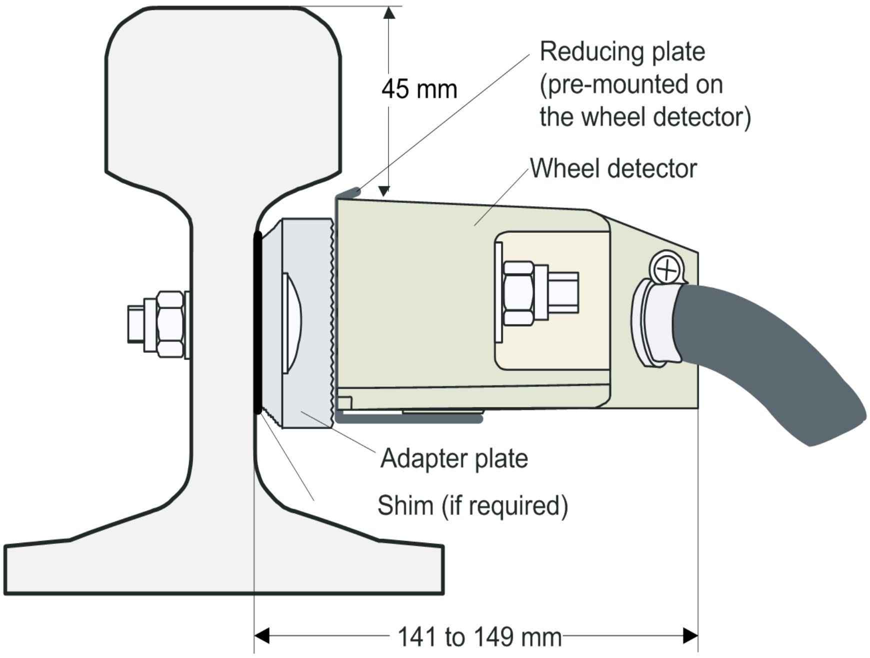
Wheel detection components are placed at the beginning and end of each track vacancy detection section (TVDS) to be monitored. To determine whether there is a vehicle in a TVDS, the system compares the number of axles entering it with the number leaving it.

WSD Wheel Detector

The WSDs (figure 2) are installed at the limits of a TVDS. A WSD consists of two independent detector subsystems (double wheel detector) installed in a glass-fiber reinforced plastic housing. The WSD requires a periodic (six monthly) recalibration and functional test. The recalibration process once triggered operates automatically, with no user serviceable components within the WSD housing. The WSD is mounted in the track on the gauge side of the rail. The wheel detector is connected to a trackside connection box (cable distribution box) by a four-core cable (two cores per detector subsystem). The cable is 5 m (optionally 10m or 15m) long. The WSD wheel detector is either bolted to the rail web or clamped to the base of the rail.

Figure 2 – Wheel Sensor Double (WSD)

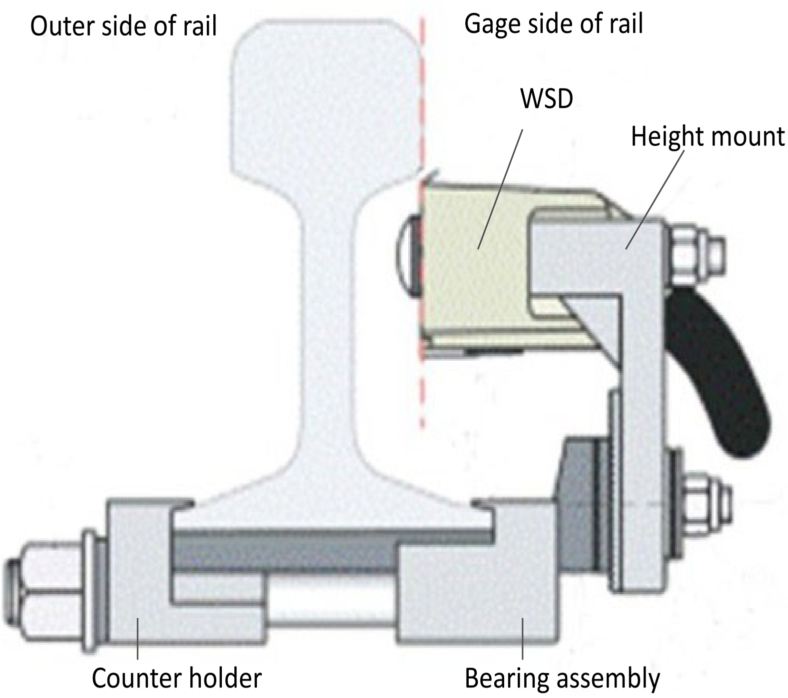
Planning stipulates whether rail web or rail base attachment is to be used. The rail base attachment is rail specific. The correct rail base bracket is to be used with the correct rail type. Both types of mountings are shown in figures 3 and 4.



The rail web mount consists of:

Adapter plate
Fastening bolts
Washers
Prevailing torque-type nuts
Shim (if required)

Figure 3 – Rail Web Mounting of WSD



The rail base mount consists of:

Wheel detector
Fastening bolts
Washers
Prevailing torque type nuts
Counter holder
Damping plate
Studs
Height Mount
Seperator
Bearing assembly
Nuts
Bearing plate
Courugated plate
Reducing plate

Figure 4 – Rail Base Mounting of WSD

Special Tools Required (Web and Base Mounting)

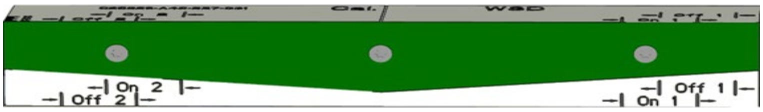
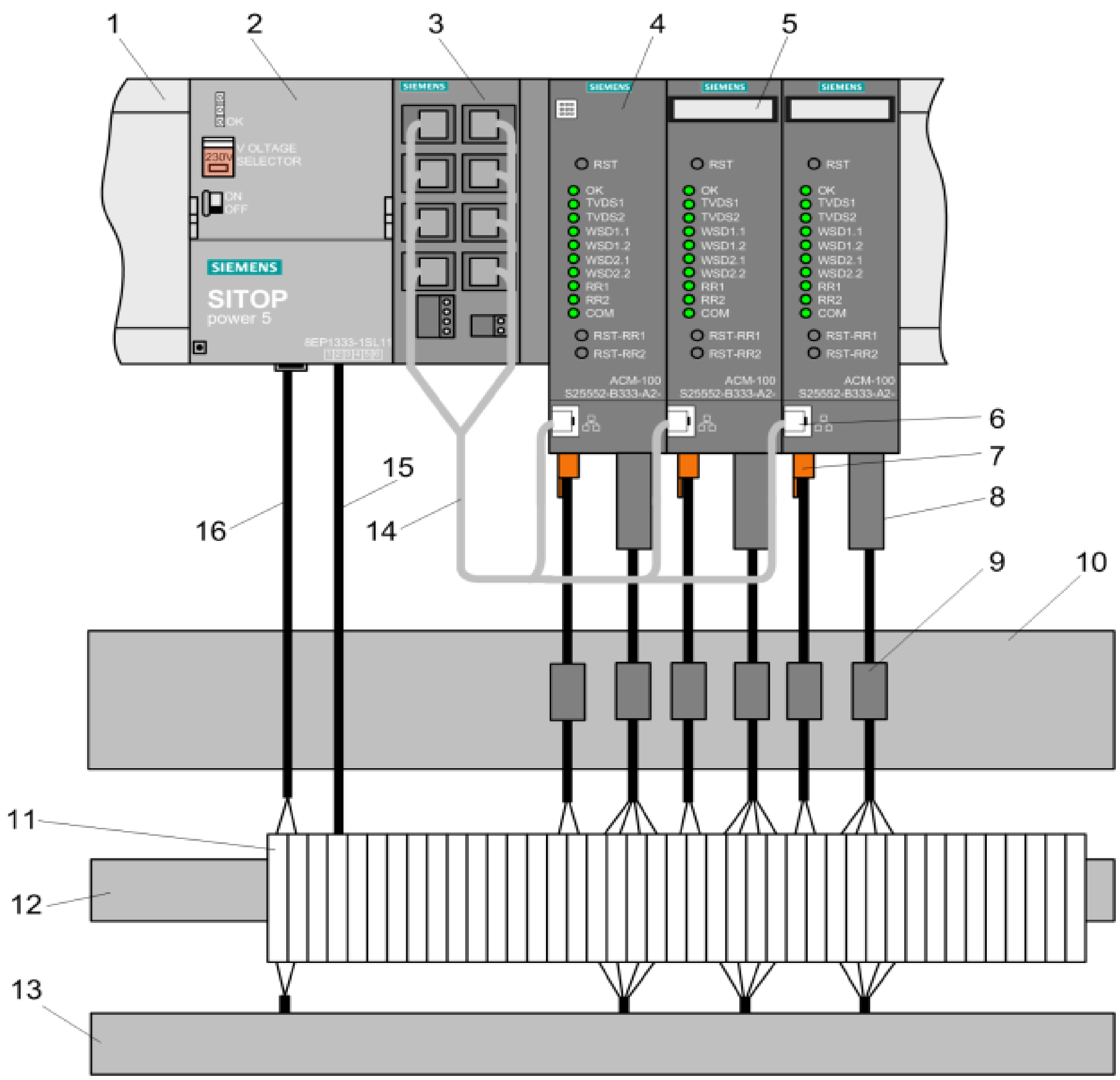


Figure 5 –Adjustment gauge C25326-A43-B27

How to Calibrate

For a full description of this process, see NR/SMS/Test/038.

Indoor Equipment



1	122 mm mounting rail
2	Power supply board
3	Switch
4	ACM100 (axle counter module)
5	ID plug
6	Ethernet socket
7	Power supply connector
8	Process connector

9	Surge protection
10	Mounting rail
11	Terminal
12	Terminal strip
13	Cable duct
14	Ethernet cable
15	Power supply (24 V DC)
16	Power supply (230 V AC)

Figure 6 – Indoor Equipment

ACM100 Evaluator

The Indoor equipment consists of a combination of standard modules (ACM100) which form an axle counting system. The ACM100, see above, has the following functions:

- Evaluation of the signal pulses transmitted by the wheel detection components
- Comparison of the number of axles counted into a track vacancy detection section with the number of axles counted out.
- Monitoring of the track vacancy detection sections and output of the clear and occupied indications.
- ACM100 has a 2-out-of-2 computer configuration, based on the fail-safe Simis principle.
- The process data (passage of a wheel) is detected by the WSD, processed and transmitted to the assigned ACM100. The ACM100 processes and evaluates the WSD signals and indicates the results to the interlocking.

Figure 7 – ACM100 Evaluator

Conditional and unconditional resets can be realised as inputs from the interlocking. The reset restriction can be cancelled from the interlocking using an optional dual-channel auxiliary axle count reset (AZGH) operation. This is also possible directly on the ACM100.

Front Panel

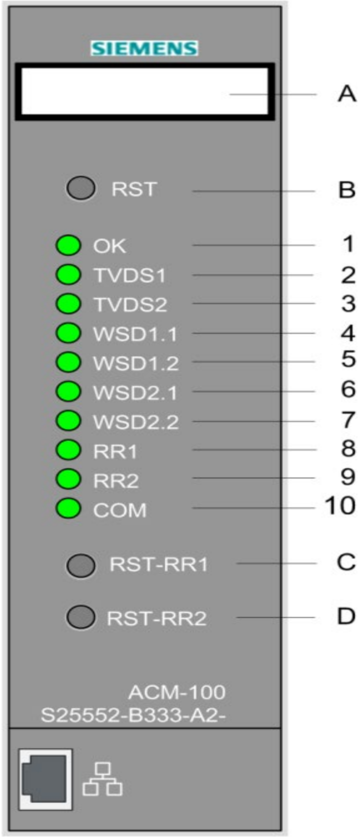


Figure 8 – ACM100 Front Panel

Item	Element	LED Condition	Meaning
A	ID plug		Configuring connector with lettering field
B	RST		Reset button (resets the ACM100)
1	OK LED	Steady green	ACM100 OK
		Flashing green	Configuration acceptance mode
		Flashing yellow	Configuration mode
		Flashing red	ACM100 faulty
		Steady red	Safety cut-off
2	TVDS1 LED	**Track vacancy detection section 1**	
		Steady green	Clear
		Flashing green	Clear and WDME
		Steady yellow	Occupied
		Flashing yellow	Occupied and WDME
		Steady red	Occupied (restart, commissioning); axle count reset required
		Flashing red	Occupied (faulty, e.g. minus axle), axle count reset required
		For safety-related information	
		Steady green	Safety-related information active
		Steady yellow	Safety-related information inactive
		Flashing red	Connection failure
		For WSD "pulse detected" indication	
		Steady green	Pulses
		Steady yellow	Pulse-free

Item	Element	LED Condition	Meaning
3	TVDS2 LED	**Track vacancy detection section 2**	Refer to TVDS1
4	WSD1.1 LED	**WSD wheel detector 1 (channel 1)**	
		Steady green	Pulse-free (No wheel detected)
		Flashing green	Pulse-free & WDME (No wheel detected with diagnostic information)
		Steady yellow	Pulses (Wheel detected)
		Flashing yellow	Pulses & WDME (Wheel detected with diagnostic information)
		Flashing red	Fault detected
		Steady red	WSD or cable faulty
5	WSD1.2 LED	**WSD wheel detector 1 (channel 2)**	Refer to WSD1.1
6	WSD2.1 LED	**WSD wheel detector 2 (channel 1)**	Refer to WSD1.1
7	WSD2.2 LED	**WSD wheel detector 2 (channel 2)**	Refer to WSD1.1
8	RR1 LED	**Reset restriction 1 (RR indication for TVDS 1)**	
		Steady yellow	Reset restriction
		Flashing red	Button fault and reset restriction
		For safety-related information and WSD "pulse detected" indication	
		Steady green	No button fault
		Steady red	Button fault
		For no TVDS and no safety-related information	
		Steady red	Button fault
9	RR2 LED	**Reset restriction 2 (RR indication for TVDS 2)**	Refer to RR1
10	COM LED	**Communication**	
		Steady green	All fail-safe connections OK
		Steady yellow	≥ 1 fail-safe connection has failed
		Steady red	Fault in computer unit
		Flashing red	No physical connection
C	RST-RR1	Reset button for reset restriction 1	Cancelation of reset restriction for TVDS 1 (AZGH) As from ERL 6, for confirmation after replacement of an ACM100
D	RST-RR2	Reset button for reset restriction 2	Cancelation of reset restriction for TVDS 2 (AZGH) As from ERL 6, for confirmation after replacement of an ACM100

Table 2 – LED Indications and Meaning

Diagnostic Overview

Figure 9 shows the LED fault indication status.

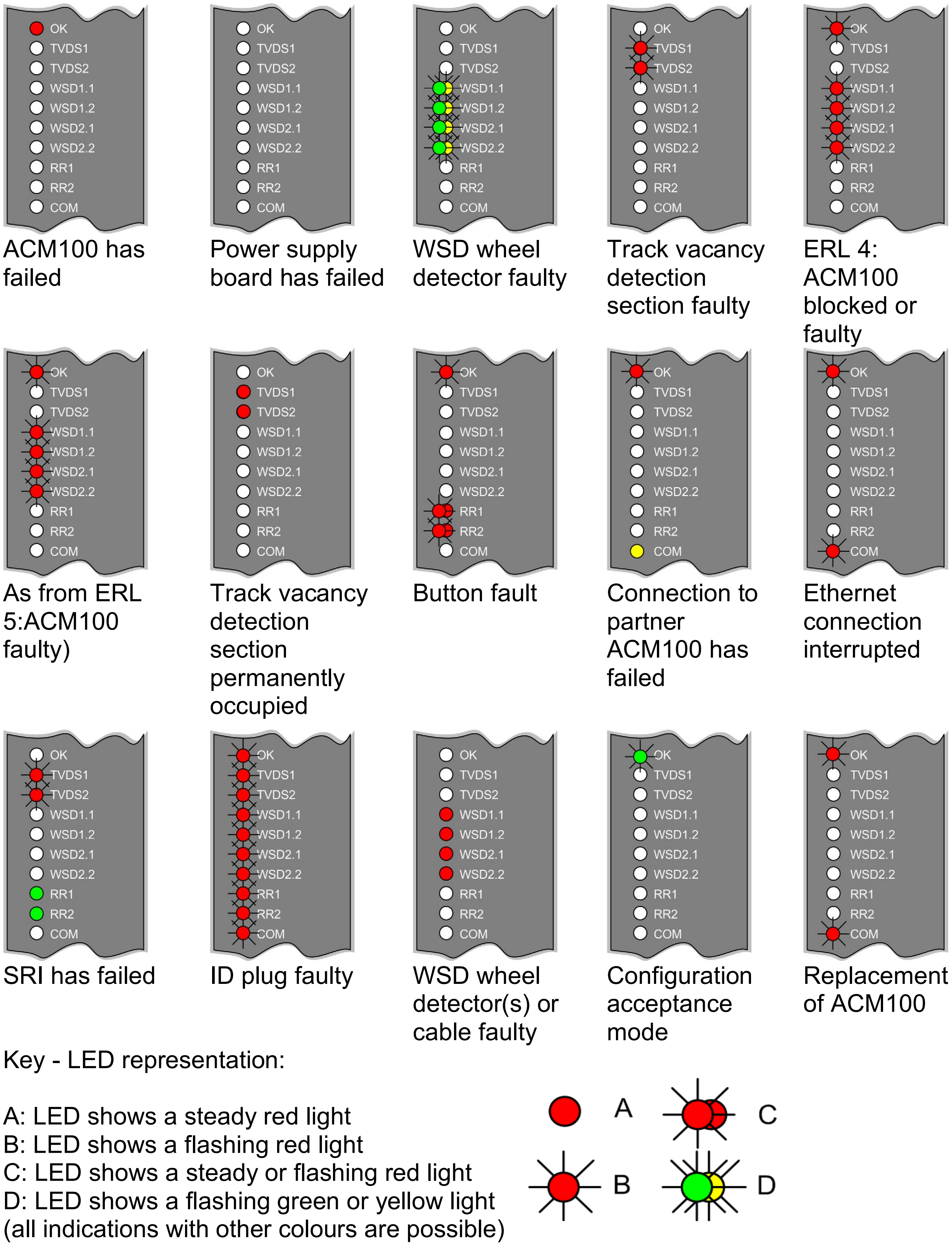


Figure 9 – LED fault indication status

Reset Procedure

The resetting of the Siemens ACM100 axle counter is performed by the signaller.

The reset procedure shall be performed when:

a) An axle counter section remains occupied after the passage of a train when the track section is ‘clear’.

b) Requested by the technician after faults.

Power Supply

The power supplies from the Simatic S7-300 range supply the power required for the ACM100 system. From the input voltage, they generate a supply voltage of 24 V DC. Different types of power supplies are used depending on the application variant. The green LED on the front panel indicates that an output voltage is present.

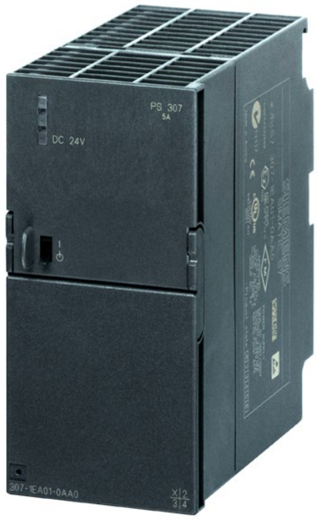


Figure 10 – Power Supply

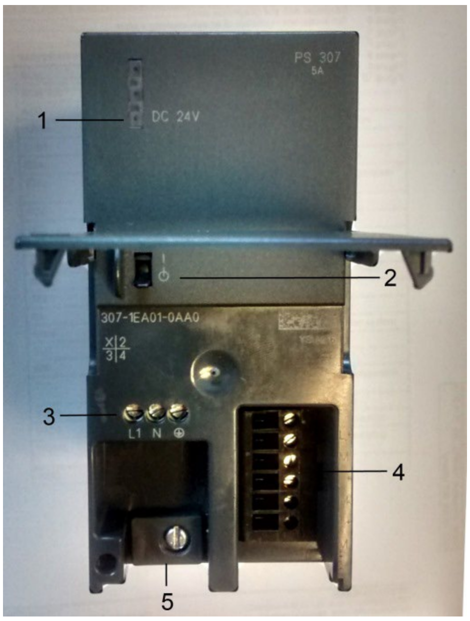


Figure 11 – Front Panel

Item	Element	Meaning / function	State in normal operation
1	DC 24 V LED	24 V DC output voltage is present	On
2	ON / OFF switch	On / off switch for 24 V DC	-
3	Terminals	Connection of mains voltage and protective earth conductor	-
4	Terminals	Connection for 24 V DC	-
5	Terminal	Strain relief for cables	-

Table 3 – Front Panel (flap open)

Diagnostic Indicators

See ACM diagnostic overview for LED indication.

c) **If …**	d) **Then …**
all LEDs on other ACMs are off as well,	The power supply board is faulty. • Check the power supply board
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.

Table 4 – Diagnostic Indicators

Battery Module

Weight	3.2 kg / 7 lbs.
Overall dimensions	W 190 mm H 151 mm D approx. 82 mm
Battery	2 pcs, maintenance free AGM batteries 12V/3,2Ah
Type	Yuasa NP3, 2-12 or B. B. Battery BP3, 6-12
Fuse	Blade fuse 15A

Table 5 – Battery Details

Figure 12 – Battery Module

Permitted temperature	Operation -15...+50°C storage/ transport -20...+50°C. Operating conditions acc. to EN 60721-3-3, climate model 3K3, no condensation
Self-discharge	The self-discharge rate of the batteries is approx. 3% per month at a temperature of 20°C. This value depends on temperature and gets worse with increasing temperature and, resp., better with falling temperature.
Class of protection	III acc. to IEC 536; VDE 0106 Part 1 Preferably, the natural protective conductor connection through the fittings should be used. Degree of protection: IP00 acc. to IEC 529

Table 6 – Battery Operating Conditions

Uninterruptable Power Supply (UPS)

The DC-UPS module 6 is DIN rail mounted. If the 24V DC supply voltage fails or drops below the set cut-in threshold, the battery module, which is maintained at full charge in continuous supply mode, is connected in to supply the loads.
The battery cut-in threshold, end-of-charge voltage, charging current and the buffering time are set via DIP-switches. A switch is provided for setting a defined buffering (stored energy) time with subsequent disconnection of the battery.
The operating states of the DC-UPS module 6 are signalled by four LEDs:

- Normal Operation (Green)
- 85% Charge (Green)
- Floating Operation (Yellow)
- Battery Not Ready (Red)

Figure 13 – UPS Module

"Normal operation" indicates the input voltage at the DC-UPS module is higher than the set cut-in threshold. The loads are being fed by the line-side power supply. If a battery module is connected, it is fully charged.

“>85% charge”, indicates the battery is charged more than 85% of its available capacity.

"Floating operation", indicates the input voltage is lower than the set cut-in threshold and the ACM100 equipment is being supplied by the battery module.

"Battery not ready" indicates one of the following, all of which require corrective maintenance:

- defective battery (battery voltage < 18.5V) or open circuit between battery and UPS module
- no battery module connected,
- reversed polarity

The interval for polling the operating state for “Battery not ready” is 20 seconds during normal operation. If a fault is rectified, the LED can remain lit for up to 20 seconds until updated at the next polling.

If the LED flashes in a 2s cycle, this indicates that the battery is defective, but still capable of floating operation. The specified hold-up times cannot be kept in such cases. **The battery module shall be replaced.**

The LED lit in **floating operation** means that the battery voltage has dropped to <20.4V and automatic disconnection to protect the battery is imminent.

When the battery has been disconnected due to overload, short circuit, exhaustive discharge protection or buffering timeout, all LEDs will switch off however the relay contact X2.4 – X2.5 will remain closed.

DIP Switch Settings

Note: L = switch positioned left (on) and R = switch positioned right (off).

Top DIP1, 2 & 3: Sets the cut-in threshold such that if the input voltage drops below this threshold the UPS module switches to the battery supply. The setting range is 22.0 to 25.5V DC in 0.5V steps -

Cut-in Voltage (V)	22.0	22.5	23.0	23.5	24.0	24.5	25.0	25.5
DIP1	R	R	R	R	L	L	L	L
DIP2	R	R	L	L	R	R	L	L
DIP3	R	L	R	L	R	L	R	L

Table 7 – DIP Switches (1)

Top DIP4, 5, 6, 7, 8 & 9: Sets the end of charge voltage threshold above which the battery stops charging. The setting range is 26.3 to 29.2V DC in 0.1V steps -

End of Charge Voltage (V)	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3
DIP4	R	R	R	R	R	R	R	R	R	R	R
DIP5	R	R	R	R	R	R	R	R	R	R	L
DIP6	R	R	R	R	R	L	L	L	L	L	R
DIP7	R	R	R	R	L	R	R	R	R	L	R
DIP8	R	R	L	L	L	R	R	L	L	L	R
DIP9	R	L	R	L	R	R	L	R	L	R	R

Table 8 – DIP Switches (2)

End of Charge Voltage (V)	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4
DIP4	R	R	R	R	R	R	R	R	R	L	L
DIP5	L	L	L	L	L	L	L	L	L	L	L
DIP6	R	R	R	R	L	L	L	L	L	R	R
DIP7	R	R	R	L	R	R	R	R	L	R	R
DIP8	R	L	L	L	R	R	L	L	L	R	R
DIP9	L	R	L	R	R	L	R	L	R	R	L

Table 9 – DIP Switches (3)

End of Charge Voltage (V)	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3
DIP4	L	L	L	L	L	L	L	L	L
DIP5	L	L	L	L	L	L	L	L	L
DIP6	R	R	R	L	L	L	L	L	L
DIP7	R	R	L	R	R	R	R	L	L
DIP8	L	L	L	R	R	L	L	L	L
DIP9	R	L	R	R	L	R	L	R	L

Table 10 –DIP Switches (4)

Top DIP10: Sets the constant charging current for the battery module. Refer to the specific battery module documentation so the optimum setting is used. The settings are 0.2A DC (DIP10 = L) or 0.4A DC (DIP10 = R)

Bottom DIP1: During the battery supply output, sets if the time on battery is until its exhaustive discharge threshold or for a predetermined time (see below). The settings are predetermined time (DIP1 = L) or exhaustive (DIP1 = R).

Bottom DIP2, 3, 4, 5, 6 & 7: Sets the maximum time the battery supply output is on. The setting range is 5 seconds to 635 seconds in 10 second steps -

Time (seconds)	5	15	25	35	45	55	65	75	85	95	105	115	125	135
DIP2	R	R	R	R	R	R	R	R	R	R	R	R	R	R
DIP3	R	R	R	R	R	R	R	R	R	R	R	R	R	R
DIP4	R	R	R	R	R	R	R	R	L	L	L	L	L	L
DIP5	R	R	R	R	L	L	L	L	R	R	R	R	L	L
DIP6	R	R	L	L	R	R	L	L	R	R	L	L	R	R
DIP7	R	L	R	L	R	L	R	L	R	L	R	L	R	L

Time (seconds)	145	155	165	175	185	195	205	215	225	235	245	255	265	275
DIP2	R	R	R	R	R	R	R	R	R	R	R	R	R	R
DIP3	R	R	L	L	L	L	L	L	L	L	L	L	L	L
DIP4	L	L	R	R	R	R	R	R	R	R	L	L	L	L
DIP5	L	L	R	R	R	R	L	L	L	L	R	R	R	R
DIP6	L	L	R	R	L	L	R	R	L	L	R	R	L	L
DIP7	R	L	R	L	R	L	R	L	R	L	R	L	R	L

Time (seconds)	285	295	305	315	325	335	345	355	365	375	385	395	405	415
DIP2	R	R	R	R	L	L	L	L	L	L	L	L	L	L
DIP3	L	L	L	L	R	R	R	R	R	R	R	R	R	R
DIP4	L	L	L	L	R	R	R	R	R	R	R	R	L	L
DIP5	L	L	L	L	R	R	R	R	L	L	L	L	R	R
DIP6	R	R	L	L	R	R	L	L	R	R	L	L	R	R
DIP7	R	L	R	L	R	L	R	L	R	L	R	L	R	L

Time (seconds)	425	435	445	455	465	475	485	495	505	515	525	535	545	555
DIP2	L	L	L	L	L	L	L	L	L	L	L	L	L	L
DIP3	R	R	R	R	R	R	L	L	L	L	L	L	L	L
DIP4	L	L	L	L	L	L	R	R	R	R	R	R	R	R
DIP5	R	R	L	L	L	L	R	R	R	R	L	L	L	L
DIP6	L	L	R	R	L	L	R	R	L	L	R	R	L	L
DIP7	R	L	R	L	R	L	R	L	R	L	R	L	R	L

Time (seconds)	565	575	585	595	605	615	625	635
DIP2	L	L	L	L	L	L	L	L
DIP3	L	L	L	L	L	L	L	L
DIP4	L	L	L	L	L	L	L	L
DIP5	R	R	R	R	L	L	L	L
DIP6	R	R	L	L	R	R	L	L
DIP7	R	L	R	L	R	L	R	L

Table 11 – DIP Switches (5)

Bottom DIP8: Sets if the battery supply output maximum time is reduced by 5 seconds. The settings are 5 second reduction (DIP8 = L) or no reduction (DIP8 = R).

Bottom DIP9: Sets the operational state of the battery when supplying the output. The settings are fully functional (DIP9 = L) or no battery output (DIP9 = R).

Ethernet Switch

The ACMs are connected using the Scalance Ethernet switches. ACMs are connected to the switch via RJ45 sockets. For diagnostic purposes, a service PC or laptop can be connected to the switch. The power supply is connected via terminals.

The operating and display elements (LEDs, buttons) depend on the type of switch used. Detailed information may be found in the documentation for the relevant switch.

See ACM diagnostics overview for LED indication.

Figure 14 – Ethernet Switch

End

Includes:	All Thales Axle Counter Systems
Excludes:	All other types and makes of Axle Counter System

GENERAL

Thales equipment was previously known as Alcatel Systems.

1. Test Equipment (Where required)

There are certain items of specialist equipment required to complete all the testing on axle counter equipment; these are as follows:

a) Dummy Wheel (for the type of system to be tested).
b) Counting Test Unit (Not Essential).
c) Thales Test Unit.
d) Wago Termination Tool (do not use a screwdriver).
e) ISDN Dataline Tester.
f) Lineside Test Switch Box (silver suitcase, use with electronic meter).
g) Axle Counter Test Box (AzLM series).
h) Diagnostic PC.

2. Detection points (ZP)

A Thales detection point (ZP) is comprised of 2 field elements. A rail contact (count head), which is mounted to the rail, and a line side junction box (EAK) which is usually mounted in the cess of sometimes the 10ft. The 2 elements are connected via tail cables and together for the detection point (ZP).

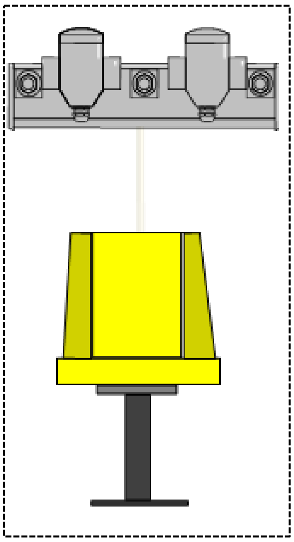


Figure 1 – ZP 30H Style

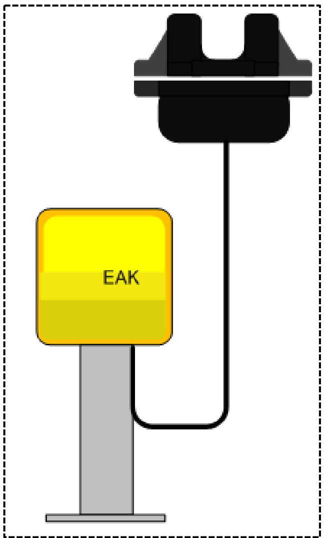


Figure 2 – ZP 30K Style

3. Rail Contacts (Count Heads)

Single rail contact systems are fitted with SK11 count heads and double rail contact systems with SK30. The latest types are the SK30H & SK30K types, which are backward compatible with the SK30 but with different voltage tolerances (MESSAB and PEGUE).

If SK30, SK30H & SK30K heads are fitted to bullhead rail a flux plate should also be fitted with them to obtain the correct phase reversal voltages (Where fitted).

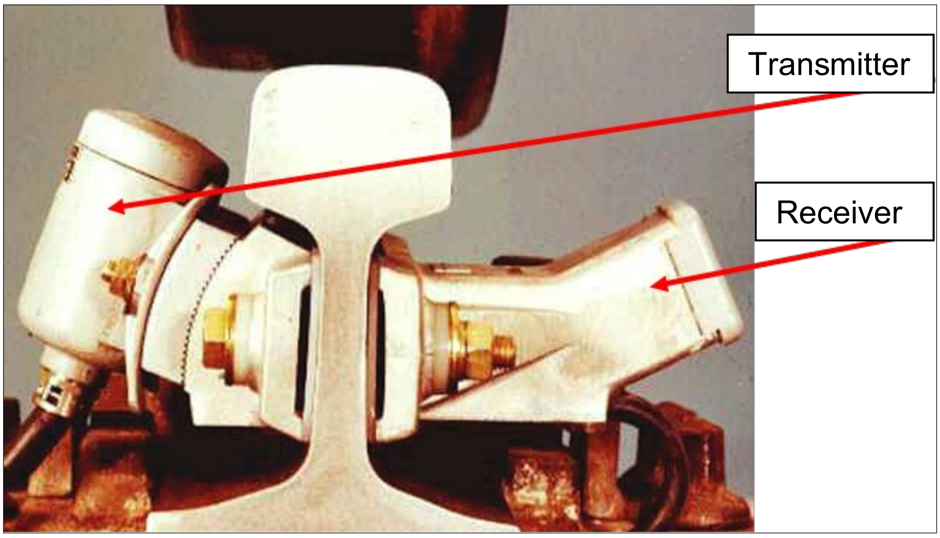


Figure 3 - View of Thales count heads (SK30H)

Figure 4 - View of Thales count heads (SK30K)

4. Lineside Junction Boxes (EAK)

The cable cores (from the rail contact cables) from the cable clamp to the terminations in the EAK are to be twisted together between these points. This is to reduce signal loss.

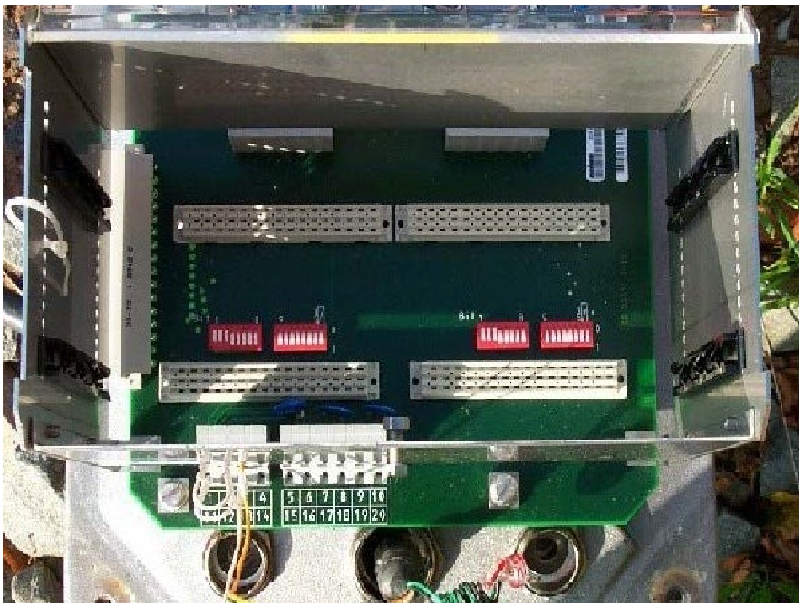


Figure 5 - Top View of the EAK30H Lineside Junction Box

The evaluator batteries and the EAK30H local power supply batteries (where provided) are 'sealed for life' and therefore apart from cleaning do not require maintenance.

Figure 6 - Top View of the EAK30K Lineside Junction Box

5. AzL70 Series

There are four versions of the AzL70 axle counters; they all work on the principle of counting in at one set of count heads and counting out at another. The count in and out information is processed in the evaluator, which feeds an output to a TPR. The different types are listed below:

AzL70 Single Rail Contacts:

This is the earliest type of the AzL70 series and is a two rail system (SK11 rail contacts on the 6ft and cess rails) with a stagger between the two rail contacts.

The stagger distance is chosen by the manufacture to enable the system to detect trains travelling at the highest specified speed.

This distance must not be altered from its original setting, if due to rail creep the stagger distance alters; arrangements must be made to correct it.

The rail contacts are connected to the evaluator via a four wire cable, the TX frequencies for each count head are the same thus the signals are sent back on separate wires to an AzL70 evaluator.

The lineside junction box is an EAK unit that does not have pluggable circuit cards.

AzL70 Double Rail Contacts:

This is a one rail version with SK30 rail contacts. Both of the rail contacts fixed to one rail (usually the cess). Again they are staggered but with both attached to one mounting plate the distance between them is pre-defined therefore rail creep is not a problem.

The lineside junction box is an EAK30 unit having pluggable cards. This unit enables signals of different frequencies to be sent along a common cable pair (a two-wire transmission system) to an AzL70 evaluator with amended configuration strapping.

AzL70/30 High Frequency Double Rail Contacts:

This is a single rail version with SK30 rail contacts. It uses an EAK30 lineside junction box with a two-wire transmission system to an AzL70/30 evaluator which has a different card configuration to the previous types.

AzL70/30S Voice Frequency Double Rail Contacts:

This is similar to the previous system but the outputs from the EAK30 units are at a lower frequency, therefore some of the cards in the EAK30 and evaluator are slightly different.

Because of the variations in type and updates that have occurred it is important that you check the part codes on any cards before replacing them.

Although the cards might look the same and have the same name, if the codes are different they are not inter changeable.

Evaluators

Before removing any card from an evaluator rack, it is necessary to power-down the rack equipment to avoid damage. This is done by removing the fuse feeding the rack.

On all evaluators the count indicator board (ZIANZG) provides indication only, it is not required for operation of the axle counter system therefore you may find that not all evaluators at a site are fitted with them.

AzL70 Evaluator

This evaluator is used on both the AzL70 one and two rail versions. Because of the EAK30 unit on the one rail contact system the evaluator although the same type for both systems has a different strapping configuration to handle the different frequencies involved.

AzL70/30 Evaluator

This type of evaluator differs from the AzL70 type by having a combined input set (LTV-E count in and LTV-A count out). The reset restrictions have also been revised (GRDFR in place of FRMKTR). The other cards in the system perform similar functions as in the AzL70.

6. AzLM Series

AzLM consists of the Axle Counter Evaluator (ACE) and one or more detection points.

There are two variants of the detection point which can be used electively within the AzLM; Zp30H or Zp30K.

The ACE is available with a 2oo2 (Parallel) or 2oo3 (WNC) architecture.

The ACE architecture can be centralised or distributed. A centralised solution can use the Convertor ISDN / Ethernet (CIE).

A detection point DP consists of an Electronic Junction Box (EAK) and rail contacts Sk with cable:

a) Detection point Zp30H with rail contacts Sk30, Sk30H and Sk30K (with new analogue card).

b) Detection point Zp30K with rail contacts Sk30K

Up to 32 sections can be supervised from one ACE. An ACE reports the state of a section via a parallel relay interface to a relay interlocking.

7. AzLE Series

This type of evaluator unit can be used with either ZP30H or ZP30K type detection points. It can be located either in an axle counter REB or a trackside location case.

The unit is the same size as an AzLM 2-10 and manages up to 8 sections and 12 detection points.

Although still a 2 out of 2 evaluator with relay interface, it differs to the AzLM by using modem and section boards as opposed to serial, CPU and parallel boards.

Interface to the detection point is achieved via 2 x copper wire ISDN, however no PDCU is required as surge/lightening protection is built into the modem boards. Site specific data is stored on a programme plug as opposed to a compact flash card.

Detection point power supply: The AzLE subrack can accommodate up to 3 detection point power supply boards. Each detection point power supply board can remotely supply a maximum of 4 detection points (ZPs)

Internal power supply board: The AzLE subrack can accommodate up to 2 internal power boards to supply the modem and section boards. The number of required in internal power boards is dependent on how many section and modem boards are to installed.

Section board: The AzLE subrack can accommodate up to 4 section boards. Each section board performs as a 2 out of 2 system and can supervise up to 2 sections dependant on configuration. The section board can be configured for 2 or 3 vital relay outputs and has vital inputs similar to the AzLM. Non vital outputs are also available and configurable.

Modem board: The AzLE subrack can accommodate up to 3 modem boards which perform the interface to the detection point (ZP) via ISDN. Each modem board can connect up to 4 detection points and is configurable to forward the information of 1 of these detection points to another subrack.

Reset procedures are similar to that of AzLM.

<u>Subrack:</u>

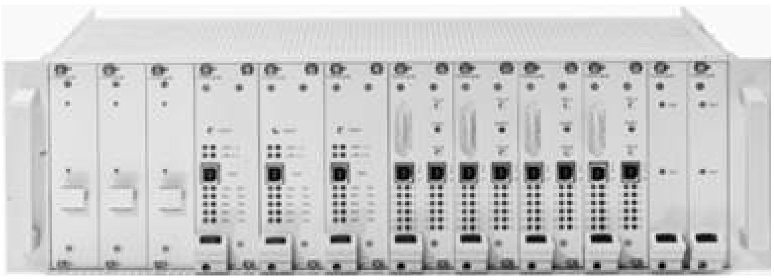


Figure 7 - Subrack

Figure 8 – Modem Board

Figure 9 – Section Board

Figure 10 - Detection Point Power Supply Board

Figure 11 - Internal Supply Board

8. Abbreviations Found in AzL Axle Counters

Abbreviation	Meaning
2oo2	2 out of 2
2oo3	2 out of 3
ACE	Axle Counter Evaluator
AZA	
AzLM	Multi Section Axle Counter
BG	Printed Circuit Board (PCB)
BGT	Sub rack
CPU	Central Processing Unit
DC	Direct Current
DP	Detection Point
E/A	Input/Output
EAK	Electronic Junction Box
E-Es	Electronic Module
I/O	Input/Output
KL	Terminal
S/E	Transmitter/Receiver
SK	Rail Contact
SSI	Solid State Interlocking
SV	Power Supply
VCC	Supply Voltage
Zp	Detection Point
ZpR	CPU in the detection Point

This list is not exhaustive; reference should be made to the appropriate system manuals for abbreviations not listed.

9. AzL70/30 EAK30 Junction Box Cards

Viewed left to right:

Card	Function
SE01	Tx/Rx for Count Head SK1
SE02	Tx/Rx for Count Head SK2
LtAnp	Cable Adaptor
SV	Power Supply

10. AZL70 Evaluator Rack Cards

Viewed left to right:

Card	Function
FRMKTR	Reset Restriction
ANP	Part Input Set
EV	Part Input Set
DIS	Part Input Set
	Repeat of above 3 cards for each input
ZST	Counter Control
Biz	Binary Counter
Biz	Binary Counter
UMO	Translator
KTR	Checking
AS	Output
ZIANZG	(If Fitted) Count Indication
WDH	Repeater
BUPL	Test Points
SIPL	Fuses
SVB	Power Supply B
SVA	Power Supply A
SBG	Filters

11. AzL70/30 Evaluator Rack Cards

Card	Function
GDRFR	Reset Restriction
LTV-E	Line Amplifier Count In
Dis	Discriminator
LTV-A	Line Amplifier Count Out
Dis	Discriminator
	Space (see note)
ZST	Counter Control
Biz	Binary Counter
Biz	Binary Counter
UMO	Translator
KTR	Checking
AS	Output
ZIANZG	(If Fitted) Count Indication
WDH	Repeater
BUPL	Test Points
SIPL	Fuses
SVB	Power Supply B
SVA	Power Supply A
SBG	Filters

If extra count heads for counting out are fitted (e.g. over a set of points) the LTV-A and Dis cards for this count head are fitted here.

12. LED Indications : SK30H

PCB	LED Position	LED Colour Status	What The Led Status Is Indicating	Normal Operating Led Status Without Wheel Influence
Analogue Card (Anpassung)	H1/1	Red	Wheel on Sk1	Off
	H1/2	Green	MESSAB1 in tolerance of PEGUE 1	Flashing
	H2/1	Red	Wheel on Sk2	Off
	H2/2	Green	MESSAB2 in tolerance of PEGUE 2	Flashing
	H3/1	Red	H24V out of tolerance	Off
	H3/2	Green	H5V O.K. / available	On
Digital Card (Auswertung)	H1/1	Green	Transmitting data, connection to ACE available	Flashing
	H1/2	Green	Self-test of CPU 1 not successful	Off
	H2/1	Green	Transmitting data, connection to ACE available	Flashing
	H2/2	Green	Self-test of CPU 2 not successful	Off

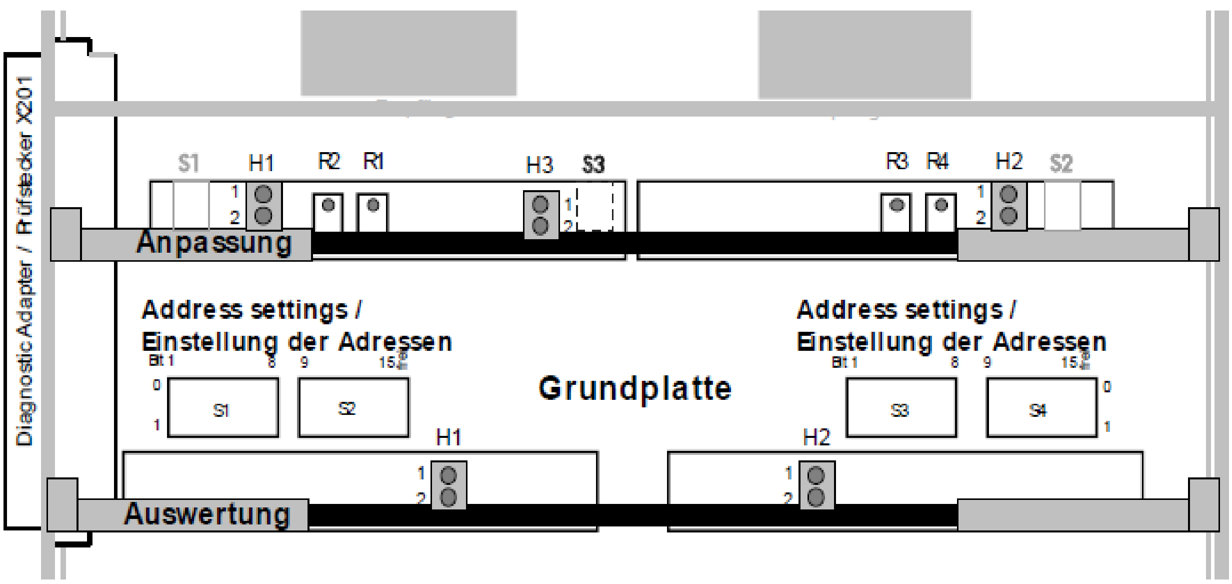


Figure 12 - Position of SK30H LED's

13. LED Indications : SK30K

PCB	LED Position	LED Colour Status	What The Led Status Is Indicating	Normal Operating Led Status Without Wheel Influence
Analogue Part	H11	Red	wheel on Sk1	Off
	H1	Green	MESSAB1 in tolerance of PEGUE 1	Flashing
	H8	Red	Illuminate during fault conditions (Short circuit on Sk1)	Off
	H12	Red	wheel on Sk2	Off
	H2	Green	MESSAB2 in tolerance or PEGUE 2	Flashing
	H9	Red	Illuminate during fault conditions (Short circuit on Sk2)	Off
	H3	Red	H24V out of tolerance	Off
	H10	Green	H5V o.k. / Available	On
Digital Part	H4	Green	Transmitting data, connection to ACE available	Flashing
	H14	Red	Self-test of CPU 1 not successful	Off
	H6	Green	Transmitting data, connection to ACE available	Flashing
	H16	Red	Self-test of CPU 1 not successful	Off

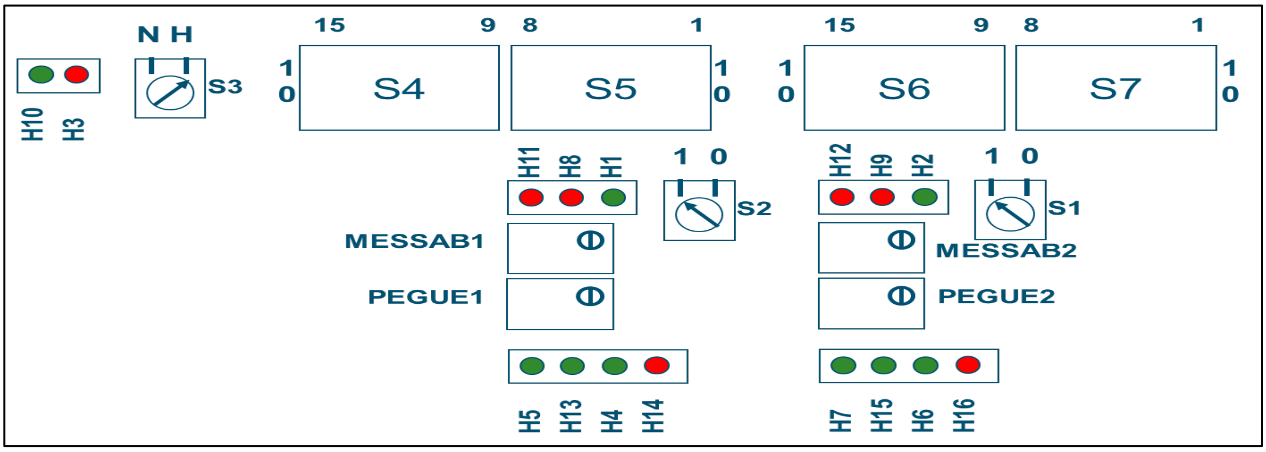


Figure 13 - Position of SK30K LED's

The switch positions on this card should be S1=1, S2=1, S3=H

14. LED Indications : Evaluator Serial I/O Card (Zp-Vorrechner)

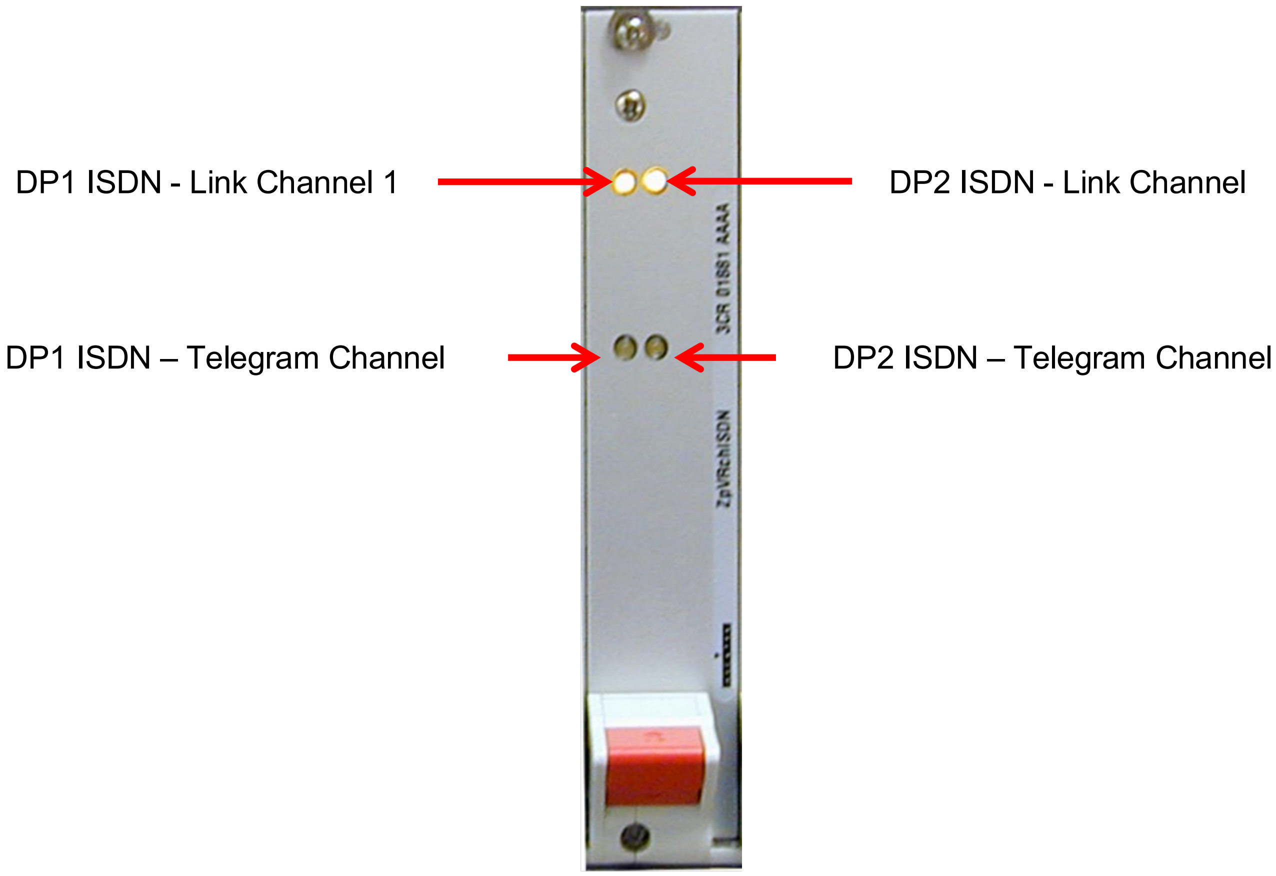


Figure 14

LED	Colour	State	Meaning
DP1 ISDN - Link Channel	**Yellow**	Extinguished	No ISDN link from Zp
		Illuminated	ISDN link operational
DP2 ISDN - Link Channel	**Yellow**	Extinguished	No ISDN link from Zp
		Illuminated	ISDN link operational
DP1 ISDN – Telegram Channel	**Yellow**	Illuminated / Extinguished	No valid telegram from Zp
		Pulsing	Valid telegram from Zp
DP2 ISDN – Telegram Channel	**Yellow**	Illuminated / Extinguished	No valid telegram from Zp
		Pulsing	Valid telegram from Zp

15. LED Indications : Evaluator Parallel I/O Card

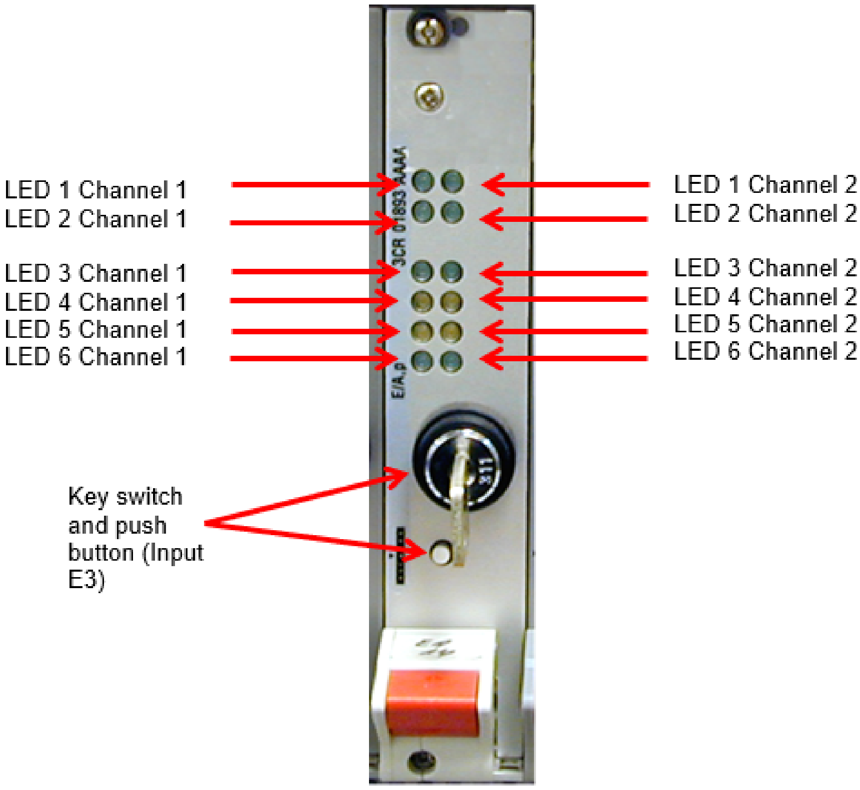


Figure 15

LED	Channel	Colour	State	Meaning
1	1 + 2	**Green**	Extinguished	External Input 1 not active
			Illuminated	External Input 1 active
2	1 + 2	**Green**	Extinguished	External Input 2 not active
			Illuminated	External Input 2 active
3	1 + 2	**Green**	Extinguished	Associated section is occupied
			Illuminated	Associated section is clear
4	1	**Yellow**	Illuminated	Non Vital Output 1 Energised
	2	**Yellow**	Illuminated	Non Vital Output 2 Energised
5	1	**Yellow**	Illuminated	Non Vital Output 3 Energised
	2	**Yellow**	Illuminated	Non Vital Output 4 Energised
6	1 + 2	**Yellow**	Illuminated/ Extinguished	Incorrect Polling of Input/Output
			Polling	Correct Polling of Input/Output

On earlier cards (V1.0.3) the only difference is rows 5 and 6, row 5 is polling and row 6 when illuminated indicates that the key switch and push button is active, its normal state should be extinguished.

Key switch/push button E3 can be configured as external input 3. The use of the function is controlled via Local Instruction. Interference with this key switch/button can cause locking of the inputs/outputs of the parallel card.

LED Indications: ACE DC to DC Power Cards

There are variants of this card in use at his time.

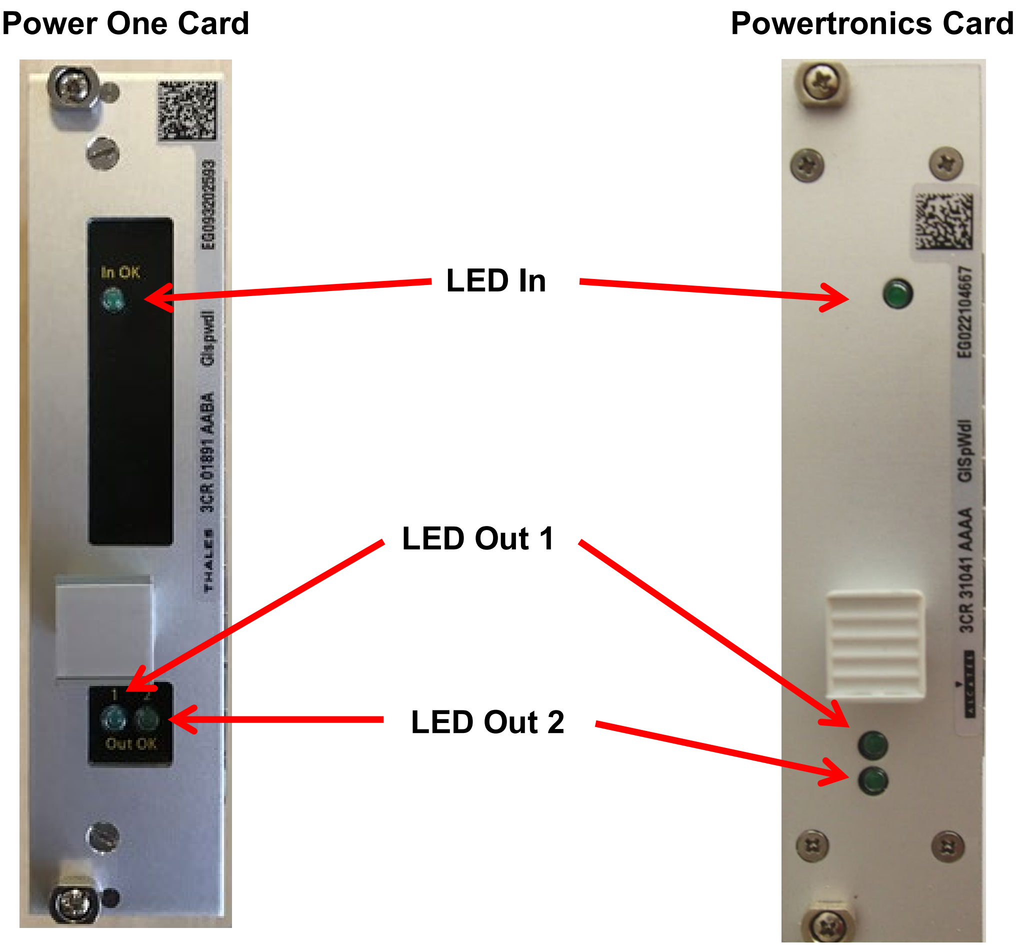


Figure 16

LED In	LED Out 1	LED Out 2	Function
Green	Green	Green	Normal Operation
Green	Off	Green	Temperature too high, over-load, over voltage output 1 or under voltage output 1
Green	Green	Off	Temperature too high, over-load, over voltage output 2/3 or under voltage output 2/3
Off	Green	Green	Not possible or “LED In” has failed
Off	Off	Off	No input voltage, input voltage too low, input open/high or voltage too high

If the PowerOne version of the DC/DC converter card is used it should be supplier version V106 or greater.

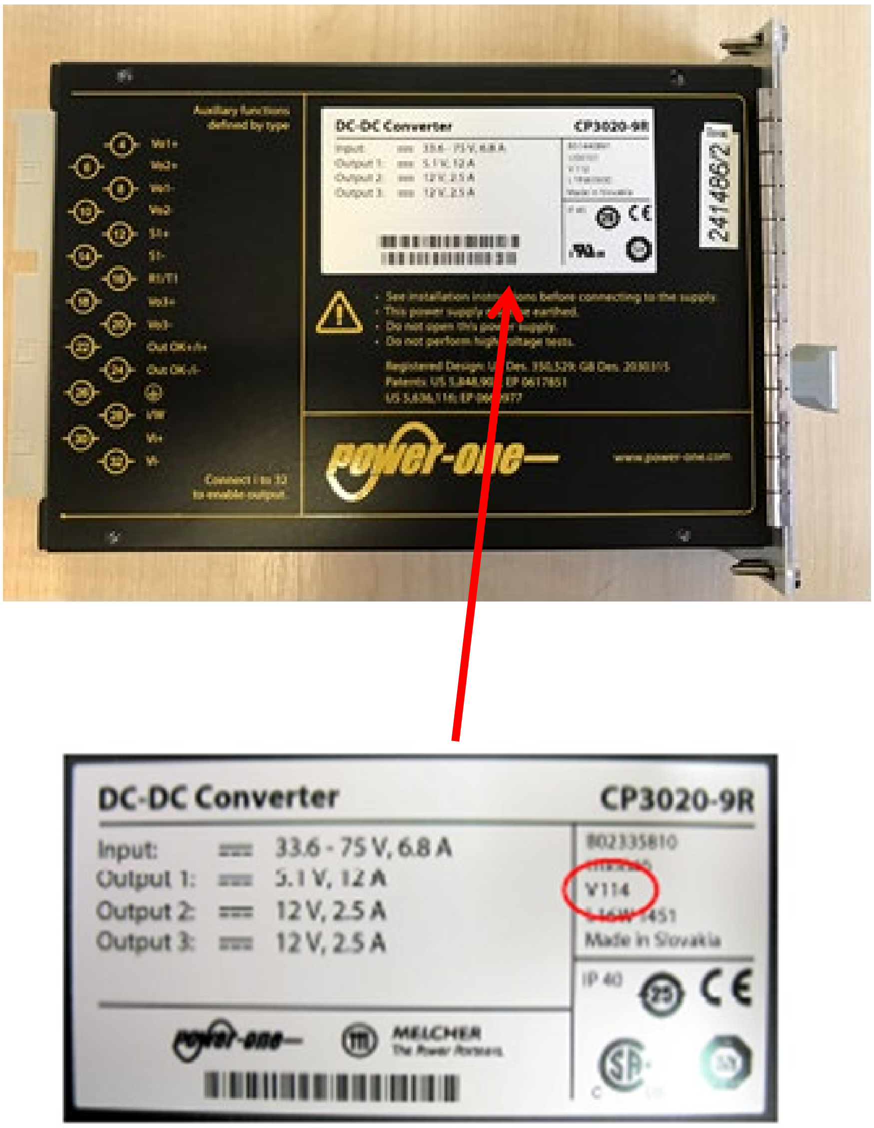
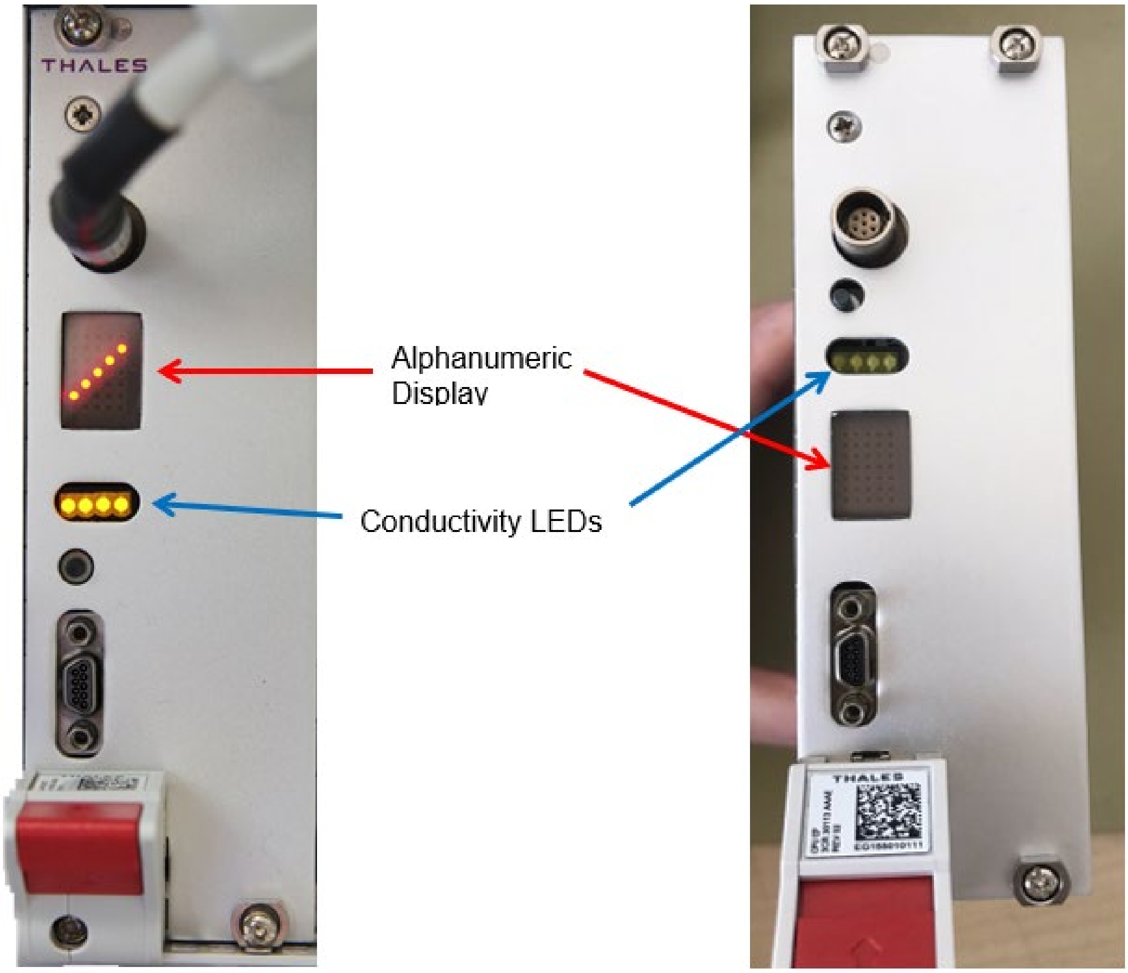


Figure 17

16. LED Indications: Evaluator CPU Cards (EP & EPCM Type)



EPCM CPU Card **EP CPU Card**

Figure 18

Indication	Colour	State	Meaning
Alphanumeric Display	Red	Frozen bar	No CPU activity or CPU starting up
		*	
		Blank	
		Rotating bar	Correct CPU activity

Connectivity LED's		
LED	**Colour**	**Meaning**
1		There is communication via the Ethernet Port
2		There is internal communication between CPU's
3		There is internal communication between CPU's
4		Thales use only

17. Single Channel Controller (SCC)

This board has been introduced due the obsolescence of the current EP (Embedded Pentium) & EPCM (Embedded Pentium Celeron Mobile) CPU's.

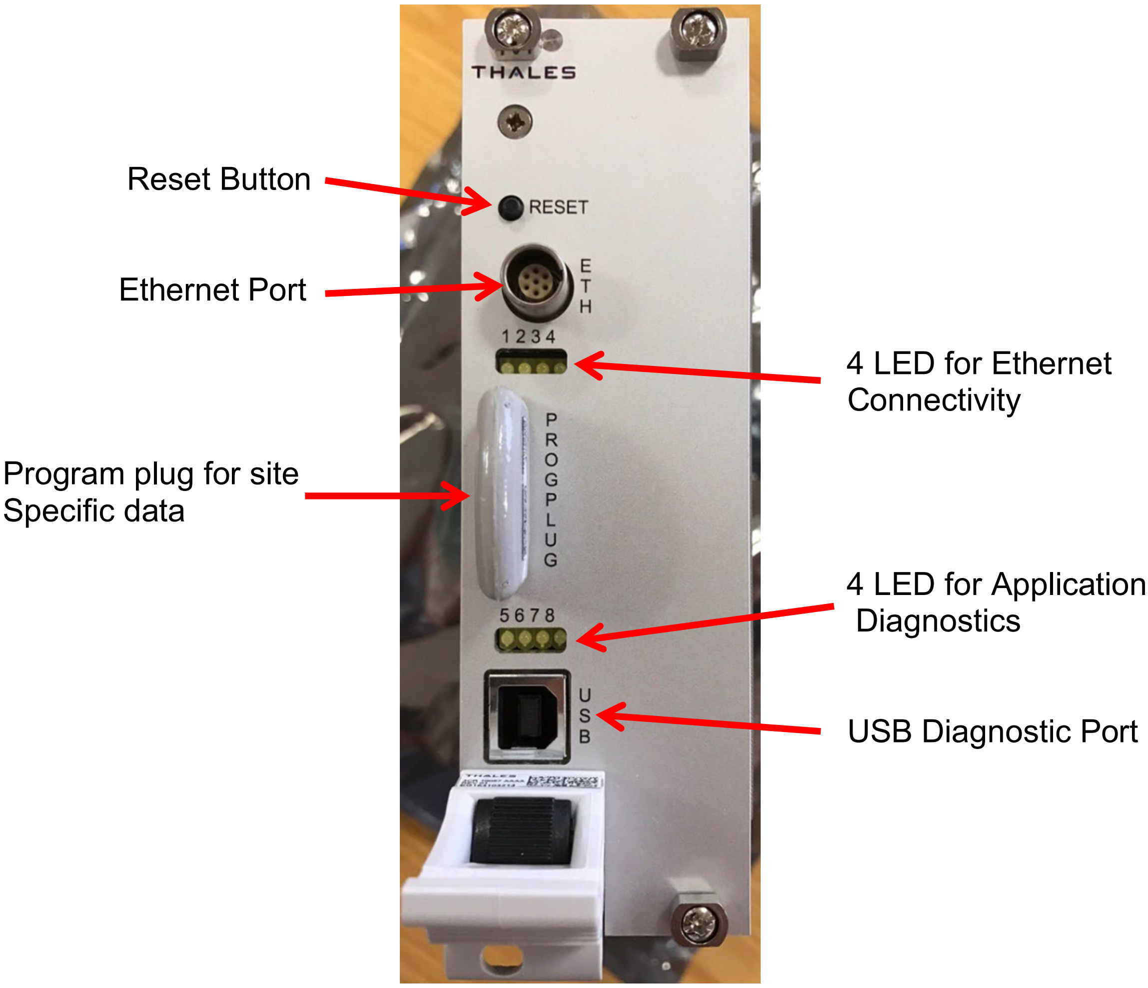


Figure 19

Connectivity LED's		
LED	**Colour**	**Meaning**
1		There is communication via the Ethernet Port
2		There is internal communication between CPU's
3		There is internal communication between CPU's
4		Thales use only
Diagnostic LED's		
LED	**Colour**	**Meaning**
5		These are polling LED's these indicate normal operation
6		
7		
8		

18. CPU Compatibility

There are four different types of CPU for the AzLM ACE:-

a) EP – (Embedded Pentium) Rev 1 (Commonly known as Rev A).
b) EP – (Embedded Pentium) Rev 2 (Commonly known as Rev B).
c) EPCM – (Embedded Pentium Celeron Mobile).
d) SCC – Single Chanel Controller.

These are to be installed in an ACE in pairs and are not mix and match. If CPU 2 only needs to be replaced it should be replaced with the same part number and rev / version number above. If this is not possible both CPUs should be replaced.

EP and EPCM CPUs use the serial connection of CPU 1 or Ethernet port of CPU2. The SCC board uses the USB on CPU 1 and Ethernet port of CPU2.

There are now three types of 128mb compact flash card, WD, Silicon Drive and Swissbit. WD and silicon drive and be mixed and matched in once ace.

19. Flash Cards Compatibility

Figure 20 – Swissbit Compact Flash Cards

Figure 21 – WD & Silicon Drive Compact Flash Cards

<u>Swissbit Type</u>

Swissbit can't be used with WD and silicon drive.

Swissbit cards can only be used by EPCM boards. For ACE's with Swissbit cards only EPCM CPU's can be used.

<u>WD (Western Digital) & Silicon Drive Types</u>

EP Rev 1, EP Rev 2 & EPCM can all use WD and Silicon drive.

	WD (Western Digital)	Silicone Drive	Swissbit
EP Rev 1	YES	YES	NO
EP Rev 2	YES	YES	NO
EPCM	YES	YES	YES
SCC	NO	NO	NO

Table – Compact Flash Card : Compatibility Matrix

<u>Program Plug Type</u>

SCC CPU uses a program plug and not a compact flash card. If the CPU needs to be changed from a EP Rev 1, EP Rev 2 & EPCM to SCC the data will need to be transferred from the compact flash card to the program plug and this must be completed by Thales.

20. Converter ISDN Ethernet (CIE) Card

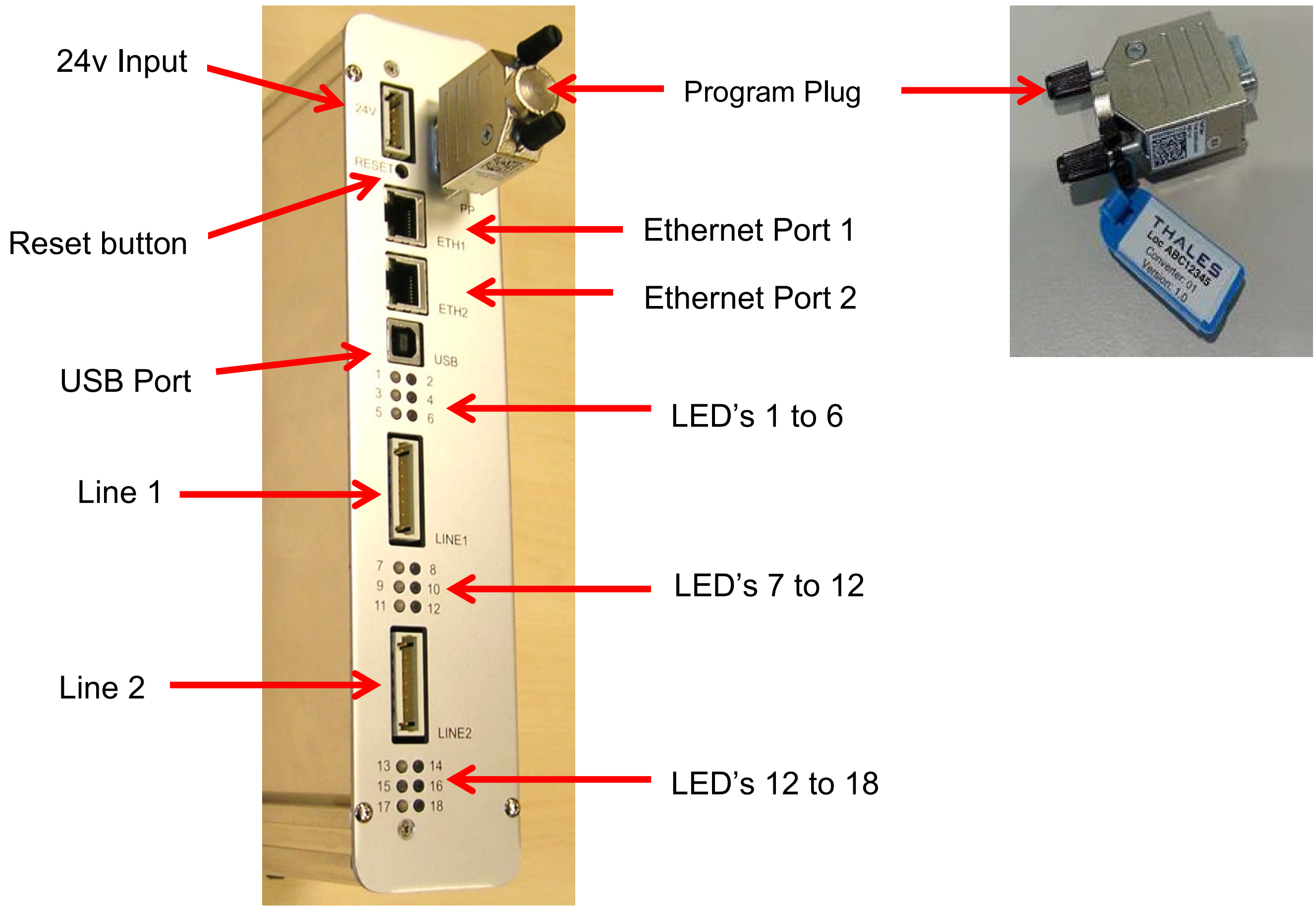


Figure 22

LED	Meaning	Normal Operation
1	Life signal CPU	**Green LED toggles** every second
2	Life signal CPU	**Yellow LED toggles** every second
3	PIC trigger	**Yellow LED toggles** every second
4	Not used	**Off**
5	24V redundant	**Green LED on**: Connected to 2 power supplies
6	24V non-redundant	**Off**: 24 V redundant available, LED 5 on.
7	Modem 1	**Green LED toggles** (every 200 ms) with each received correct telegram from modem 1 / 2.
8	Modem 2	
9	Not used	**Off**
10	DIP-Switches	**Off**
11	Line 1	**Green LED on**: ISDN connection modem 1 ok
12	Line 2	**Green LED on**: ISDN connection modem 2 ok
13	Fuse 1	**Off**
14	Fuse 1	**Red LED on**: Fuse Line 1 defect
15	Not used	**Off**
16	Not used	**Off**
17	Fuse 2	**Off**
18	Fuse 2	**Red LED on**: Fuse Line 2 defect

21. PDCU

Figure 23 - The Power Data Coupling Unit

22. ACE 2oo2 HEX Address's and CAN Numbers (If fitted)

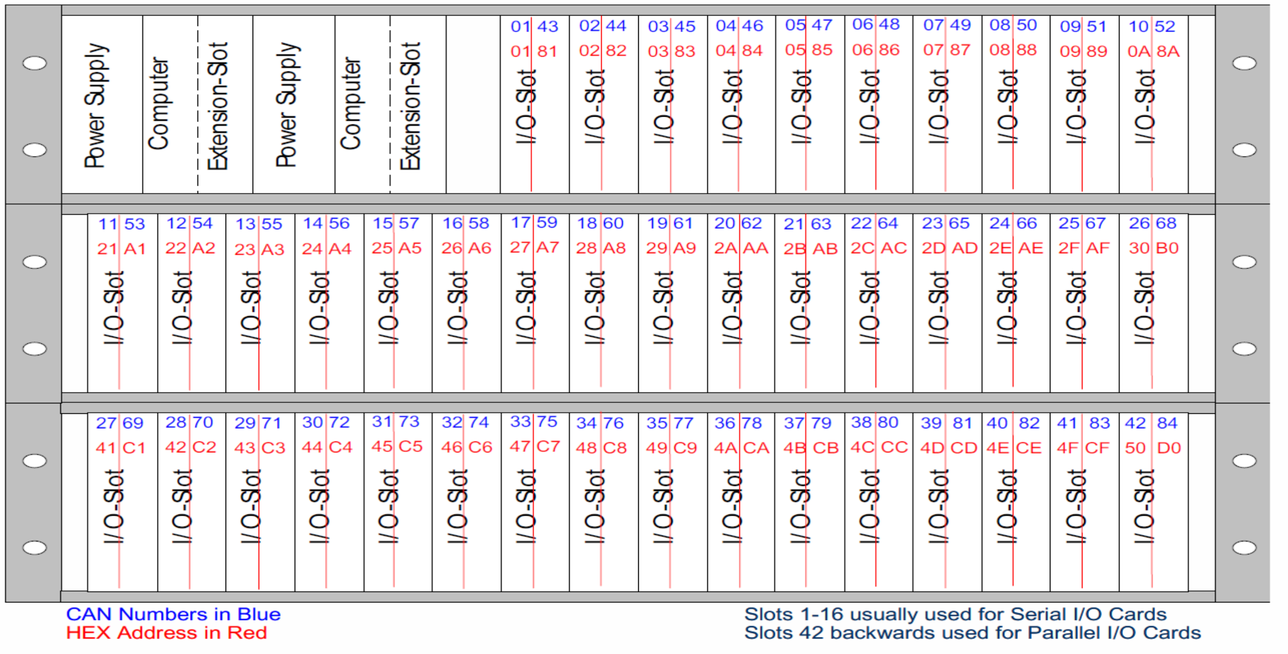


Figure 24

23. ACE 2oo3 HEX Address's and CAN Numbers (If fitted)

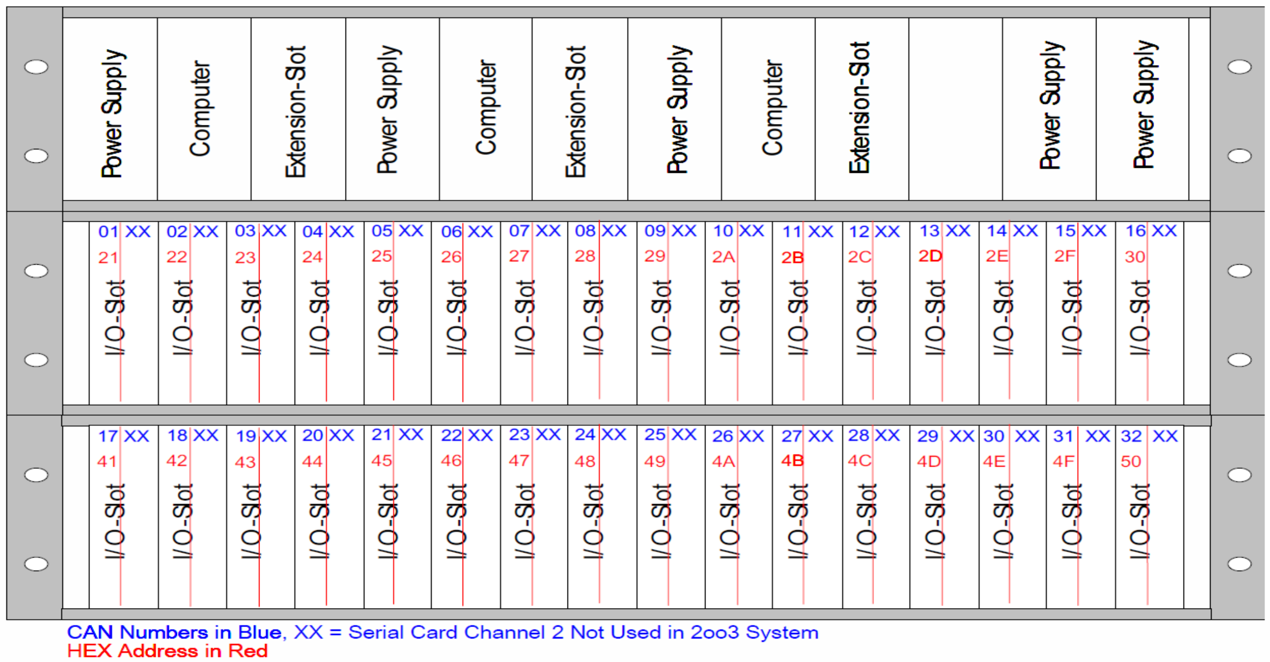


Figure 25

END

GENERAL

Harmon Crossing Processor

Figure 1 – The Harmon Crossing Processor (HXP) is a microprocessor based level crossing control system. Various models are available, however, only the HXP-3R and HXP-3R2 are currently in use on Network Rail infrastructure.

The '3' in the identity relates to these systems being from the Series 3 of the HXP systems – previous generations have been used in the United States – whilst the 'R' indicates that hardware redundancy is inherent within the units through the use of 'normal' and 'standby' systems.

The HXP-3R level crossing control system is able to control a level crossing on a single line. It should be thought of as being formed from two distinct parts, whilst the HXP-3R2 is able to control a level crossing on a double line railway. The HXP-3 comprises of either one (HXP-3R) or two (HXP-3R2) cabinets within which a series of modules, as described below, are contained.

Some modules are installed into predetermined slots within the cabinet and all modules shall be installed with the component side facing to the left.

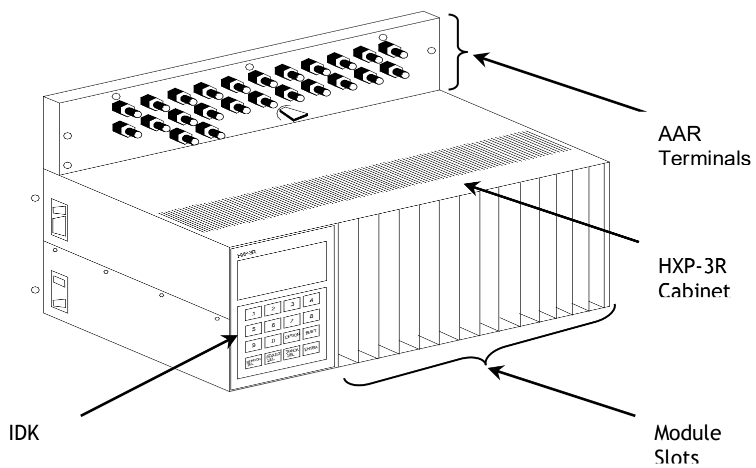


Figure 1 – HXP-3R

Central Processor Unit

The Central Processor Unit (CPU) controls the functions of the HXP-3. Both RAM and ROM memory for the system are located on this module along with non-volatile RAM for storing location specific parameters. Two CPU Modules (Normal and Standby) are installed next to each other in the HXP-3, the second acting as a backup for the first.

Serial Interface Module

The Serial Interface Module (SIM) is required to provide an interface between the HXP-3 and the Information Display Keypad (IDK). Its functions are controlled by a microprocessor located on the module. The SIM's memory is contained in Static RAM and can be accessed by microprocessors on either the CPU or the SIM. Two SIM Modules (Normal and Standby) are installed next to each other in the HXP-3, the second acting as a backup for the first.

Relay Driver Module

The Relay Driver Module (RYD) generates and controls the Motion Detector Relay Drive voltage, which is the main output of the HXP-3. System parameters are stored in Non-Volatile RAM located on this module. The module contains a power supply used to drive the HXP-3 circuits. Two RYD Modules (Normal and Standby) are installed next to each other in the HXP-3, the second acting as a backup for the first.

Transmitter Receiver Module

The Transmitter Receiver Module (TRM) serves as the Track transmitter and receiver for the HXP-3. Each track requires Two TRMs, one Normal and one Standby, to be installed into the HXP-3.

Random Signature Island Module

The Random Signature Island (RSI) Module provides Island relay control without requiring the selection of different operating frequencies. It contains a microprocessor, which triggers the transmitter to generate bursts of energy. These bursts of energy are of random frequency and duration in order to create a signature that can be selectively identified by the receiver, which monitors for the return of each signature. This allows the RSI to maintain Island operation without requiring different frequencies at adjacent Islands. The HXP-3 requires two RSI modules for each line of track present, the second acting as a backup for the first.

Transfer Logic Module

The Transfer Logic Module (TLM) monitors the Island transmitter and receiver currents along with the Island Relay Drive output and the MDR Drive output. If a fault is detected, the TLM transfers operation to the redundant system. All the power fuses in the HXP-3 are located on the TLM.

One TLM shall be installed in all HXP-3 cabinets.

Recorder Memory Module

The Recorder Memory Module (RMM) is used to record internal and external events and a clock is located on this module for time stamping these events.

Information Display Keypad

The Information Display Keypad (IDK), which plugs into the SIM and is secured to the front of the cabinet, is used to enter location parameters and to display system information. The module is made up of a Liquid Crystal Display (LCD) and 16 key keypad that interfaces with the HXP-3 via the SIM.

Auxiliary Relay Drive Module

The Auxiliary Relay Drive Module (AXD) is only present on HXP-3R2 models and has three identical AX Relay Drive outputs for adjacent crossing control or for traffic pre-emption. Each of these outputs can be programmed through the CPU Module. Where AXDs are used on HXP-3R2 equipment, two modules (Normal and Standby) are installed side by side, the second acting as a backup for the first.

End

Includes:	Siemens TRAINGUARD FUTUR 2500 Radio Block Centre (RBC) Cubicle
Exclude:	All other type of RBC/RBC Cubicles

GENERAL

The integrated RBC system is housed in a cubicle with all the associated equipment.

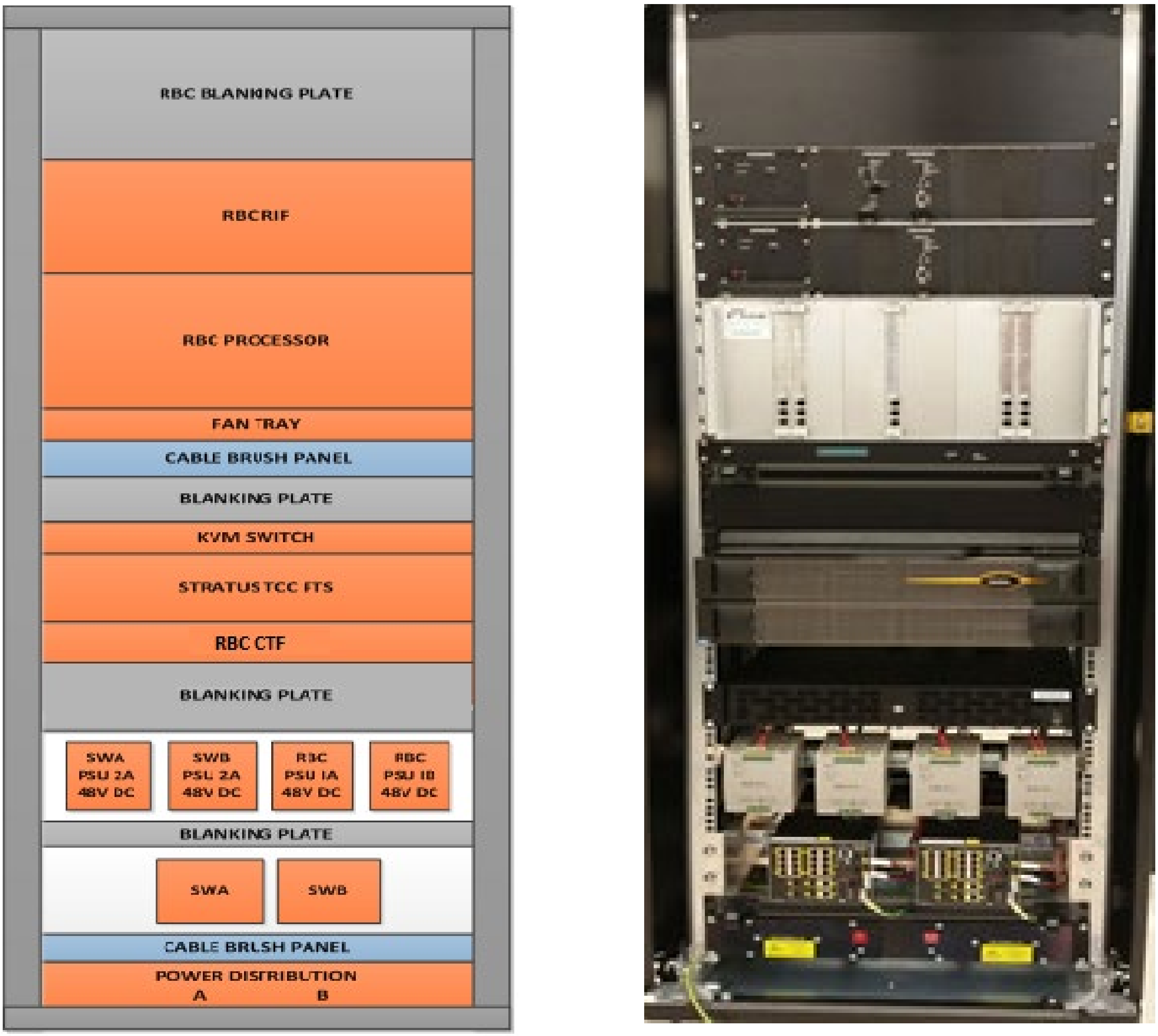


Figure 1 - RBC Cubicle

The TRAINGUARD FUTUR 2500 RBC cubicle is composed of the following elements:

Control Elements:

a) 1 RBC RIF

b) 1 RBC Processor MKII.

Cooling Elements:

a) 3 FAN Tray Modules (1 at the front; centre of the cubicle, 2 at the rear, one at the top, one at the bottom)

Maintenance Elements:

a) 1 KVM. The KVM is made up of:

- 1 KVM Switch
- 1 KVM Rack Console

b) 1 Keyboard

c) 1 PC Debug

d) 1 I/O Board for PC

e) 2 Converters from USB to Ethernet.

f) 1 PBA RBC CTRL

g) 1 Patch Panel

h) 1 GSM-R Stratus TCC FTS Element. This is made up of:

- 1 Server
- 2 ISDN Boards (The ISDN boards are housed in the server)

i) RBC Common Technicians Facility (CTF) – Blue Chip C110 PC

j) Dual Power Supply Unit (PSU) 48V

k) 2 Network Switches (SWITCH A and SWITCH B).

l) Dual Power Supply 110V AC PSUs – A and B supply for the RIF

RBC RIF:

The RBC-RIF is part of the WESTCAD-E architecture and is co-located in the RBC Cubicle and includes the Temporary Speed Restriction (TSR) functionality. The RBC-RIF will also handle the RBC arming process by passing indications to the Control Centre operator.

RBC Processor:

The RBC Processor is built on Ethernet IP Network (LAN/WAN). This provides flexibility to the system and an easy way to connect the RBC to other vital modules.

KVM Switch:

The ‘KVM Switch’ interconnects the TCC and the PC Debug with the ‘KVM Rack Console’ and the ‘Keyboard’.

GSM-R Stratus TCC FTS:

The GSM-R Stratus TCC FTS receives messages from the RBC Processor through the Ethernet interfaces and sends them to the train through the ISDN module.

In addition, it receives messages from the train through the ISDN modules and transmits these messages to the RBC Processor using the LAN network.

The Stratus TCC FTS is made up of:

a) 1 Stratus (server)

b) 2 ISDN Boards (The ISDN boards are housed in the server)

The Server is dual-redundant (CPU A and CPU B), and it is fault tolerant.

Each CPU has got an ISDN Board mounted. “ISDN A” is housed in “CPU A” and “ISDN B” is housed in CPU B.

Common Technicians Facility

This is a local technician’s workstation comprising of a Blue Chip C110 PC loaded with the CTF software. The local TF application is automatically executed when the PC is turned on. The CTF is a diagnostic tool that offers the user fault indications of the system, and replay functionality. The TF in this cubicle (RBC TF-L) is also linked to the RBC TF-S and RBC TF-R to allow remote access from Arch 886.

Power Supplies:

- A Dual Power supply Unit (48V) is provided to power the RBC RIF.
- A separate Dual Power supply (110V DC) is sourced from the signalling supply in LBER to provide power for the RBC Processor.

CISCO 16 Port Network Switches SWA and SWB:

The Cisco Catalyst is a COTS network switch. This connects with the RBC Cubicle at LBER and provides remote communication from TBROC over T-SPN (Thameslink Signalling Private Network).

Datalogger (Test tool)

A data-logger will be attached to the RBC via the Network Switches in the same cubicle. This is a test tool and no maintenance is needed to be provided.

END

Trainstops contain moving parts which can cause severe personal injury.

Equipment Replacement Guidance

1. Replacing a Trainstop (Complete)

The tools required for the following procedure are:

- JE Trainstop
- Common hand tools such as adjustable spanners;
- Approved mechanical lifting equipment with ability to lift 100 kg;
- Trainstop Trip Arm gauge;
- Open ended or ring spanners to suit fixings;
- 20W-50 engine oil;
- Steel measuring tape, ruler, scriber, square, centre punch, hammer;
- Two Packer Plates – can be supplied with the new Trainstops, or separately;
- Sole Plate

Removal

1.1 Keeping clear of the Trip Arm, isolate the supply from the Trainstop.

1.2 Disconnect the tail cables. Place the free end in a safe and dry place ensuring that the cable is not a trip hazard.

1.3 Disconnect the earth bonding cable from the Earth Connection Point on the exterior of the machine case.

1.4 Undo the four fixings securing the Trainstop to the bearers or Sole Plate.

1.5 Take note whether Packer Plates are fitted between the Trainstop and the bearer or Sole Plate.

1.6 Using appropriate lifting equipment, remove the Trainstop and put it in a safe place.

Replacement

1.7 Using appropriate lifting equipment, position the replacement Trainstop on the bearers, fitting Packer Plates if necessary.

1.8 Adjust the position of the Trainstop such that the distance from the inside of the running rail to the centre of the Trip Arm is 222 mm +/- 3 mm, with the body of the Trainstop parallel to the running rail.

1.9 Secure the Trainstop to the bearers using the original fixings (if these fixings are undamaged). If fixings are damaged, they must be replaced with serviceable items.

1.10 Connect the earth bonding cable to the Earth Connection Point on the exterior of the machine case.

1.11 With the Trip Arm in the raised position, use the Trainstop Trip Arm gauge to check that the top of the Trip Arm is 76 mm +/- 3 mm above a line joining the tops of the running rails (Figure 1).

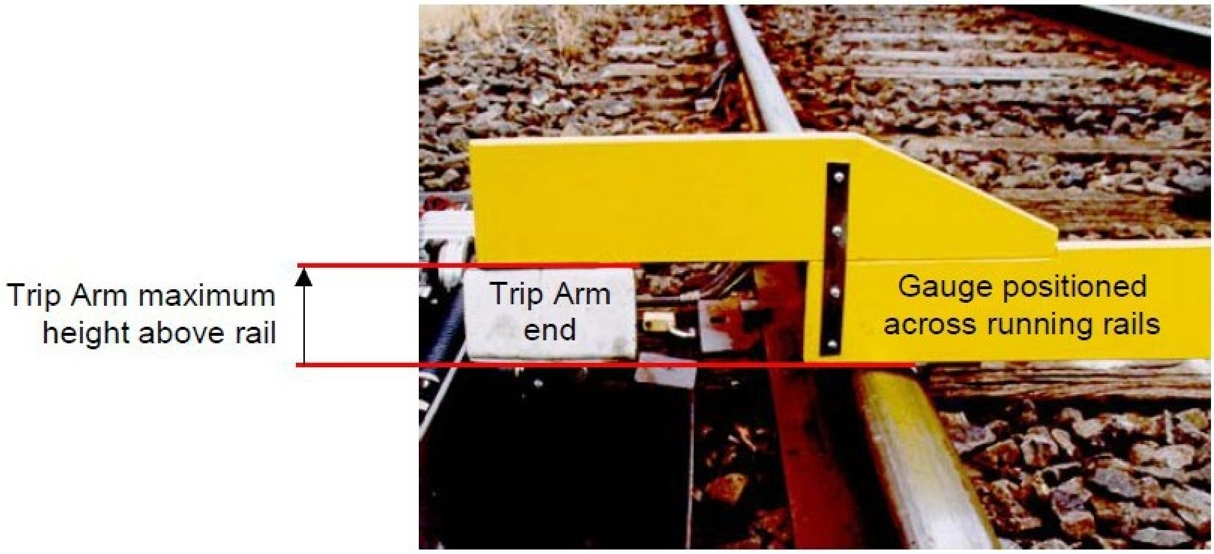


Figure 1 – Height of Trip Arm Checked with Gauge

1.12 Open the top cover of the Trainstop and check the oil level in the dashpot. Oil should be level with the mark on the outside of the dashpot (see Figure 2) when the Trip Arm is raised. If low, fill to the mark with 20W-50 engine oil.

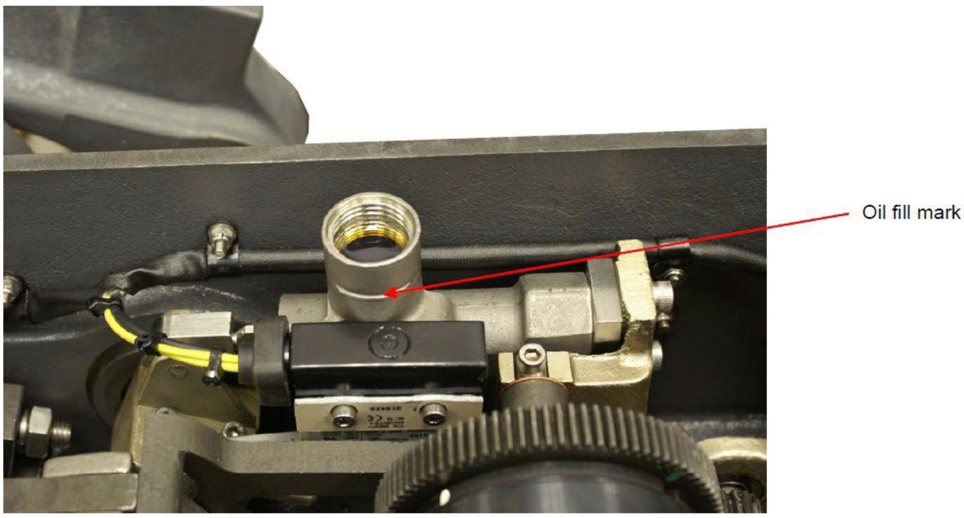


Figure 2 – Dashpot Oil Fill Mark

1.13 Check that the interior of the Trainstop is clear of any tools or equipment, then close and secure the top cover.

2. Replacing a Trainstop Trip Arm

The tools required for the following procedures are:

- Trip Arm Gauge;
- Ruler or steel measuring tape;
- Open ended spanners;
- Ring set spanners;
- Socket set;
- Spanners 24 mm AF;
- Trip Arm;

Removal

2.1 Check you are clear from the Trip Arm, isolate the supply and disconnect the tail cables.

Note the assembly order (base of Trip Arm) – this is for the securing bolt and associated washer, see Figure 3.

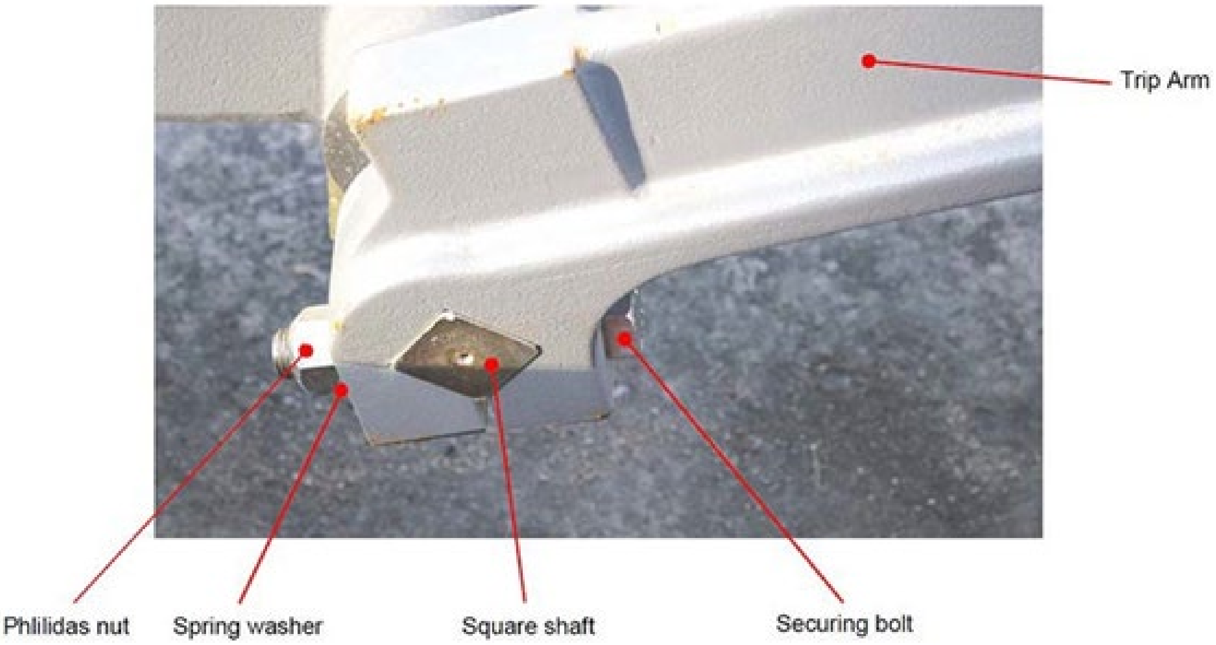


Figure 3 – Trip Arm Securing Bolt

2.2 Remove the securing bolt from the Trip Arm and slide the Trip Arm clear off the square shaft.

Note the assembly order of the shouldered stud fitted towards the top of the Trip Arm.

2.3 Remove the shouldered stud and retain for re-fitting the replacement Trip Arm.

Replacement

2.4 Fit the shouldered stud that was retained from the original Trip Arm.

2.5 Slide the Trip Arm fully onto the square shaft; ensure the shouldered stud engages with the Detector Arm, see, Figure 4.

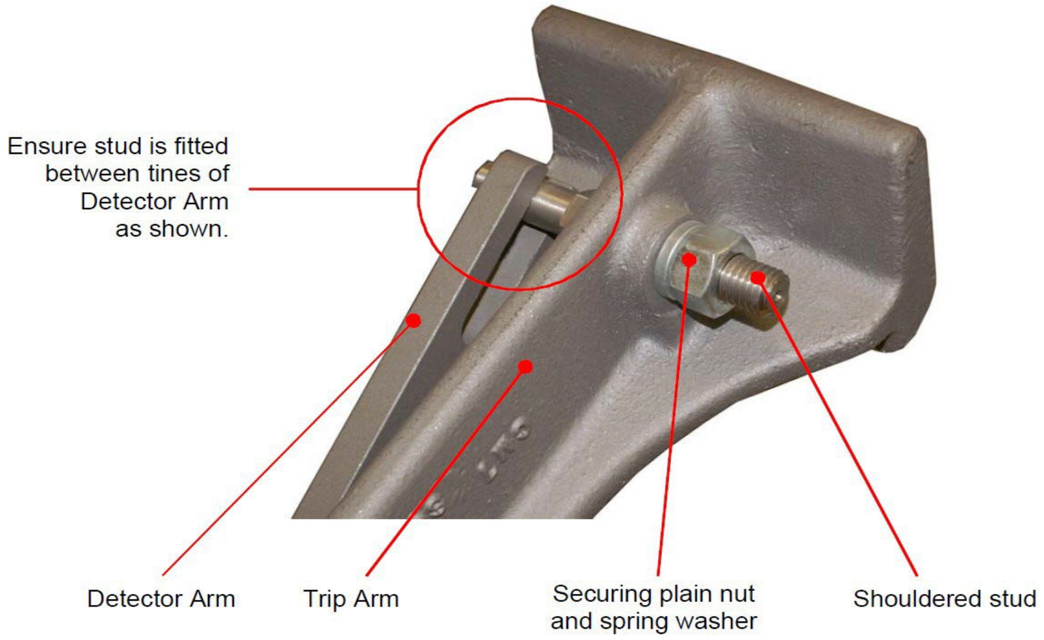


Figure 4 – Trip Arm Correctly Engaged with Detector Arm

2.6 Fit the securing bolt, spring washer and Philidas nut, shown in Figure 3.

2.7 Tighten the securing bolt fully and check that the Trip Arm if secure on the square shaft.

3. Replacing a Motor Assemble

The tools required for the following procedure are:

- Motor Assembly
- Two Nord-lock washers
- Philips cross-head screwdriver;
- Electrical screwdriver;
- Hex key 4 mm AF;

Removal

3.1 Check you are clear from the Trip Arm, isolate the supply and disconnect the tail cables.

3.2 Open the top cover to access the interior of the machine.

3.3 Identify the Rectifier Assembly and Motor Assembly (shown in Figure 5).

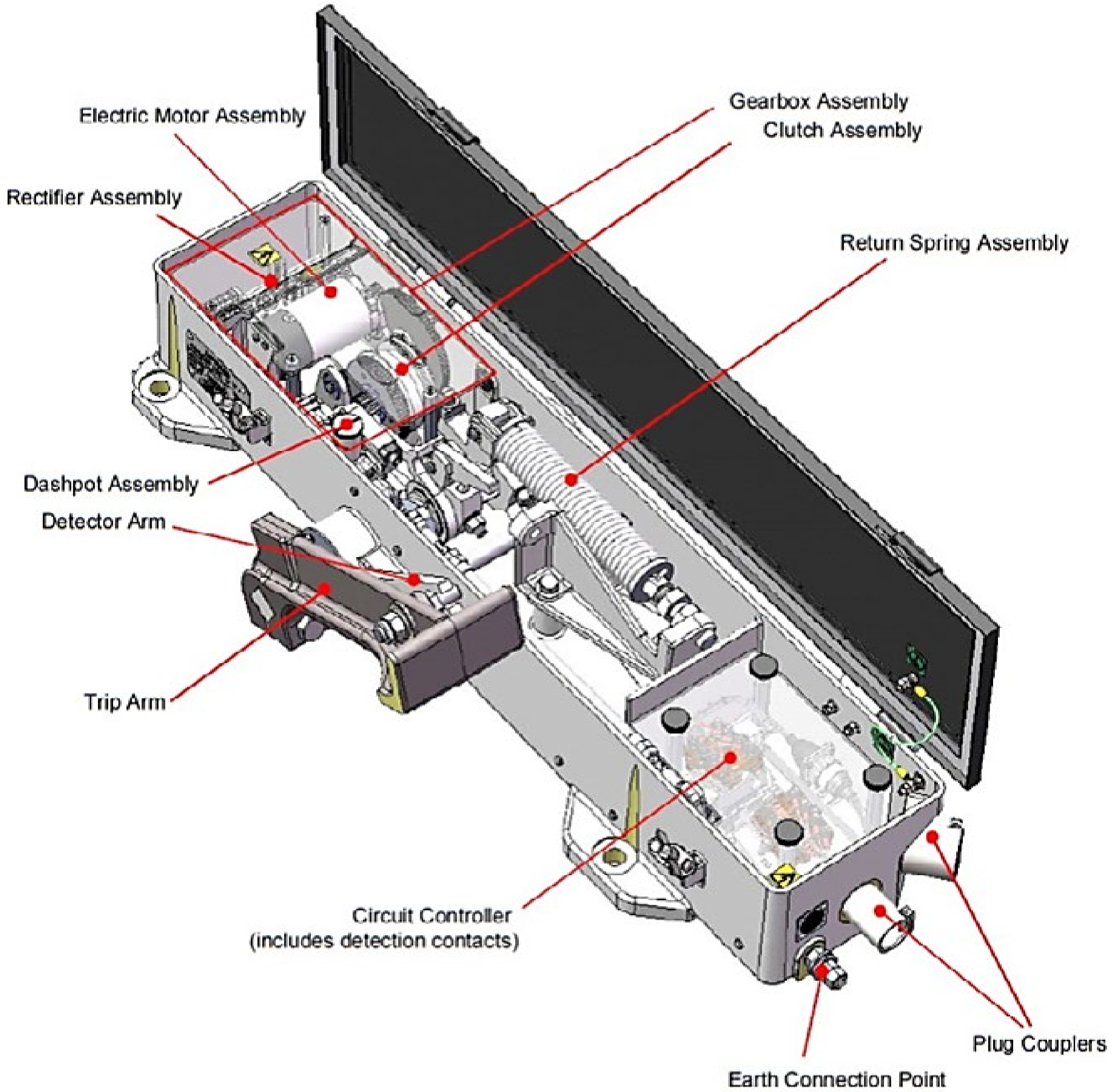


Figure 5 – Style JE Trainstop Main Assemblies

3.4 At the Rectifier Assembly, unscrew the cover fixings and remove the transparent cover.

3.5 Retain cover and fixings for re-use.

3.6 At the Motor Assembly, remove the two mounting plate securing screws (hex socket headed) and associated washers (shown in Figure 6).

3.7 Retain the screws for re-use and discard the washers.

3.8 Lift the Motor and Mounting Plate clear of its mounting and trace the motor supply cable to the terminal block. Take note of the positions of the motor wires in the terminal block.

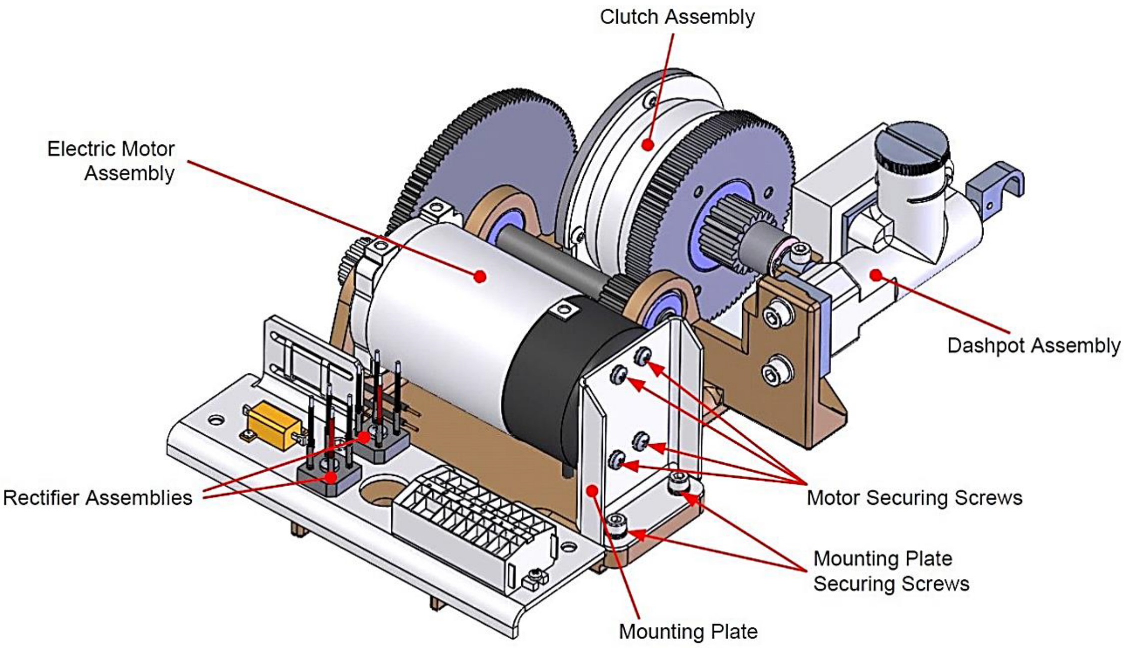


Figure 6 – Gear Box Assembly

3.9 Disconnect the motor wires from the terminal block and remove the Motor Assembly from the Trainstop.

3.10 At the Motor Assembly, remove the four motor securing screws and associated washers (shown in Figure 6). Retain the screws, washers and Mounting Plate for re-use.

Replacement

3.11 Fit the mounting plate on the replacement motor assembly and secure using the four motor securing screws and associated washers (shown in Figure 6).

3.12 Fit the replacement motor and mounting plate into the Trainstop, laying the motor supply cable towards the terminal block. Take care not to trap the motor supply cable.

3.13 Secure the motor assembly by re-fitting the two mounting plate securing screws and two new Nord-lock washers (shown in Figure 6).

3.14 At the terminal block, connect the motor wires in the positions previously noted (Terminal 4 +ve red wire, Terminal 5 -ve blue wire).

3.15 Re-fit the transparent cover over the Rectifier Assembly.

3.16 Close and secure the Trainstop top cover.

End

SYSTEM OVERVIEW

1. Advanced Railway Automation Management and Information System (ARAMIS)

ARAMIS is a sophisticated Rail Traffic Management System which supports planning, supervision, dispatch, control and analysis of train services.

The system has a modular architecture allowing it to be scaled to suit specific customer requirements.

ARAMIS is a Software Product which can be deployed on any suitably designed hardware platform that meets its hardware requirements. The system is configured to its specific installation by data.

The following sections will provide an introduction to the hardware and software elements of the ARAMIS system, and its interfaces.

2. Hardware Components

All the serviceable ARAMIS hardware components are defined as Line Replaceable Units (LRUs).

3. Software Sub-systems

3.1 ARAMIS-D

ARAMIS-D is the primary system within the Plan / Re-Plan layer, and is responsible for near to real-time train planning.

Note, ARAMIS-A is also a function of ARAMIS-D (accessed via the ARAMIS-D menu) that enables the production of analytical reports on the running of the railway, based on data that was collated within ARAMIS-D.

Note: Client HMI is also referred, this is Graphical User Interface (GUI) which is integral to the system, allowing users to access functions of ARAMIS-D

3.2 ARAMIS-W

ARAMIS-W is a web server application that takes a real time read-only feed of data from ARAMIS-D to enable it to present a subset of ARAMIS-D features to ‘remote’ authenticated users.

Such users access the functions provided through Microsoft Explorer browser clients. These are provided and maintained by NR and therefore not covered by this manual.

4. Thales Integration Layer (TIL)

The Thales Integration Layer (TIL) is the generic reference for a collection of components that provide a messaging abstraction layer between ARAMIS-D and the UK focused systems that lie within the External Layer.

5. Maintenance Terminal

The maintenance terminal provides the tools the maintainer needs to undertake the monitoring, log management and Virtual Machine (VM) management tasks. It provides access to the Nagios application for monitoring, the common storage VM for log management and VMware for VM management.

6. Operation Decision Support Tool (ODST)

ARAMIS Traffic Management has been deployed in the ODST configuration for both Wales and Anglia Routes. An ODST system is integrated with Network Rails conventional systems via LINX but is isolated from signalling control. ARAMIS is used as a plan; re-plan tool and the recommendations are then actioned on the control system.

This manual focusses on the sub-systems below the cut-line, known as the 'Plan/Re-Plan Layer' which is performed by the ARAMIS System.

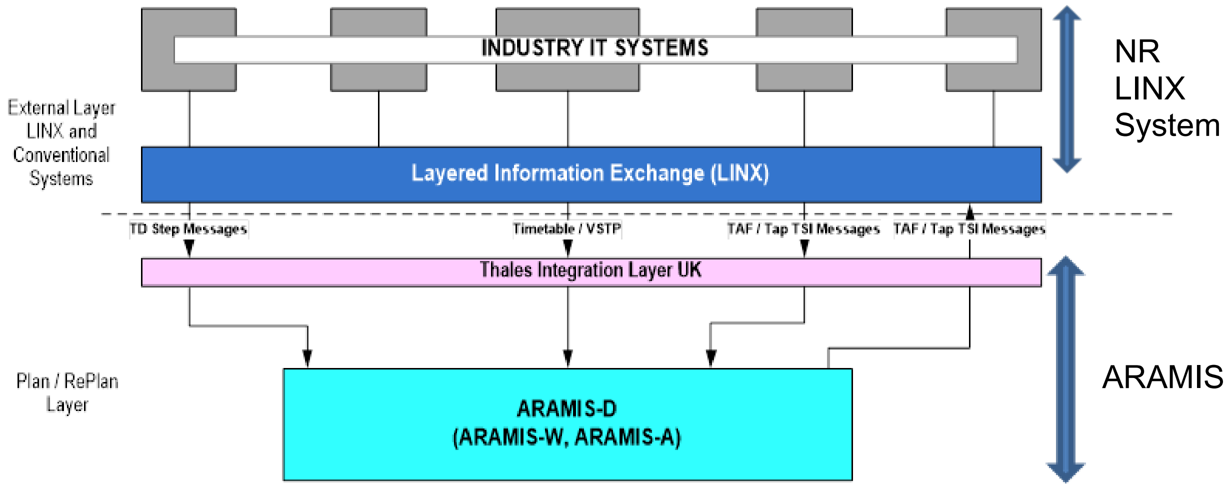


Figure 1 - ODST High Level Summary Schematic of the ODST Architecture

7. Interfaces

ARAMIS interfaces with Network Rail's Layered INformation eXchange (LINX) system via the TIL. This is an inter-system message broker based on IBM Message Queue (MQ) and File Transfer Protocol (FTP) technologies.

LINX enables ARAMIS to communicate with conventional NR systems such as Integrated Train Planning System (ITPS) and Train Running Under System TOPS (TRUST).

From these systems ARAMIS receives dynamic railway data including Train Describer Step messages, Timetable messages and Telematics Applications for Passenger services (TAP) / Telematics applications for Freight services (TAF) messages.

Communication from the ARAMIS system to LINX and the ARAMIS-W clients is provided by services from Network Rail Telecoms (NRT).

Also, in Anglia, connectivity between Upminster and Romford is provided by NRT services.

The NRT services in the Rail Operating Centre (ROC) are provided by firewalls and a range of switches. The NRT demarcation point between Thales and NRT is the NRT ‘Meet Me’ rack.

Thales systems are patched into this rack as are NRT systems and a patch is then made between the two end points.

Maintenance of the ‘Meet Me’ rack is undertaken by Network Rail Telecoms.

8. Power Distribution

8.1 ARAMIS Workstation

- A primary 110Vac Uninterrupted Power Supply (UPS) A - Supplies ARAMIS monitors and Kernel Virtual Machine (KVM) via 110V AC Power Distribution Unit (PDU) mounted in the 19inch equipment rack under the desk.
- A secondary 110Vac UPS B supply – For future provision only.

8.2 ARAMIS Cubicle

The ARAMIS cubicles will be powered via two 230v AC PDU strips providing dual-redundant power to the equipment in the cubicle. These will be fed from separate PDUs within the Equipment Room.

This enables the E&P maintainer to turn off and maintain a single supply without impacting ARAMIS it there are no existing power supply faults.

9. Data Cabling

9.1 Above Workstation Surface Level

ARAMIS monitors are connected via Display Port Cables to the Amulet KVM located in cabinets below the workstation surface.

ARAMIS Keyboard and Mouse are connected to the Amulet KVM via USB cables, typically located in cabinets below the workstation surface.

9.2 Below Workstation Level Wales

From the ARAMIS cabinets under the workstation; the Amulet KVM are wired to a Fibre Optic Patch Panel using a 2-core Multimode Fibre cable.

A ruggedised 2-core Multimode Fibre cables are used to connect the Fibre Optic Patch Panel from the workstations, to another Fibre Optic Patch Panel housed in the main equipment rack for patching to the Client Personal Computer (PC).

10. Below Workstation Level Upminster

From the ARAMIS cabinets under the workstation; the Amulet KVM are wired to a desktop machine in the Upminster under desk equipment cabinet.

11. System Maintenance Features

The ARAMIS hardware platform has been designed with simplicity, availability and reliability in mind.

ARAMIS uses COTS components utilising the best of Information Technology (IT) design such as the use of redundancy, VMWare, Storage Area Networks (SAN), blade servers and Redundant Array of Independent Disks (RAID) disks for incremental/differential back-ups. The hardware platform features:

11.1 Dual redundant Hot Swappable Components

The servers provided by Thales are high quality industrial servers that incorporate redundant, hot swappable power supplies, fans and disks.

It is possible to hot swap all these hardware components without powering down.

For example, even a faulty disk can be removed without powering down, and a replacement disk inserted.

The new disk will be re-built by the system using RAID technology with minimal intervention required by the Maintainer.

11.2 Self-monitoring Servers

The servers are monitored by the Manufacturer’s Server Management Facility that provides an intuitive monitoring and reporting system.

This will report errors when they occur and present them as status indications against physical representations of the equipment impacted.

No sophisticated analysis of log files or error messages is required.

The Network Rail Maintainer can get an overview of the system status from the Nagios based monitoring system.

11.3 Use of Virtual Machines

The system requires multiple servers to host ARAMIS, Oracle data bases and other software components that make up the TMS as a whole.

However, the use of virtual machines enables these applications to be hosted on the same physical hardware, increasing the reliability by reducing the number of hardware components and associated communications infrastructure that would be required by stand-alone servers.

11.4 Use of Virtual Machines and Disk Images

The combination of virtual machines and the ability to take disk images of the virtual machine, and its hosted operating system and applications enables the complete server software architecture to be stored in one file.

This greatly eases configuration, loading and control of the system avoiding the need for the Maintainer to know the structure and configuration of the hosted software.

11.5 Pre-configured Spares

All agreed spares provided for the system will be fully pre-configured and ready to use, facilitating as far as possible, the ability to plug and play with as little post-installation configuration as possible.

12. Maintenance Mode

12.1 Placing a Server into Maintenance Mode

A server that is experiencing performance issues can have a negative impact on the system as VMware will be continually moving virtual machines between resources.

This can be addressed by exploiting the built-in redundancy of the system and placing the problematic server into maintenance mode to restrict it from use by VMware.

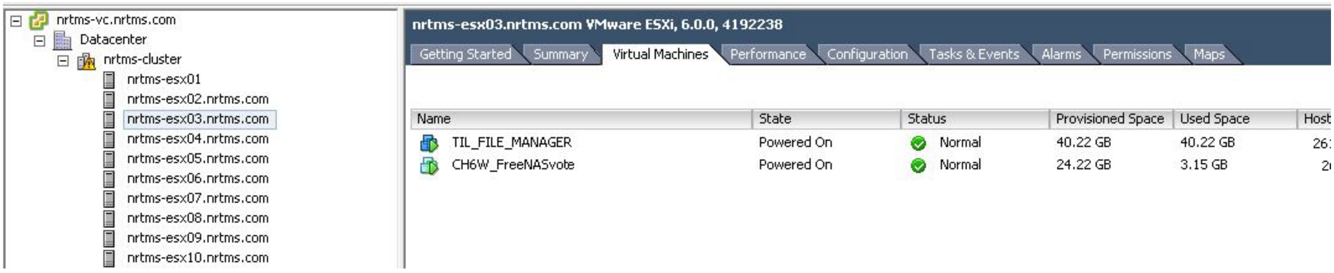
The redundancy within the system allows for three servers to be placed into maintenance mode before there are any performance 19impacts.

However, problematic servers should be repaired or replaced as soon as an issue is identified to guarantee the availability of ARAMIS is maintained.

All instances of placing a server into maintenance mode should be reported to the Thales Service Centre.

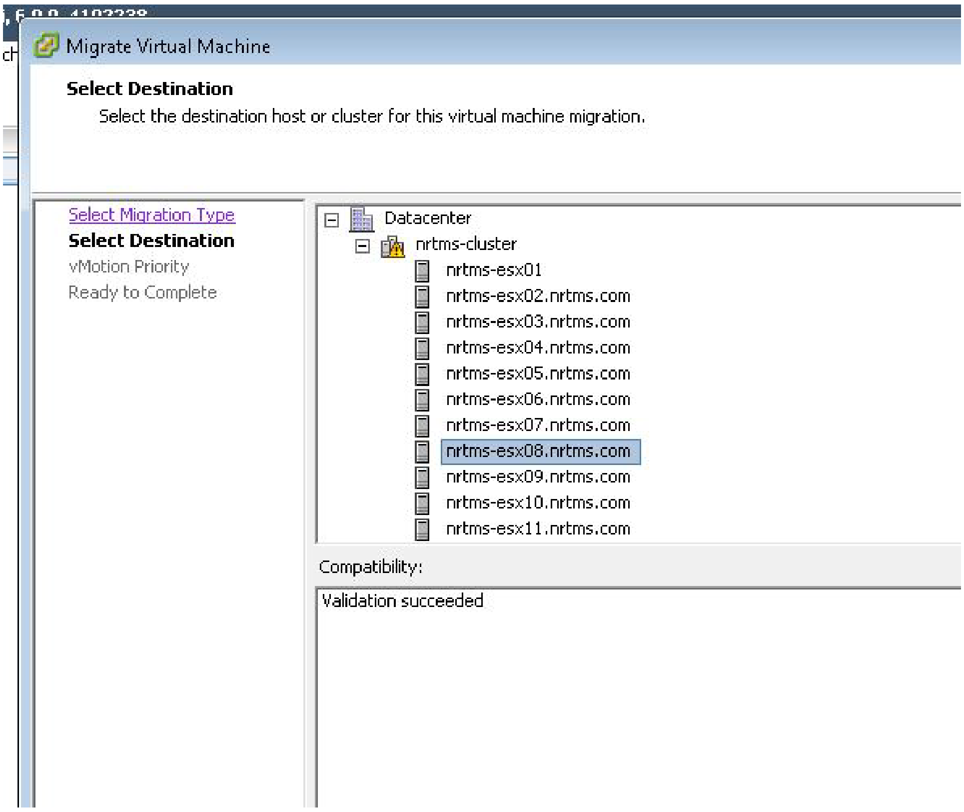
The following steps should be completed to restrict a server from use by VMware:

1. Select the failed server from the list of servers.

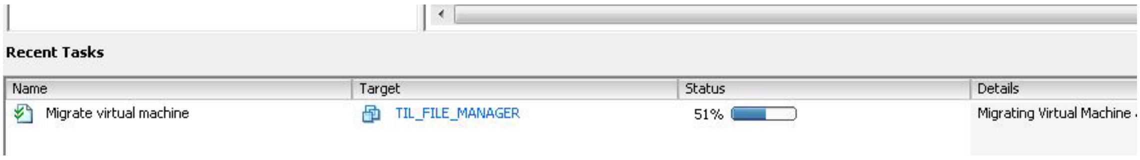


2. For each VM on that server, right click and select migrate.

3. Select another available server to migrate the VM to.



4. Once migration of VM is complete, select High Priority from the dialogue.

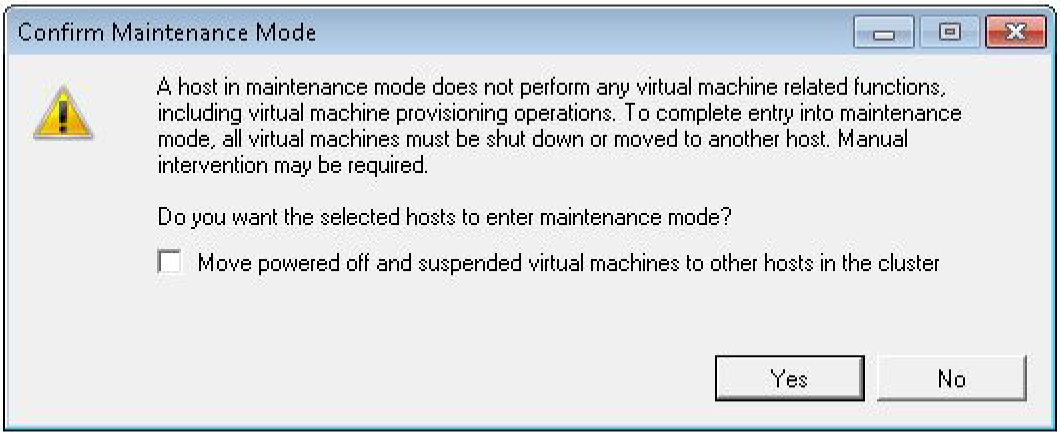


5. Click Finish.

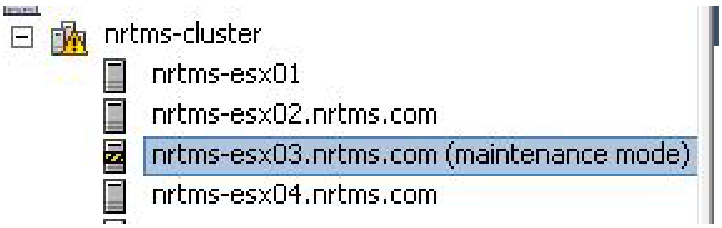
6. Repeat steps 2 – 5 for all remaining VMs.

7. Right click on failed server which now has no active VMs running on it. Select enter maintenance mode.

8. Deselect the check box regarding VM allocation on the dialogue as this has been manually achieved in the steps above.



9. The failed server should now be identified in the list as being in maintenance mode.



13. System Hardware Components 2nd Line Maintenance Responsibilities

The table 1 lists the ARAMIS hardware LRU components and describes their 2nd Line maintenance responsibilities in accordance with the maintenance philosophy.

ARAMIS Hardware Components	Hardware Sub-Components	Hardware Profile ANNEX Reference	2nd Line Maintenance Responsibility
Workstation Monitor - NEC Multisync EA273WMi	-	A1	Network Rail
Workstation Keyboard - Microsoft Wired Keyboard 600	-	A2	Network Rail
Workstation Mouse - Microsoft Basic Optical Mouse	-	A2	Network Rail
Zero Client – Amulet DXZ4-M	-	A3	Network Rail
Client PC - Dell Precision 7910 Rackmount	Workstation	A4	Thales
	Hard Disk Drive (SSD)	A4	Network Rail
	Fan	A4	Network Rail
	Power Supplies	A4	Network Rail
Virtual Server - Dell PowerEdge R530 Rackmount	Server	A5	Thales
	Hard Disk Drive (SD)	A5	Network Rail
	Fan	A5	Network Rail
	Power Supplies	A5	Network Rail
Maintenance Server - PowerEdge M620 Blade	Blade Servers	A6	Thales
	Hard Disk Drive	A6	Network Rail
	Fan	A6	Network Rail
	Power Supplies	A6	Network Rail
	10GB Network Interface Card	A6	Thales
Server Storage SAN - HP MSA 2040	2040 SAN	A7	Thales
	Hard Disk Drive	A7	Network Rail
	Power Supplies	A7	Network Rail
	HP MSA SAN Controller (Single Only)	A7	Network Rail
Network Core Switch - Cisco Nexus 5672UP	Core Switch	A8	Thales
	Power Supplies	A8	Network Rail
	Fan	A8	Network Rail
Network Access Switch - Cisco Catalyst 2960XR-24TS-I	Access Switch	A9	Thales
	Power Supplies (with in-built Fan)	A9	Network Rail
Network Management Switch - Cisco Catalyst 2960XR-48TS-I	Management Switch	A10	Thales
	Power Supplies (with built in Fan)	A10	Network Rail
Firewall - CISCO ASA 5545-X WITH FIRE POWER Services	Firewall	A11	Thales
	PSU	A11	Network Rail
	HDD (single only)	A11	Network Rail
Server HMI - KVM Rackmount Console Unicorn 17	-	A12	Network Rail
Maintenance Terminal – Dell Latitude E5570 Laptop	-	A13	Thales

Table 1 - ARAMIS hardware LRU components

14. Acronyms and Abbreviations

Term	Description
ARAMIS ODST	Advanced Railway Automation Management & Information System Includes ARAMIS-A / ARAMIS-D, ARAMIS-W and ARAMIS-TIL products.
ATS	Automatic Transfer Switch
CATS	Course A Training System
CCTV	Closed-Circuit Television
CPC	Client PC
CPU	Central Processing Unit
ESXi	VMware ESXi is a purpose-built bare-metal hypervisor that installs directly onto a physical server.
FT	Fault Tolerant
Gbps	Gigabits per second
HA	High Availability
HMI	Human Machine Interface
iSCSI	Internet Small Computer System Interface
LAN	Local Area Network
LX	Level Crossing
M&S	Maintenance and Support
Mbps	Megabits per second
MSVR	Maintenance Server
MWS	Maintenance Laptop
NR	Network Rail
NRT	Network Rail Telecoms
NRTMS	Network Rail Traffic Management System
O&M	Operations and Maintenance
ODST	Operations Decision Support Tool
PC	Personal Computer
PCIe	Peripheral Component Interconnect Express
PCoIP	PC over Internet Protocol
PDU	Power Distribution Unit
PSU	Power Supply Unit
RAID	Redundant Array of Independent Disks
ROC	Rail Operating Centre
SAN	Storage Area Network
SATA	Serial AT Attachment
SCSI	Small Computer System Interface
SSD	Solid State Drive/Disk
SSM	Shift Signaller Manager

Term	Description
SWA	Access Switch
SWC	Core Switch
TAF	Telematic Applications for Freight
TAP	Telematic Application for Passenger
TRC	Train Running Controller
TRESIM	Simulator by The Rail Engineering Company
vCPU	virtual CPU
VM	Virtual Machine
vSAN	virtual Storage Area Network
USB	Universal Serial Bus

Table 2 – Acronyms and Abbreviations

15. Configuration of the Amulet

CONFIGURATION PROCESS

This process shall only be carried out by a competent person, if at any point during the process you are unsure of what you seeing or actions you should take you must immediately stop work and seek advice.

Establishing a PCoIP connection

15.1 After a short delay, the built-in On-Screen Display will be visible on the monitor connected to the port

NOTE: *The zero client can be configured to use DHCP or a static IP address. To change the settings in the On-Screen Display, open the Options menu (top left), click the Configurations item and then the Network tab. If required, the default password is ahkdante. Do not change the default password.*

15.2 Click the Connect button. The 'Discovering hosts' message will display, followed by a list of all available hosts.

NOTE: *The Connect button is greyed out until the DXZ4 has a network connection and an IP address. If no PCoIP hosts are available, the connect button will still work but, after trying and failing to discover any hosts, the 'No Hosts available for connection' message is displayed.*

Amulet Configuration

15.3 Plug in AMULET via Ethernet to a hub.

15.4 Plug in laptop to a hub, set IP to 192.168.1.10

15.5 Browse to IP 192.168.1.50

15.6 Login – password is “ahkdante”.

15.7 Change session to “Direct to Host”.

15.8 Set IP 192.168.1.100

15.9 Power – Set both timeout to 0 seconds.

Configuration -> Power

15.10 Set power configuration as follows:

- Screensaver, suspect, power off timeouts all 0.
- Remote host power control – off.
- Power on after power loss – checked.
- Enable wake on USB, Wake on LAN – checked.

Configuration -> USB -> Authorised devices

15.11 Set authorised device as follows:

VID	PID
045E	07F8
045E	00CB
04B4	6572

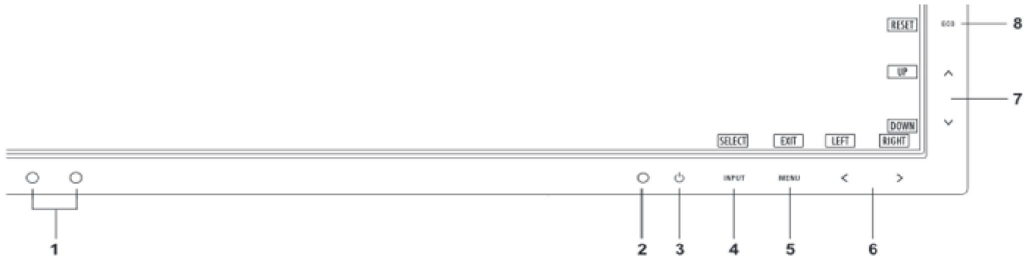
Select a PCoIP host from the list using the host IP address as a reference and click OK.

If the connection is successful, the Link LED displays constant green and the video from the remote workstation displays on the monitor(s).

16. Component Breakdown

16.1 Workstation Monitor - NEC Multisync EA273WMi

Front View



1 Ambibright Sensor Human Sensor	Detects the level of ambient lighting, allowing the monitor to make adjustments to various settings resulting in a more comfortable viewing experience. Do not cover this sensor.
2 LED	Indicates that the power is on or off.
3 Power	Turns the monitor on and off.
4 INPUT/SELECT	Enters the OSD Control menu. Enters OSD sub menus. Changes the input source when not in the OSD Control menu.
5 MENU/EXIT	Accesses OSD menu. Exits the OSD sub menu. Exits OSD Control menu.
6 LEFT/RIGHT	Navigates to the left or right through the OSD Control menu. You can adjust the BRIGHTNESS directly while the OSD menu is off*.
7 UP/DOWN	Navigates up or down through the OSD Control menu. You can adjust the VOLUME directly when not in the OSD Control menu*.
8 RESET/ECO	Resets the OSD back to factory settings in the OSD control menu. Switches among ECO MODE settings. Activates Auto Adjust function if helded for 3 seconds while the OSD menu is off (Analog input only)*.

* When Hot Key function is OFF, this function is disabled.

Back View

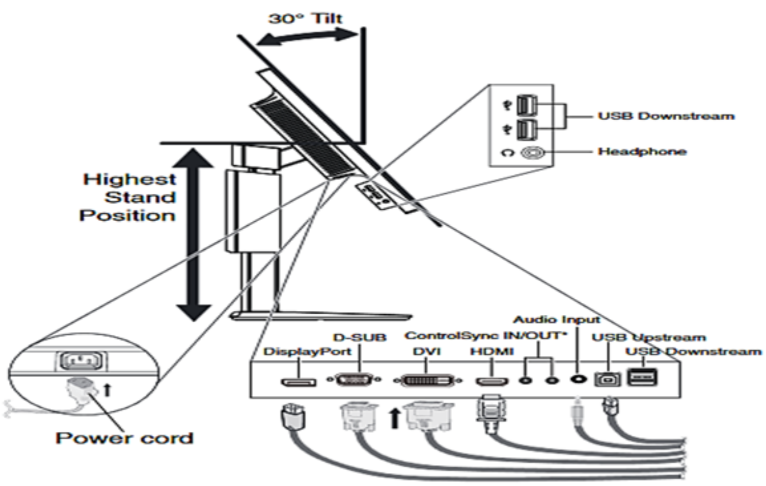


Figure 3 – Monitor Connections

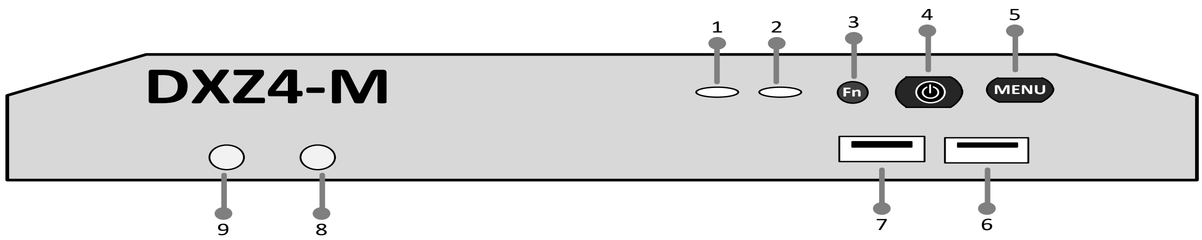
Workstation Keyboard - Microsoft Wired Keyboard 600 & Optical Mouse -

Figure 4 - Workstation Keyboard - Microsoft Wired Keyboard 600 & Optical Mouse

16.2 Zero Client – Amulet DXZ4-M

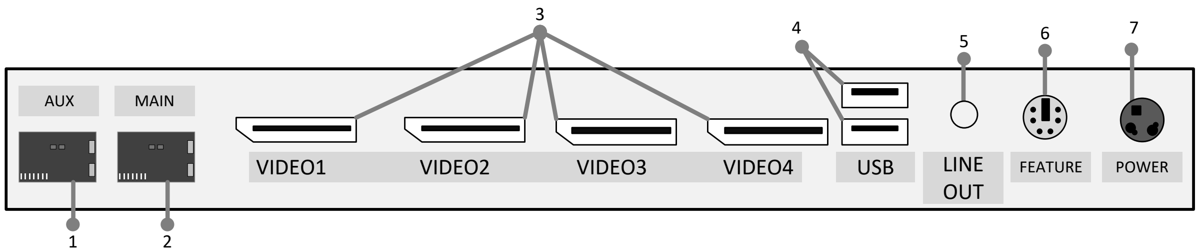
A Zero Client provides an interface between the monitors/keyboard/mouse to its associated Client PC via a network connection.

Front View



1	Switch Status LED	4	Power Button & LED	7	USB 2.0 Keyboard Port
2	Link LED	5	Menu Switch LED	8	3.5mm Earphone Port
3	Functional Switch Button & LED	6	USB 2.0 Mouse Port	9	3.5mm Microphone Port

Back View

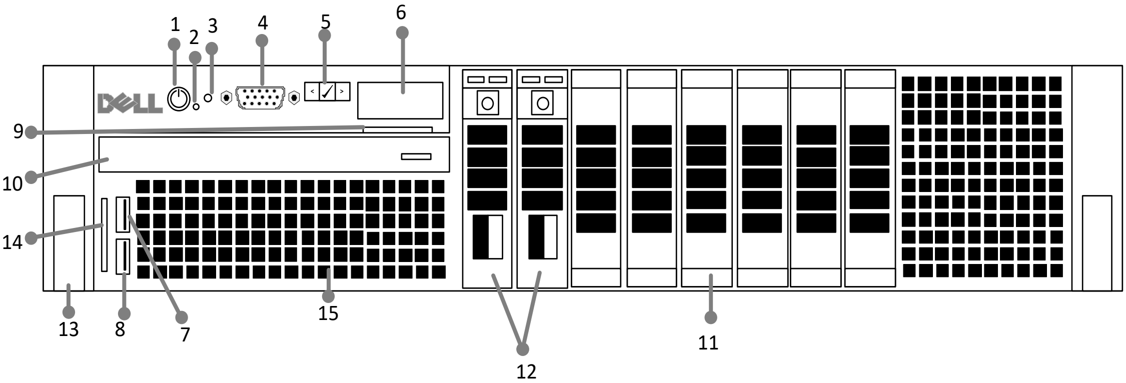


1	AUX SPF+ Network Port	4	USB 2.0 Ports	7	DC Power Port
2	Main SPF+ Network Port	5	3.5mm Line Out Audio Port		
3	Video Out Ports	6	Amulet Feature Port		

16.3 Client PC - Dell Precision 7910 Rackmount

Client PCs are windows-based workstations with standard configurations and ARAMIS Client software with specific configurations installed.

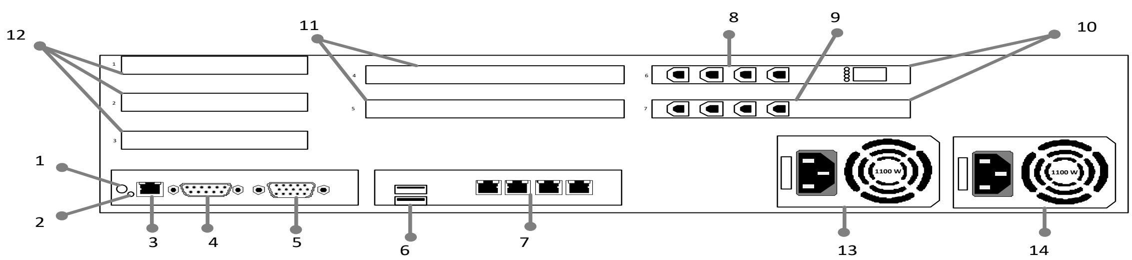
Front View



1	Power On Button	6	LCD Panel*	11	Hard Drive / SSDs slot
2	NMI Button	7	USB Port/iDRAC	12	2 x Hard drive (OCC)
3	System ID Button	8	USB Connector 2.0	13	Device Pull-Out Flaps
4	Video Connector	9	Information Tag	14	SD Card Slot
5	LCD Menu Buttons	10	Optical Drive (optional)	15	Vents

* LCD Display displays Blue background in normal working. When faulty will display fault and back light will change colour to Amber

Back View

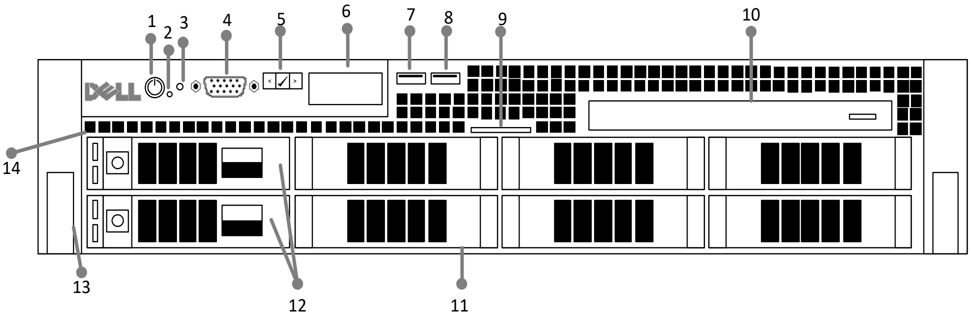


1	System ID Port	6	USB Connector 2.0	11	PCIe Card Slots
2	System ID Button	7	Ethernet Connectors	12	½ PCIe Card Slots
3	iDRAC8 Enterprise Port	8	PCIe Amulet Host Card	13	Power Supply Unit 1
4	Serial Port	9	PCIe Graphics Card	14	Power Supply Unit 2
5	Video/VGA Port	10	PCIe Card Slots		

16.4 Virtual Server - Dell PowerEdge R530 Rackmount

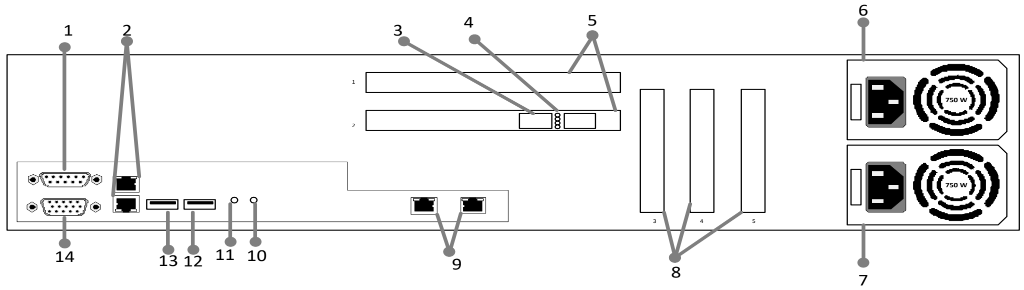
VM Servers runs the TM software on a virtualised estate.

Front View



1 Power On Button
2 NMI Button
3 System ID Button
4 Video Connector
5 LCD Menu Buttons
6 LCD Panel
7 USB Port/iDRAC
8 USB Connector 2.0
9 Information Tag
10 Optical Drive (optional)
11 Hard Drive / SSDs slot
12 2 x Hard drive bays (OCC)
13 Device Pull-Out Flaps
14 Vents

Back View

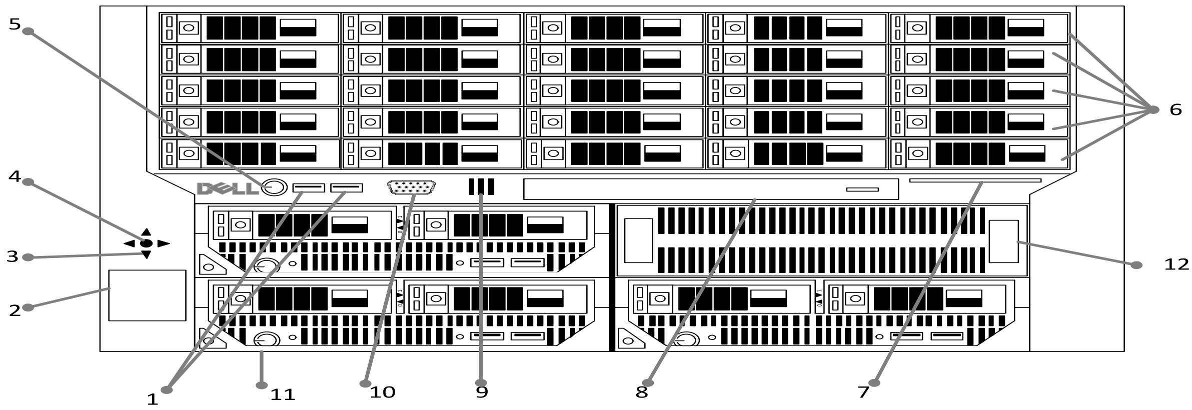


1 Serial Port
2 Ethernet Connectors
3 PCIe Connectors
4 PCIe Monitoring Lights
5 PCIe Card Slots
6 Power Supply 1
7 Power Supply 2
8 ½ PCIe Card Slots
9 Ethernet Connectors
10 System ID Port
11 System ID Button
12 USB Connector 3.0
13 USB Connector 2.0
14 Video / VGA Port

16.5 Maintenance Server – Dell PowerEdge VRTX Chassis & M620 Blade

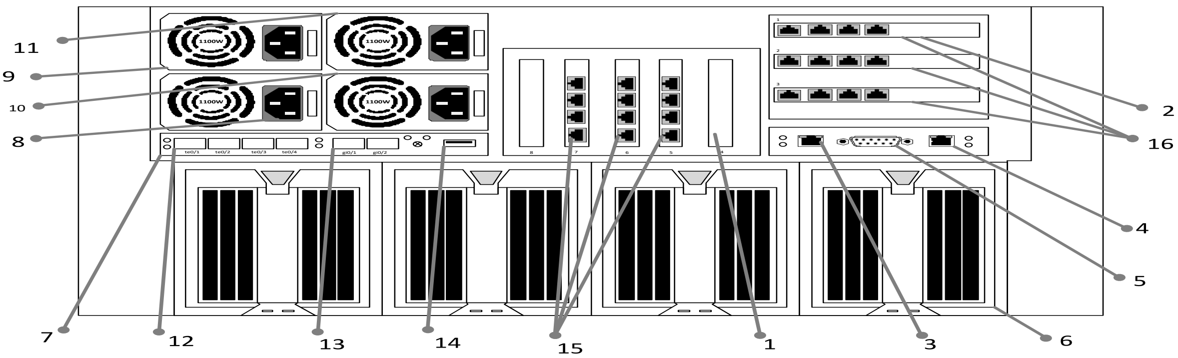
Maintenance Server provides the means by which system and data updates are propagated onto the live system. All updates are tested on the maintenance server first.

Chassis - Front View



1	USB Connectors	5	Power Button	9	Vents
2	LCD Panel	6	Hard Drives	10	Video Connector
3	LCD Menu Scroll Buttons	7	Information Tag	11	Server Module
4	Selection Button	8	Optical Drive	12	Blanking Module

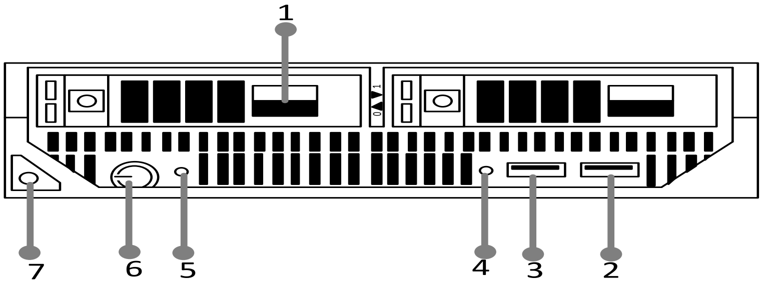
Chassis - Back View



1	½ PCIe Card Slots	7	NIC I/O Module Ports	13	NIC SPF+ Ports
2	PCIe Card Slots	8	Power Supply Unit (PSU4)	14	NIC I/O USB Port
3	CMC GbE Port 2	9	Power Supply Unit (PSU3)	15	NIC PCI RJ45 ports
4	CMC GbE Port 1	10	Power Supply Unit (PSU1)	16	NIC PCI RJ45 ports
5	Serial Connector	11	Power Supply Unit (PSU2)		
6	Blower Module	12	NIC SPF+ Ports		

16.6 M630 Blade

Front View

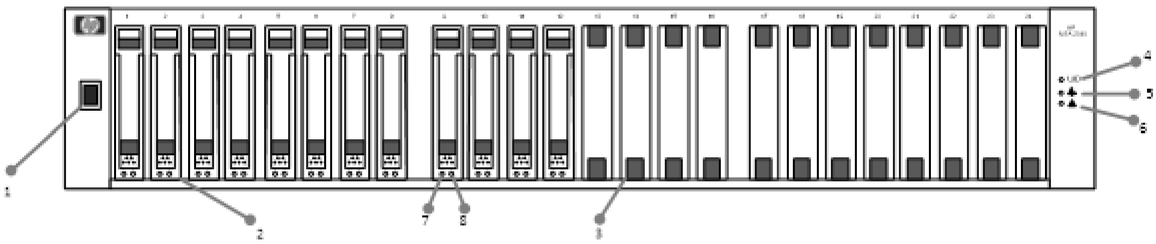


1	Hard Drive or SSDs	4	Management Indicator	7	Status Server Module Handle
2	USB2 Port	5	Power On Button		
3	USB1 / iDRAC Port	6	Server Module Power Indicator		

The back view is not shown as this would not be visible or accessible to the Maintainer due to this being housed within the VRTX Chassis.

16.7 Server Storage SAN – HP MSA 2040 & Controller

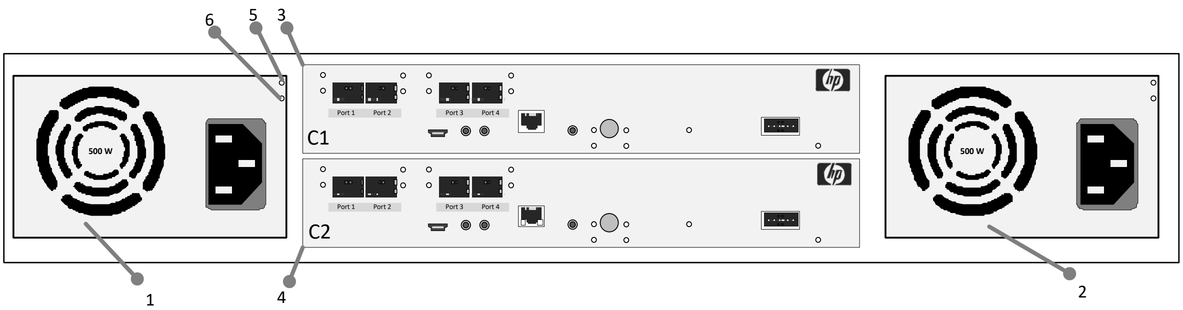
Virtual SANs present Oracle RAC with its expected disk hardware, as if it were physical disks.



Front View

1	Enclosure ID LED	4	Unit Identification LED	7	Disk Drive Online / Activity LED
2	Server Hard Drive	5	Heartbeat LED	8	Disk Drive Fault LED
3	Hard Drive Blanking	6	Fault ID LED		

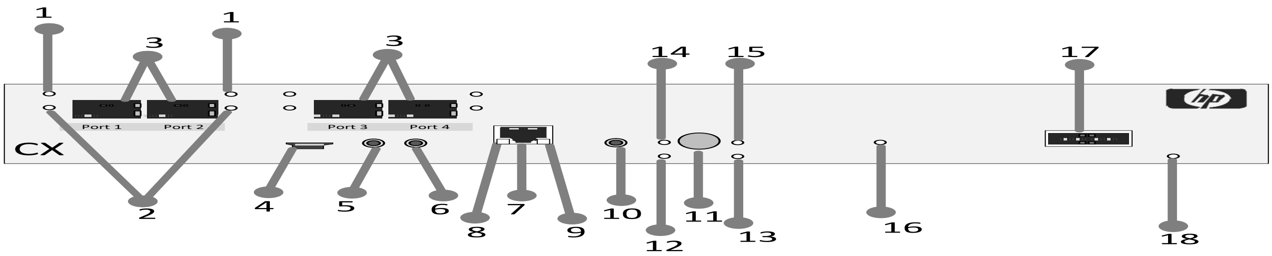
Back View



1	Power Supply Unit 1	3	SAN Controller Module 1	5	Input Source Power LED
2	Power Supply Unit 2	4	SAN Controller Module	6	Voltage/Fan Fault/Service

16.8 SAN Controller

Front View

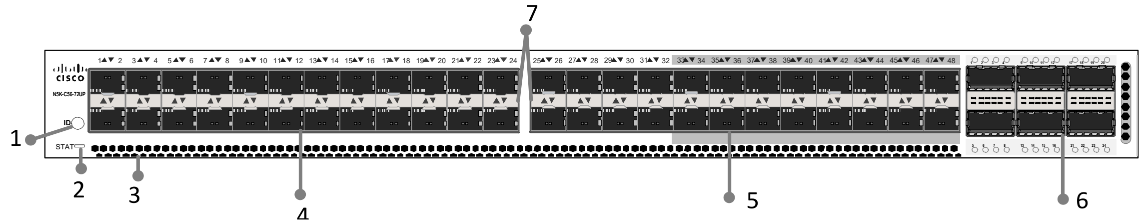


1	Link Status LED FC Mode	7	Network Port	13	Fault/Service Required LED
2	Link Status LED iSCSI	8	Network Port Activity LED	14	OK to Remove LED
3	SPF+ Host Ports	9	Network Port Speed LED	15	FRU OK LED
4	CLI Port Mini-USB	10	Service Port 1	16	Cache Status LED
5	Service Port 2	11	Disabled Button	17	SAS Expansion Port
6	CLI Port	12	Unit Locator LED	18	SAS Expansion Port

16.9 Network Core Switch - Cisco Nexus 5672UP

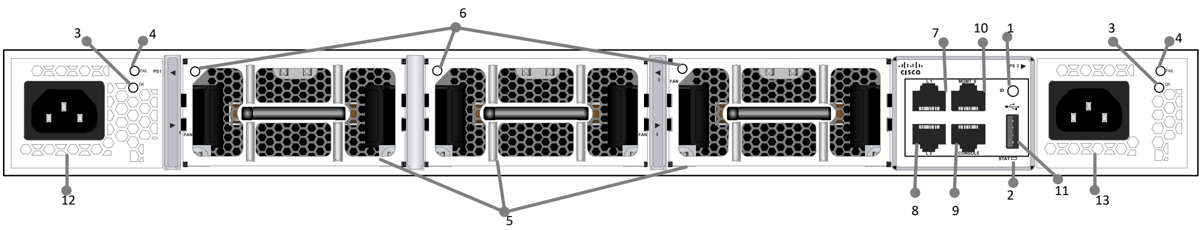
- Network Core Switch provides access to the virtual server.

Front View



1	Chassis Located LED	4	SPF+ Ports	7	Port LEDs
2	Power Status LED	5	SPF+ Ports		
3	Vents	6	QSFP+ Ports		

Back View

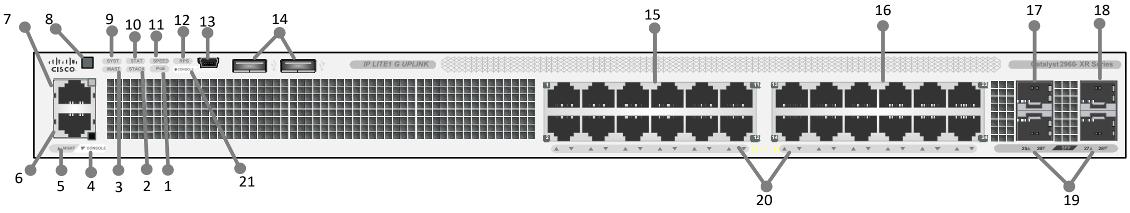


1	Chassis Locator LED	6	Fan Blower Status LED	11	USB 2.0 Port
2	Power Status LED	7	L1 RJ45 Port	12	Power Supply Unit 1
3	PSU OK LED	8	L2 RJ45 Port	13	Power Supply Unit 2
4	PSU FAIL LED	9	CONSOLE RJ45 Port MGMT RJ45 Port		
5	Fan Blower	10			

16.10 Network Access Switch - Cisco Catalyst 2960XR-24TS-I

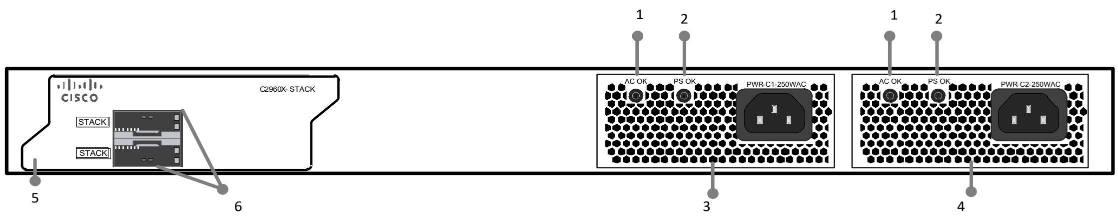
Description: Network Access Switch provides access to the Client PC.

Front View



1	Power over Ethernet LED	8	Mode Button	15	Ethernet Ports RJ45
2	Stack LED	9	System LED	16	Ethernet Ports RJ45
3	Master LED	10	STAT LED	17	Ethernet SFP Ports
4	Console LED	11	Speed LED	18	Ethernet SFP Ports
5	MGMT LED	12	IPRS LED	19	SFP Port LEDs
6	Console RJ45 Port	13	USB Type B Console Port	20	RJ45 Port LEDs
7	MGMT RJ45 Port	14	USB Type A Port	21	USB Type B Port LED

Back View

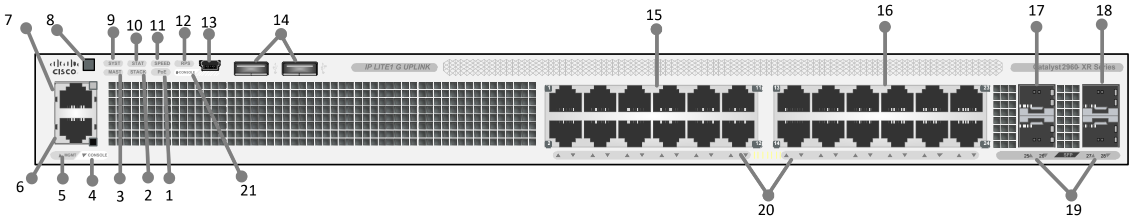


1	PS OK LED	3	Power Supply Unit 1	5	CISCO Stack Module
2	AC OK LED	4	Power Supply Unit 2	6	Cisco Stack Ports

16.11 Network Management Switch - Cisco Catalyst 2960XR-48TS-I

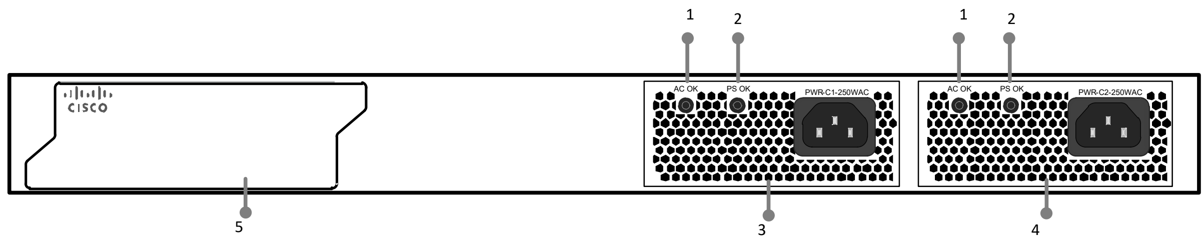
Network Management Switch provides access to the Maintenance Blade Server and the Virtual Servers.

Front View



1	Power over Ethernet LED	8	Mode Button	15	Ethernet Ports RJ45
2	Stack LED	9	System LED	16	Ethernet Ports RJ45
3	Master LED	10	STAT LED	17	Ethernet SFP Ports
4	Console LED	11	Speed LED	18	Ethernet SFP Ports
5	MGMT LED	12	IPRS LED	19	SFP Port LEDs
6	Console RJ45 Port	13	USB Type B Console Port	20	RJ45 Port LEDs
7	MGMT RJ45 Port	14	USB Type A Port	21	USB Type B Port LED

Back View

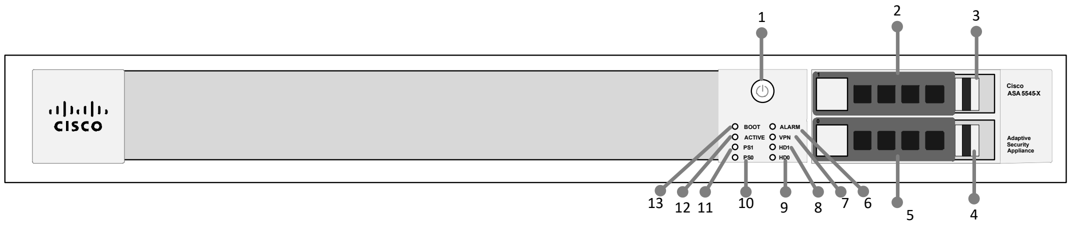


1	PS OK LED	3	Power Supply Unit 1	5	Stack Module Plate
2	AC OK LED	4	Power Supply Unit 2	6	

16.12 Firewall - CISCO ASA 5545-X with Fire Power Services

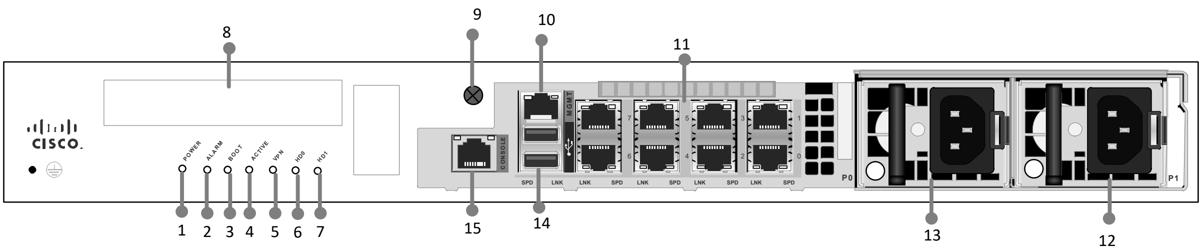
The CISCO Firewall provides integrated threat protection against cyber and advanced malware.

Front View



1	Power Button	6	Alarm	11	PS0
2	Hard-disk Slot	7	VPN	12	Active
3	Hard-disk Release Button	8	HD1	13	Boot
4	Hard-disk Release Button	9	HD0		
5	Hard-disk Slot	10	PS1		

Back View

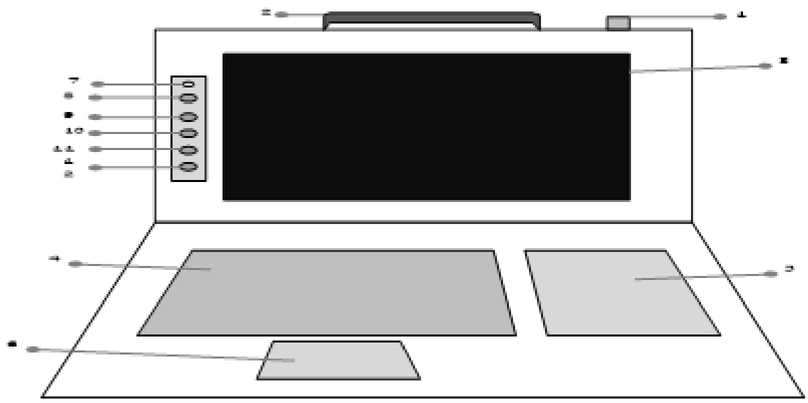


1	Power LED	6	HD0 LED	11	RJ-45 Ports
2	Alarm LED	7	HD1 LED	12	Power Supply 1
3	Boot LED	8	I/O Slot	13	Power Supply 0
4	Active LED	9	Thumbscrew	14	USB Ports
5	VPN LED	10	Management I/O Interface	15	Console Port

16.13 Server HMI - KVM Rackmount Console Unicorn 17

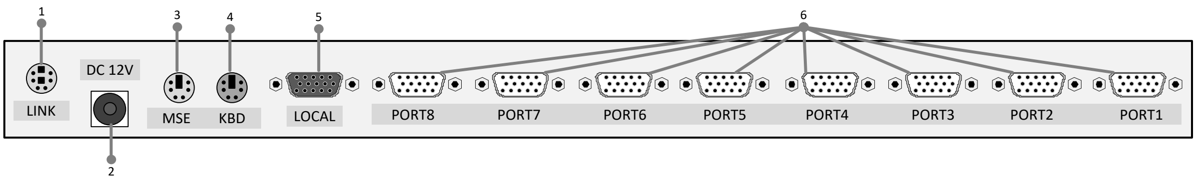
The KVM Rack-mount Console is used as the HMI for the Servers which will be utilised for diagnostics and maintenance of the devices.

Front View



1	Key Lock	6	Mouse Track Pad	11	Down Navigation Button
2	Handle	7	Power LED	12	Menu Button
3	17” LCD Screen	8	Power Button		
4	Full QWERTY Keyboard	9	Auto Adjust Button		
5	Number Pad	10	Up Navigation Button		

Back View



1	KVM External Control Link	3	PS/2 Mouse Port	5	Local KVM Out Port
2	12V DC Power Port	4	PS/2 Keyboard Port	6	KVM Input Port (8)

16.14 Maintenance Terminal - Dell Latitude E5570 Laptop

The Maintenance Terminal is a fixed laptop provided for Thales maintenance staff, enabling them to undertake diagnostics, software upgrades, software and data updates. This maintenance terminal also provides system status view for maintenance staff.

END

Equipment Identification

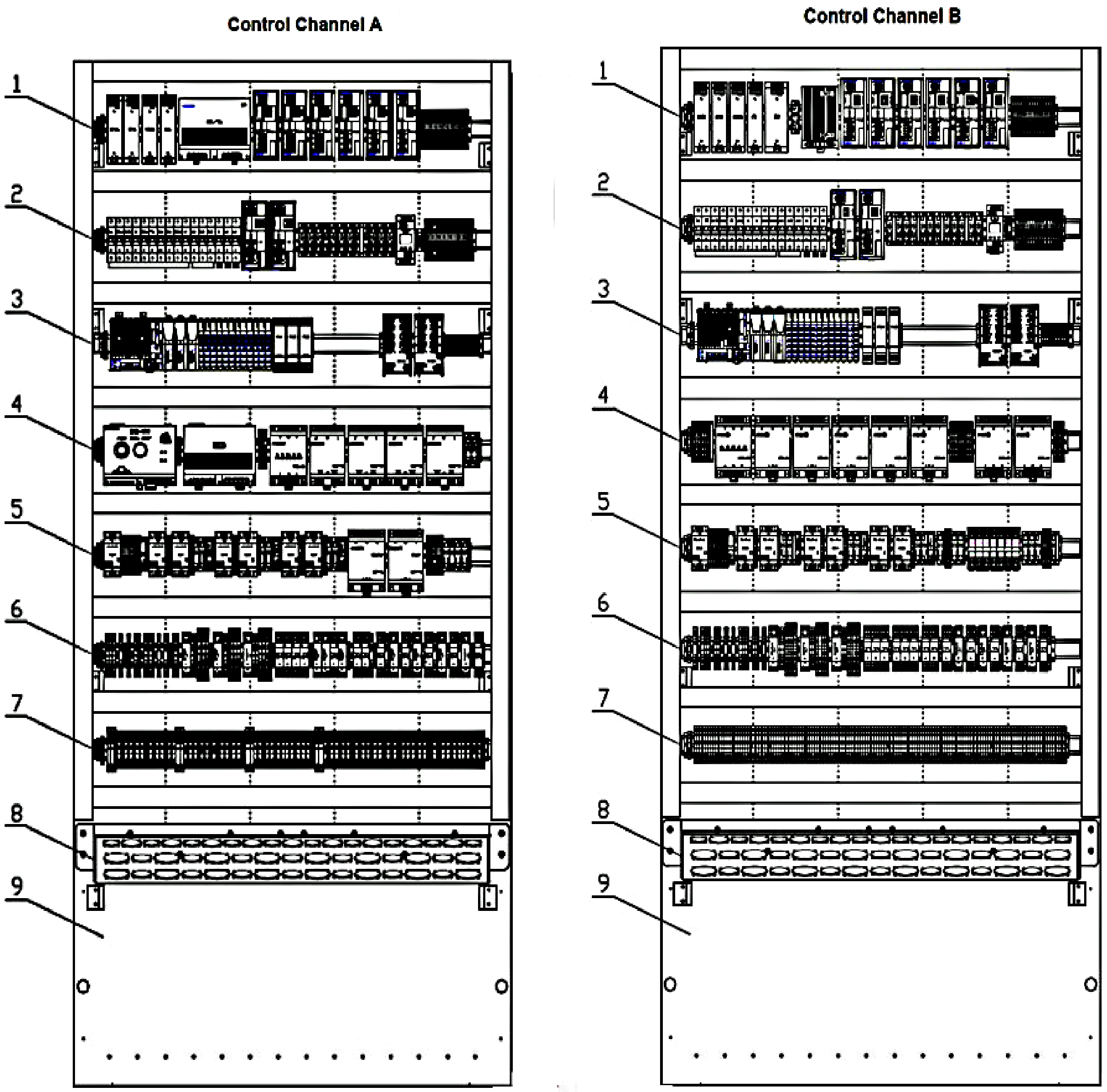
Section Index

1. Definitions & Abbreviations

EBI Gate 2000 (SPA-5/GBR)	Brand name for the family of SPA-5 level crossing systems
LX	Level Crossing System. Set of devices that warn road users about approaching trains.
PLC	Programmable Logic Controller
CPU	Central Processing Unit – main part of the PLC
PE	Protective Earth
+UA, +UB	Isolated power supply voltages for Control Channels A and B
RCD	Residual Current Device
ERP-9	Remote Control Device
DnC	Diagnostic and Control
CF	Compact Flash - Memory card installed in the CPU socket
POD	Primary Obstacle Detector
COD	Complementary Obstacle Detector
DVR	Digital Video Recorder
BPM	Barrier Protection Modules
ERR-8	Set of Power Supply and Control Racks ERR-8 Release 01 for *EBI* Gate 2000 (SPA-5/GBR)

2. Control Rack – Layout & Equipment Descriptions

2.1 Control Rack Layout



Control Channel A	
Number	**Terminal Strip ID**
1	LAA
2	LAB
3	LAC
4	LAD
5	LAE
6	LAF
7	Plug coupler sub-assembly
8	
9	

Control Channel B	
Number	**Terminal Strip ID**
1	LBA
2	LBB
3	LBC
4	LBD
5	LBE
6	LBF
7	Plug coupler sub-assembly
8	
9	

2.2 Control Rack – Manual Control Module EMH-261

EMH-261 module is equipped with:

- Button (with backlight) used during system start up procedure,
- Two LED indication lamps informing about correct operation of the data logger function.

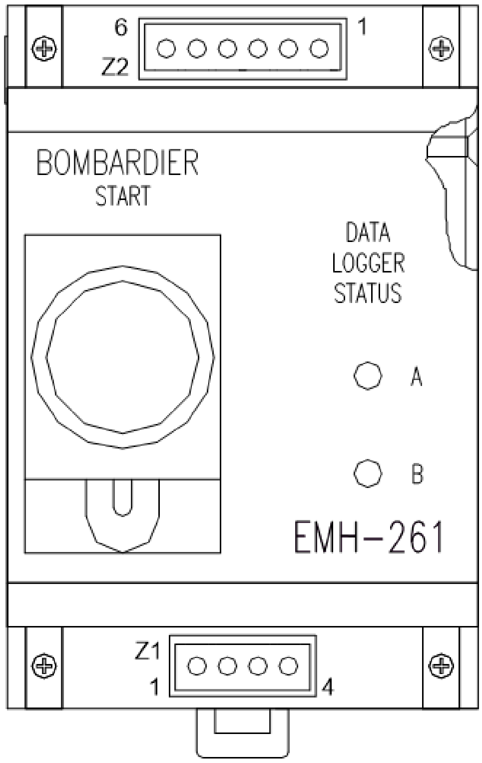


Fig. 1. EMH-261 front view

2.3 Control Rack – Manual Control Module EMH-264

EMH-264 module is equipped with:

- Button that enables the function of red road light failure reset,
- Button that enables the function of obstacle detection alarm reset,
- Switch that enables control over COD shutters,
- Switch that enables control over BOD outputs.

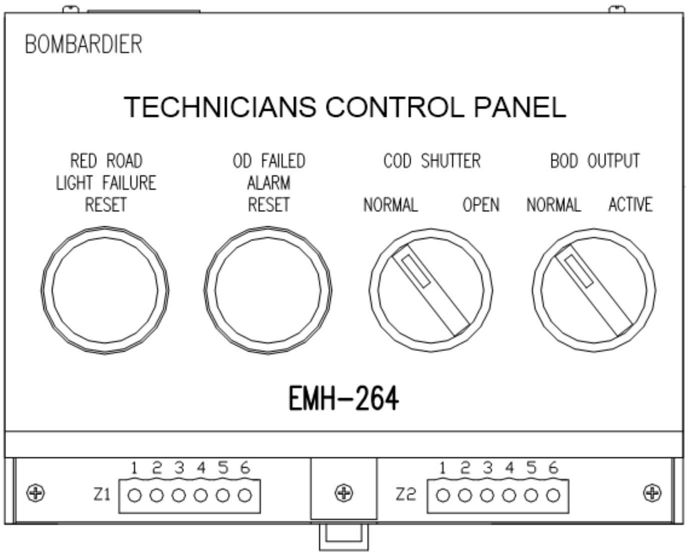


Fig. 2. EMH-264 front view

2.4 Control Rack – Digital input modules

- There is a set of digital input modules connected to each CPU within each PLC.

- The working status of the each module is reported via lit “r” LED placed on the front panel.

- The “e” LED should remain turned off. The status of each pin (DI1, DI2, etc.) is indicated by green LEDs with indicating numbers.

- When an input is in active state a corresponding LED is lit.

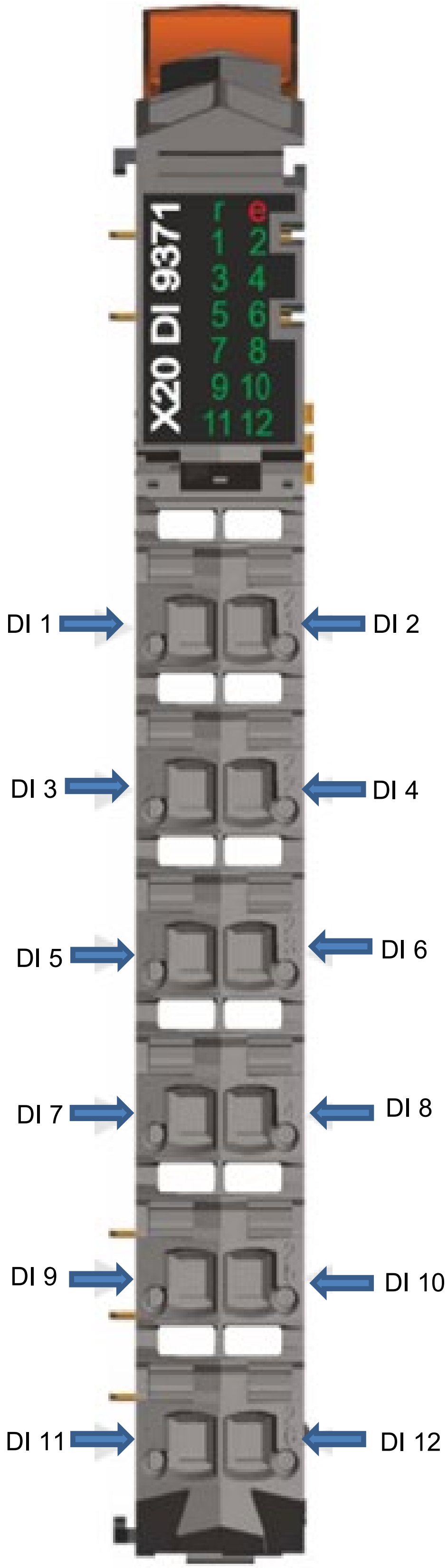


Fig. 3. Input module X20DI9371 (12 inputs)

2.5 Control Rack – Digital output modules

There is a set of digital output modules connected to each CPU within each PLC.

The working status of the each module is reported via lit "r" LED placed on the front panel.

The "e" LED should remain turned off. The status of each pin (DO1, DO2, etc.) is indicated by orange LEDs with indicating numbers.

When an output is in active state a corresponding LED is lit.

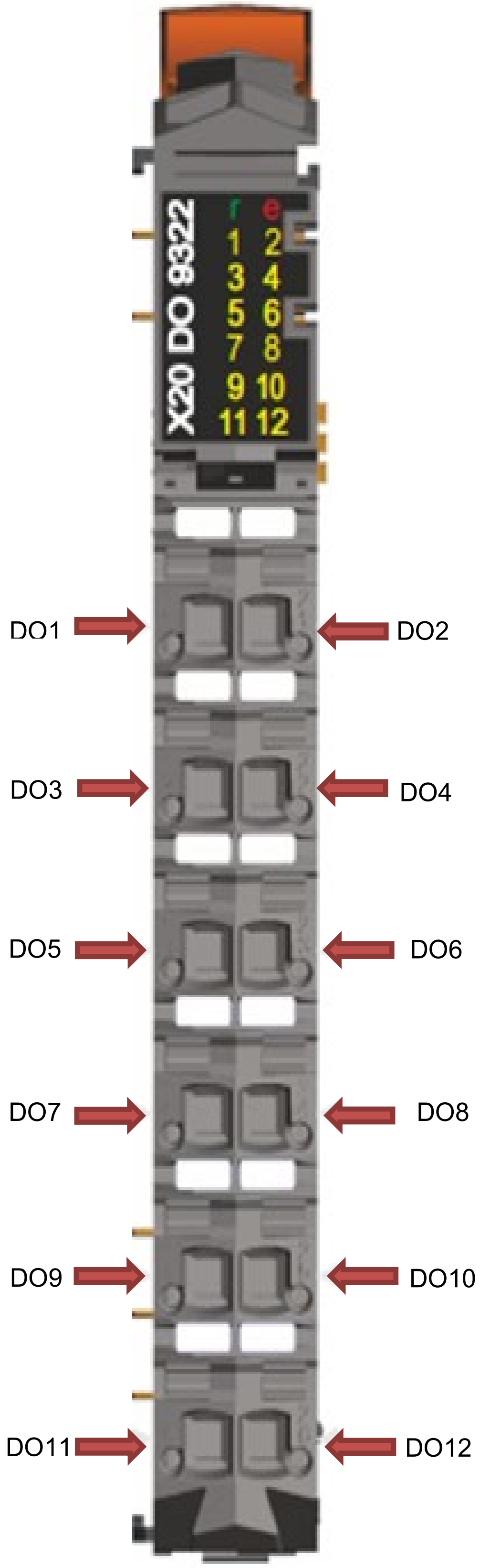


Fig. 4. Output module X20DO9322 (12 outputs)

2.6 Control Rack – List of input and output signals

The inputs and outputs are numbered according to following rules:

- groups represent PLC input or output modules that are marked from left to the right using capital letters A, B, C, ... ,
- The version of the group configuration is marked with number 1, 2, ...

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Gen1 Waveform	inGen1 A	inGen1 B
2	21	Gen1Start LX	inGenStart A	inGenStart B
3	12	Hut door	inHutDoor A	inHutDoor B
4	22	Fire Danger	inFire A	inFire B
5	13	Battery Voltage of channel A/B	inBatteryA	inBatteryB
6	23	Mains Power 230V of channel A/B	inMainsA	inMainsB
7	14	Earth leakage detector TH1 of channel A/B	inTH1A	inTH1B
8	24	Earth leakage detector TH2 of channel A/B	inTH2A	inTH2B
9	15	Battery Voltage of channel C	inBatteryC	-
10	25	Mains Power 230V of channel C	inMainsC	-
11	16	Earth leakage detector TH1 of channel C	inTH1C	-
12	26	Earth leakage detector TH2 of channel C	inTH2C	-

Table 1 - Input group A1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Lidar A/B LL fault	inCOD_LL_FLT_A	inCOD_LL_FLT_B
2	21	Lidar A/B LL clear	inCOD_LL_FRE_A	inCOD_LL_FRE_B
3	12	Lidar A/B HL fault	inCOD_HL_FLT_A	inCOD_HL_FLT_B
4	22	Lidar A/B HL clear	inCOD_HL_FRE_A	inCOD_HL_FRE_B
5	13	Lidar C/D LL fault	inCOD_LL_FLT_C	inCOD_LL_FLT_D
6	23	Lidar C/D LL clear	inCOD_LL_FRE_C	inCOD_LL_FRE_D
7	14	Lidar C/D HL fault	inCOD_HL_FLT_C	inCOD_HL_FLT_D
8	24	Lidar C/D HL clear	inCOD_HL_FRE_C	inCOD_HL_FRE_D
9	15	Technician Reset Button: Road signals OK acknowledge	inTechnReset A	inTechnReset B
10	25	COD Shutter Normal/Open	inCOD_SHUTTER A	inCOD_SHUTTER B
11	16	BOD Output Normal/Active	inBOD_OUTPUT A	inBOD_OUTPUT B
12	26	POD Failed Alarm Reset	inOD_FLT_ALM_RST A	inOD_FLT_ALM_RST B

Table 2 - Input group B1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Gen 1 Waveform	outGen1 A	outGen1 B
2	21	Opto-coupler cyclical test pulse	outTT A	outTT B
3	12	-	-	-
4	22	EMH module LED1/LED2 – Logger A/B status	outEvLogger A	outEvLogger B
5	13	EMH module LED – START	-	outStartPLC
6	23	Gen2 Waveform	outGen2 A	outGen2 B
7	14	Radar START	outOD_START A	outOD_START B
8	24	Radar STOP	outOD_STOP A	outOD_STOP B
9	15	LIDAR Power ON/OFF	-	outCOD_ON_OFF
10	25	LIDAR Shutter OPEN/CLOSE	-	outCOD_OP_CL
11	16	LCU Raise Locked	outLCU_Locked	-
12	26	XCU Crossing Clear Ind.	-	outXCU_CCind

Table 3 - Output group C1/GBR (DO 12out module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Signal at time of clearing controls. (CC)NPR de-energised, (CC)SR and (BARR)CR energised.	outIL_XZGR A	outIL_XZGR B
2	21	Crossing locked down. (DN)SR energised	outIL_DN_SPR A	outIL_DN_SPR B
3	12	Operates when raise sequence is pre-selected	outIL_RAISE_NZPR A	outIL_RAISE_NZPR B
4	22	Operates when auto mode is set	outIL_ASPR A	outIL_ASPR B
5	13	Operates when the barrier are up or the crossing is opening	outIL_XNSKPR A	outIL_XNSKPR B
6	23	Operates when the signaller has operated the manual raise control, and the LCU is not being used	outIL_RAISE_N2PR A	outIL_RAISE_N2PR B
7	14	COD HL FRE Total to DVR/POD FRE to DVR	outDVR_HL_FRE	outDVR_POD_FRE
8	24	COD LL FRE Total to DVR/OD Not Failed	outDVR_LL_FRE	outDVR_OD_NFLT
9	15	BOD FREE Total to DVR/OD START to DVR	outDVR_BOD_FREE	outDVR_OD_START
10	25	OD FLT RESET to DVR/OD STOP to DVR	outDVR_OD_RESET	outDVR_OD_STOP
11	16	Interlocking - reserved	-	-
12	26	-	-	-

Table 4 - Output group D1/GBR (DO 12out module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Absent Switch in Closed position if absent switch provided	inIL_ABS_LPR A	inIL_ABS_LPR B
2	21	Absent Switch in Open position if absent switch provided	inIL_ABS_LPZR A	inIL_ABS_LPZR B
3	12	Train Approaching from either direction	inIL_TAR A	inIL_TAR B
4	22	Operates to prove that the level crossing is effective in interlocking	inIL_DN_S2PR A	inIL_DN_S2PR B
5	13	Operates to prove signal clearing conditions have released in the interlocking	inIL_DN_S2PZR A	inIL_DN_S2PZR B
6	23	Operates when crossing is free to open	inIL_XZR A	inIL_XZR B
7	14	Operates to prove that all routes over the level crossing are normal	inIL_NL2PR A	inIL_NL2PR B
8	24	Feedback signal of output XZGR	inIL_XZGRf A	inIL_XZGRf B
9	15	Feedback signal of output (DN)SPR	inIL_DN_SPRf A	inIL_DN_SPRf B
10	25	Feedback signal of output (RAI.)NZPR	inIL_RAISE_NZPRf A	inIL_RAISE_NZPRf B
11	16	Feedback signal of output ASPR	inIL_ASPRf A	inIL_ASPRf B
12	26	Feedback signal of output XNSKPR	inIL_XNSKPRf A	inIL_XNSKPRf B

Table 5 - Input group E1/GBR (DI 12int module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	RADAR - Cleared	inPOD_FRE A	inPOD_FRE B
2	21	RADAR - Active	inPOD_ACT A	inPOD_ACT B
3	12	RADAR - Fault	inPOD_FLT A	inPOD_FLT B
4	22	Feedback of Radar START	inOD_STARTf A	inOD_STARTf B
5	13	Feedback of Radar STOP	inOD_STOPf A	inOD_STOPf B
6	23	ID of control channel A (-UA)/ ID of control channel B (+UB)	inChannel_ID A	inChannel_ID B
7	14	TD254D Inductive Loop – BOD12/BOD34	inBOD_L12_FLT	inBOD_L34_FLT
8	24	TD254D Inductive Loop - BOD1/BOD3	inBOD_L1_FREE	inBOD_L3_FREE
9	15	TD254D Inductive Loop – BOD2/BOD4	inBOD_L2_FREE	inBOD_L4_FREE
10	25	-	-	-
11	16	-	-	-
12	26	-	-	-

Table 6 - Input group F1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	XCU NORMAL	inXCU_Normal A	inXCU_Normal B
2	21	XCU DOOR	-	inXCU_Door
3	12	XCU SIGNALS ON	inXCU_SignalsON A	inXCU_SignalsON B
4	22	XCU Crossing Clear	inXCU_CrossClear A	inXCU_CrossClear B
5	13	Level Crossing locked	inIL_LC_LOCKED A	inIL_LC_LOCKED B
6	23	Feedback signal of output (RAISE)N2PR	inIL_RAISE_N2PRf A	inIL_RAISE_N2PRf B
7	14	LCU NORMAL	inLCU_Normal A	inLCU_Normal B
8	24	LCU HAND	inLCU_Hand A	inLCU_Hand B
9	15	LCU RAISE	inLCU_Raise A	inLCU_Raise B
10	25	LCU STOP	inLCU_Stop A	inLCU_Stop B
11	16	LCU LOWER	inLCU_Lower A	inLCU_Lower B
12	26	LCU DOOR	inLCU_Door A	-

Table 7 - Input group G1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Feedback of entrance barriers direction of movement	inBM_Dirf A	inBM_Dirf B
2	21	Barrier MB1/BM2 intermediate position	inBM_1m	inBM_2m
3	12	Barrier BM1/BM2 lowered position	inBM_1d	inBM_2d
4	22	Barrier BM1/BM2 raised position	inBM_1u	inBM_2u
5	13	Barrier BM1/BM2 door	inBM_1ok	inBM_2ok
6	23	Barrier BM1/BM2 intact	inBM_1i	inBM_2i
7	14	Feedback of exit barriers direction of movement	inBM_DirExf A	inBM_DirExf B
8	24	Barrier BM3/BM4 intermediate position	inBM_3m	inBM_4m
9	15	Barrier BM3/BM4 lowered position	inBM_3d	inBM_4d
10	25	Barrier BM3/BM4 raised position	inBM_3u	inBM_4u
11	16	Barrier BM3/BM4 door	inBM_3ok	inBM_4ok
12	26	Barrier BM3/BM4 intact	inBM_3i	inBM_4i

Table 8 - Input group H1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	-	-	-
2	21	-	-	-
3	12	-	-	-
4	22	-	-	-
5	13	-	-	-
6	23	-	-	-
7	14	Interlocking - reserved	-	-
8	24		inIL_TAZPR A	inIL_TAZPR B
9	15	-	-	-
10	25	-	-	-
11	16	-	-	-
12	26	-	-	-

Table 9 - Input group I1/GBR (DI 12in module)

LED No.	Terminal	Description	Signal in Control Channel A	Signal in Control Channel B
1	11	Entrance barriers direction of movement	outBM_Dir A	outBM_Dir B
2	21	Barrier BM1/BM2 move on	outBM_1move	outBM_2move
3	12	Barrier BM1/BM2 brake on	outBM_1brake	outBM_2brake
4	22	Barrier BM1/BM2 lanterns on	outBM_1lamps	outBM_2lamps
5	13	Exit barriers direction of movement	outBM_DirEx A	outBM_DirEx B
6	23	Barrier BM3/BM4 move on	outBM_3move	outBM_4move
7	14	Barrier BM3/BM4 brake on	outBM_3brake	outBM_4brake
8	24	Barrier BM3/BM4 lanterns on	outBM_3lamps	outBM_4lamps
9	15	-	-	-
10	25	-	-	-
11	16	-	-	-
12	26	-	-	-

Table 10 - Output group J1/GBR (DO 12out module)

2.7 Control Rack – Power Supply Module EMF-8

Power Supply Modules EMF-8 are controlling chambers of road signals. The external elements of EMF-8 are presented below:

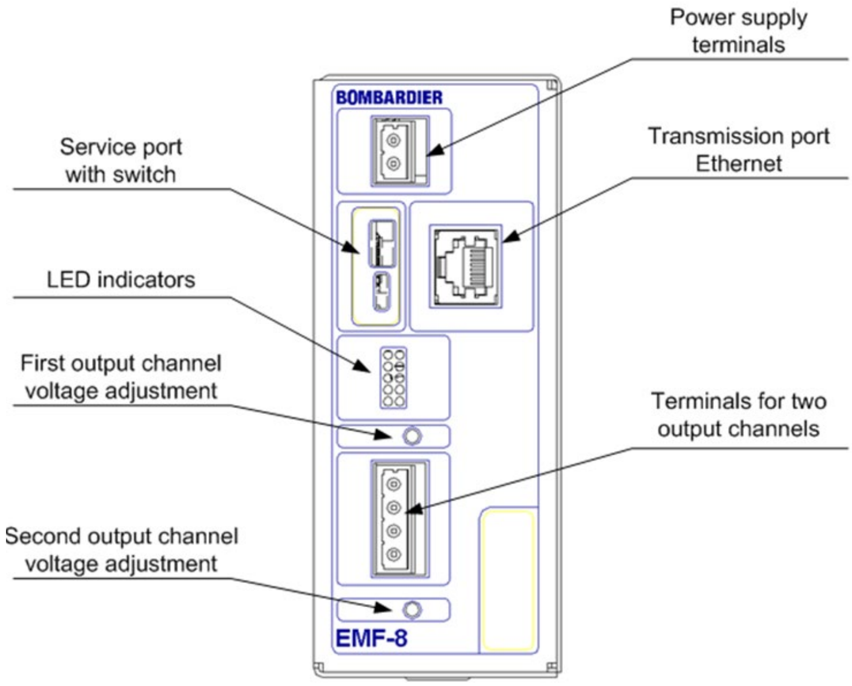
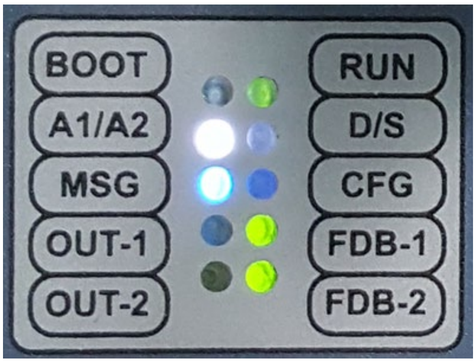


Fig. 5. Power Supply Module EMF-8

Fig. 6 - Power Supply Module EMF-8, Sound Generator EDG-5 – LED indicators

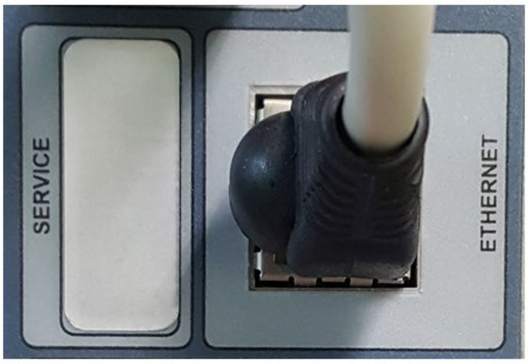


The meanings of LED indicators (front panel description in brackets):

- TransmissionRx (MSG) - LED blinks for about 100ms after receiving message,
- ActiveModes (A1/A2):
    - LED continuous on – Active,
    - LED 2Hz flash – Active Without Transmission,
    - LED off – in case of all other states.
- OutputSignal (OUT1, OUT2) - requested state of output signals,
- DiagStart (D/S):
    - LED off – no Diag or Start state,
    - LED on – Start state,
    - LED 2Hz flashing – Diag state.
- Feedback (FDB-1, FDB-2) – read back state of output signal:
    - LED on – output signal is active,
    - LED off – output signal is inactive,
    - LED 10Hz flashing – output signal state is incorrect.
- Config (CFG):
    - LED off – configuration OK,
    - LED 2Hz flashing – no configuration data,
    - LED 1Hz flashing – invalid configuration data.
- Run (RUN) – blinks for about 10ms when device works properly with about 2Hz frequency, continuous on or off when device stops.

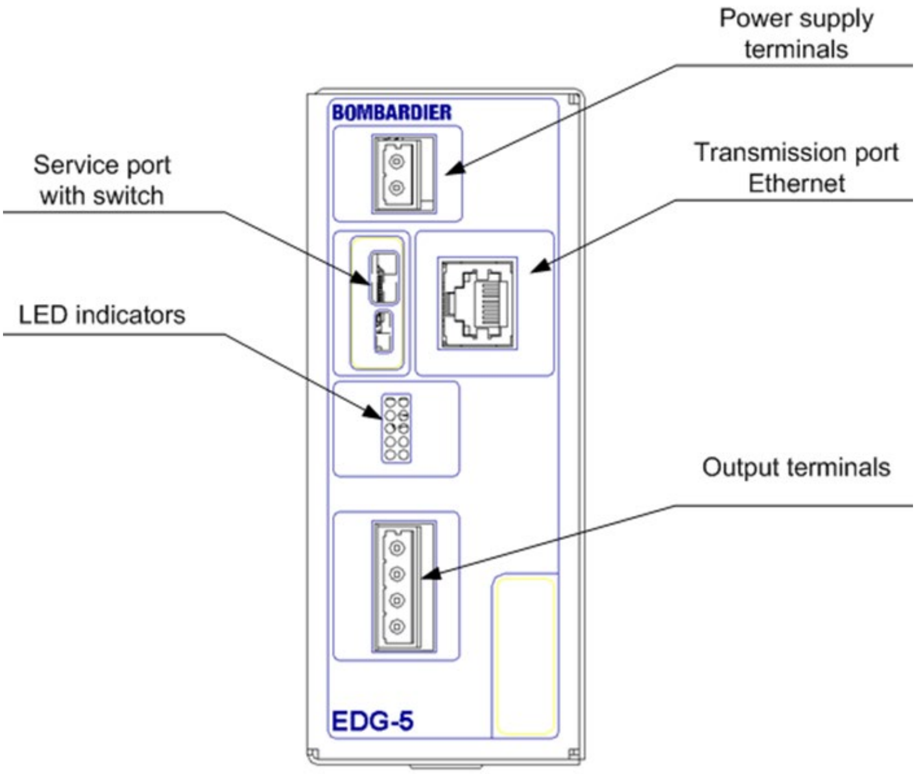
Fig. 7. Power Supply Module EMF-8, Sound Generator EDG-5 – Service port

- Service port of EMF-8 shall be sealed with a special sticker.



2.8 Control Rack – Sound Generator EDG-5

- Sound Generators EDG-5 are controlling acoustic warning signals. The external elements of this module are presented below:



- The meaning of LED indicators is the same as for EMF-8.

- Service port must be sealed with a special sticker.

2.9 Control Rack – Signal Amplifier EDZ-35

Signal Amplifier EDZ-35 consists of five electronic keys acting as buffers for PLC outputs.

Each output circuit (K1, K2, K3, K4, K5) is equipped with voltage and current indication circuit with two LED lamps.

In each pair the green LED represents the output voltage detection and the red LED represents current detection.

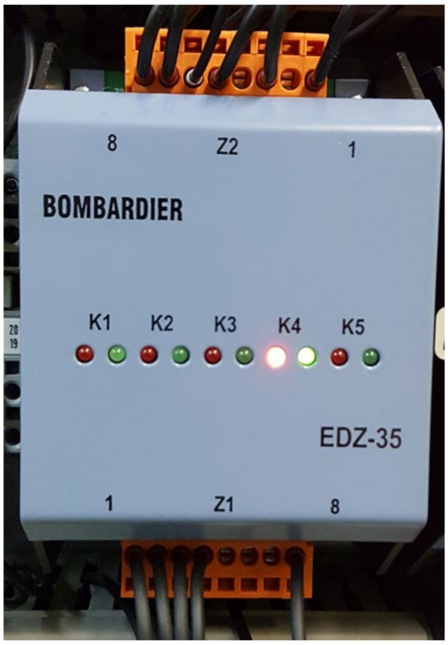


Fig. 9. Signal Amplifier EDZ-35

2.10 Control Rack – Electronic Key EDZ-5

Electronic Key EDZ-5 is a simple electronic key. It is equipped with red LED lamp which is lit when the module is activated.

Fig. 10. Electronic Key EDZ-5

2.11 Control Rack and Power Supply Rack – Earth Leakage Detector

Power supply channels A and B are insulated with each other and with the equipotential bar PE.

The Earth Leakage Detectors are applied to check the resistance between PE, UA and UB. There is also an "Earth Leakage Detector" in power supply channel C.

The "Earth Leakage Detector" is equipped with:

- LCD display which presents actual value of insulation resistance,
- ON LED lamp which is lit when the module is powered,
- Two AL1, AL2 LED lamps informing about two levels of insulation degradation.

Fig. 11. Earth Leakage Detector

2.12 Control Rack – Current Transducer

Current Transducer is applied in control circuit of barrier machines to allow high current measurements for analogy input cards of PLC A and B.

It is equipped with LED indicator informing that the module is powered (PWR) and that an error in module operation was detected (ERR).

Current Transducer has two plugs.

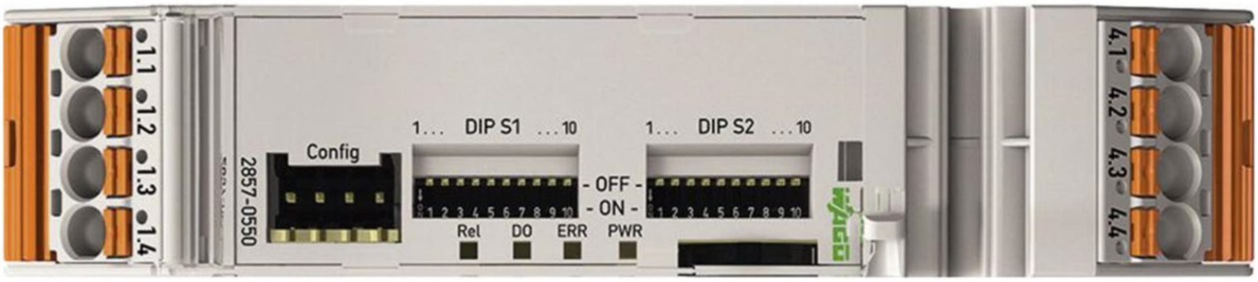


Fig. 12. Current Transducer - WAGO current measurement unit

2.13 Control Rack – ETHERNET Switch

The ETHERNET communication is held via ETHERNET switches. These modules are equipped with LED lamps:

- Pwr – the module is powered,
- L/A is lit up green – link is active,
- L/A is flashing green – link is active and data is transferred.

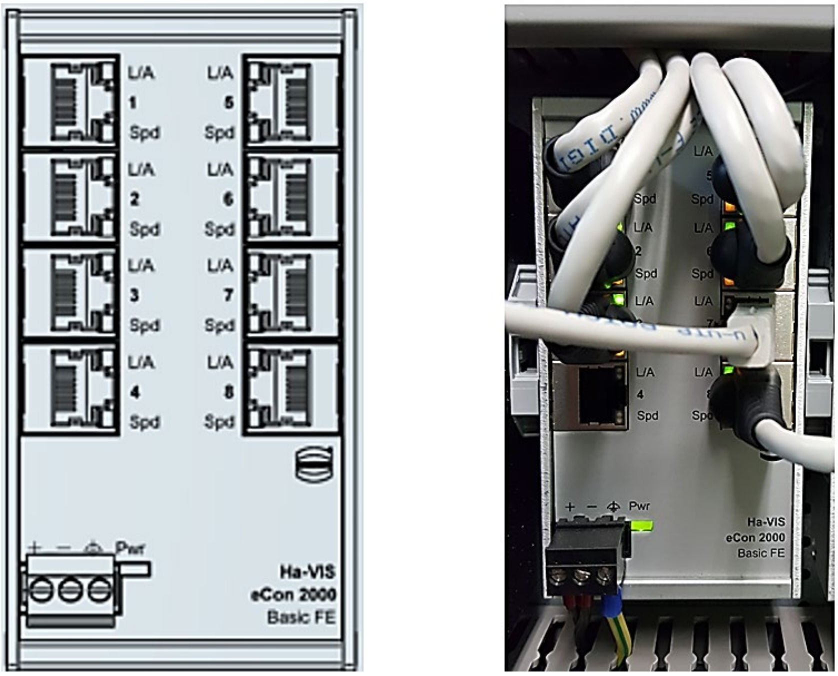
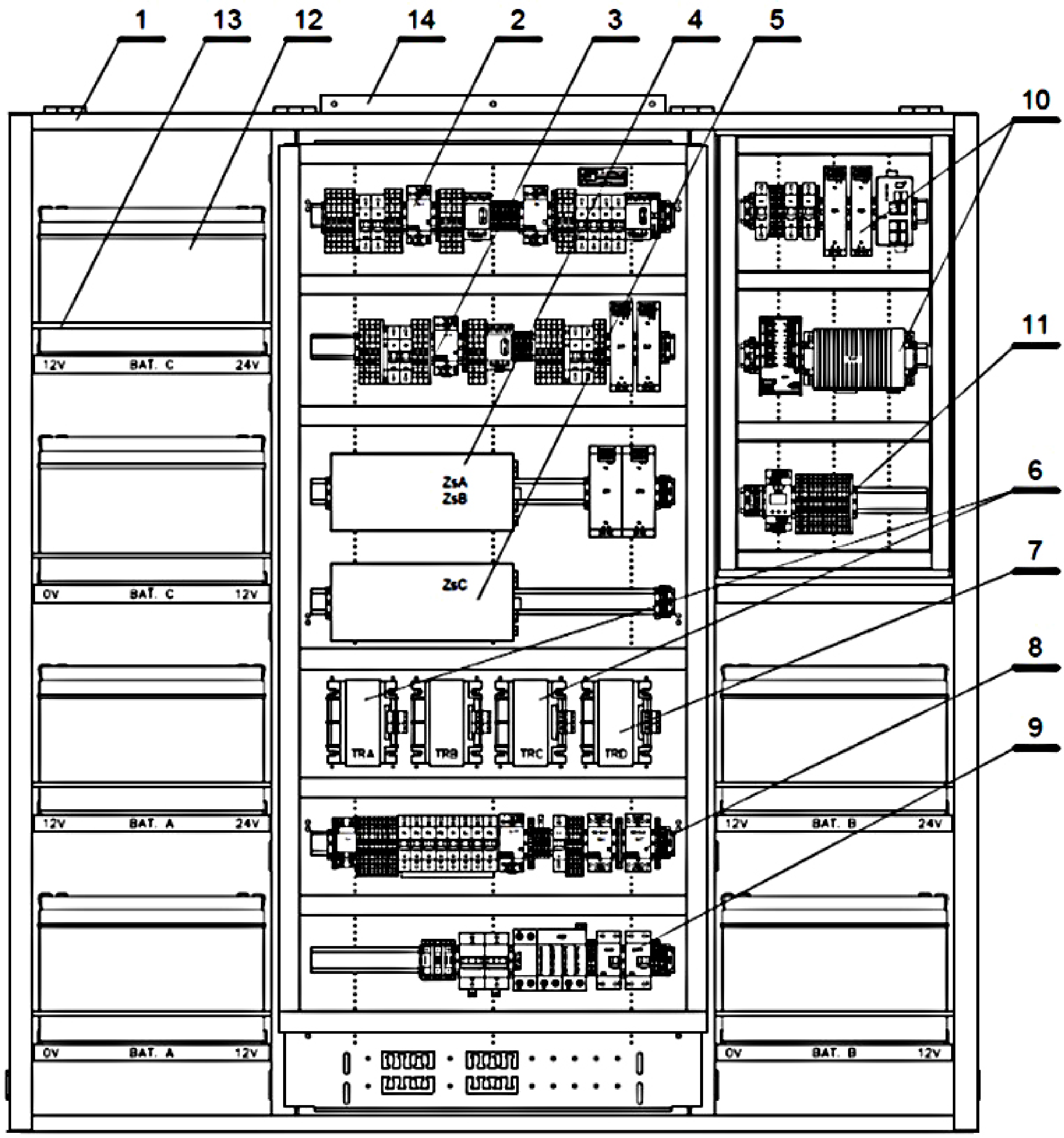


Fig. 13. ETHERNET Switch

3. Power Supply Equipment and Fuses

3.1 Power Supply Rack – General View



Number	Description
1	Chassis
2	ZZA Terminal Strip
3	ZZB Terminal Strip
4	ZZC Terminal Strip
5	ZZX Terminal Strip
6	Transformers TRA, TRB & TRC
7	Autotransformer TRD

Number	Description
8	ZZD Terminal Strip
9	ZZE Terminal Strip
10	LTZ Module
11	ZZE Terminal Strip in LTZ Module
12	Batteries 12v, 85 Ah
13	Battery Blocking Bars
14	Mounting Bracket

3.2 Power Supply and Control Racks – Before switching on checklist

Before switching on the ERR-8 below listed steps have to be performed:

- Check using AC voltmeter if the main power supply voltage is above 195V,
- Check using DC voltmeter if batteries voltage is above 26V,
- Perform visual inspection of all terminal strips,
- Check if all fuses are turned off in terminal strips LAB and LBB.

3.3 Power Supply and Control Racks – Switching on and off

To switch on the ERR-8 follow the instructions described in the manual, To switch off move downward levers of all fuses listed in 3.4

3.4 Power Supply and Control Racks – Manual restart procedure

It is enough to switch off only the fuses LA and LB on Control Racks to execute manual restart procedure.

3.5 Power Supply and Control Racks – Fuses

On both racks there is a set of fuses that check power supply for ERR-8 sub-circuits.

In order to turn on a fuse move the lever up to the end.

In order to turn off move the lever downward.

The list of all fuses with explanation of their function and position on the racks:

Power supply rack

TYTAN	Fused mains power switch
ISOLATION SWITCH	Safety mains power disconnector
FA	Mains power supply for power channel A
FB	Mains power supply for power channel B
FC	Mains power supply for power channel C
FD	Mains power supply for POD internal heater
TV	Mains power supply for DVR LCD
FL	Internal lighting
FF	Fan
FS	General purpose electric outlet, heater
P.P	Smoke detector
RCD1, RCD2	Residual Current Device
ZA	Power channel A: batteries load fuse
ZB	Power channel B: batteries load fuse
ZC	Power channel C: batteries load fuse
ZiA	Power channel A: battery charging fuse
ZiB	Power channel B: battery charging fuse

ZiC	Power channel C: battery charging fuse
BS	Power supply for COD shutter motors
BV	Power supply for DVR and BPM modules
BL	Power supply for CODs
BR	Power supply for POD

Control rack (channel A)

LA	Fuse of PLC in channel A
ODŁ.A	Fuse of EMB-1 module
RS14A	Fuse of red chambers in road signals 1, 2, 3, 4 (channel A)
RSYA	Fuse of amber chambers in road signals 1, 4, 5, 8
BMA	Fuse of group of barrier machines BM1 and BM3
RS58A	Fuse of red chambers in road signals 5, 6, 7, 8 (channel A)
D1	Fuse of audible signal DZ1
D5	Fuse of audible signal DZ5
BM1	Main fuse of barrier machine BM1
BM3	Main fuse of barrier machine BM3
B1	Fuse of electromagnetic brake in BM1
B3	Fuse of electromagnetic brake in BM3

Control rack (channel B)

LB	Fuse of PLC in channel B
INT	Fuse of output part of interlocking interface
RS14B	Fuse of red chambers in road signals 1, 2, 3, 4 (channel B)
RSYB	Fuse of amber chambers in road signals 2, 3, 6, 7
BMB	Fuse of group of barrier machines BM2 and BM4
RS58B	Fuse of red chambers in road signals 5, 6, 7, 8 (channel B)
D2	Fuse of audible signal DZ2
D6	Fuse of audible signal DZ6
BM2	Main fuse of barrier machine BM2
BM4	Main fuse of barrier machine BM4
B2	Fuse of electromagnetic brake in BM2
B4	Fuse of electromagnetic brake in BM4

3.6 Guidelines for Stabilized Power Supply DC/DC Converter MERAWEX

The output voltage of Stabilized Power Supply DC/DC Converter MERAWEX is adjusted during production process.

As the performance of lead-acid batteries depends on the charging voltage the user is not allowed to make any adjustments of their output voltage.

3.7 Guidelines for other DC/DC converters (Phoenix Contact)

The output voltage of other DC/DC converters (Phoenix Contact) is adjusted during its production and installation process. It is not allowed to make any adjustments of their output voltages.

3.8 Adjusting output voltage of Power Supply Module EMF-8

Power Supply Module EMF-8 consists of two independent DC/DC converters. It is used as a power supply for the road signals.

Adjustment of its output voltages can be done (when necessary) by means of two multi-turn potentiometers (shown below) with use suitable screwdriver.

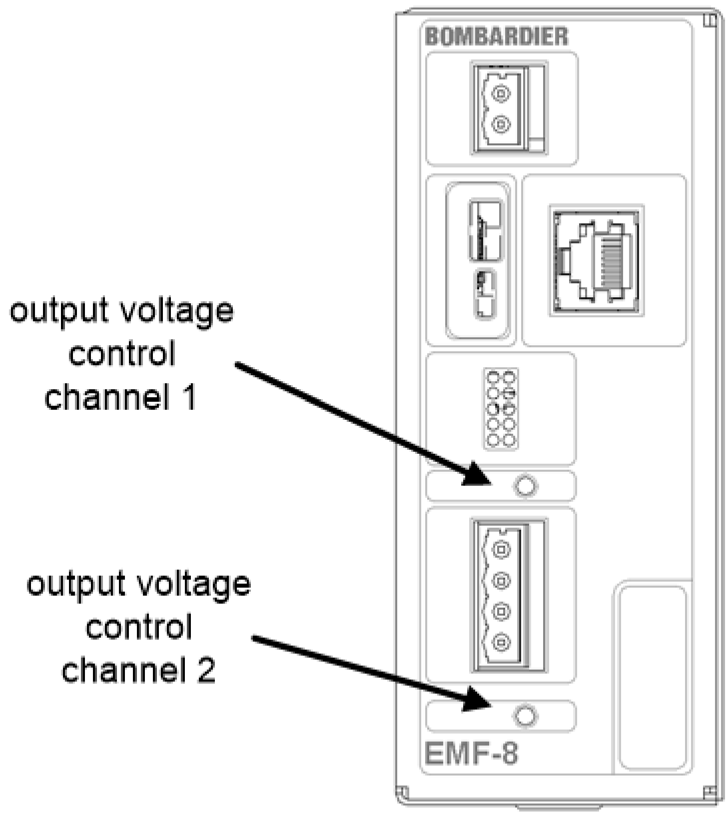


Fig. 14. Adjusting EMF-8 output voltage

END

This appendix covers the checking the status of various equipment at the interlocking, acronyms and system restart.

1. CALS Board (Internal)

1.1 Observe all the power supply LEDs of the CALs (CALS PAP i=1 to 3) are lit.

1.2 Check the PAP rack's circuit breaker is powered. The Start (green) button shall be engaged, the Stop (red) shall not be engaged.

1.3 If the circuit breaker is not powered, check incoming power. If this is within +-20% of 24 V, re-engage the circuit breaker.

1.4 If the circuit breaker trips again, replace the CALS board.

1.5 Using a meter, check the following voltages at the measurement points on the CALS board:

- 5V VME (+4.7 V to +5.5 V)
- =12V VME (+11.5 V to 12.5 V)
- -12V VME (-11.5 V to 12.5 V)
- 5V VL (+4.7 V to 5.5 V)
- 24 VREG (23 to 25V)

If these voltages are not measured, replace the CALS board.

2. CME+ Board

2.1 Observe the LEDs of the CME:

	VA	VA
(Unlit) E ⊗	(Flashing) ⊗ ⊗ (Steady)	(Flashing) ⊗ ⊗ (Steady)
	Rx	Tx
(Unlit) E ⊗	(Flashing) ⊗ ⊗ (Steady)	(Flashing) ⊗ ⊗ (Steady)
	VA	VA

If these indications are not correct, replace the CME+ board.

3. CIER Board

3.1 Observe the CIER board is displayed in red on the Technicians Terminal.

3.2 Observe on the front face of the CIER board that the LEDs of Ethernet ports 1 and 2 are not flashing. Also, and/or the two LEDS of the Console port are steady green or off.

If these indications are not correct, replace the CIER2 board.

4. CAP Board

4.1 Observe LEDS of the CAP board are in the following state:

(Flashing) BFL ⊗
(Flashing) CPU ⊗

If the CPU LED is lit, replace the CAP dongle (BCH).

If the LEDs are in the expected state, replace the CAP board.

5. CVO Board

5.1 Observe LEDS of the CVO board are in the following state:

lit)	W	⊗	⊗	H	(unlit)
(pulsating)	M	⊗	⊗	E	(unlit)
(flashing)	1	⊗	⊗	2	(unlit)

If these indications are not correct, replace the CIER2 board.

6. CIER Ethernet Cables

6.1 Disconnect the Ethernet cables between the CIER board and the Ethernet switch.

6.2 Using another Ethernet cable, connect between the CIER board and the Ethernet switch and check for the following states on the Technicians Terminals:

a) If the connection stays green, keep the new Ethernet cable.

b) If the connection remains faulty, reconnect the existing Ethernet cable.

7. Acronyms

Acronym	French Meaning	English Meaning
AG	**AG**uile	Point
BCH	**B**ou**CH**on	Dongle
CALM	**C**arte **AL**imentation d'une architecture bi-**M**TOR	Power Supply Board for MTOR architecture
CALS	**C**arte **AL**imentation **S**ol	Power Supply Board
CAP	**C**arte d'**AP**plication	Processing Unit Board
CIER	**C**arte **I**nterface **E**thernet **R**éseau	Ethernet Network Interface Board
CG	**C**hien de **G**arde	Watchdog
CME	**C**arte **M**émoire d'**E**change	Shared Memory Board
CRCD	**C**arte à **R**elais à **C**ommande **D**iversifiée	Duplicated Output Relay Board
CSD	**C**alculateur de **S**écurité **D**isponible	Module containing CAP, CVO & CME boards and CAP & CVO dongles
CVO	**C**arte **VO**teur	Voting Board
HES	**H**ybride d'**E**ntrée de **S**écuité	Hybrid Safety Inputs
MTOR	**M**odule **T**out **O**u **R**ien	Digital Module
PAP	**P**anier d'**AP**plication	Application Rack
PES	**P**anier d'**E**ntrées / **S**orties	Inputs / Outputs Rack
PVF	**P**anier d'**V**entilation **F**orcée	Forced Ventilation Rack
SEI	**S**ystème d'**E**nclenchement **I**nformatisé	Interlocking System
SSKC	**S**ous-**S**ystème (**K**) **C**ontrôleur commande	I/O Module command control sub-system
SX	**S**ignau**x**	Signal
TTD	**T**erminal **T**echnique **D**eporté	Remote Technicians Terminal
UT	**U**nité de **T**raitement	Processing Unit

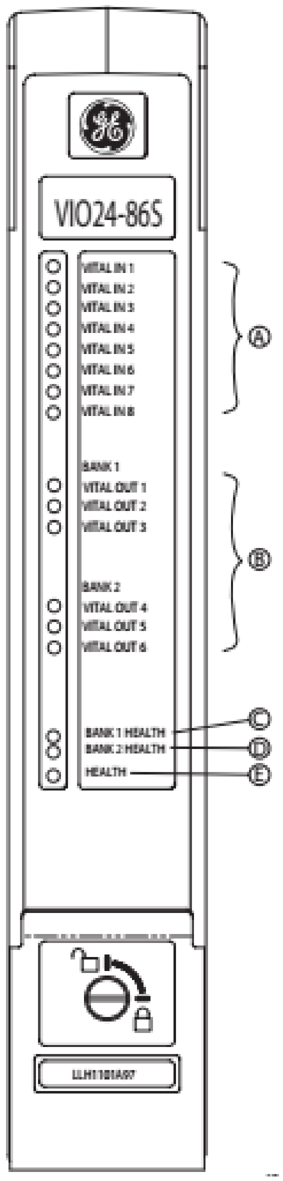
8. Interlocking Restart

When restarting the interlocking, all interlocking controls such as route bars, shall be reapplied using the TT.

END

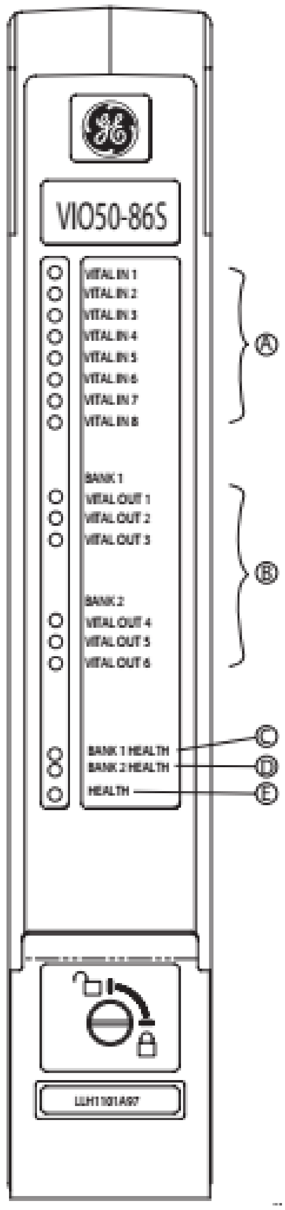
Status and Description of LED Indications.

1. VIO24-86S



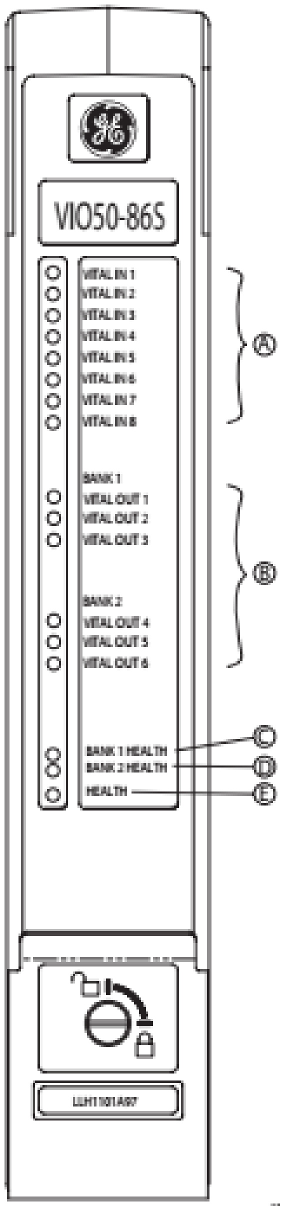
VIO24-86S		
LED	**Status**	**Description**
A. VITAL IN 1-8	On	Input is energised (When input rises above 16.0 ± 0.5VDC). Will accept voltages up to 64 VDC.
A. VITAL IN 1-8	Off	Not Energised (When input falls below6.0 ± 0.5VDC)
B. VITAL OUT 1-3	On	Output is energised
B. VITAL OUT 1-3	Off	Not Energised
B. VITAL OUT 4-6	On	Output is energised
B. VITAL OUT 4-6	Off	Not Energised
C. BANK 1 HEALTH	On	Bank 1 vital outputs 1-3 are functioning properly.
C. BANK 1 HEALTH	Off	1 or more of Vital Outputs 1-3 has failed. If 1 Vital Output fails the other 2 Vital Outputs on the same Bank are shutdown.
D. BANK 2 HEALTH	On	Bank 2 vital outputs 4-6 are functioning properly.
D. BANK 2 HEALTH	Off	1 or more of Vital Outputs 4-6 has failed. If 1 Vital Output fails the other 2 Vital Outputs on the same Bank are shutdown.
E. HEALTH	On	Module able to function properly.
E. HEALTH	Off	Module is in Safe State Retention State (check system log & Alarms).

2. VIO50-86S



VIO50-86S		
LED	**Status**	**Description**
A. VITAL IN 1-8	On	Input is energised (When input rises above 39.0 ± 0.5VDC). Will accept voltages up to 64 VDC
A. VITAL IN 1-8	Off	Not Energised (When input falls below12.5 ± 0.5VDC)
B. VITAL OUT 1-3	On	Output is energised
B. VITAL OUT 1-3	Off	Not Energised
B. VITAL OUT 4-6	On	Output is energised
B. VITAL OUT 4-6	Off	Not Energised
C. BANK 1 HEALTH	On	Bank 1 vital outputs 1-3 are functioning properly.
C. BANK 1 HEALTH	Off	1 or more of Vital Outputs 1-3 has failed. If 1 Vital Output fails the other 2 Vital Outputs on the same Bank are shutdown.
D. BANK 2 HEALTH	On	Bank 2 vital outputs 4-6 are functioning properly.
D. BANK 2 HEALTH	Off	1 or more of Vital Outputs 4-6 has failed. If 1 Vital Output fails the other 2 Vital Outputs on the same Bank are shutdown.
E. HEALTH	On	Module able to function properly.
E. HEALTH	Off	Module is in Safe State Retention State (check system log & Alarms).

3. VLD-R8AC



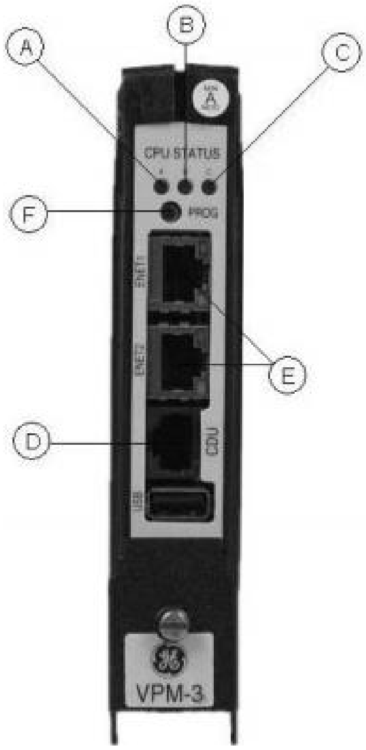
VLD-R8AC		
LED	**Status**	**Description**
A. LAMP 1-8	On	Lamp Output LED is lit when corresponding Lamp Output is energised.
A. LAMP 1-8	Off	Lamp Output LED is not lit when corresponding Lamp Output is not energised. See Note 1. All Lamps out, See Note 2.
B. VSSR	On	Vital Signal Stop Relay is energised.
B. VSSR	Off	VSSR is disabled. See Note 1. See Note 2. See Note 3.
C. HEALTH	On	Module Health LED is lit when VSSR is energised and all internal self-tests pass.
C. HEALTH	Off	Input power is <85VAC RMS or 110VAC lost for more than 0.5s or one or more health check failed, VSSR output disabled. VLD is in Safe State. (It will be 30s before the module attempts to recover).

Note 1: The VLD-R8AC contains feedback circuitry to allow the VPM to monitor and report on the integrity of the lamp output circuitry. The response to a detected fault on defined outputs (off when should be on, on when should be off, etc.) is a de-energising of all the Lamp Outputs and a disabling of the Vital Signal Stop Relay (VSSR) output. After a lamp module has been shut down, the VPM disables the eight Lamp Outputs and the VSSR output for a minimum of 30 seconds. After 30 seconds have passed, the VSSR output is enabled and the VPM performs a health check. If the lamp module passes the health checks, the VLD-R8AC resumes normal operation. Otherwise, if the lamp module fails one or more health checks, the VSSR output is disabled and the VPM waits another 30 seconds before retrying.

Note 2: If the VLD-R8AC internal monitoring circuit senses an unsafe fault all outputs on the module are de-energised and the VSSR output is de-energised. Outputs that are red-retained are immediately energised over a back contact of the VSSR.

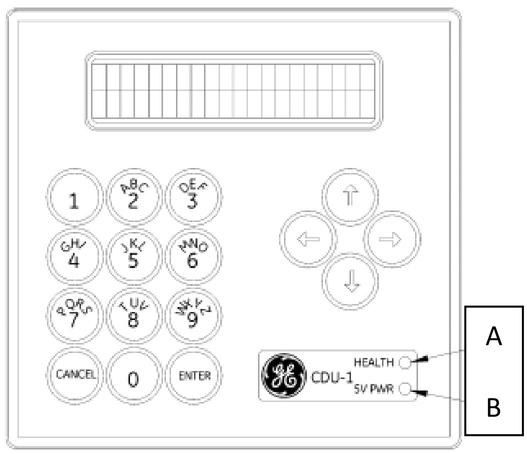
Note 3: If the VSSR de-energises due to a failure in the VLD-R8AC module, the module cannot be re-initialised without manual intervention. If the VSSR de-energises due to power failure, the module and VSSR will re-initialise automatically when power is restored.

4. VPM-3



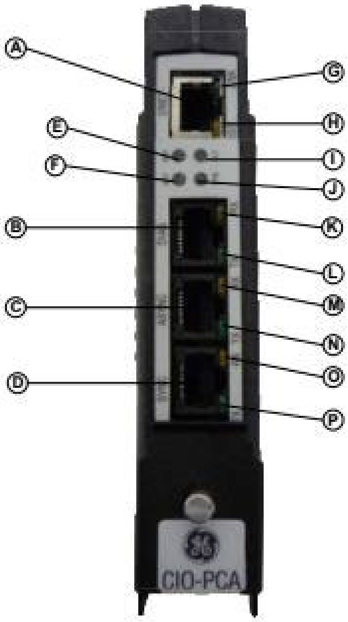
VPM-3		
LED	**Status**	**Description**
A, B or C	Off	CPU is not functioning.
A, B or C	Steady On	The CPU is initialising (only valid status during startup). If one or more continuously illuminated during normal operation, the CPU is not functioning.
A, B or C	Flashing	CPU is Active and functioning normally
All three CPU LEDs	Flashing amber/ red pattern	Update mode (the mode used to update VPM-3 executive software or application programs).
E. Green LED Ethernet connection	Steady/ Flashing	Connected/active
E. Amber LED Ethernet connection speed	On	100Mbs
E. Amber LED Ethernet connection speed	Off	10Mbs
F. Prog Button		1. If depressed during a power cycle, causes the VPM-3 to enter update mode. 2. Used to confirm Local Presence when requested.

5. CDU-1



CDU-1		
LED	**Status**	**Description**
A. HEALTH	On	System CPUs are operating normally
A. HEALTH	Off	A CPU has halted/or not operating and also during system resets.
B. 5V PWR	On	Output of Central Power Supply is within acceptable parameters.
B. 5V PWR	Off	No power

6. CIO-PCA



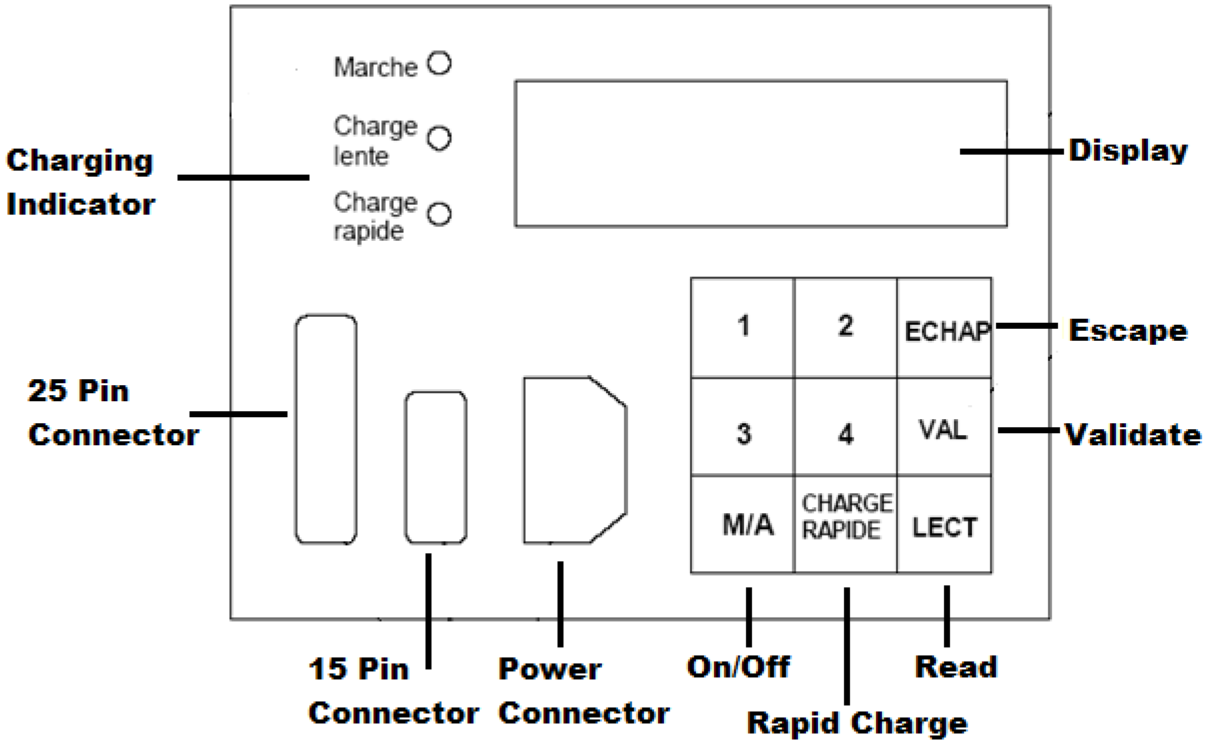
VPM-3		
LED	**Status**	**Description**
E. BKP	On	Receiving data from ElectroLogIXS backplane
F. ASY	On	A valid frame (good CRC) has been received from ASYNC (radio control) port.
G. LINK	On	Ethernet connected to ElectroLogIXS and active
G. LINK	Flashing	Activity on the link
H. 100 (Amber)	On	Ethernet data rate. Connection at 100M
H. 100 (Amber)	Flashing	Data collisions detected
I. HLT	Flashing	CIO-PCA Health. LED flashes approx. once per second when module functioning properly
J. SYN	On	A valid frame (good CRC) has been received from SYNC (radio control) port.
K. RX (Amber)	On	Receive data present on DIAG port to ElectroLogIXS
M. RX (Amber)	On	Receive data present on ASYNC port to ElectroLogIXS
O. RX (Amber)	On	Receive data present on SYNC port to ElectroLogIXS
L. TX (Green)	On	Transmit data present on DIAG port to ElectroLogIXS
N. TX (Green)	On	Transmit data present on ASYNC port to ElectroLogIXS
P. TX (Green)	On	Transmit data present on SYNC port to ElectroLogIXS

END

1. Equipment Description

SNCF Catalogue number for the tester and all the associated cables is: 7.954.5494, Supplier: ALSTOM. This will become stand PADS number after trial Certification.

It is a portable tool with and is designed to be laid flat on the balise. The upper face features: a display, three light indicators, three connectors and a nine touch keypad.



*****IMPORTANT NOTE*****

The Battery Life for the tester is an estimated 3 hours. The Tester is to remain on charge when not in use.

There are two charging rates available;

- ‘Charge Lente’ Slow Charge – 30 Hours
- ‘Charge Rapid’ Fast Charge – 14 Hours

If ‘Charge Rapid’ is used, the tool will automatically switch back to Charge Lente after the charge cycle has completed and can be powered by at this rate continuously.

When the tool has less than 10 mins remaining, a ‘BAT’ message will display on the right hand side of the display.

2. Main functions

The test tool is capable of all measurements necessary for the installation and maintenance of the Balises. It is used for testing both KVB SN Balises and encoders, and can carry out the following functions:

- Test “serial” Balises and display the messages.
- Read “serial” message on an encoder output.
- Read “serial” message on maintenance connector of the encoder SBI card.
- Read messages at the end of a Balise tail cable.
- Read maintenance messages produced by encoder through the UCS maintenance card.

3. Accessories

The Test tool should have the following cable connectors as part of the kit:

- Mains cable and supply power connector.
- 25-pin cable to SBI Card Output
- 25-pin cable to UCS Card
- 25-pin cable to Balise tail cable
- 15-pin cable to SBI Maintenance Output

Figure1 - Cable connector identification

4. Test tool software

The Maintenance Tool software reference is V 2 0 0.

This software version can be identified by switching on, press the ‘M/A’ (on/off) and the ‘1’ key simultaneously.

The version number will be displayed for 6 seconds.

5. Using the Test Tool

5.1 Starting & selecting a function

To turn on the tester, press ‘M/A’ key on the keyboard.

To switch the tester off, press the ‘M/A’ key again.

The tool automatically selects the function to be performed by recognizing the connection that has been made.

If two connections are made simultaneously, the message “double connexion en entrée interdite” (double connection in inputs are forbidden) is displayed.

If there is no cable, the “test balise” function is automatically selected.

6. Reading either encoder or extension encoder maintenance messages

6.1 With the tester connected to the UCS maintenance card, after turning on, the following is message is displayed;

1	.	A	F	F	I	C	H	E		C	O	N	F	I	G				
2	.	L	E	C	T	U	R	E		I	N	C	I	D	E	N	T	S	
3	.	E	T	A	T		D	E	S		E	N	T	R	E	E	S		
4	.	E	F	F	A	C	E	M	E	N	T		M	E	M	O	I	R	E

6.2 Choose the required function by pressing key ‘1’, ‘2’, ‘3’ or ‘4’.

Key ‘1’ allows the encoder configuration. See Section 7

Key ‘2’ allows the reading of the encoder failure memory. See Section 8

Key ‘3’ makes it possible to read continuously the encoder input states. See Section 9

Key ‘4’ allows the erasing of the encoder failure memory. See Section 10.

A standby message is displayed as soon as any of these four key has been pressed.

	V	E	U	I	L	L	E	Z		P	A	T	I	E	N	T	E	R	

(Please Wait)

7. Encoder Configuration

Key ‘1’ makes it possible to display the input card types, the balise driven by every output and the number of programmed messages for every output.

C	E	1	:	E	L	I	I	S	1	:	A			0	2	3	M	E	S
C	E	2	:	E	C	I	I	S	2	:	A			0	0	8	M	E	S
C	E	3	:	E	C	I	I	S	3	:	A			0	1	2	M	E	S
C	E	4	:	-	-	-	I	S	4	:	N	O	N		U	T	I	L	

This display describes the following configuration:

- 1st input card: ELI (not used in UK)
- 2nd input card: ECI
- 3rd input card: ECI
- 4th input card non installed
- Output 1: balise of type A with 23 programmed messages (including one anomaly message)
- Output 2: balise of type A with 8 programmed messages (including one anomaly message)
- Output 3: balise of type A with 12 programmed messages (including one anomaly message)
- Output 4: free

7.1 As soon as the configuration is displayed the operator can access the encoder software version number by pressing key “1”.

C	O	D	E	U	R		/		E	X	T	E	N	S	I	O	N		
V	E	R	S	I	O	N		L	O	G	I	C	I	E	L	L	E		
					X	X	X												

(Encoder/extension – Software version)

7.2 Pushing on key ‘ECHAP’ (escape) returns the user to the main menu.

8. Reading the Fault Memory

8.1 From the main menu shown in section 6, press key ‘2’ to read the fault memory.

Pressing the ‘VAL’ key returns the user to the previous failure.

8.2 Record any failure and investigate where practicable.

8.3 Escalate any failure to SM’s.

Transferring data from the UCS card failure memory into the tool can last a few seconds. During this period of time the standby message is displayed. If no failure is recorded the following message is displayed:

					A	U	C	U	N		I	N	C	I	D	E	N	T	
						E	N	R	E	G	I	S	T	R	E				

(No failure recorded)

If there are any failures the last failure is displayed:

I	N	C	I	D	E	N	T		8	/	8								
L	B		X	X	X	X	X				L	A		X	X	X	X	X	
A	D	R		X	X	X	X	X	X										
0	0	0	1	J		0	9	H		2	9	M	N		1	2	S		

The first line shows the failure number and all the failures recorded (in this example the 8th failure out of 8 recorded).

The second line makes clear the kind of encoder software mistake either for LB (firmware) or LA (application).

The tables of the main failure codes and their meaning can be found below.

The third line shows the software address (if the information is available) where the failure happened.

The fourth line specifies the time spent between the moment the failure has taken place and its reading by the tool in days, hours, minutes and seconds (in this example the 8th failure took place 1 day, 9 hours, 29 minutes and 12 seconds before being read by the tool).

Note: An encoder power supply failure disturbs the earlier failures dating. If the tool detects the power supply failure (by inconsistency between the failure order in the memory and the dating values); it will not display any time value for the earlier failures. If it does not detect it the time values will be distorted.

List of Error Codes

Applicative software errors

Error codes #	Description
100	No error
101	Non detected breakdown
107	Lack of BCC
108	New BCC
109	BCC reading anomaly
110	Incorrect BCC checking sum
111	Incorrect BCC signature
112	Incorrect n°1 input card signature
113	Incorrect n°2 input card signature
114	Incorrect n°3 input card signature
115	Incorrect n°3 input card signature
116	Incorrect input card signatures
117	Incorrect SBI card signature
124	Incorrect output cards signature
125	Incorrect card signatures
126	N°1 exit anomaly message
127	N°2 exit anomaly message
128	N°3 exit anomaly message
129	N°4 exit anomaly message
130	Anomaly messages on several exits

 # for UCS version 1.0.4 or 2.0.3

Firmware Errors

Error codes #	Description
1	No mistake detected
2	Incorrect reading memory checking sum
3	BCC error
4	Saved memory error
5	No error in the saved memory

 # for UCS version 1.0.4 or 2.0.3

9. Reading the Encoder Input States

9.1 From the main menu shown in section 6, press key '3' to read the encoder input states. The following message is displayed;

```
ETATS DES ENTREES

Entrer le numero de
la carte: 1,2,3,4,
```

(State of the entries - Enter the card 1, 2, 3, 4)

9.2 By pressing '1', '2', '3', or '4' tool displays continuously the state of the card inputs selected:

C		**E**	**N**	**T**	**R**	**E**	**E**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	
A		**T**	**Y**	**P**	**E**				**1**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	
R		**A**	**S**	**P**	**E**	**C**	**T**		**E**	**C**	**F**	**F**	**D**	**D**	**D**	**D**	**D**	**D**	
3		**E**	**T**	**A**	**T**				**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	

(Entree = Entry Type = Type Aspect = Aspect Etat = State)

9.3 To return to start, press 'ECHAP' (escape) Key.

The symbols displayed to define the input types are:

Input type	Symbol
TE0	0
TE1	1
TE2	2
TE3	3
TE4	4

The symbols displayed to define the input aspects are:

Aspect	Symbol
Off or non-active	E
Fixed and on or active	F
Flashing (not used in UK)	C
Free input	D

The "state" line shows the instantaneous state of the inputs read by the encoder while it was scanning them for the last time before the failure.

This state can take the value 1 or 0.

10. Erasing the failure memory

10.1 From the main menu shown in Section 6, press key '4' to erase the encoder failure memory. The following message is displayed;

C	**O**	**N**	**F**	**I**	**R**	**M**	**E**	**R**		**E**	**F**	**F**	**A**	**C**	**E**	**M**	**E**	**N**	**T**
M	**E**	**M**	**O**	**I**	**R**	**E**		**I**	**N**	**C**	**I**	**D**	**E**	**N**	**T**				
				V	**A**	**L**		**/**		**E**	**C**	**H**	**A**	**P**		**?**			

(Confirm erasing incident memory – Validate / escape)

10.2 To cancel the request and return to start, press 'ECHAP' (escape) Key.

10.3 Key “VAL” triggers the erasing of all the failures in the memory.

The “wait message” is displayed then the action is confirmed by the following display:

MEMOIRE EFFACEE

(Memory erased)

10.4 To return to start, press ‘ECHAP’ (escape) Key.

11. Error codes generated by the tool

If faults occur when using it, the test tool will generate one of the following messages (see table below). The LCD displays the error code number followed by its label.

Error code	Displayed message	Meaning
10	Double connection in input forbidden (double connexion entrée interdite)	It is not possible to connect simultaneously a cord to each connector (15-pin and 25-pin)
12	Memory reading impossible. (lecture memoire impossible)	The encoder shows that it is impossible for it to read the failure memory.
14	Maintenance Link fault between encoder and tool (défaut liaison maintenance codeur-testeur)	After a request the tool has not received an encoder answer within expected time
16	Balise message code x unknown (Type de balise non reconnu:XX)	Presence of an unknown field code in a KVB SN message.
18	synchronization word missing or inconsistent (mot de synchronisation inconsistent ou incoherent)	Synchronization words were not found in the received message
26	Balise configuration not recognised: XX (type de balise non reconnu)	The Balise configuration transmitted in the message is not of a valid configuration (XX is equal to the decimal value of the transmitted configuration)
27	CS or CRC incorrect digital message (SC ou CRC incorrect message numérique)	The test tool has recognized a message from KVB SN but the checksum (CS) or the cyclic redundancy code (CRC) is wrong
28	Erasing memory impossible (effacement mémoire impossible)	The erasing memory order has not been carried out.
29	Maintenance Link fault between encoder and tool (défaut liaison maintenance codeur-testeur)	The frame code has not been recognised
30	Sampling fault, internal to the tool (erreur d’échantillonnage interne testeur)	There have been collisions on SPI connection.
31	Maintenance Link fault between encoder and tool (défaut liaison maintenance codeur-testeur)	Parity error
32	Sampling fault, internal to the tool (erreur d’échantillonnage interne testeur)	Granted time to sample data has gone beyond limit.

The list of error codes is not exhaustive.

Some codes rarely occur; if it happens to be the case ask the supplier.

Press the ‘ECHAP’ (‘Escape’) key if you want to clear an error message from the display.

In the case of a ‘test tool software problem’, software may no longer respond and it may be impossible to clear the display.

In this case, cut the power supply then start again (press the ‘on/off’ key twice successively).

END

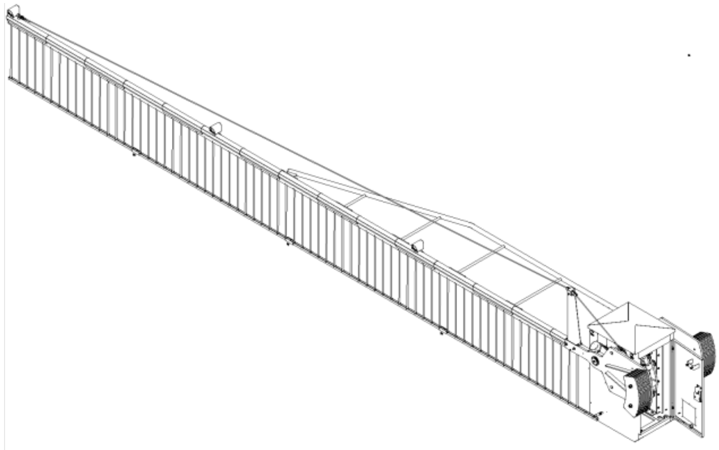


Figure 1 - Overview of the Newgate Barrier

1. Acronyms & Glossary

For the purposes of this document the following acronyms are used.

Term	Description
BL	Barrier Lower
BLSS	Barrier Limit Safety Switch
BPC	Boom Proving Contact
BR	Barrier Raised
BRSS	Brake Release Safety Switch
CRS	Centres
D1	Barrier Up Command
D2	Barrier Down Command
DFT	Dry Film Thickness
DN	Down
DNS	Barrier Down Signal
L.H	Left Hand
LCIAB	Level Crossing In a Box
LCU	Local Control Unit
LPSS	Locking Pin Safety Switch
MCB	Manual Crossing Barrier
MCB's	Miniature Circuit Breakers
MDPC	Maintainers Door Proving Contact
NGR	Newgate Rail
NR	Network Rail
OD	Object Detection
ODPC	Operators Door Proving Contact
PL	Plug
PPG	Paint System Company
PX	Proximity Sensor
R.H	Right Hand
RER	Lights On Signal
STO	Safe Torque Off
SUPPORT MEMBER	A rigid assembly used on barriers with booms 7.1m and over to support the barrier boom and prevent excessive sideways movement.
UPS	Uninterruptable Power Supply

2. Technical Data: Booms

Construction : Steel Frame, Aluminium Arm

Available Spans:

Single Sided

- 3600mm
- 4100mm
- 4600mm
- 5100mm
- 5600mm
- 6100mm
- 6600mm

Double Sided

- 7100mm
- 7600mm
- 8100mm
- 8600mm
- 9100mm

All Spans 7100mm+ are fitted with straining wire and support member.

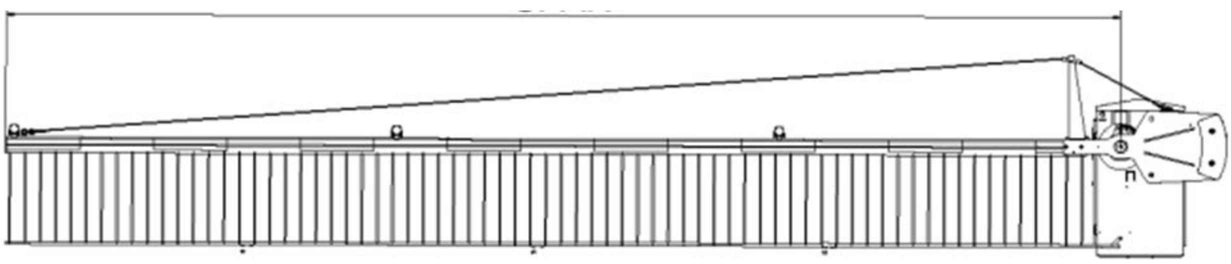
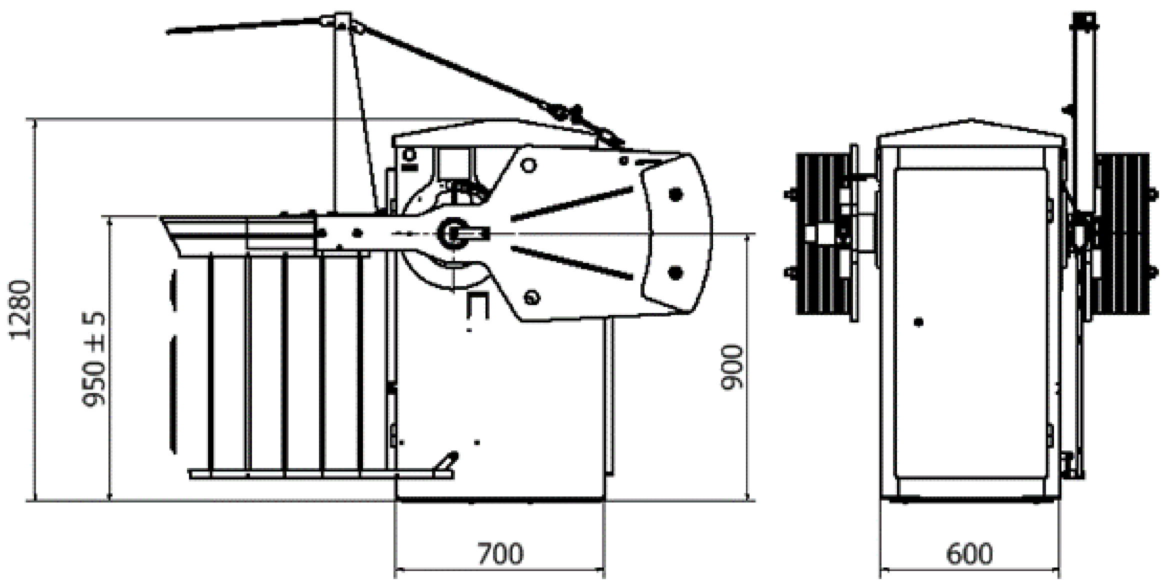


Figure 2 – Span (Side View)

Booms are powder coated white RAL9010 and are fitted with 600mm long red (BS381C-537) vertical stripes. 50mm wide red and white reflective tape is fitted either side of the boom. A-Frame if fitted is powder coated white RAL9010.

3. Technical Data: Barrier Machine

Power Requirements	110v 1ph 50Hz
Fused Rating	20 amps
Operation Movement	0-85° (Horizontal to Vertical)
Time of Operation	8 to 10 seconds (Lower)
	6 to 10 seconds (Raise)
Handing	R.H. or L.H. (Optional)
Manual Operation	By Manual Pump
Weight	475 kg (Barrier excluding Weights, Side arms & Booms)
	85 Kg (each sidearm)
	9.5 Kg(each weight)
Dimensions	
IP Rating	IP56
Control System	Various (as specified)
Storage Temperature	0 to +50 °C (do not store outside for long periods of time)
Operating Temperature Range	-25 to + 40 °C (external ambient)
Noise Level	Less than 70 Db

NOTE: The Barrier Machine is fitted with safety interlocks to the operators and technicians' doors to prevent the machine from running when either door is open.

Should this be bypassed for fault diagnostics and testing setup purposes only, the areas shown in figures 3 & 4 should be treated with extreme caution.

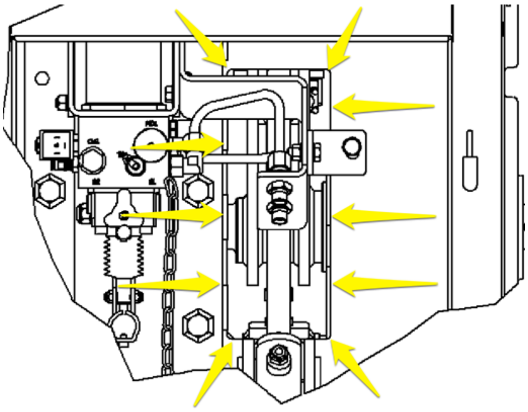


Figure 3 – Danger Zones

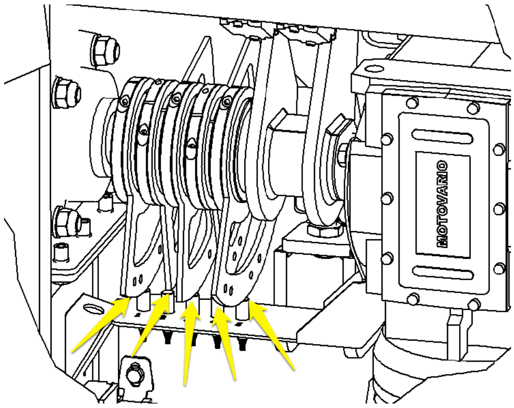


Figure 4 - Proximity Sensors

4. Product Functionality and System Operation

4.1 Product Functionality

The Newgate NGR18000 barrier machine consists of a rigid pressed steel frame containing an electric motor and gearbox, transmitting drive directly to the output shaft; the shaft is attached to the frame by self-aligning ball bearings.

The movement of the shaft is controlled via the position limit cams and proximity sensors. The proximity limit cams are set in house to control:

- Upper & Lower limits of the barrier movement.
- Fast/Slow speed changeover positions.
- Lights on feedback signal to control system.

The position limit cams are factory set, if adjustment is required to satisfy carriageway cross fall or camber, design information to be supplied to manufacture for machine to be factory set as require.

Either a single or pair of side arms are attached to the output shaft, holding the bias weights, boom, straining wire and support member.

The barrier can be operated manually in the event of a power failure by opening the rear access door, disengaging the motor brake and using the hydraulic hand pump to operate the boom

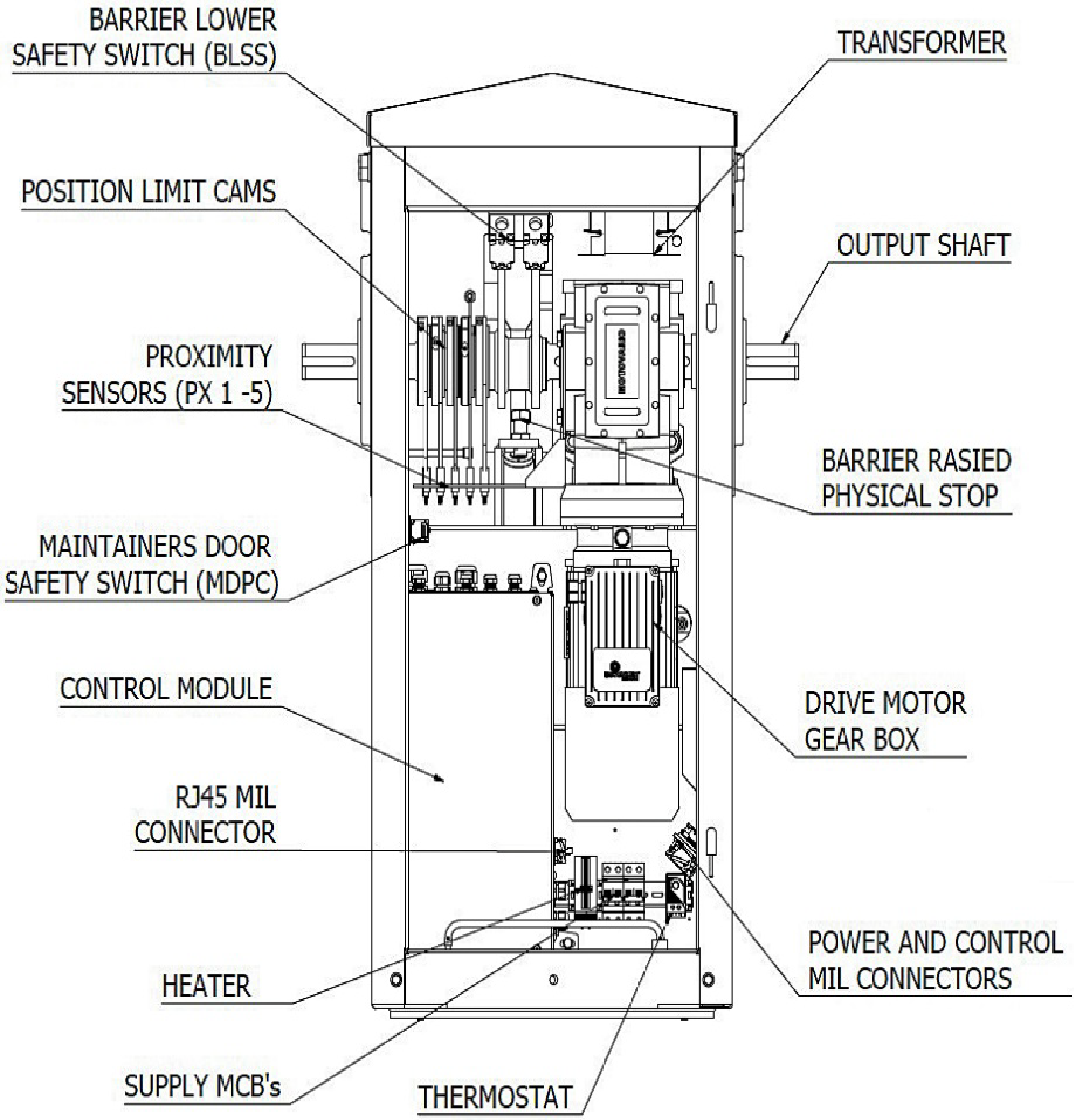


Figure 5 - View with Technician's door removed

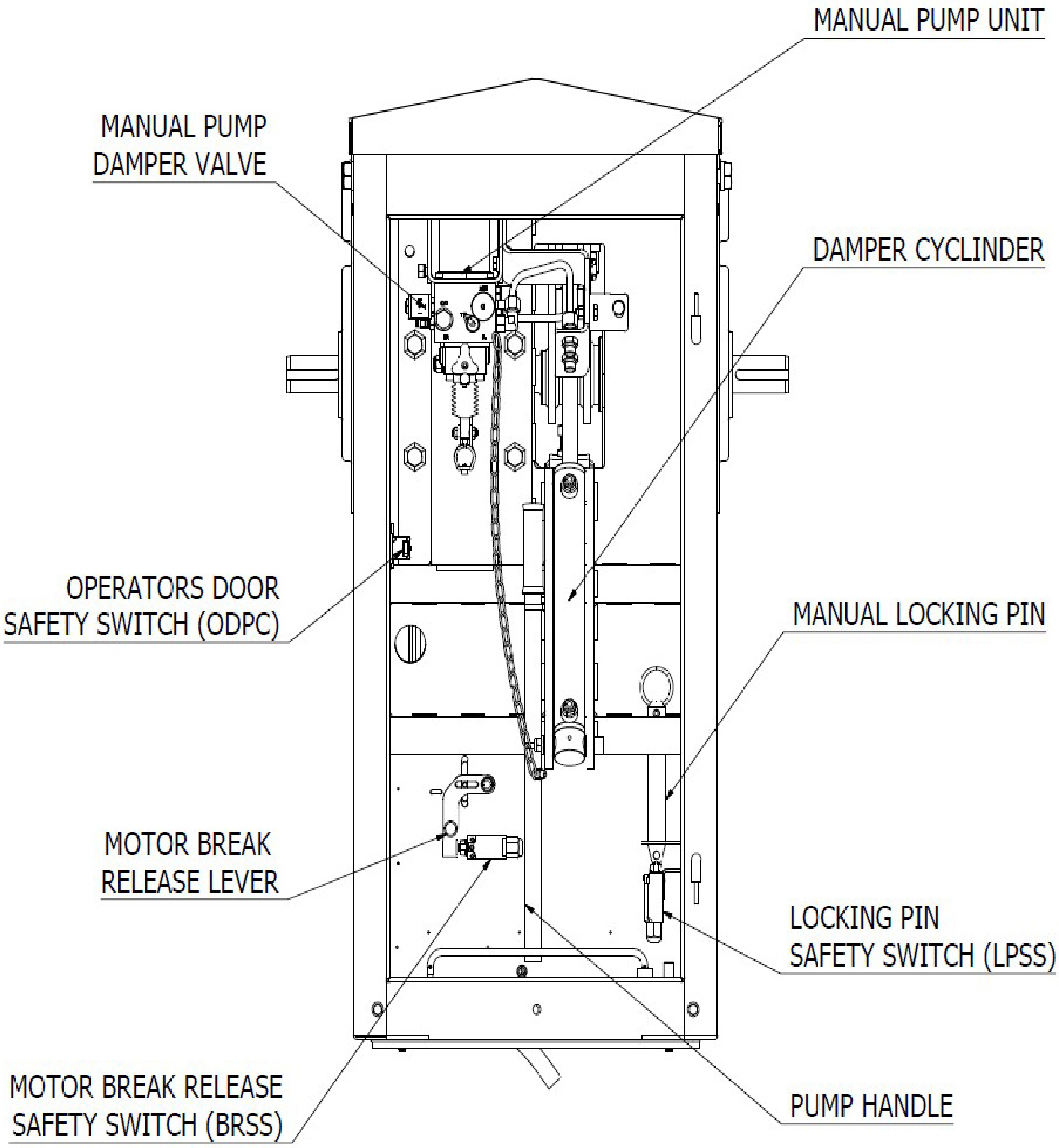


Figure 6 - View with Maintenance door removed

4.2 Product Compatibility

The Newgate Rail (NGR) Barrier machine housing is designed to be directly replaceable with existing BR843 machines. The standard stud 500mm x 440mm centres and foundation requirements are the same.

For seamless repairs original NGR booms and boom braces should be used. BR843 boom braces are not compatible with the NGR18000 barrier machine.

4.3 System Operation

The motor is controlled by the frequency inverter unit which provides the following functions for the barrier machine enabling consistent and reliable operation:

- Separate raise and lower acceleration / deceleration time periods.
- Separate fast and slow speed changeover angles thus ensuring a smooth transition to the raised and lowered rest positions.

The acceleration, deceleration, fast and slow speeds are determined by the fixed parameters in the inverter settings, pre-set for the barrier option required.

The safety controller logic performs the barrier control operation via the inputs and outputs assigned to the controller.

The default rest state of the barrier is in the raised position awaiting a lower signal from the external control system.

4.4 Lowering Operation

a) Lower signal received (D2), barrier accelerates to the fast speed setting.

b) Lights On angle position ≤ 40º detected by the Proximity Sensor PX3, Lights On interlock interface signal (RER) to external control system enabled.

c) Fast/slow speed changeover angle position detected by Proximity Sensor PX4, barrier decelerates to the slow speed setting.

d) Lowered angle position detected by the Proximity Sensor PX2, barrier again decelerates to the lowered stop position.

e) Barrier angle ≥ 4º, barrier lower safety limit switches BLSS 1&2 actuated, Safety Down interlock to external control (DN) activated and timer initiated in controller logic, after time period motor inverter STO interlock removed, inverter inoperable.

f) Barrier Down interlock to external control (DNS) activated.

4.5 Raise Operation

a) Raise signal received (D1), motor inverter STO interlock initialised, inverter operable.

b) Timer initiated in safety controller logic, after 0.5 seconds the barrier accelerates to the fast speed setting.

c) Lights Off angle position ≥ 40º detected by the Proximity Sensor PX3, Lights Off interlock interface signal (RER) to external control system enabled.

d) Fast/slow speed changeover angle position detected by Proximity Sensor PX 5, barrier decelerates to the slow speed setting.

e) Barrier Raised angle position detected by the Proximity Sensor PX1, barrier again decelerates to the Raised stop position.

f) Barrier Up interlock to external control (UP) activated.

g) Barrier Down interlock to external control (DNS) activated.

4.6 Additional Control System Interface Signals

a) Boom Proving (BPC) – Barrier boom in position on boom adapter, Boom Proving interlock contact to external control system activated.

b) Door Proving (ODPC+MDPC) – Barrier main casing access doors closed, Door Proving contact to external control system activated.

c) Boom Lights – The boom lights operation are controlled from the external control system.

5. Barrier Control Module and Barrier Mounted Equipment

5.1 Barrier Control Module

The Control Module is designed on a plug and socket basis (PL1-7) (see Figure 4 for location) to enable the whole Control Module assembly to be removed and replaced without the need to disconnect any cables from the termination points.

This is aimed at reducing the down time of the barrier operation should there be a need to replace the Control Module assembly.

The function signals to the barrier (Lower, Raise, and- Boom Lights) are controlled externally and the interface signals for specific positions of the barrier during the operation are transmitted to the external equipment.

Electrical control equipment mounted within the barrier casing, external to the Control Module, act to provide a safe, accurate and consistent function for the barrier.

The position limit cams are pre-set to obtain the optimum performance of the barrier and should not be adjusted.

5.2 Barrier Mounted Equipment and Function

This equipment comprises of the following items:

Braked Motor Assembly

Used to drive the barrier machine gearbox allowing the boom to be raised and lowered. The assembly also provides locking of the boom in the raised and lowered rest positions.

Proximity Sensors (PX1-5)

PX1 – Barrier not Raised

To detect whenever the barrier is not in the raised position.

Initiates the raise deceleration time period which is pre-set in the inverter parameters

PX2 – Barrier not Lowered

To detect whenever the barrier is not in the lowered position.

Initiates the lower deceleration time period which is pre-set in the inverter parameters.

PX3 – Lights On

To detect whenever the barrier is between 0º - 40º.

PX4 – Barrier Lower Fast Speed

To detect when the barrier inverter is to be switched between fast and slow speed during the lower cycle.

PX5 – Barrier Raise Fast Speed

To detect when the barrier inverter is to be switched between fast and slow speed during the raise cycle.

Lowered Safety Limit Switches (BLSS 1 & 2)

To detect when the barrier is between 4º - 0º in order to output safety signal for Barrier Down.

Operator Door Safety Switch (ODPC)

Used to isolate barrier control preventing the machine to be operated when the operator’s door is open.

Maintainer Door Safety Switch (MDPC)

Used to isolate barrier control preventing the machine to be operated when the maintainer’s door is open.

Locking Pin Safety Switch (LPSS)

To isolate barrier control when the locking pin is not in the home stored location.

Motor Brake Release Safety Switch (BRSS)

To isolate barrier control when the motor brake override lever is not in the normal operating position.

Manual Pump Damper Valve

This valve, when energised causes the hydraulic oil to bypass the manual pump cylinder.

6. Handling

6.1 Transporting

For ease of transportation, the barrier pedestal is despatched with the boom and if applicable A frame detached.

The boom side arms are secured in the vertical position with pins to lock them in place.

The assembly is transported, mounted to a pallet (for stability), due to the weight of the item a local risk assessment should be carried out and a lifting plan in place before lifting the equipment on site.

The use of a lifting appliance e.g. fork truck or small crane is strongly recommended.

6.2 Lifting

The barrier should always be lifted using the appropriate lifting equipment.

To lift remove the four M20 bolts around the top of the barrier pedestal (highlighted) and replace with M20 Lifting eyebolts to DIN580 or equivalent rated to 830kg slinging at 45°.

Attach 4 legged lifting chains (7mm chain) rated to 3100kg to lifting eyes.

NOTE: See below table for maximum machine weight, ref 9100mm = 947kg.

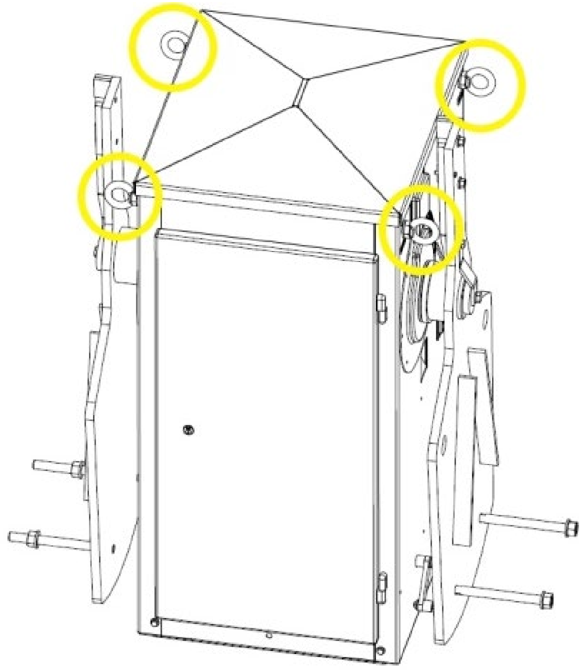


Figure 7 – Lifting Eyes

Boom Assembly Length	Estimated Total Assembly Weight (kg)	Boom Weight (kg) *=inc boom brace	Pedestal with side arms and weights (kg)
3600mm	599	28.5	570
4100mm	621	32	589
4600mm	643	35	608
5100mm	665	38	627
5600mm	687	41	646
6100mm	719	45	674
6600mm	751	48	703
7100mm	869	65*	804
7600mm	909	67*	842
8100mm	943	72*	871
8600mm	984	75*	909
9100mm	1025	78*	947

7. Replacement of Damper Cylinder or Hydraulic Hose

7.1 Isolate the barrier machine at the LXP fuse links.

7.2 Visually check for signs of oil seepage.

7.3 Remove barrier machine locking pin.

7.4 Release plunger on manual hand pump.

7.5 Release motor brake leaver and secure in manual position.

7.6 Remove and replace Damper Cylinder or Hydraulic Hose.

In order to take the strain off of the "Damper Cylinder Assembly", and ease its replacement the barrier locking pin should be removed and the barrier lowered by hand to the ¾ raised position.

7.7 Top up hydraulic oil.

7.8 Check hand pump for ease of operation.

7.9 Toggle pump direction leaver to the left to raise the boom.

7.10 Manually pump to raise barrier.

7.11 Manually raise and lower the barrier a minimum of three times. Leaving the barrier in the raised position.

7.12 Recheck oil level again.

7.13 Recheck for leaks from cylinder pipes and couplings.

7.14 Reconnect machine to power supply.

7.15 Raise and lower the barrier a minimum of three times on power. Leaving the barrier in the raised position.

7.16 Check for leaks from cylinder pipes and couplings.

7.17 Check oil level is correct.

7.18 Dispose of any contaminated items as per NR Environmental policy.

8. Barrier Cage Removal, Replacement and Clearance's

<u>Front Guard Removal</u>

8.1 Isolate barrier machine power from supply.

8.2 Switch supply MCB’s to off position. Check with a multi-meter there is no mains supply from the output of the circuit breaker to check it is switched off before proceeding with the work.

8.3 Remove M8 bottom fixings and side fixings with 13mm A/F spanner from front guard. (See Figure 8).

8.4 If fitted remove Bolt on Infill, remove fixings M8 fixings using 13mm A/F spanner.

8.5 Remove bolts on infill.

Figure 8 – Infill bolts

8.6 Carefully remove Top M20 fixing with 30m A/F spanner, note guard is now loose. (See Figure 9).

8.7 Re-fitting is the reverse of removal, torque M8 fixings to 29Nm.

8.8 Reconnect the power supply.

Figure 9 - Top M20 fixing

Side Arm Guard Removal

8.9 Isolate barrier machine power from supply.

8.10 Switch supply MCB’s to off position. Check with a multi-meter there is no mains supply from the output of the circuit breaker to check it is switched off before proceeding with the work. (See Figure 10).

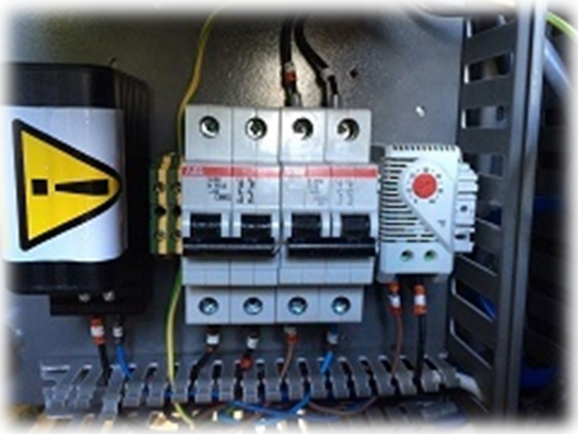


Figure 10 – Isolation MCB’s

8.11 Lift sliding door panel vertically until it is clear of door guides, the spring-loaded plungers will need to be retracted to allow the door to pass by the panel support brackets and enable complete removal. (See Figure 11).

Figure 11 - Sliding Door Panel

8.12 If fitted remove Bolts on Infill, remove fixings M8 fixings using 13mm A/F spanner.

8.13 Remove bolts on infill. (See Figure 12)

Figure 12 – Infill Bolts

8.14 Remove M8 bottom fixings and side fixings with 13mm A/F spanner from front guard. (See Figures 13 & 14)

Figure 13 – Bottom Fittings

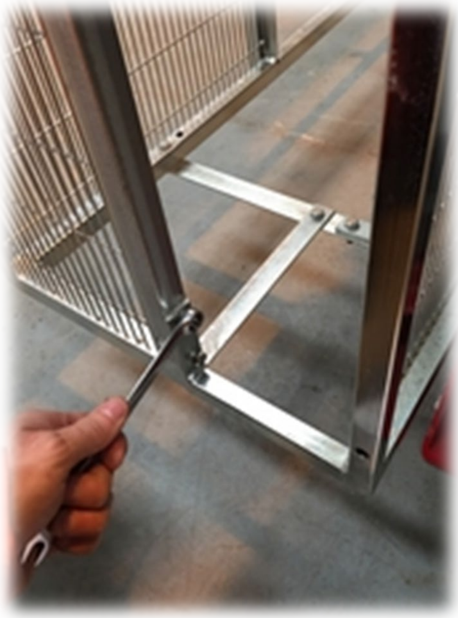


Figure 14 – Bottom fittings 2

8.15 Carefully remove Top M20 fixing with 30m A/F spanner, note guard is now loose.

Figure 15 – Top M20 Fixings

<u>Remove front guard.</u>

8.16 Remove Side Arm Guard by removing two M8 fixings fitted either side of barrier machine. Use 13mm A/F spanner or 13 A/F socket. (See Figure 15)

Figure 16 – M8 Side arm fixings

8.17 Remove remaining M20 fixings with 30mm A/F spanner. (See Figure 17)

8.18 Carefully lift machine guard away from barrier machine.

Figure 17 – Remaining M20 Bolts

8.19 Re-fitting is the reverse of removal, torque M8 fixings to 29Nm.

8.20 Reconnect the power supply.

END

1. Balise

All Balise are the same pieces of equipment but can be used in one of two modes.

The most common is the fixed mode configuration; this is where the Balise contains a programme applicable to its location and has no physical link with any other equipment.

The second type is the switchable configuration which is only used at locally monitored level crossings on the Cambrian. In this configuration the Balise contains a permanent programme applicable to its location which can be temporarily suppressed.

The suppression is in the form of an input received via a fixed cable link from a controlling Lineside Encoder Unit located at the crossing.

The train reads the Balise in either configuration by telepowering. This is where the train transmits a signal into the Balise, the signal energises the Balise and allows the same antenna to read the information stored in the Balise.

2. Fixed Mode Balise

These are passive programmable devices that are only energised and read by the systems fitted to the train.

Balise groups are arranged in the following configurations, a single balise, two Balise and four Balise. N_PIG=0 is always located at the higher Kilometric number.

Balise groups are used to pass the following information to trains:

<u>General</u>

a) Odometry.

b) Direction of travel.

c) Stop if in Shunt Mode.

d) Stop if in Staff Responsible Mode.

e) Text Messages, “AOCL Ahead, ABCL Ahead, TMOB Ahead”.

f) Awakening function.

<u>Transition Area</u>

g) Registration.

h) Connection.

i) Annunciation.

j) Annunciation Boarder.

Balise Groups BG12001 and BG12003 at Sutton Bridge consist of four Balise and are described as Duplicated Balise; these groups consist of two pairs of Balise containing the same information.

They are duplicated because of their critical function in the transition process. As long as the train has read one pair in each group, no error message is generated for transmission to the RBC and it transitions correctly.

Because no error message is transmitted it is necessary to manually test the operation of the Duplicated Balise Groups as part of the annual maintenance regime.

Balise Groups BG12000 and BG12002 at Sutton Bridge each consist of a single Balise. They are provided to reset and synchronise the on board odometry before a train entering the Cambrian reads BG12001.

These two Balise Groups are identical in terms of the effect they have on the on board systems and are duplicated for redundancy purposes.

A train entering the Cambrian Line would be unaware of the existence of Balise' so should a fail to read occur, no error message is transmitted from the train. It is therefore necessary to manually test the operation these Balise Groups as part of the annual maintenance regime.

3. Automatic Wheel Diameter Calibration

For a train to accurately calculate its position along the route, it is critical that the on-board systems have accurate information of wheel diameter, this can be achieved in one of two ways.

The first is by manual measurement of the wheel which is carried out as part of the train's normal maintenance programme and the second is carried out automatically whilst the train is in service.

Using automatic calibration, the train counts the revolutions of the wheel whilst travelling over a known distance. Having this information allows the on board systems to calculate the wheel diameter.

The advantage of the automatic calibration over manual calibration is that it does not require a maintenance intervention to carry out the task, it is more accurate and the interval between updates of wheel diameter is more frequent.

On the Cambrian certain Balise Groups are designated for Automatic Wheel Calibration. This makes the distance between these groups critical to achieving accurate wheel diameter calculations.

The identity of Balise Groups at the start and termination of the calibration areas are stored in the on-board system, and markers are provided track side at the designated Balise Groups to assist in accurate calibration of the N_PIG=0 Balise.

4. Switchable Balise

Balise in this configuration are only provided on the approach to locally monitored level crossings. The purpose of these Balise is to impose a pre-set temporary speed restriction when the conditions to illuminate the Drivers Crossing Indicator (DCI) white flashing indication are not met.

The TSR Balise has data permanently programmed into them in the same way as a fixed mode Balise.

The TSR message is suppressed when the conditions to illuminate the DCI white flashing indication are met.

To effect the suppression an output is fed from the level crossing controlling relays via a Lineside Encoder Unit (LEU) to the TSR Balise.

The LEU acts as an interface between the crossing relays and the Balise, this converts the relay logic into a message transmitted via a cable connection to the TSR Balise.

The Balise responds to messages and this response forms part of the health monitoring available at the LEU.

An output of the LEU health monitoring is used to operate a BR930 series relay, the relay is energised when the LEU is healthy and de-energised when it is not healthy.

Contacts of this relay are used in the DCI control circuits, when energised it is possible for the DCI to display a white flashing indication if all other conditions are met. If the relay is de-energised the DCI is only be capable of displaying a red flashing indication.

5. Positioning of Balise

a) On the signalling plan the kilometric positions of the N_PIG=0 and N_PIG=1 balise are shown in the tables and the spacing is always shown as the 3m nominal. The precise location of the N_PIG=1 balise is less relevant whether it is used for calibration or not.

b) N_PIG=0 is always the 'reference' location for the group and shall be maintained at the designed location shown on the signalling plan +/- 30cm.

c) For the Cambrian the nominal design spacing between individual Balise within a group is 3m.

The absolute minimum spacing is 2.6m and the maximum is 5.6m for reliable operation.

6. Balise Brackets

Individual Balise brackets are designed for the various types of sleepers and rail fixings in use on the Cambrian.

All brackets are designed to vertically position the Balise at the correct height relative to the rail head.

When mounting a Balise on steel sleepers an additional spacer is required between the bracket and the Balise. The spacer is required to increase the air gap between the top of the sleeper and base of the Balise to confirm correct operation of the Balise.

END

Includes:	EFOY - Fuel Cells
Excludes:	All other types of Fuel Cell

Do not smoke in the vicinity of the Pro 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.

System Overview

1. Connections - General

1. Connection for charge line.
2. Connection for operating panel.
3. Connection for data interface.
4. On/Off Reset Button.
5. LEDs.
6. Connection for exhaust hose and fill opening for EFOY service fluid.
7. Connectors for EFOY fuel cartridges.
8. Cooling inlet (reverse).
9. Warm-air outlet and connection for off-heat duct.

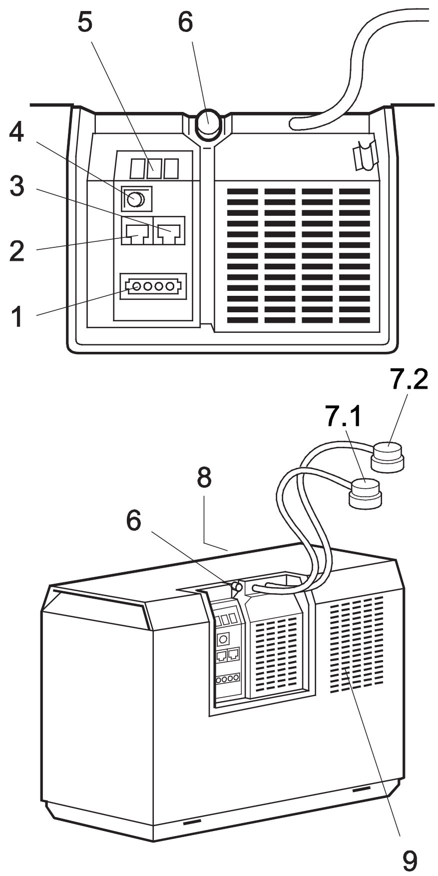
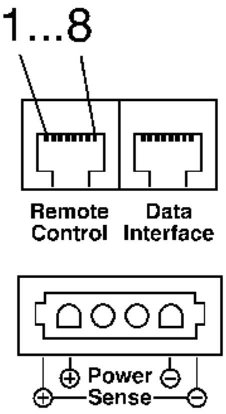


Figure 1 - Connections

2. Connection - Remote Control

Pin	Description
1.	DuoCartSwitch DCS1
2.	RxD (Operating panel OP2)
3.	TxD (Operating panel OP2)
4.	GND, Ground
5.	Battery +
6.	Fuel Cartridge Sensor FS1
7.	Remote On
8.	M/S (Master/Slave) & Hybrid

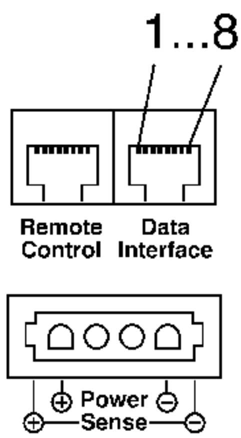
Table 1 - Pin Configuration



3. Connection – Data Interface

Pin	Description
1.	DuoCartSwitch DCS1.
2.	RS232 RxD (Receive Data).
3.	RS232 TxD (Transmit Data).
4.	GND, Ground.
5.	Battery +.
6.	Fuel Cartridge Sensor FS1.
7.	Remote On.
8.	M/S (Master/Slave) & Hybrid.

Table 2 - Pin Configuration



4. Indications Panel

The integrated LEDs provide an overview of the operating status of the EFOY Pro fuel cell. You operate the device using the buttons.

1. Button.
2. Green LED.
3. Yellow LED.
4. Red LED.

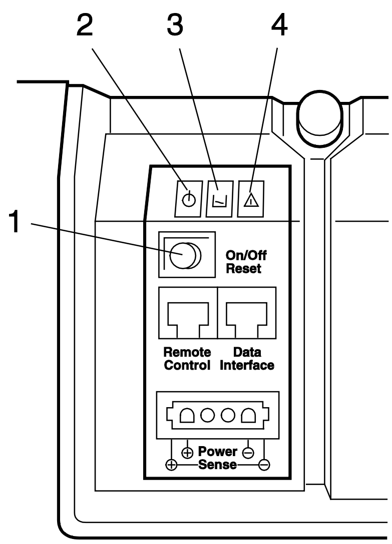


Figure 2 – Panel Indications

Button action	Result	Starting state	Resulting state
Push briefly (< 0.5s)	Reset	On, Off or Automatic	Automatic
Push longer (> 3s)	Switch On / Off	On or Automatic	Off
		Off	On

Table 3 – Button Pushes

LED state	Green LED	Yellow LED	Red LED
On	Ready	Add service fluid	Error
Flashing	Shutting down or antifreeze mode	Fuel empty	Interruption
Off	Off or error	No error	No error

Table 4 – LED Indication Meanings

5. Operation via the Operating Panel

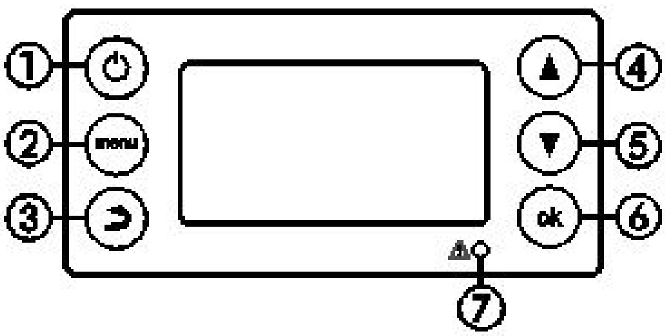
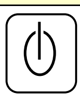


Figure 3 – Operations Panel

5.1 Buttons and symbols on the operating panel Buttons/LEDs.

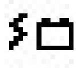
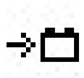
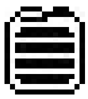
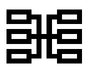
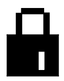
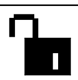
No.	Symbol	Description
1.		Switch EFOY Pro fuel cell on/off.
2.	[menu]	Display the main menu.

No.	Symbol	Description
3.	[⮌]	Scroll back one level in the menu.
4.	[▲]	Scroll up one line in the display.
5.	[▼]	Scroll down one line in the display.
6.	[ok]	• Open the selected menu. • Confirm a selection.
7.		Red LED lights up to indicate a fault.

Table 5 – Button Meanings

5.2 Symbols on the Display.

The display shows different symbols depending on the operating status and operating mode of the EFOY Pro fuel cell:

Symbol	Description
	Current battery voltage.
	Current charging current of the EFOY Pro fuel cell.
	Fill level of the fuel cartridge. The fuel gauge for the fuel cartridge is just an indicator and calculates the methanol consumption. The FS1 fuel cartridge sensor should be used to measure the actual fill level. The fuel cartridge should only be replaced once it has been completely emptied.
	A cluster icon is displayed for EFOY Pro devices that run in parallel (Not Used on NR Equipment).
	If want to operate the EFOY Pro fuel cell using an external controller, the external control function shall be enabled (see "External control" clause 6.4). If this is not enabled, a padlock symbol appears.
	If the external control is switched on, an open padlock appears at the bottom right of the display.
RC	If you have switched external control on and the device is in "Remote Control" mode, "RC" (Remote Control) appears at the bottom right of the display.
LiFe	Lithium iron phosphate (LiFePO4) was selected as battery type. “LiFe” appears at the top right of the display.

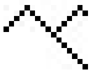
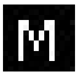
Symbol	Description
	EFOY GO! was selected as battery type. “GO!” appears at the top right of the display.
	The altitude was set above 1500 meter. An icon appears at the bottom right of the display.
	MODBUS RTU was selected as communication protocol. “M” appears at the bottom right of the display.

Table 6 - Symbols

6. Operating Modes

The EFOY Pro fuel cell can be operated in one of the following modes:

- Automatic.
- Manual On.
- Manual Off.
- External control.
- Hybrid.

6.1 Automatic

Automatic mode starts as soon as you connect the device to the battery.

The device monitors the battery voltage independently.

The EFOY Pro fuel cell switches on automatically if the battery voltage drops below 12.3 V / 24.6 V (factory setting: Lead batteries).

The battery is then charged until the cut-off threshold of 14.2 V / 28.4 V is reached (factory setting: Lead batteries).

When the device is started, it goes through a start phase, which might last up to 20 minutes. It only reaches its full rated output after this phase.

During normal operation, the EFOY Pro fuel cell briefly interrupts power generation several times each hour.

A charging current of 0.0 A is displayed when this occurs. This interruption lasts maximum 30 seconds.

If the device fails to start, check that the cap is not still attached to the exhaust hose connector. Remove the cap.

To optimise the battery maintenance, the charging current should not be stopped abruptly when the cut-off threshold is reached.

For this reason, the EFOY Pro fuel cell continues charging the battery for up to three hours at a reduced current after the configured cut-off threshold is reached (factory default lead batteries: 14.2 V / 28.4 V).

The length of the recharging period depends on the battery voltage and power consumption.

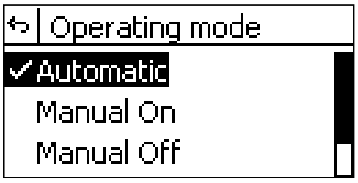
6.2 Manual On

You can switch the device on manually if the battery voltage is below 13.2 V / 26.4 V (Lead batteries).

a) Press [⏻] on the operating panel, or select "Operating mode" in the main menu. The operating mode selection appears.

b) Select the "Manual On" operating mode.

c) Press [ok] to confirm your selection.



After the start phase, the device is then in "charging mode".

The device operates independently of the configured switch-on voltage, and charges the battery until the cut-off threshold is reached.

$$(U_{batt} > 14.2\ V / 28.4\ V \text{ and } I_{off} < 4.0\ A / 2.0\ A)$$

After reaching the switch-off threshold the EFOY Pro fuel cell should switch into automatic mode.

NOTE: *The EFOY Pro fuel cell can only start if it is connected to an intact battery and a filled fuel cartridge. The EFOY Pro fuel cell does not switch on if the battery is damaged or has been deeply discharged.*

If the device fails to start, check that the cover lid is not still attached to the exhaust hose connector. Remove the cover lid.

6.3 Manual Off

To protect the components, the device should not be switched off until it has been running for at least 30 minutes since it was started.

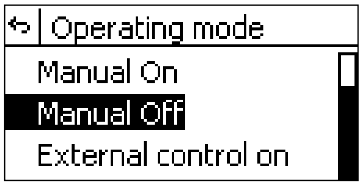
If the device is switched off before this period has elapsed, it should continue running for the remainder of the required running time.

The message "Shutdown procedure" is shown on the display. Do not disconnect the fuel cartridge or battery during the shutdown procedure.

The battery protection and automatic antifreeze functions remain active after the device is switched off.

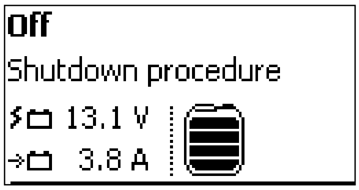
a) Press on the operating panel, or select "Operating mode" in the main menu. The operating mode selection appears.

b) Select the "Manual Off" operating mode.



c) Press [ok] to confirm your selection.

d) Wait until the shutdown procedure has finished and "Shutdown procedure" is no longer displayed on the info screen.



The EFOY Pro fuel cell shuts down in a controlled manner when you press [ok]. This might take some time, to check that all protective features are applied.

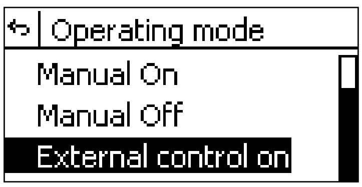
6.4 External Control

The EFOY Pro fuel cell can also be controlled externally. In that case, the automatic charge control mechanism should be partly or totally deactivated.

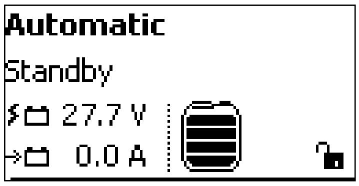
For an external control the operation mode "External control" shall be enabled.

a) Press on the operating panel, or select "Operating mode" in the main menu. The operating mode selection appears.

b) Select the "External control on" operating mode.

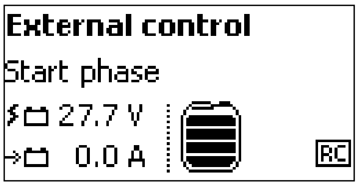


c) Press [ok] to confirm your selection.



An open padlock is displayed at the bottom right of the display.

If the controller now receives an external signal, e.g. on Pin 7 (Data Interface), "RC" (Remote Control) is displayed at the bottom right of the display.



If you have not enabled external control, a closed padlock is displayed at the bottom right of the display when an external signal is being received.

NOTE: *Incorrectly set operating parameters might damage the device. This could nullify your warranty. Only use the precise values permitted for the battery parameters and battery protection settings.*

6.5 Remote On / Off

The EFOY Pro fuel cell can be switched on or off externally using one of two methods. One option is by using a switching contact on Pin 7 at the Data Interface plug, e.g. a solar charger.

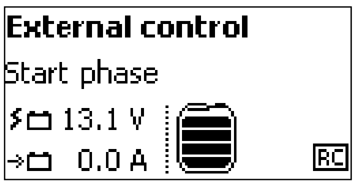
The second option is a software signal. (See Connections Section 3 for the pinning).

The "External control" operating mode shall be enabled (see External control 6.4).

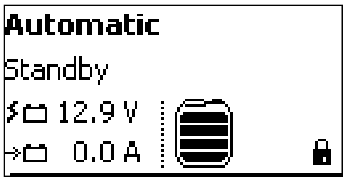
Remote on/off signal via Pin 7 (Data interface)

An open padlock is displayed at the bottom right of the display.

If the EFOY Pro receives an external positive voltage signal on Pin 7, "RC" (Remote Control) is displayed at the bottom right of the display.



The EFOY Pro starts charging, regardless of the switch-on voltage and charges the batteries until the set switch-off parameters are reached.



If you have not enabled external control, a closed padlock is displayed at the bottom right of the display when an external signal is being received.

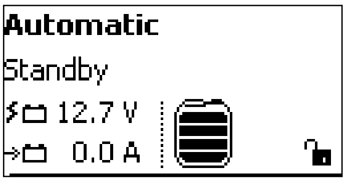
If the external signal on Pin 7 is always active, the EFOY Pro starts when the battery voltage is below 13.2 V / 26.4 V (Lead batteries) or 14.0 V / 28.0 V (LiFePO4) and stop when the switch-off voltage is reached.

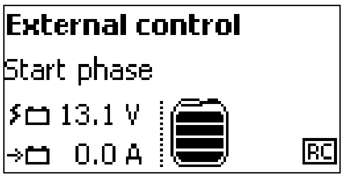
The charging starts again at 13.2 V / 26.4 V (Lead batteries) or 14.0 V / 28.0 V (LiFePO4). The EFOY Pro does not stop charging in this operation until removing the external signal on Pin 7.

If the external signal is removed (off), the EFOY Pro charges the battery until the set switch-off parameters are reached and switch back in automatic mode.

Remote on/off signal via software command

An open padlock is displayed at the bottom right of the display.





If the EFOY receives a software signal via SIO command REMOTE ON or via Modbus address 41030, "RC" (Remote Control) is displayed at the bottom right of the display.

The EFOY Pro starts charging, regardless of the switch-on voltage and charge the batteries until the set switch-off parameters are reached.

The signal only has to be sent once. The EFOY Pro completes a charging cycle and switch off if the set switch-off parameters have been reached.

After the charging cycle the EFOY Pro switches again into automatic mode.

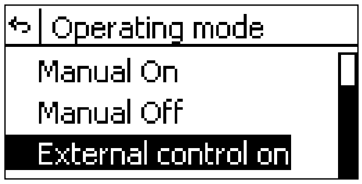
In the case of a software command, the charging cycle can be stopped by sending the SIO command REMOTE OFF or via Modbus address 41030.

6.6 Hybrid

The EFOY Pro can be set into Hybrid mode by a voltage signal or a software control. In this operation mode all parameters are disabled, like switch-on voltage or battery protection.

Only the frost protection mode is an exception, this re-mains enabled.

The "External control" operating mode shall be enabled (see External control 6.4).



The hybrid mode has to be separately activated.

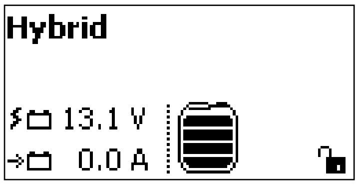
Activation via voltage signal:

Connect Pin 4 (GND, Ground) or the negative battery pole with Pin 8 (Hybrid).

Activation via software control:

Send at least every 15 seconds the SIO command HY-BRID or Modbus address 42002 Hybrid to the EFOY Pro fuel cell.

The operation mode “Hybrid” displays, and the open padlock shows at the bottom right of the display.



To start and stop the EFOY Pro fuel cell a positive voltage signal shall be connected to Pin 7 (Remote On) or via software SIO command REMOTE ON/OFF or Modbus address 41030 (see Remote On / Off Clause 6.5).

The battery voltage shall not exceed the set value switch-off voltage (Hybrid).

If the voltage signal on pin 7 or the “Remote ON” software commands is continuous, the EFOY Pro fuel cell charges the battery continuously in full and part load mode as a constant voltage (CV) charger.

7. Automatic Anti-Freeze Feature

The device has an intelligent automatic antifreeze feature.

This operating status switches on automatically as soon as the temperature drops below +3 °C / +37.4 °F.

This prevents the device from freezing. If the device is operating in antifreeze mode, the message "Antifreeze" is shown in the second line of the display.

NOTE: *The automatic antifreeze feature only works when the fuel cell is connected to a filled EFOY fuel cartridge and an intact battery.*

For a five-month winter period in Central Europe, the device requires approx. 10 litres / 2.64 gallons of methanol in antifreeze mode.

NOTE: *Charging Lithium (LiFePO4) batteries is not always possible at temperatures below 0 °C. The instructions from the battery manufacturer should be observed.*

8. Battery protection

The EFOY Pro fuel cell has automatic battery protection when the EFOY Pro fuel cell is switched off.

Battery protection is enabled automatically if the battery voltage (Lead-batteries) drops below 11.2 V / 22.4 V for more than 15 minutes.

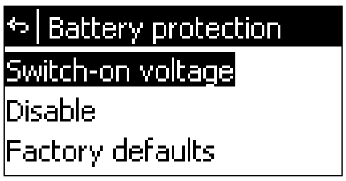
"Battery protection" mode ends as soon as the voltage reaches 13.2 V / 26.4 V.

If the battery protection is activated, the standard switch-off criteria are ignored.

The battery protection function provides deep discharge protection for the battery, even when the EFOY Pro fuel cell is switched off and does not take over the charging function.

8.1 You can select the following menu options in the "Battery protection" menu:

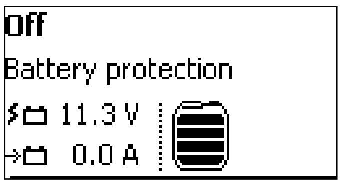
- Switch-on voltage.
- Enable/Disable.
- Factory defaults.



This option allows you to undo all the battery protection settings.
Press [ok] to confirm or [↩] to cancel.

8.2 If you want to switch off the EFOY Pro fuel cell after the battery protection function has started, press. [⏻]

The function is re-enabled automatically when the device is switched on or is operated in automatic mode.



8.3 Check your system if the fuel cell repeatedly switches back to battery protection.

Either the battery has already been damaged or too much energy has been discharged.

Battery protection only works if a full EFOY fuel cartridge is connected.

9. Battery Value Ranges

Lead-acid, -gel & AGM batteries	ID	Factory defaults	Min.	Max.
Battery protection (12 V)	46	11.2 V	10.5 V	12.0 V
Battery protection (24 V)	47	22.4 V	21.0 V	24.0 V

LiFePO4 batteries	ID	Factory defaults	Min.	Max.
Battery protection (12 V)	48	11.0 V	10.5 V	12.5 V
Battery protection (24 V)	81	22.0 V	21.0 V	25.0 V

Permitted value ranges for EFOY GO!	ID	Factory defaults	Min.	Max.
Battery protection	14	11.2 V	10.5 V	12.5 V

Table 7 – Battery Ranges

10. Fuel cartridges

Completely empty fuel cartridges can be disposed of with your plastic waste.

Partly full or damaged fuel cartridges shall be treated as hazardous waste and returned to the supplier for reuse.

10.1 Fuel Cartridge Indications

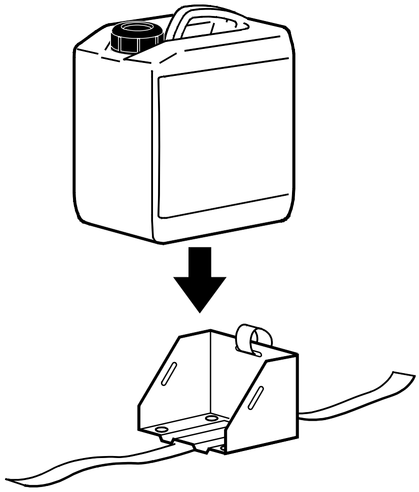
When the fuel cartridge is empty, the yellow LED on the device flashes and the red LED on the operating panel. "Fuel cartridge empty" also appears on the operating panel.

Fuel cartridge empty
Please replace the fuel cartridge, and press OK.

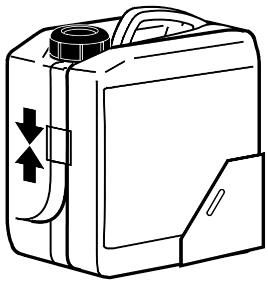
The fuel cartridge can be changed while the device is in operation.

EFOY fuel cartridges are intended for single use only and cannot be refilled.

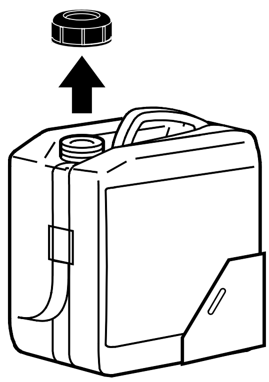
10.2 Inserting the fuel cartridge



a) Insert a new, full, and sealed fuel cartridge into the fuel cartridge holder (if fitted).



b) Fasten the belt on the fuel cartridge holder.



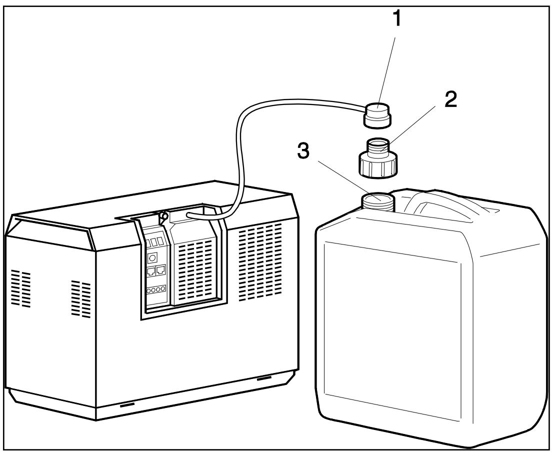
c) Do not remove the child-proof screw cap until the new EFOY fuel cartridge has been inserted into the fuel cartridge holder.

<u>Connecting the M28 Fuel Cartridge Only</u>

The M28 fuel cartridge can only be connected using the M28 adapter.

When connecting an M28 cartridge the M28 Adapter (2) is first screwed onto the Fuel Cartridge (3).

Then the Fuel Cell Connector (1) is screwed into the M28 Adapter (2).



Connecting Other Fuel Cartridges

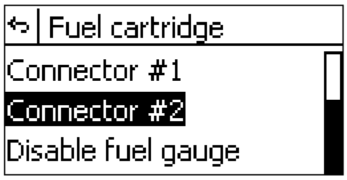
d) Screw the fuel cartridge connector onto the new EFOY fuel cartridge.

e) Press [ok] on the operating panel so that the red warning light and error message are no longer displayed.

f) Select the installed fuel cartridge on the operating panel.

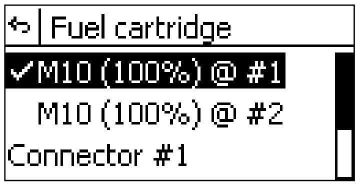
10.3 Selecting a fuel cartridge

a) When you select the "Fuel cartridge" submenu in the main menu, the display shows the fuel cartridges already enabled and the device connectors.



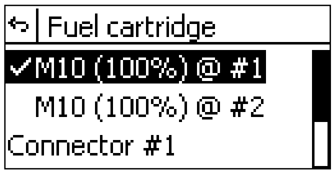
b) The connectors are displayed according to whether you are using an EFOY Pro or EFOY Pro Duo device.

c) If you have not connected a full fuel cartridge, disable the fuel gauge by selecting "Disable fuel gauge" in the menu.



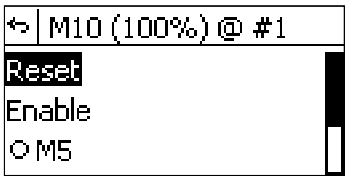
d) Select an active fuel cartridge to edit it directly.

e) Press [ok] to confirm your selection.



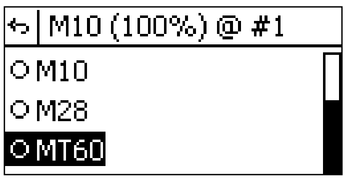
f) You can select the following actions in the fuel cartridge submenu:

- Reset: Resets the counter after the fuel cartridge has been changed.



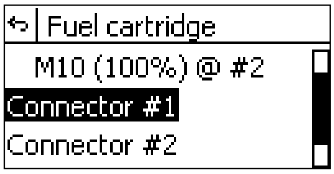
- Enable: Enables the fuel cartridge.

- M5 / M10 / M28 / MT60: Changes the fuel cartridge type for the respective connector.



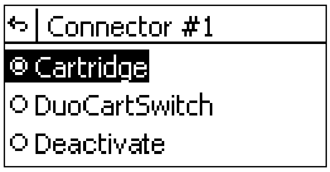
g) Select a connector to edit the connector and any associated fuel cartridges.

Press [ok] to confirm your selection.



h) You can select the following actions in the connector submenu:

- Cartridge: A single fuel cartridge is to be used at the connector. The associated fuel cartridge is displayed at the highest level of the menu.
- DuoCartSwitch: A DuoCartSwitch is to be used at the connector.
- Deactivate: Disables the connector.



i) Press the menu button once to return to the front screen.

11. DuoCartSwitch DCS 1

The DuoCartSwitch enables you to connect two fuel cartridges to the cartridge connector of one EFOY Pro fuel cell.

The switching valve switches automatically from the fuel cartridge in operation to the reserve fuel cartridge.

This means that the autonomy of the application can be doubled.

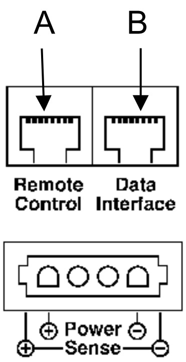
Figure 4 - DuoCartSwitch

11.1 Connecting the DuoCartSwitch

a) Screw the fuel-cartridge connector of the EFOY Pro on the DuoCartSwitch.

b) Connect one DuoCartSwitch via a Port Doubler to each RJ45-plug of the EFOY Pro:

- A: Remote Control plug.
- B: Data Interface plug.



11.2 If a DuoCartSwitch is added it needs to be activated, for instructions explaining how this is done see Clause 10.3.

12. Fuel cartridge sensor FS1

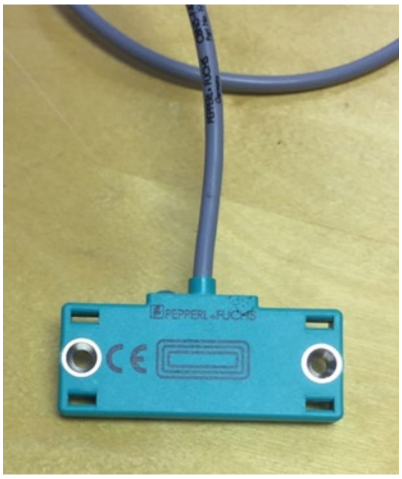


Figure 5 – FS1 Sensor

a) By default, the EFOY Pro does not monitor the actual fill level of the fuel cartridge.

b) The fuel gauge for the fuel cartridge is just an indicator and calculates the methanol consumption.

c) The FS1 fuel cartridge sensor shall be used to measure the actual fill level.

d) The EFOY Pro reports a fuel level error if the cartridge is used up.

e) The optional fuel cartridge sensor FS1 indicates if the fuel level drops below the position of the sensor.

f) This early warning gives the user time to change the cartridge before it is completely empty.

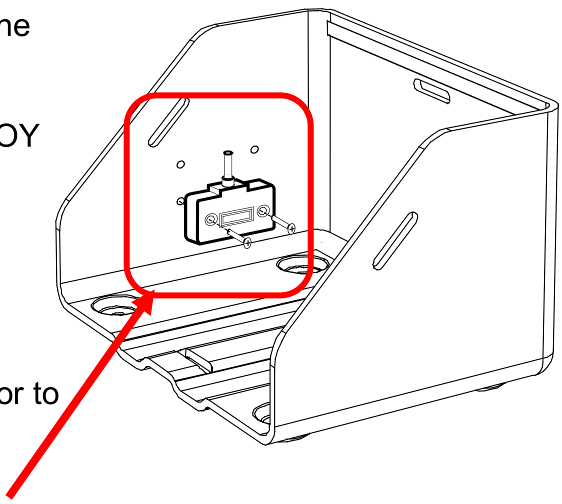
g) The fuel cartridge sensor FS1 may also be used with fuel cartridges that are partly empty.

h) It sends a signal to the EFOY Pro fuel cell when the fill level falls below the sensor.

i) You connect the sensor to the EFOY Pro data interface.

j) The sensor should be combined with a remote monitoring system, e.g. the GSM modem.

k) You fasten the fuel cartridge sensor to the fuel cartridge holder using two screws.



12.2 You can choose from two different heights to mount the FS1.

13. Long term storage

13.1 Store the EFOY Pro fuel cell in a cool place, but at a temperature over +1 °C / +34 °F.

13.2 If the EFOY Pro fuel cell is exposed to temperatures below 0 °C / 32 °F without connected batteries and filled fuel cartridges, it shall be defrosted for approximately 24 hours at room temperature before use.

13.3 After long term storage over 6-month SFC recommends to check the functionality of the EFOY Pro fuel cell before installation.

a) For that purpose, connect the fuel cell to a battery to run a charging cycle.

b) A charging cycle can last several hours.

c) After successfully passing the charging cycle run the transport lock procedure.

d) Press the [menu] and [▼] button on the Operating panel at least 3 seconds and follow the instructions on the display.

Note that liquid can drop out of the exhaust hose tube when running the transport lock procedure.

14. Old devices

Old devices shall be treated as hazardous waste and disposed of in line with NR Environmental Policy.

For advice on returning old devices, please contact the EFOY hotline.

END

Sequence for replacing an WSD Wheel Detector

1. Disconnect the wheel detector cabling in the corresponding disconnection box.

2. Remove the cable securing clips from the WSD cable.

   Refer to Figure 1 and Figure 2 for steps 3 to 8.

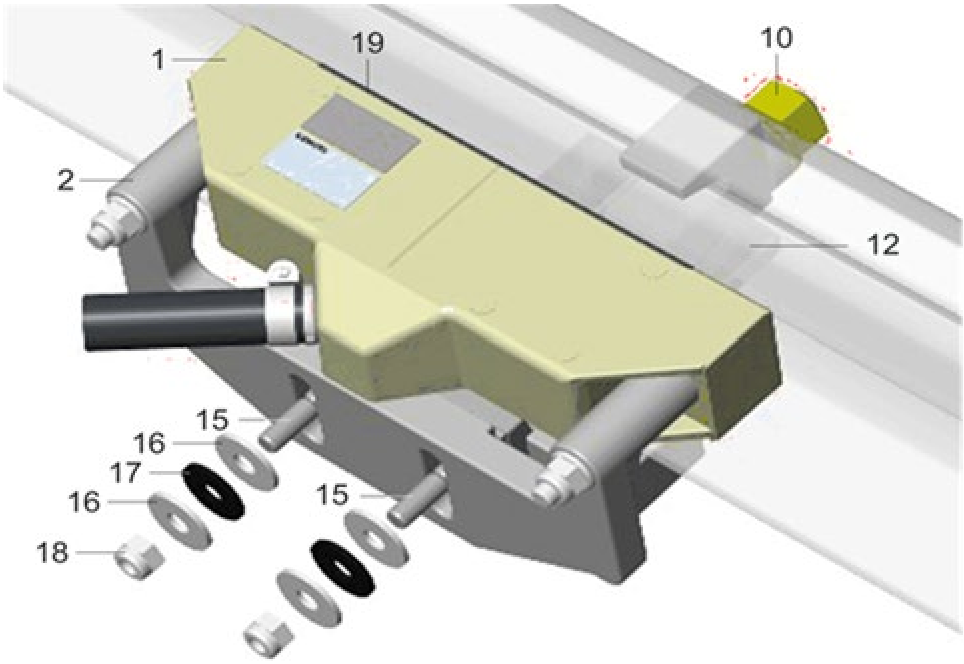


Figure 1 - Parts Identification

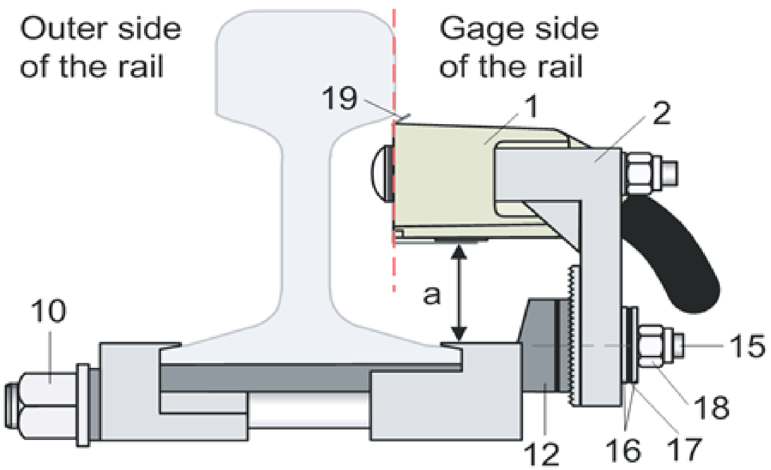


Figure 2 – Mounting Layout

3. Remove the WSD (1) and the height mount (2) from the rail:

   a) Remove two M12 hexagon nuts (18) along with six washers (16 and 17).

   b) Remove the WSD and height mount from the remaining clamp metalwork.

Optionally, if the remaining components of the clamp is to be removed from the rail then:

   c) Remove the M24 collar nut (10) and spring washer (11), see Figure 3.

Figure 3 – M24 Collar Bolt

   d) The clamp metalwork on the non-gauge side could require a tap from a hammer to release the remaining clamp from the bottom of the rail, See Figure 4.

Figure 4 - Removed Clamp Metalwork

4. Remove the WSD (1) from the height mount (2) by removing two M12 hexagon nuts (6), two washers (5), two separators (4) and two bolts (3).

5. Install the replacement WSD to the height mount by refitting the two bolts (3), two separators (4), two washers (5) and two M12 hexagon nuts (6).

6. Tighten the two hexagon nuts (6) using a torque wrench (torque setting of 45 Nm).

   If step 8c has been performed, then:

   a) Fit the bearing assembly (8) on the gauge side of the rail base.

   b) Fit the counterholder (9) on the outer side of the rail base onto the threaded rod of the bearing assembly (8).

   c) Loosely bolt the M24 collar nut (10) onto the threaded rod of the bearing assembly (8) with the spring washer (11) in between.

   d) Insert the bearing plate (12) between the rail base and the bearing assembly (8).

7. Install the height mount (2) with replacement WSD to the rail:

   a) Fit the height mount (2) with the wheel detector (1) onto the studs (15) of the bearing plate (12).

   b) Fit a 36mm washer (16), a damping washer (17), another 36mm washer (16) and an M12 prevailing torque-type hexagon nut (18) onto each stud (15) and tighten them finger-tight.

   c) Move the bearing plate (12) horizontally until the reducing plate (19) of the wheel detector is flush with the side of the rail head (viewed from above).

   d) Tighten the M24 collar nut (10) using a torque wrench (torque setting of 200 Nm). As you do so, make sure the bearing plate does not move horizontally and that the wheel detector is parallel to the rail.

   e) Place the adjustment gauge on the top of the wheel detector. The green sheet-metal strip is located on the top of the adjustment gauge. The inscription “Cal.” faces the rail head and is thus not visible.

   f) Loosen the two hexagon nuts (18) again to allow the height mount to be moved vertically with the wheel detector.

   g) Adjust the height mount using the adjustment gauge so that the top of the wheel detector to 45mm (tolerance +0mm/-2mm) below the top of the rail. The mounting height of 45mm below the top of the rail has been reached

When the top of the adjustment gauge is on the same level as the top of the rail. For an accurate measurement place a straight edge across both rail heads.

h) Tighten the two hexagon nuts (18) using a torque wrench (torque setting of 40 Nm).

i) Check that the reducing plate (19) is still flush with the side of the rail head (seen vertically from above). If necessary, loosen the collar nut (10) and readjust the bearing plate.

8. Reconnect the wheel detector wires in the corresponding disconnection box referring to cabling wiring diagrams.

9. Clamp the WSD cable to the securing clips.

END

Includes:	Siemens S21, Ansaldo, Alstom Atlas 200, TASS and Tracklink III Balises
Excludes:	All other Balises and Beacons

SECTION A - SIEMENS S21 PROGRAMMING

Further information can be found in the Siemens S21 A6Z00032385088 (Operating Instructions TPG-Eurobalise).

Programming the Eurobalise Using the TPG.

Warning: Strong electromagnetic fields are generated during the use of the TPG. These might interfere with cardiac pacemakers and might have long-term detrimental effects on health. When the TPG is active keep a minimum distance of 200mm from the unit.

NOTE: *Before starting the programming or verification process, it is recommended to check that the TPG housing battery is fully charged. When the TPG housing red light is on, the battery charge is low.*

1. Hand-held Terminal

1.1 Check the hand-held terminal is switched on.

1.2 To switch on the Hand-held - press the On/Off button in the bottom left corner of the keypad for about three seconds.

1.3 The LED in the top right corner of the keypad flashes green once.

1.4 The display of the Hand-held Terminal is switched on. Either the desktop or the last page used is displayed.

If the Hand-held Terminal has no system time or an incorrect system time due to a discharged battery, set the correct date and the time of day.

This can be done through the start menu, select settings followed by Control Panel.

Figure 1 – Hand-held Terminal

Further details are contained within the manual.

1.5 Setting the date and time is important because the file names contain the system time.

1.6 It is only by entering a system time that various files can be distinguished.

To switch off the device press the On/Off button in the bottom left corner of the keypad.

NOTE: *switching off the Hand-Held Terminal during Eurobalise programming leads to incorrectly programmed Eurobalises.*

Do NOT switch off the hand-held terminal while any function is being executed.

When the Hand-held Terminal is switched on again, the TPG continues the operating step where it left off.

If the Hand-held Terminal is switched off during the execution of a function, the TPG attempts to resume the functional sequence.

For safety reasons, however, the TPG then aborts the functional sequence and issues an error message.

The Hand-held Terminal is now switched off.

NOTE: *The Hand-held Terminal features a touch screen which can be used to call up most of the functions. The touch screen can be operated either by finger (or fingernail) or with the supplied stylus. The stylus is found in a slot above the touch screen.*

Figure 2 – Stylus Location

2. Transferring the telegram to the handheld

NOTE: *This process requires an NR laptop or desktop PC which has a DVD drive and "windows Device Mobile Centre" software installed.*

2.1 Insert the CD-ROM with the correct telegram into the PC or Laptop.

2.2 Connect the hand-held terminal to the PC Dock using the USB cable and wait for Windows Mobile Connect to launch.

2.3 Once windows mobile has started, click [connect without setting up your device] hover the mouse over [file management] and select the drop-down menu [browse contents of your device].

Figure 3 – Hand-held Terminal

2.4 The computer drives are now shown, select [Flash Disk] select a folder or make a new one in preparation of file transfer from the DVD.

2.5 Drag and drop the telegram file from the DVD into the folder on the Flash Drive, once completed, the hand-held terminal is ready to programme a balise.

NOTE: *the MD4 Checksum paperwork is stored in the same file as the telegram, this is needed later.*

3. TPG Base Unit on the Eurobalise

3.1 Place the TPG base unit on the Eurobalise and align the TPG base unit using the housing feet see Figure 4.

Figure 4 - TPG Base Unit Positioned on Eurobalise.

or

3.2 Turn the TPG base unit upside down and lay it on its upper side.

Figure 5 - Eurobalise Positioned on TPG Base Unit

3.3 Position the Eurobalise with the upper side (Siemens logo) facing downward on the TPG base unit and align the Eurobalise using the housing feet.

4. TPG Start-up (Battery Operation)

4.1 Press the “On” button on the TPG base unit.

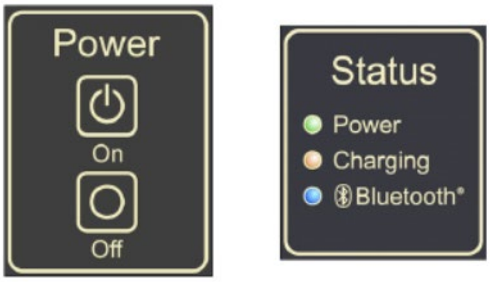


Figure 6 – Power Switch and Indications

The TPG base unit switches on, and the green “Power” LED is illuminated.

5. TPG Start-up (External Power)

5.1 Use the “External power” socket to connect the TPG base unit with a 110V or 230V at 50 Hz or 60 Hz external power source.

5.2 The TPG base unit switches on, and the green “Power” LED is illuminated.

6. Programming

6.1 In the functional area EUROBALISE, select the PROGRAM command, a selection dialog opens.

6.2 Select the telegram file provided for the Eurobalise in the selection dialog, the programming runs automatically. This is indicated by the progress bar.

6.3 When the operation has ended, one of the following messages is shown:

a) MD4: The 16 hexadecimal characters.

The Eurobalise has been correctly programmed and the newly programmed data has been read.

Check the displayed 16 Hexadecimal characters of the MD4 checksum document from the relevant folder on the CD-ROM.

If the checksum is incorrect repeat the programming operation. A maximum of three attempts are allowed.

b) Signal Level too low

The Eurobalise reply level is too weak, the programming is aborted.

Clean the Eurobalise and repeat the programming.

c) Wrong Eurobalise Identifier or not a Siemens Balise.

d) The Eurobalise type cannot be programmed or the unit is faulty.

6.4 Complete the Certificate of Conformity (CoC) when the Balise has been correctly programmed. Place the CoC in a plastic sleeve and attach to the Balise.

7. Checking the Programming

7.1 Make sure that the Eurobalise is correctly placed and that the TPG is switched on.

7.2 In the BALISE functional area, select the TLG COMPARISON command, a selection dialog opens.

7.3 Select the telegram file on the hand-held for the comparison, the TPG reads the Eurobalise telegram and compares it with the selected telegram file.

This is indicated by the progress bar. When the operation has ended, one of the following messages are shown:

a) Compared Telegrams are Identical:

The Eurobalise telegram corresponds to the telegram file, programming is successful.

b) Compared telegrams are NOT identical:

The Eurobalise telegram fails to correspond to the telegram file, the wrong telegram might have been programmed into the Balise or the system has failed.

c) Signal level too low:

Clean the Eurobalise and repeat the process.

8. Verification

Determination of Signal Level

8.1 The TPG should be correctly placed and switched on.

8.2 In the BALISE functional area, select the SIGNAL LEVEL command.

NOTE: *the TPG measures the level of the reply signal from the Eurobalise. The status of the measuring operation is shown by a progress bar on the display.*

8.3 On completion, one of the following messages is displayed:

a) Signal Level OK.

b) Signal Level too Low.

Clean the Eurobalise and repeat the measurement.

9. MD4 Checksum

9.1 The TPG should be properly connected and switched on.

9.2 In the Eurobalise functional area, select the DISPLAY MD4 command, the TPG reads out the Eurobalise telegram and calculates the MD4 checksum.

This is indicated by the progress bar. When the operation has ended, one of the following messages are shown:

a) MD4: the 16 hexadecimal characters, check the displayed characters of the MD4 checksum against the checksum on the programming and verification form from the DVD folder.

If correct – confirmation of the correctly programmed telegram, complete the Certificate of Conformity (CoC).

If incorrect – Check the function of the hand-held against a known working Balise, if OK fail the programming.

b) Signal level too low, clean the Eurobalise and repeat the process.

SECTION B - ANSALDO BALISE PROGRAMMING

Further information can be found in the Ansaldo CL-OM-00323 (Manual for Balise Programming).

NOTE: *prior to use the battery level of the VPT should be confirmed, this is achieved by setting the external switch to [programming] then to [verification] and check the corresponding LED turns on. There are 3 LEDs to show the charge status 100%, 66% and 33%. If the indication 33% or the discharge LED is on recharge the VPT as soon as possible.*

Warning: Do not use the equipment to program or check Balise's while the battery is on charge.

Check the battery status of the Pocket PC, the charge percentage is visible in [Start]-[Settings]-[System] -[Power].

1. Loading Telegrams into The Pocket PC

NOTE: *A PC, on which the files are already installed is to be used for programming and/or checking the Balise telegrams.*

The telegram files have the extension TGO; the name of the file should correspond with the Balise identifier.

The ActiveSync software for the handheld computer should already be installed on the same PC.

1.1 Connect a null modem cable, to the serial port on the PC and to the serial port of the Pocket PC.

1.2 Clip on the protector of the Pocket PC on the connector cable 2. Use the cable equipped with RS232 connectors to make the serial link between the Pocket PC and the PC.

1.3 Communication between the Pocket PC and the PC is established automatically.

1.4 On the PC, when the "Definition of a partnership" window appears, select [NO] at the request "Do you wish to establish a partnership?" on the PC, then select [Next].

1.5 Once connected, the window shown in Figure 7 appears:

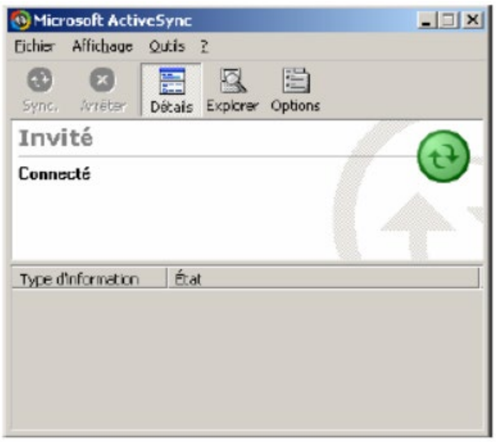


Figure 7 – PC Connection Window

1.6 In the PC window, open the Pocket PC folder, to which the file(s) is transferred, by clicking on the “Explorer” icon.

1.7 On the PC, select the files (or the whole folder) to be transferred and insert them into the destination folder on the Pocket PC.

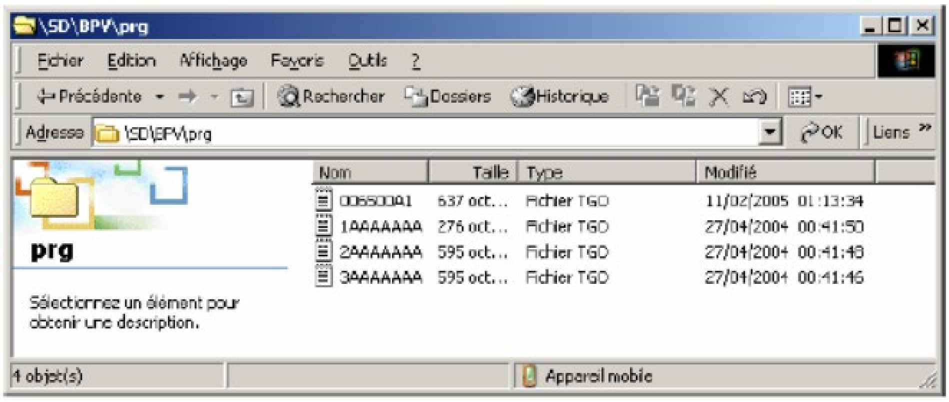


Figure 8 – File Transfer

1.8 Check, in the Pocket PC folder, that the necessary files have been downloaded.

1.9 Close the ActiveSync application on both computers and disconnect the Pocket PC from the PC (disconnection of the cable closes the ActiveSync application automatically).

CHECK CORRECT WORKING OF THE VPT BY USING A “SPECIMEN” BALISE.

1.10 Check the VPT operation against a known working Balise for correct telegram reading.

1.11 Switch the Pocket PC on by pressing the key (top right) and the display should appear.

Figure 9 – Location of On/Off Switch

NOTE: *It is not necessary to restart the BPV application for each balise. If there is no image, recharge the batteries located in the Pocket PC.*

1.12 Run the application by clicking on [START]-[Programs]-[File Explorer]-[SD]-[BPV] then on “bpv”.

Figure 10 –Application Sequence

NOTE: *The Balise Part Number, Serial Number and Version Number are necessary. This is indicated by a sticker on the balise.*

Figure 11 – Balise Details

1.13 Check the Balise part number corresponds with the part number on the screen. If they do not match, click on the X to exit the program, and modify the part number in the file pn.txt.

Figure 12 – Balise Part Number

1.14 Enter the balise serial number (S/N, 7 to 9 characters) and then click okay.

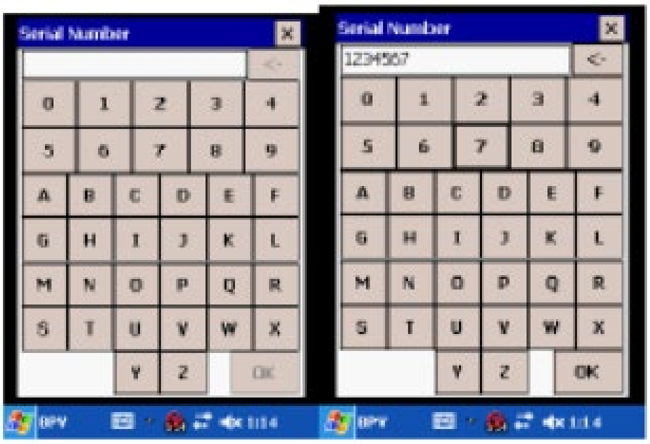


Figure 13 – Entering the Serial Number

1.15 Enter the balise Version Number and then click okay.

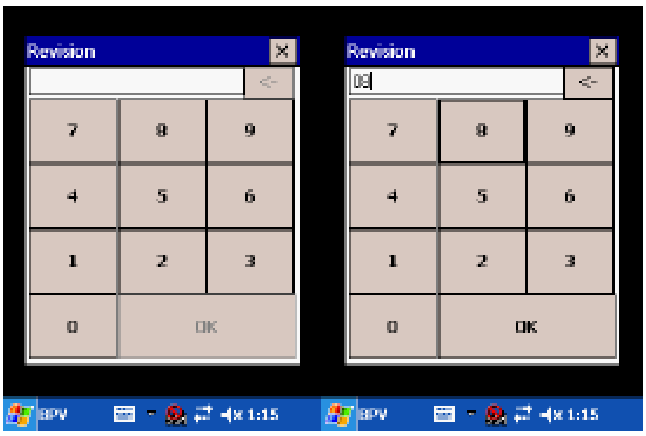


Figure 14 - Entering Version Number

1.16 Enter the 8-digit ID-BOA comprised of the N_BG+A+N_PIG i.e. BG123456A0 and then click okay.

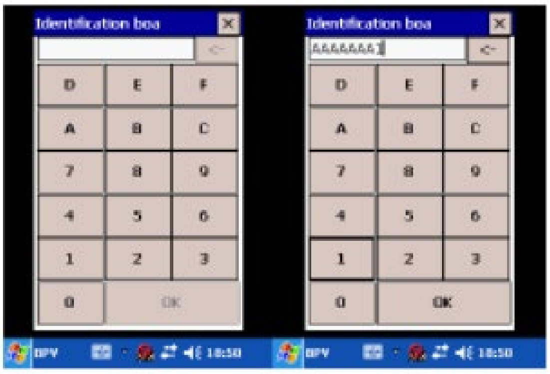


Figure 15 - 8-digit ID-BOA

1.17 When the data input phase is finished, the display shows the version of the application software installed in the Pocket PC, as well as the names of the files < >.TGO which are in the Pocket PC in sub-folders PRG. Verify that the correct .TGO file is available for the balise being programmed.

2. Functions available via the menu

2.1 When the phase of inputting data relating to the Balise has finished, the Pocket PC screen displays the following window:

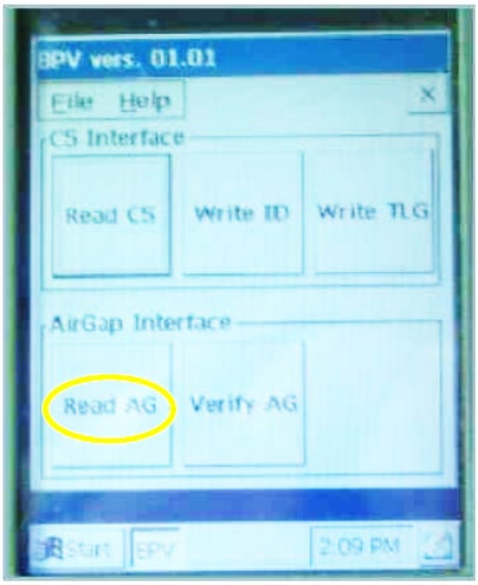


Figure 16 – Inputting complete Screen

2.2 To check the Balise across the air-gap, it is necessary to position the rack above the Balise, in direct contact with it, as close to the centre as possible.

Figure 17 – Checking the Air Gap

2.3 In the case where the selected function ends incorrectly, (with a message “ERROR [rack inactive / defective]”), before trying again, first set the external switch to the centre position.

3. Activation of Menu Functions

<u>Reading a Telegram (C5)</u>

3.1 Set the switch on the inside of the rack to “ON”, and the external switch to “PROGRAMMING” [P].

3.2 This operation (which can be selected by clicking on [Read C5] in interface C5 in the Main Menu (Figure 16) allows data stored in the Balise to be read.

3.3 It is necessary to wait about 10 seconds before the data stored in the Balise is displayed on the screen.

3.4 The following data appears in the first line (in hex):

a) The 16 bits hard-wired in the Balise (E89C).

b) The Balise ID the telegram shown in 256 Hex characters.

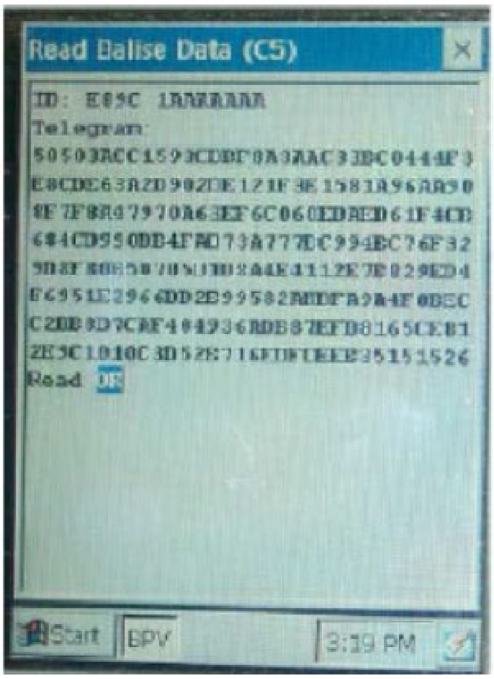


Figure 18 – Balise Data

NOTE: *During this operation, the data stored in the Balise is read but no check is made on them. If the data link is disconnected, or if there is no message in the balise, it reads as all 'F'.*

3.5 A read OK message states that the ID_BOA and the telegram can be read.

3.6 A Read NOK message states that either the ID_BOA or the telegram cannot be read.

Writing ID BOA (C5)

3.7 Set the switch on the inside of the rack to “ON”, and the external switch to “PROGRAMMING” [P].

3.8 Select [Write ID] to write the Balise ID.

NOTE: *writing the Balise ID is subject to entering the correct login (User Identification) and password, just after clicking on [ID boa].*

Figure 19 – Entering the Balise ID

3.9 A successful write is shown by an on-screen message, for example: “Write AAAAAAA2... OK”.

Writing A Telegram to A Balise (C5)

3.10 Set the switch on the inside of the rack to “ON”, and the external switch to “PROGRAMMING” [P].

3.11 Select [Write Telegram] to write the Telegram.

NOTE: *this operation is only possible if the Balise ID of the Balise corresponds to the telegram that you want to write.*

3.12 After the balise ID is checked the telegram to be written is displayed on the Pocket PC. Select [confirm] to write the telegram if correct or [cancel] if the wrong telegram is displayed.

NOTE: *when the write phase has ended, the data stored in the Balise is read back automatically and then displayed; confirmation (OK) of the result of the comparison between the telegram to be stored and the telegram actually stored then appears (see Figure 20).*

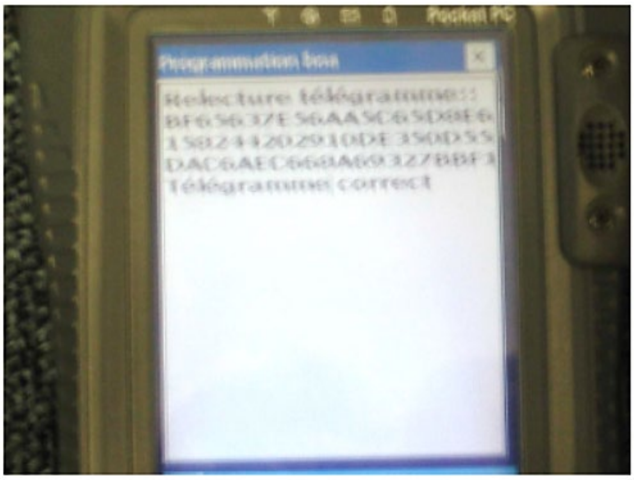


Figure 20 - Telegram

Reading A Telegram (Air-Gap)

3.13 This operation can be selected by clicking on [Read AG] in the AIR-GAP interface in the Main Menu (Figure 16).

3.14 Position the rack above the Balise, in direct contact, taking care to maintain a distance of at least 1 metre from any metallic object likely to affect the performance of the radiating elements in the rack and in the Balise.

3.15 Connect the Pocket PC to the rack; then set the switch inside the rack to the “ON” position and the external switch to “VERIFICATION”.

3.16 Select [Read AG] in the AIR-GAP interface in the Main Menu of the Pocket PC which activates the Balise and reading of the telegram.

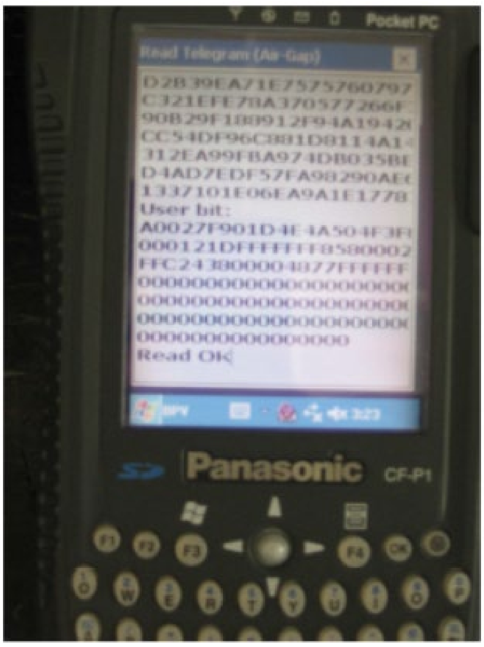


Figure 21 – Read AG

<u>Verification</u>

NOTE: *Position the rack above the Balise, in direct contact, taking care to maintain a distance of at least 1 metre from any metallic object likely to affect the performance of the radiating elements in the rack and in the Balise.*

3.17 Set the switch inside the rack to “ON” and the external switch to “VERIFICATION”.

3.18 Select [Verify AG] in the AIR-GAP interface in the Main Menu (Figure 16), the telegram sent by the Balise is read, but is also compared with the telegram contained in a pre-loaded file in the Pocket PC.

3.19 Choose fixed Balise [PRG] which activates the Balise and reading of the transmitted telegram.

3.20 Select [OK], the corresponding “User bit” are displayed and the result of the comparison appear in the last line (see Figure 22).

Figure 22 – Balise Testing Air Gap

SECTION C - ALSTOM ATLAS 200 EUROBALISE PROGRAMMING AND VERIFICATION

Warning: Strong electromagnetic fields are generated during the use of the BEPT, these might interfere with cardiac pacemakers and should not be used by anyone with a pacemaker fitted.

Further information can be found in the Alstom Atlas 200 ALS/UK/ATLAS200-SYS-MAN-00005 (BEPT User Manual).

1. Connecting the BEPT to the Handheld PC

1.1 Verify that no USB media is connected to the BEPT before the power up sequence has finished, if fitted the BEPT attempts a factory reset.

1.2 Switch-on the BEPT Core, ON/OFF indicator is lit.

1.3 After the booting delay, PC Ready indicator is lit.

1.4 BEPT Core is now ready to be used.

1.5 Insert the USB stick to the BEPT, with the relevant telegram files to be programmed.

NOTE: *Do not insert the USB stick before the BEPT has finished its start-up process, this causes the BEPT to try and enter a recovery mode and the BEPT cannot boot.*

1.6 Place the BEPT on the top of the Balise locating the feet of the test set in the recess on the Balise.

1.7 Start the handheld PC and wait for it to boot up.

1.8 Use the WiFi connection tool to connect the handheld to the BEPT using the SSID and Password.

NOTE: *The WiFi code matches the serial number on the BEPT.*

1.9 Once connected to the WiFi open internet explorer 11 and navigate to the following address http://192.168.10.1/BEPT.

1.10 The handheld now shows a login window.

2. Programming

2.1 Select the [programming] account and login using your credentials.

2.2 On the left-hand menu select [Write Eurotelegram] and the following window opens:

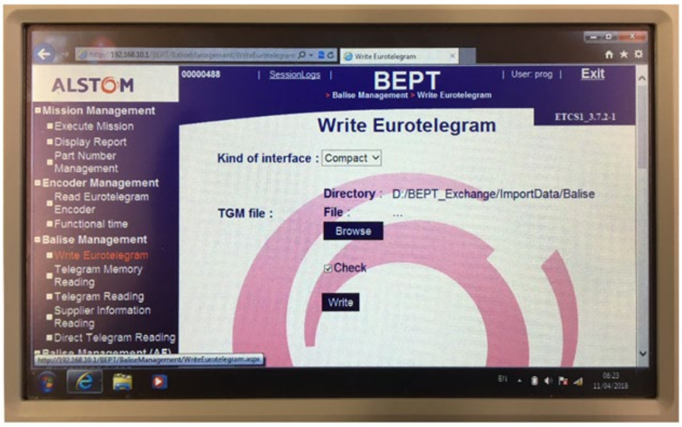


Figure 23 – Write telegram screen

2.3 Confirm the interface drop down menu is set to [Compact] then left click [Browse] and a pop-up window appears.

2.4 Scroll to the bottom of the left-hand window to select the last drive letter, usually the 'F' drive. Once selected the telegrams on the USB stick are available in the right-hand window.

Figure 24 – Telegram selection

2.5 Scroll the right-hand window until you see the telegram file you are looking for, select the file with the touch screen pen and click [ok].

2.6 The pop-up window closes, and the handheld displays the telegram file that is to be programmed into the Balise.

NOTE: *Confirm the telegram being loaded is the correct telegram for the Balise being programmed and it matches the certificate of conformity.*

Figure 24 – Telegram written successfully

2.7 Confirm the check tick box is selected and click [Write] the telegram is written to the balise.

Two possible results are returned:

a) ✓ Eurotelegram written successfully.

b) × An error has occurred.

2.8 Providing the write was successful you can now check the telegram by selecting [telegram reading] in the left-hand menu.

NOTE: *Do not select Telegram Memory reading as this does not show the signal strength meter.*

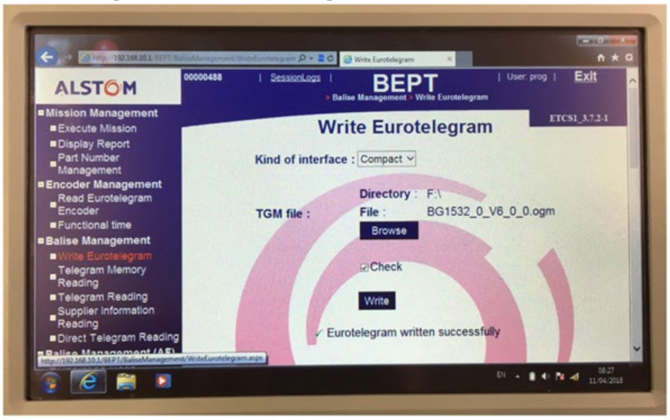


Figure 25 - Telegram reading

2.9 Confirm the [Check Telegram] tick box is NOT selected and click [Read], it takes approx. 10 seconds to read the telegram in the Balise. Once read the following window appears (Figure 26).

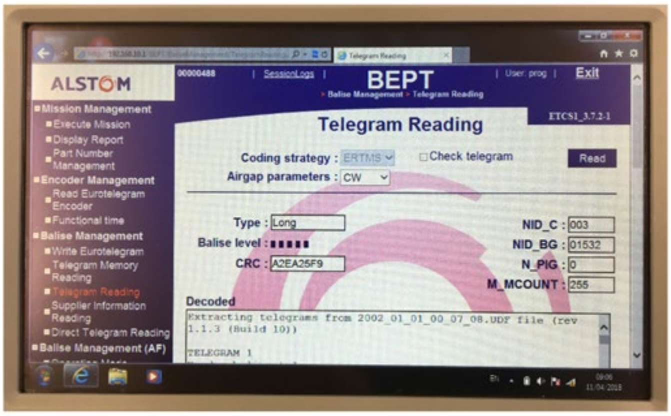


Figure 26 – Telegram check

2.10 In this window you can check the correct telegram has been loaded by checking the following:

a) NID_C – Country Code (UK is 003).

b) NID_BG – The Balise Group Number.

c) N_PIG – Position in Group.

d) M_MCOUNT – Should show 255 which is the packet number for End of Telegram.

e) Balise Level - minimum 4 out of 5 bars.

f) CRC - checksum code.

2.11 Complete all programming paperwork and complete the programming section of the certificate of conformity which shall be attached to the Balise.

3. Verification.

3.1 Select [verification] account and login using your credentials.

3.2 On the left-hand menu select [Telegram Reading].

NOTE: *Do not select Telegram Memory reading as this does not show the signal strength meter.*

Figure 27 – Telegram reading

3.3 Confirm the [Check Telegram] tick box is NOT selected and click [Read], it takes approx. 10 seconds to read the telegram in the Balise. Once read the following window appears (Figure 28).

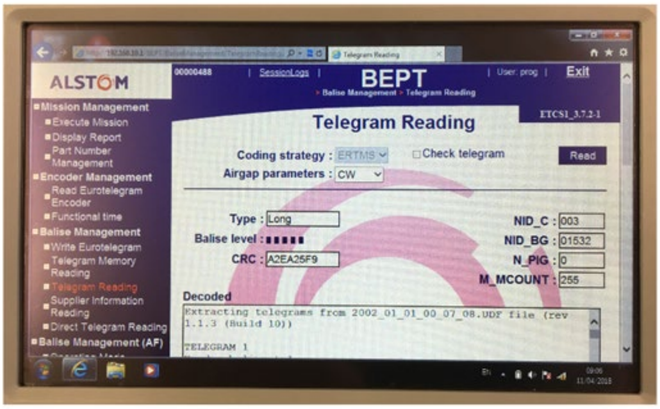


Figure 28 – Telegram check

3.4 In this window you can confirm the correct telegram has been loaded by checking the following against the programming paperwork and certificate of conformity entries:

a) NID_C – Country Code (UK is 003).

b) NID_BG – The Balise Group Number.

c) N_PIG – Position in Group.

d) M_MCOUNT – Should show 255 which is the packet number for End of Telegram.

e) Balise Level - minimum 4 out of 5 bars.

f) CRC - checksum code.

3.5 Complete all programming paperwork and complete the verification section of the certificate of conformity which shall be attached to the Balise.

4. Erasing

NOTE: *An Alstom Atlas 200 Balise cannot be over written with a new Telegram, in-order to change the telegram it needs to be erased first.*

4.1 Select [Eraser] account and login using your credentials.

4.2 On the left-hand menu select [Write Telegram].

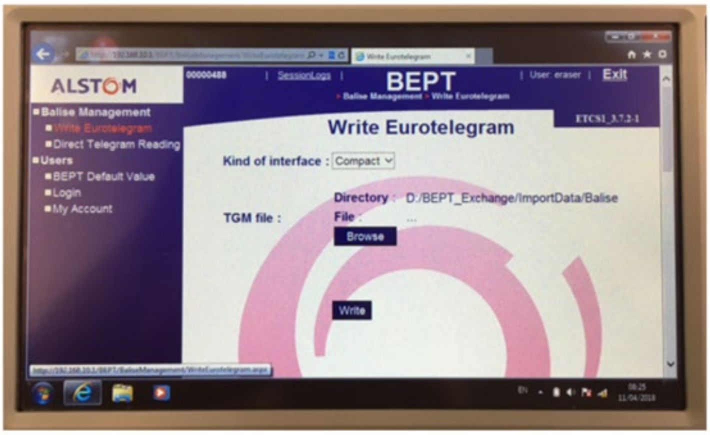


Figure 29 - Write Telegram

4.3 Confirm the interface drop down menu is set to [Compact] and click [Browse].

4.4 The Balise erase telegram is pre-loaded to the BEPT and is shown in the right-hand side of the pop-up window.

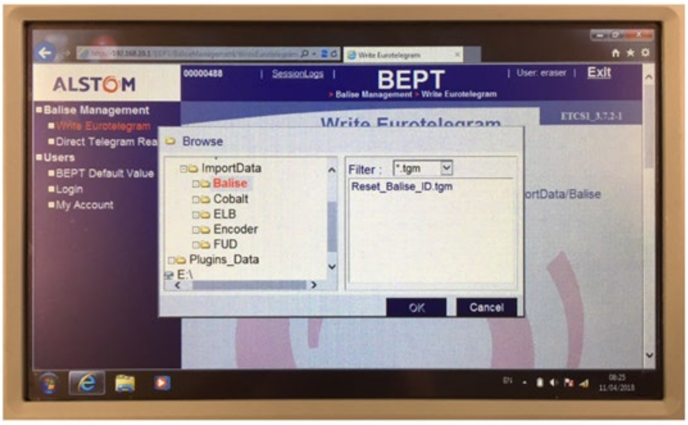


Figure 30 – Erase telegram

4.5 Select the [Reset_Balise_ID.tgm] file and then select [OK].

4.6 Once the pop-up window has closed select [Write] two possible results are returned:

a) ✓ Eurotelegram written successfully.

b) × An error has occurred.

4.7 Providing the write was successful the Balise is now ready to receive a new telegram.

SECTION D – TASS PROGRAMMING

Further information can be found in the TASS Balise C80056-SPEC-SYS-00166-07 (BEPT User Manual).

Warning: Only the supplied stylus is to be used on the display, Pens, Nails Paper Clips etc can damage the surface of the display and should not be used.

NOTE: *Before closing the handheld case, disconnect the battery charger. The display battery charger lead may be left connected if the display is inside the case, but the case cannot be closed or locked.*

NOTE: *The power supply cable and balise programming cable should only be connected in the depot environment and should be disconnected and stored before proceeding trackside.*

1. Powering Up the Toughbook PC and Display

1.1 Open the case, check the floppy disk drive (FDD), mounted in the BEPT case lid, to verify that no floppy disk is present.

1.2 Press the power button on the Toughbook PC and hold until a tone is heard. The Power status LED should be lit solidly, and the Hard Disk Access LED should light intermittently.

1.3 Once the “Display Ready” LED on the Toughbook PC illuminates, remove the stylus from the rear of the display next to the battery charger socket and use it to press and hold the monitor power button until the Power Status LED illuminates. The display should be present on the monitor within 5 seconds, once present, the BEPT is now ready for data input.

1.4 Connect the balise programming cable to the BEPT and the balise via the socket on the outside of the BEPT and the Balise connection socket.

Caution: Before proceeding with the BEPT operation verify the locking (pull to unlock) toggle switch is in the BEPT position.

To disconnect, use the key to unscrew the plug from the socket.

1.5 Position the BEPT on the Balise longitudinally with the handles of the carry handle at right angles to the balise X Axis.

1.6 Double tap on the desktop shortcut using the stylus.

1.7 Or in Windows Explorer, select C:\ProgramFiles\ATIS_TASS_BEPT\BeptTass.exe.

1.8 Enter your user name into the text field on the display, this unlocks the functions of the BEPT.

NOTE: *The entered user name remains valid for all operations until the TASS BEPT application is shut down.*

2. Programming

NOTE: *Balise programming should only be performed in the office/depot environment. The handheld case is to remain open throughout the operation.*

2.1 Select the DEPOT button, The DEPOT screen with four buttons is displayed.

2.2 Connect the balise programming cable between the case socket and the balise.

2.3 Select the PROGRAM BALISE button.

2.4 Inter-connection checks are performed; PC to BEPT reader connection and BEPT to balise connection present and correct. STATUS = “Connection Check”.

If the PC to BEPT reader connection is faulty:

- RESULT = “FAILED, PC to BEPT connection faulty”, and the programming operation is halted. Refer to section 4 for user action.

If the connection between the BEPT and the balise is faulty:

- RESULT = “FAILED, BEPT to Balise connection faulty”, and the programming operation is halted. Refer to section 4 for user action.

If the two connections are correct:

- RESULT = “Connection OK”.

2.5 Select the telegram to be programmed either from an inserted Floppy Disc or if the telegram is in the local memory of the BEPT carry out this process:

a) When prompted to insert a Floppy Disk click [Cancel].

b) A file browser window pops up which defaults to the desktop, browse the folders on the PC to the stored location and select the telegram to be programmed.

NOTE: *Selection of the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = "Cancellation of TGM file selection".*

2.6 The selected telegram file is submitted to coding strategy check, STATUS = "Telegram Coding Check".

If the coding strategy check fails:

- RESULT = "FAILED, telegram file corrupt" and the programming operation is halted.

If the coding strategy check is successful,

- RESULT = "Telegram file OK".

NOTE: *If the coding strategy check is passed, the STATUS and RESULT fields might change too quickly to notice.*

The selected telegram data is written to the balise via the cable and balise connector, STATUS = "Writing telegram".

If the write operation is unsuccessful:

- RESULT = "FAILED, write operation unsuccessful" and the programming operation is halted. Refer to section 4 for user action.

If the write operation is successful:

- RESULT = "Write operation OK".

NOTE: *If the write operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

2.7 The telegram data is read from the balise via the cable and balise connector, STATUS = "Reading telegram".

If the read operation is unsuccessful i.e. no telegram is read from the balise:

- RESULT = "FAILED, read operation unsuccessful" and the programming operation is halted.

If the read operation is successful,

- RESULT = “Read operation OK”.

NOTE: *If the read operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

2.8 The read telegram data is compared with the selected telegram file data, STATUS = “Comparing telegrams”.

If the comparison is unsuccessful i.e. the read data and the selected data are not identical:

- RESULT = “FAILED, Write telegram not same as Read telegram” and the programming operation is halted.

If the comparison is successful i.e. the read data and the selected data are identical:

- RESULT = “Write telegram same as read telegram”.

NOTE: *If the comparison operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

2.9 The user is prompted to disconnect the balise programming cable, STATUS = “Disconnect programming cable”. The disconnection can either be at the BEPT case socket, or at the balise connector. Check that the handheld case is located on top of the balise.

2.10 When the handheld case is correctly located on the balise, and the cable is disconnected, the user selects the OK button.

2.11 If the BEPT to balise connection is still detected as being present, the user is presented with the disconnection prompt again, up to a maximum of three times.

- RESULT = “FAILED, cable not disconnected”, and the programming operation is halted.

2.12 If the BEPT to balise connection is detected as being removed, the BEPT telepowers the balise. The balise transmits the telegram data currently held in memory, and the BEPT receives and logs this data. STATUS = “Reading via airgap”.

If no telegram data is received:

- RESULT = “FAILED, no telegram received via airgap” and the programming operation is halted.

If telegram data is received:

- RESULT = "Read operation OK".

NOTE: *If the airgap read operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

2.13 The received telegram data is compared with the selected telegram file data, STATUS = "Comparing telegrams".

If the comparison is unsuccessful i.e. the received data and the selected data are not identical:

- RESULT = "FAILED, Read telegram not same as selected" and the programming operation is halted.

If the comparison is successful i.e. the received data and the selected data are identical:

- RESULT = "PASSED, balise programming successful". This result confirms that the selected telegram data has been successfully programmed into the balise, and the balise is functional.

NOTE: *The user is presented with a popup requesting whether the selected telegram file is to be deleted. If YES is selected, the telegram file is deleted from where it was selected, if NO, it is not. Selection of either button ends the programming operation, and all buttons in the DEPOT screen are enabled.*

3. Reading a balise

3.1 Confirm that the programming cable is disconnected.

3.2 Check that the BEPT case is located on top of the balise.

3.3 After power up, start up and the entry of a user name, select the DEPOT button. The DEPOT screen with four buttons is displayed.

3.4 Select the READ BALISE button.

3.5 Inter-connection checks are performed; PC to BEPT reader connection present and correct, BEPT to balise connection NOT present. STATUS = "Connection Check":

If the PC to BEPT reader connection is faulty:

- RESULT = "FAILED, PC to BEPT connection faulty", and the read operation is halted.

If the connection between the BEPT and the balise is present:

- RESULT = "FAILED, BEPT to Balise connection faulty", and the read operation is halted.

If the two connections are correct:

- RESULT = "Connection OK".

3.6 A popup is displayed for the user to select whether a telegram comparison is required. Select YES if comparison is required, NO if not.

If Yes is selected choose the telegram to be compared either from an inserted Floppy Disc, or if the telegram is in the local memory of the BEPT carry out this process:

a) When prompted to insert a Floppy Disk click [Cancel].

b) A file browser window pops up which defaults to the desktop, browse the folders on the PC to the stored location and select the telegram to be compared.

NOTE: *Selection of the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = "Cancellation of TGM file selection".*

3.7 The selected telegram file is submitted to a coding strategy check, STATUS = "Telegram Coding Check".

If the coding strategy check fails:

- RESULT = "FAILED, telegram file corrupt" and the read operation is halted.

If the coding strategy check is passed,

- RESULT = "Telegram file OK".

NOTE: *If the coding strategy check is passed, the STATUS and RESULT fields might change too quickly to notice.*

3.8 The user is prompted to enter the ID number of the balise being read, the OK button is enabled only if an ID has been entered in the Balise ID text field. No more than 14 characters can be entered.

Clicking on Cancel removes the popup, stop the current process and re-enable all buttons, RESULT = "Cancellation of Balise ID selection".

3.9 The BEPT telepowers the balise. The balise transmits the telegram data currently held in memory, and the BEPT receives and logs this data. STATUS = “Reading via airgap”.

If no telegram data is received:

- RESULT = “FAILED, no telegram received via airgap” and the read operation is halted.

If telegram data is received:

- RESULT = “Read operation OK”.

NOTE: *If the airgap read operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

3.10 The received telegram data is compared with the selected telegram file data, STATUS = “Comparing telegrams”.

If the comparison is unsuccessful i.e. the received data and the selected data are not identical:

- RESULT = “FAILED, Read telegram not same as selected” and the read operation is halted.

If the comparison is successful i.e. the received data and the selected data is identical:

- RESULT = “PASSED, balise read successful”. This result confirms that the selected telegram data is present and not corrupt in the balise, and the balise is functional.

3.11 The user is presented with a popup requesting whether the selected telegram file is to be deleted. If YES is selected, the telegram file is deleted from where it was selected, if NO, it is not. Selection of either button ends the programming operation, and all buttons in the DEPOT screen are enabled.

If NO selected:

a) The user is prompted to enter the ID number of the balise being read, see figure 15. The OK button is enabled only if an ID has been entered in the Balise ID text field. No more than 14 characters can be entered.

b) Clicking on Cancel removes the popup, stop the current process and re-enable all buttons, RESULT = “Cancellation of Balise ID selection”.

3.12 The BEPT telepowers the balise. The balise transmits the telegram data currently held in memory, and the BEPT receives and logs this data. STATUS = "Reading via airgap".

If no telegram data is received:

- RESULT = "FAILED, no telegram received via airgap" and the read operation is halted.

If telegram data is received:

- RESULT = "Read operation OK".

NOTE: *If the airgap read operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

3.13 The received telegram data is submitted to a coding strategy check, STATUS = "Telegram Coding Check".

If the coding strategy check fails:

- RESULT = "FAILED, telegram file corrupt" and the read operation is halted.

If the coding strategy check is passed:

- RESULT = "PASSED, balise read successful". This result confirms that a non-corrupt telegram is stored within the balise, and the balise is functional.

4. Commissioning a Balise (Trackside)

NOTE: *Before proceeding trackside, verify that both the power supply cable and the balise programming cable have been disconnected from the unit, and that the handheld case is closed.*

CAUTION: When operating trackside, balise programming or reading should only be initiated when the BEPT is in place, on the balise, which is properly fixed in the four foot.

4.1 Power up the PC and monitor as per section 1-8 inclusive.

4.2 Check that the programming cable is disconnected.

4.3 Close and seal the case, ensuring that the monitor is not still in the case.

4.4 Check that the BEPT case is located on top of the balise.

4.5 After start up and the entry of a user name, select the TRACKSIDE button.

4.6 Select the COMMISSION button.

4.7 Inter-connection checks are performed; PC to BEPT reader connection present and correct, BEPT to balise connection NOT present. STATUS = “Connection Check”:

If the PC to BEPT reader connection is faulty:

- RESULT = “FAILED, PC to BEPT connection faulty”, and the commission operation is halted.

If the connection between the BEPT and the balise is present:

- RESULT = “FAILED, BEPT to Balise cable connected”, and the commission operation is halted.

If the two connections are correct:

- RESULT = “Connection OK”

4.8 A file browser window defaulting to the c:\Program Files\ATIS_TASS_BEPT\Telegram.

4.9 The file directory is be displayed, select the telegram to be programmed either from an inserted Floppy Disc or if the telegram is in the local memory of the BEPT carry out this process:

a) When prompted to insert a Floppy Disk click [Cancel].

b) A file browser window pops up which defaults to the desktop, browse the folders on the PC to the stored location and select the telegram to be programmed.

NOTE: *Selection of the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = “Cancellation of TGM file selection”.*

4.10 Clicking on the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = “Cancellation of TGM file selection”.

4.11 The selected telegram file is submitted to a coding strategy check, STATUS = “Telegram Coding Check”.

If the coding strategy check fails:

- RESULT = "FAILED, telegram file corrupt" and the commission operation is halted.

If the coding strategy check is passed:

- RESULT = "Telegram file OK".

NOTE: *If the coding strategy check is passed, the STATUS and RESULT fields might change too quickly to notice.*

4.12 The user is prompted to enter the ID number of the balise being commissioned, the OK button is enabled only if an ID has been entered in the Balise ID text field. No more than 14 characters can be entered.

4.13 Clicking on Cancel removes the popup, stop the current process and re-enable all buttons, RESULT = "Cancellation of Balise ID selection".

4.14 The BEPT telepowers the balise. The balise transmits the telegram data currently held in memory, and the BEPT receives and logs this data. STATUS = "Reading via airgap".

If no telegram data is received:

- RESULT = "FAILED, no telegram received via airgap" and the commission operation is halted.

If telegram data is received:

- RESULT = "Read operation OK".

NOTE: *If the airgap read operation is successful, the STATUS and RESULT fields might change too quickly to notice.*

4.15 The received telegram data is compared with the selected telegram file data, STATUS = "Comparing telegrams".

If the comparison is unsuccessful i.e. the received data and the selected data are not identical,

- RESULT = "FAILED, Read telegram not same as selected" and the commission operation is halted.

If the comparison is successful i.e. the received data and the selected data are Identical:

- RESULT = “PASSED, balise read successful”. This result confirms that the selected telegram data is present and not corrupt in the balise, and the balise is functional.

The user is presented with a popup requesting whether the selected telegram file is to be deleted. If YES is selected, the telegram file is deleted from where it was selected, if NO, it is not.

Selection of either button ends the programming operation, and all buttons in the TRACKSIDE screen are enabled.

5. Reading a Balise (trackside)

NOTE: *Before proceeding trackside, verify that both the power supply cable and the balise programming cable have been disconnected from the unit and that the handheld case is closed.*

CAUTION: When operating trackside, balise programming or reading should only be initiated when the BEPT is in place, on the balise, which is properly fixed in the four foot.

5.1 Power up the PC and monitor.

5.2 Check that the programming cable is disconnected.

5.3 Close and seal the case, ensuring that the monitor is not still in the case.

5.4 Check that the BEPT case is located on top of the balise.

5.5 After start up and the entry of a user name, select the TRACKSIDE button. The TRACKSIDE screen with four buttons is displayed.

5.6 Select the READ BALISE button. Inter-connection checks are performed; PC to BEPT reader connection present and correct, BEPT to balise connection NOT present. STATUS = “Connection Check”:

If the PC to BEPT reader connection is faulty:

- RESULT = “FAILED, PC to BEPT connection faulty”, and the read operation is halted.

If the connection between the BEPT and the balise is present:

- RESULT = “FAILED, BEPT to Balise cable connected”, and the read operation is halted.

If the two connections are correct:

- RESULT = “Connection OK”

5.7 The user is prompted to enter the ID number of the balise being read. The OK button is enabled only if an ID has been entered in the Balise ID text field. No more than 14 characters can be entered.

5.8 Clicking on Cancel removes the popup, stop the current process and re-enable all buttons, RESULT = “Cancellation of Balise ID selection”.

5.9 The BEPT telepowers the balise. The balise transmits the telegram data currently held in memory, and the BEPT receives and logs this data. STATUS = “Reading via airgap”.

if no telegram data is received:

- RESULT = “FAILED, no telegram received via airgap” and the read operation is halted.

If telegram data is received:

- RESULT = “Read operation OK”. Note: If the airgap read operation is successful, the STATUS and RESULT fields might change too quickly to notice.

5.10 The received telegram file is submitted to a coding strategy check, STATUS = “Telegram Coding Check”.

If the coding strategy check fails:

- RESULT = “FAILED, telegram file corrupt” and the read operation is halted.

If the coding strategy check is passed:

- RESULT = “PASSED, balise read successful”. This result confirms that a non-corrupt telegram is stored within the balise, and the balise is functional.

6. Checking Telegram Coding

6.1 Power up the PC and monitor.

6.2 After start up and the entry of a username, select the TELEGRAM CHECK button. The TELEGRAM CHECK screen with two buttons is displayed.

6.3 Select the TELEGRAM CHECK button. The Result and File name fields are cleared.

6.4 Files directory is displayed, Select the telegram to be programmed either from an inserted Floppy Disc or if the telegram is in the local memory of the BEPT carry out this process:

a) When prompted to insert a Floppy Disk click [Cancel].

b) A file browser window pops up which defaults to the desktop, browse the folders on the PC to the stored location and select the telegram to be programmed.

NOTE: *Selection of the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = "Cancellation of TGM file selection".*

6.5 A single telegram file or multiple telegram files, in a single directory, may be selected by highlighting them and selecting Open. Selection of multiple directories is not possible.

6.6 Clicking on the file browser window Cancel button closes the file browser window, stop the current process and re-enable all buttons, RESULT = "Cancellation of TGM file selection".

6.7 Once selected, the file browser window closes, and each selected telegram file is checked in turn. The FILENAME field displays the telegram filename currently being checked.

If the current file passes the telegram check:

- RESULT = "Telegram File OK". Note: If the check operation is successful, the FILENAME and RESULT fields might be updated too quickly to notice.

If the current telegram file is corrupt i.e. the check fails:

- RESULT = "FAILED, telegram file corrupt".

A popup is displayed detailing the filename of the corrupted telegram, and a prompt for the user to select the OK button to continue.

Once OK is selected; the check on the remaining files recommences until complete. If other corrupt telegram files are encountered, the error message and popup are repeated.

When all selected telegram files have been checked,

If all the selected telegram files have passed the coding check:

- RESULT= "PASSED, all telegram files correct", FILENAME = name of the last telegram file checked.

If X number of telegram files have failed the coding check:

- RESULT = "FAILED, X telegram file(s) corrupt", FILENAME = name of last telegram file checked.

7. Closing Screens and Shutting Down

7.1 Select START – SHUT DOWN

7.2 Select Shutdown in the popup menu.

SECTION D – TRACKLINK III READING AND TESTING

Further information can be found in Tracklink III HSD2300_095-SWT (Tracklink III Beacon Programmer and Tester).

1. Checking the Programmer / Test Tool

1.1 Switch on the portable tag programmer / tester tool at the power on button by pressing and holding for 4 seconds.

1.2 After a short power up period, the display shows the standard windows start up screen.

1.3 Confirm that the antenna is connected to the USB port on the Left side of the tablet. To run the Tracklink III Software program double tap on the icon.

Figure 31 – Tracklink III Icon

1.4 Prior to reading an installed beacon, check that the reader is functional, by using the supplied Test Tag.

1.5 Connect the antenna, place the Test Tag on top of the antenna and select the 'Read Tag' button. '1264400C6300' should be displayed in the Page 1 field on the PC screen.

1.6 Once the Programmer / Tester has successfully read the test tag, locate the beacon to be tested / programmed.

1.7 Place the antenna over the centre of the beacon and within 0.8m of the beacon under test and select the "Read Tag" button.

NOTE: *Check no other beacons or test tags are within 2 metres of the beacon.*

1.8 To clear the data that has been read from a previous tag, select 'Read Tag' with the antenna facing away from the tag. This clears the tag data.

1.9 If any of the tags are not read, repeat the process, if unsuccessful, verify programmer/tester operation by reading the red test tag. If operation with the red test tag is okay, then the beacon might need replacing. Refer to Tag Reading/Verifying Flowchart for further details.

2. Programming a Tracklink III Beacon

2.1 Programming is required when there is a need to create a new beacon for replacement of a faulty beacon.

2.2 To write a beacon, the Operator first Logs on. Select the 'Logon' button, and the logon window appears.

2.3 Enter 'PASSWORD' in the password field and select 'OK'.

2.4 Once logged on, the 'Open File', "Write Tag', 'Log Off" buttons become available.

2.5 Select the 'Open File' button, this should open the 'Master File' (Default), if not, select the 'Set Root Directory' button and select the 'Master File' for use.

***NOTE: Master (Default)** — The master directory contains data which are the files that are* to be used for programming the beacons.

***NOTE: User** — The user directory is available if files need to be saved i.e. for investigative purposes.*

2.6 A window displaying a list of data files (abbreviated by station, platform and platform end) is displayed. Double tap the required file on the list with the Programmer/Tester stylus.

Once a file has been selected, locate the beacon to be programmed, place the antenna directly on top of the centre of the beacon and select the 'Write Tag' button to program the new beacon with the required data.

***NOTE:** Check no other beacons or test tags are within 2 meters of the beacon under test. The Programmer/tester is designed to test/read/write only one beacon/tag at a time and two beacons/tags in close proximity affect its ability to write.*

2.7 Confirmation that the pages (address) 0001 to 0007 have been written show as 'Pass'.

2.8 Confirmation that the correct data has been written to the beacon/tag may be obtained firstly by repeating the 'Read' function and confirming Page 1 and the "Operational Data, are correct, then by pressing the 'Verify' button.

2.9 In the "Verification of Written Data Screen", check the data in address 000F begins with 0314, the "Hex Data" for addresses 0001 to 0004, match "Page 1", data and that addresses 0005 to 0007 equals 0000000000000000.

NOTE: *by pressing the "Verify" button, the data contents of all pages in the beacon/tag is displayed and then, the "Lock" button is available to use, as shown below in Screen-8.*

NOTE: The Lockinq process sets the beacon/taq data to read only and cannot be chanqed once the beacon/taq has been locked!

2.10 Once the beacon/tag has been successfully written, and subsequently verified as correct using the "Read" button then the "Verify" button, the beacon/tag data, can then be locked.

NOTE: The Lock process sets the beacon/tag data to read only, and cannot be changed again!

2.11 If the beacon/tag has NOT been successfully written, an error message appears when using the "Verify" button. If the "Verification Failed" message appears, repeat the process to re-write the data to the tag/beacon.

Once the beacon/tag has been successfully written, select the 'Lock' button. A prompt window shall be displayed as shown below in Screen-10.

NOTE: The "Lock" button is unavailable until the beacon/taq data has been verified usinq the "Verify" button.

2.12 Confirm that the unique beacon/tag serial number and 'Page 1' Hex Data are correct before selecting 'Yes'.

2.13 When the beacon/tag has been locked, an asterisk shall appear next to each page in the event window, and the "Lock" button becomes unavailable to use.

NOTE: This beacon cannot now be re-programmed, if it has been incorrectly programmed and locked by selecting the incorrect file. It should be quarantined immediately to avoid the accidental installation of an erroneous beacon.

2.14 Following the tag write & lock process, the operator can select "Read Tag" and confirm that the data has been written successfully.

END

1. General

This module contains guidance on three types of Instead Logger the 3, 64 and 64 Active. Confirm which type you have before proceeding.

2. Instead Data Logger Disk Analysis

2.1 After a failure / incident, and when instructed to do so, the logger disk should be removed and replaced by the attending staff.

2.2 The logger disk should be analysed by staff competent to Level 2 or equivalent.

2.3 If the disk has been changed as part of routine maintenance, it should be checked to confirm each channel is recording correctly and that the time / date is correct.

2.4 Each disk should be marked with the site name.

2.5 If the disk has been removed as part of an Investigation then in addition to the checks listed above consideration should be given as to what is known to have occurred (by what is recorded on the disk) and what testing is required to eliminate any possible causes not covered by the data on the disk.

For example, the fact that a lamp proving relay is energised does not mean that the lamp is lit, a fault in the tail cable can cause sufficient current flow to energise the relay but prevent the lamp from lighting.

This kind of analysis can both focus and reduce the amount of testing required.

2.6 Copies of the data relating to WSF / incident investigation, shall be submitted as evidence along with any other supporting test records.

3. Remove or Replace an Instead Logger Disk

(All Types)

3.1 The unit depends on having a usable disk in the drive for correct operation.

3.2 Recording always continues into the memory, even when there is not a disk in the drive.

Be aware that if the unit is left without a disk for a long time, the memory eventually fills up. If this happens, data is lost and an ‘overrun’ error message is be added to the system event log.

3.3 Never eject the disk from the drive without first pressing the ‘Change Disk’ button and waiting for the unit’s instructions. The unit stores events in memory until it has stored 256 events, at which point it writes them to the disk.

3.4 When 'Change Disk' is pressed, any events remaining in memory are written to the disk. If the disk is removed without pressing 'Change Disk' button, the last events are not be recorded. Also, the system event log is not updated on the disk.

3.5 The unit might not respond immediately to your press of the 'Change Disk' button under the following conditions:

a) If it is currently writing to the disk, it does not respond until the disk write is completed. This can take up to 2 seconds.

b) If the unit is in menu mode, this should be exited before the disk can be changed. Keep pressing 'No' until the time is displayed, then press 'Change Disk' again.

c) If the modem link is in use, the unit displays "Logging out remote user - WAIT". The remote user is then logged out at the end of their current operation. This can take some time.

4. Changing the Logger Disk

For Instead Logger type 3 and 64 (Only)

4.1 A 720K formatted disk is required to replace the one which is currently in the unit. It does not necessarily have to be blank, but anything on it is erased.

For Instead Logger type 64 Active (Only)

4.2 A 1.44M formatted disk is required to replace the one which is currently in the unit. It does not necessarily have to be blank, but anything on it is erased.

All Types

4.3 Before starting the disk changing procedure, the site name and the current date and time shall be written on the label of the new disk.

4.4 If the unit is in a location case, take steps to reduce the ingress of moisture and dirt while the front door is open.

4.5 Open the transparent door on the front of the unit and press the 'Change Disk' button. The unit displays:

a) Writing disk WAIT (Type 3 & 64) or

b) Appending data (Type 64 Active).

The unit is writing any left-over events from its memory onto the disk. After a second or so, the display changes to:

c) Remove disk now (Press no to cancel)

Press the eject button on the disk drive and remove the disk.

While there is no disk in the unit, it beeps quietly to remind you to put a new disk in. If you take more than 2 minutes to replace the disk, the beeping becomes more urgent. You can lose data if you leave the unit without a disk for too long.

4.6 The display now shows:

a) Disk removed insert new disk (Type 3 & 64) or

b) Insert formatted 1.44m disk (Type 64 Active).

Take the new disk and insert it into the drive, with the label facing towards the display. As soon as the disk clicks into the drive, the display changes to:

c) Checking Disk

4.7 The unit is now checking the disk to make sure it is correctly formatted, whether it has any data on it, and if there are any faults on it.

4.8 If the disk is OK and is blank, the unit clears the screen and returns to displaying the time and date.

5. Data on Disk

<u>For Instead Logger type 3 and 64 (Only)</u>

5.1 If Data is found on the entered disk the following messages are displayed, depending on the results of the disk check.

a) Disk is not Blank OK to Erase?

The disk has got some DOS or Windows data on it. Press ‘Yes’ to wipe the disk, or ‘No’ if you want to remove the disk and try another. If you do not respond at all, the unit wipes the disk after 60 seconds.

b) Disk is from another logger, OK to erase?

The disk has previously been used in another Instead 3 unit and might have recorded events on it.

If you press ‘Yes’, the unit wipes the disk.

If you press ‘No’, the unit asks you to replace the disk with another one. If you do not respond at all, the unit wipes the disk after 60 seconds.

c) Old disk from this logger, OK to erase?

The disk has previously been used in this Instead 3 unit and might have recorded events on it.

If you press ‘Yes’, the unit wipes the disk.

If you press ‘No’, the unit asks you to replace the disk with another one.

If you do not respond at all, the unit wipes the disk after 60 seconds.

d) Instead data on disk, add data on to end?

The disk has just been removed from this Instead 3 unit (the disk you have put in is the one that you just took out).

If you press ‘Yes’, the unit carry’s on recording on the same disk, adding new events onto the end of the previous ones.

If you press ‘No’, the unit asks whether you want to wipe the disk (press ‘9’) or replace it (remove the disk).

If you do not respond at all, the unit carry’s on using the disk, adding new events on the end of the file.

If you change your mind after removing a disk, or if your replacement disk turns out to be unsuitable, this option allows you to put the original disk back in. No data is lost.

<u>Instead 64 Active Logger Disk (Only)</u>

5.2 The disk contains DOS, Windows or unknown file(s). After 4 seconds the display asks for removal of this disk.

a) New config on disk. Update my config?

The disk contains the same site and new site configuration details.

Press ‘Yes’ to change the system configuration, or press ‘No’ to cancel.

The unit asks for confirmation and if there is no response within 30 seconds, the new system configuration is loaded and used as the new default.

b) Old config on disk. Change my config?

The disk contains the same site and old site configuration details.

Press ‘Yes’ to change the system configuration, or press ‘No’ to cancel. The unit asks for confirmation and if there is no response within 30 seconds, the new system configuration is loaded and used as the new default.

c) Change my config to Blank Site

The disk contains another site configuration details.

Press ‘Yes’ to change the system configuration, or press ‘No’ to cancel.

The unit asks for confirmation and if there is no response within 30 seconds, the new system configuration is loaded and used as the new default.

d) Use this disk as a data disk?

The disk contains the same site and new site configuration details.

The unit then requires confirmation to use this system site configuration disk as a site data disk.

Press ‘Yes’ to erase this disk and use it as a data disk, or press ‘No’ to cancel.

The unit asks for confirmation and if there is no response within 30 seconds, the unit then examines the disk to determine what files are present and if any errors exist on the disk.

e) Data already on disk 9-Erase Y-Keep

The disk has previously been used in this Instead 64 Active unit and might have events on it.

Pressing ‘9’ erases the disk.

By pressing ‘Yes’, the unit appends any events onto the end of the last event on the disk.

If there is no response after 30 seconds, the unit assumes that ‘Yes’ was intended.

f) Erase all I64 files on disk?

This message requires confirmation before erasing a disk.

Press ‘Yes’ to wipe this disk, or press ‘No’ to cancel, whereupon the unit prompts you to remove of the disk and waits for the disk to be removed.

g) Verify disk? (recommended)

This message requires confirmation before verifying a disk, i.e. checking the disk for any bad sectors.

This process can take up to 90 seconds.

Press ‘Yes’ to verify the disk, or press ‘No’ to cancel.

The unit verifies the disk after 30 seconds if there is no response to this message.

6. Disk not Usable

For Instead Logger type 3 and 64 (Only)

6.1 If the disk is unusable the following messages are displayed, depending on the results of the disk check.

a) Disk is wrong format, please replace

The disk is not 720K DOS formatted (it might be formatted at the wrong capacity or not formatted at all).

The unit cannot use the disk, it is to be replaced.

This message is accompanied by a fault indication, which is cancelled automatically when you remove the faulty disk.

b) Disk has bad sectors, please replace

The unit has detected some bad sectors on the surface of the disk. The unit cannot use the disk, it is to be replaced. This message is accompanied by a fault indication, which is cancelled automatically when you remove the faulty disk.

Place the new disk into the drive, with the label towards the display.

The display clears to show the current date and time.

Recording continues as normal.

Instead 64 Active Logger Disk (Only)

6.2 If the disk is unusable the following messages are displayed, depending on the results of the disk check.

a) Disk wrong format or bad sectors

The disk is not 1.44MB DOS formatted or the unit has detected some bad sectors.

It might be formatted at the wrong capacity or not formatted at all.

The unit cannot use the disk, it is to be replaced.

This message is accompanied by a fault indication, which is cancelled automatically when the faulty disk is removed.

b) Error reading disk directory

An error occurred while reading the disk. After a few seconds the unit requests the removal of the disk.

c) Load config failed. Blank Site

An error occurred while reading system configuration from the disk. The unit displays an error message and any code(s).

d) Disk error xxxxxxxxxxxx

After a few seconds the unit requests the removal of the disk.

e) Error writing config Disk write protected

An error occurred while reading system configuration from the disk.

The unit displays an error message and any code(s).

f) No. of channels = xx Incorrect!

The system configuration site disk contained an incorrect number of channels in the set-up file(s).

The display shows the incorrect number of channels on this disk.

This site configuration disk is ignored.

After a few seconds the unit requests the removal of the disk.

7. After the Disk has been changed

<u>All Types</u>

7.1 Write the current date and time on the removed disk and check the site name is also marked on it.

7.2 Close the front door of the unit.

END

1. Replacing Control and Evaluation Unit Components

1.1 All Control and Evaluation Unit components are replacement parts and cannot be repaired.

1.2 The UPS is an exception to this as the spent batteries can be replaced. This task shall only be undertaken by specialist personnel.

1.3 Any item requiring replacement should be replaced using the correct SMTH Test Plan.

2. Start-up Procedure

2.1 Connect the load with the UPS system without switching them on. Make sure that the UPS system has two groups of output sockets. The programmable output sockets can be switched independently of the remaining sockets. The programmable output sockets are primarily designed for less critical load which cannot be brought down using software. Critical load should not be connected to the programmable output sockets.

2.2 Connect the power supply cable (supplied with the XANTO 2000 and 3000) for the UPS system into a socket. The display on the UPS system shows “Sb”,

2.3 Hold the “ON / 🔇 / ▲” button on the UPS system down until you hear a short beep.

2.4 The UPS system carries out a self-test, after which “OK” appears on the display. The UPS system is now operating in normal mode and supplying the load with reliable power.

2.5 If an additional emergency power off switch has been installed, the emergency stop function needs to be tested.

2.6 Switch the load on one by one.

NOTE: *The internal batteries charge up to 90% of their full capacity in less than four hours. ONLINE recommends charging the batteries for 48 hours after installation or extended periods of non-use.*

The batteries start to charge as soon as the UPS system is connected to the supply network and supplied with power, irrespective of the operating mode.

3. Starting in battery mode

3.1 Hold the “ON / 🔇 / ▲” button on the UPS system down until you hear a beep.

3.2 The UPS system is starting; the display then shows the battery status and supplies the load connected with reliable power.

3.3 If the display is lit, fix all warnings and restart the UPS system.

4. Switching off

4.1 Hold the "OFF / ↵" button on the UPS system down for 2 seconds. When the continuous beep ends, the UPS system switches to standby mode.

NOTE: *If the "OFF / ↵" button is released after less than 2 seconds, the unit is not switched off.*

4.2 Disconnect the mains connection cable of the UPS system from the socket. The display on the UPS system goes out after a short time and the UPS system switches off completely.

5. Replacing an EPOS Unit

Unregistering and removing the defective EPOS-Unit

5.1 Open the EPOS configuration by double-clicking on the SAT GUI icon. First a login window appears.

5.2 Enter the login data.

5.3 The EPOS configuration window opens:

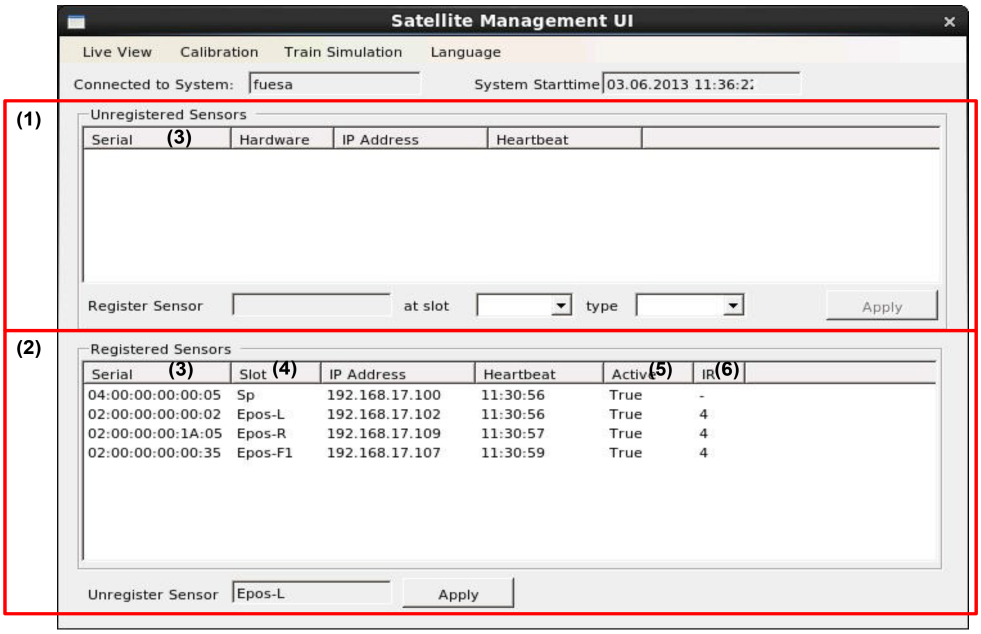


Figure 1 - "EPOS configuration" window

Number	Function Description
(1)	"Unregistered Sensors" area (SLSC modules as EPOS units, SP board).
(2)	"Registered Sensors" area (SLSC modules).
(3)	"Serial" column: Display of the MAC address.
(4)	"Slot" column: Display of the functional allocation (e.g., measurement position) of the sensors.
(5)	"Active" column: Display of the connection status.
(6)	Number of detector elements (for EPOS units).

Table 1 – Key to Figure 1

5.4 Unregister the defective EPOS-Unit:

a) Select the defective EPOS-Unit in the "registered sensors" at the bottom.

b) Click on the "Apply" button (item (1) in Figure 2).

The module that has been unregistered disappears in the "registered sensors" area at the bottom and now appears in the "unregistered sensors" area at the top.

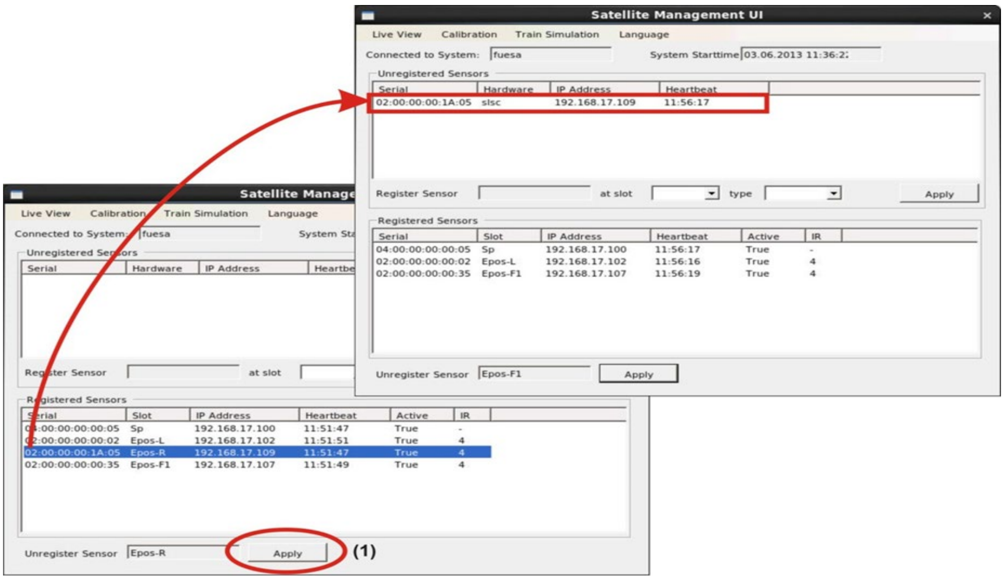


Figure 2 - Logging out the defective EPOS-Unit

Removing the HBD EPOS-Units

5.5 Loosen the two bolts of the inner cover plate (Figure 3, marked (1)) and slide the plate (Figure 3, marked (2)) away from the HBD, in the direction of the red arrow.

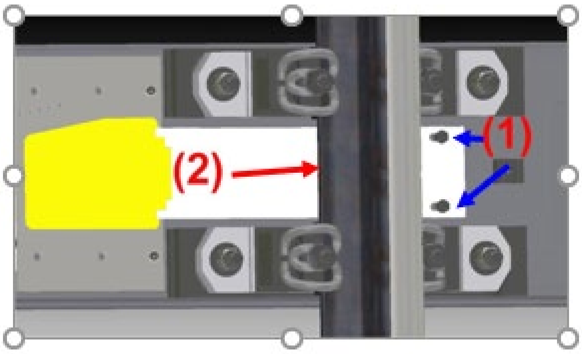


Figure 3 – Removal of the Inner Cover Plate

5.6 Loosen and remove the HBD-L and HBD-R EPOS-Unit fastening screws (each of four M12, SW19 screws, with washer and spring-lock washer) on the base plate and remove. See Figure 4.

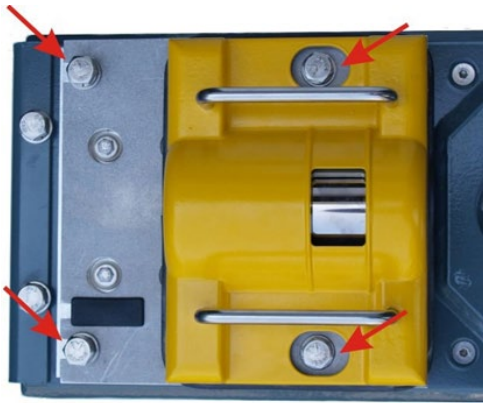


Figure 4 - HBD EPOS-Unit screw connections

5.7 Pull both HBD EPOS-Units out of the measuring sleeper and move them downwards using the shutter, putting them onto or next to the measuring sleeper (see Figure 5).

- Do not loosen the long cable.
- Do not unscrew the adjustment frame.

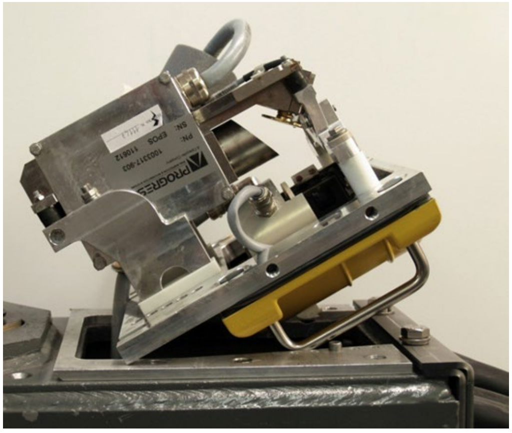


Figure 5 - HBD EPOS-Unit placed on the sleeper

5.8 If the EPOS Unit is being disconnected/removed from site or replaced, push the plug protection to one side and disconnect the plug connection.

The entry for the EPOS-Unit which has been disconnected shown in the "unregistered SLSC modules" area (seen in Figure 2) disappears.

5.9 Secure and protect the disconnected ends of the cable.

Re-assembly of the HBD EPOS-Units

5.10 If the EPOS Unit is being re-connected after being removed from site or replaced, reconnect the cable and replace the plug protection.

5.11 Re-insert the HBD EPOS units into the measuring sleeper.

5.12 Grease the screws before assembly to protect them from corrosion.

5.13 Reposition the inner cover plate so there is no gap at the HBD (Figure 6).

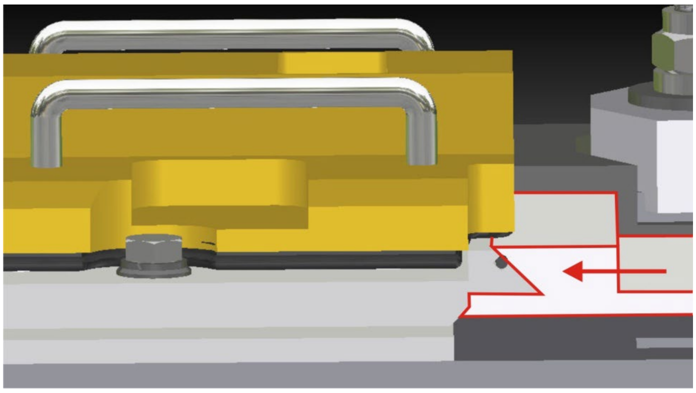
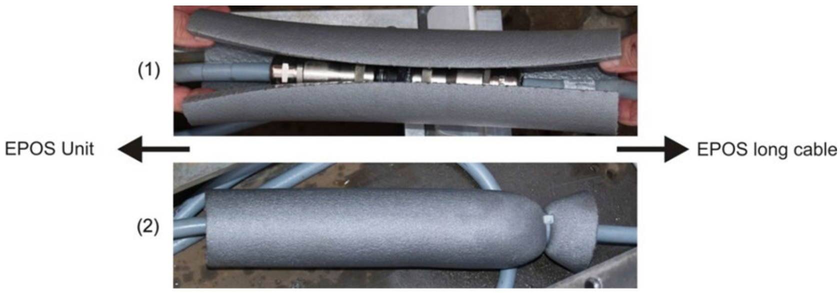


Figure 6 - Inner Cover Plate Replacement

5.14 Fasten the HBD EPOS unit with the M12 x 45 mm screws, including the washers and spring rings (tightening torque 70 Nm).

5.15 Confirm while doing so that the plug protection is not moved out of place.



(1) Position of the plug connection inside the plug protection
(2) Plug protection assembled in the correct position

Figure 7 - Plug protection

Removing the HWD EPOS-Unit

5.16 Loosen and remove the HWD EPOS-Unit fastening screws (each of four M12, SW19 screws, with washer and spring lock ring) on the base plate and remove. See Figure 8.

5.17 Pull the HWD EPOS-Unit out of the measuring sleeper carrier and move it downwards using the shutter, putting it onto or next to the measuring sleeper (see Figure 9).

Figure 8 - HWD EPOS-Unit screw connections

5.18 If the EPOS Unit is being disconnected/removed from site or replaced, push the plug protection to one side and disconnect the plug connection.

The entry for the EPOS-Unit which has been disconnected shown in the "unregistered SLSC modules" area (seen in Figure 2) disappears.

5.19 Secure and protect the disconnected ends of the cable.

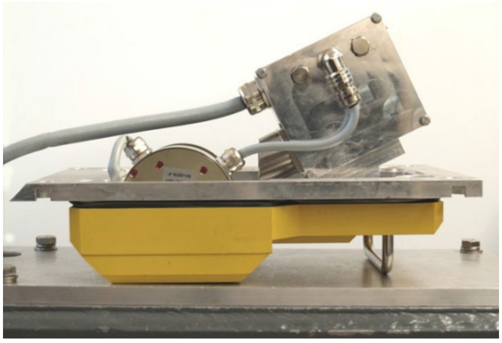


Figure 9 - HWD EPOS-Unit placed on the sleeper

Re-assembly of the HWD EPOS-Units

5.20 If the EPOS Unit is being re-connected after being removed from site or replaced, reconnect the cable and replace the plug protection.

5.21 Insert the HWD EPOS unit into the measuring sleeper.

5.22 Grease the screws before assembly to protect them from corrosion.

5.23 Fasten the HWD EPOS unit with the M12 x 45 mm screws, including the washers and spring rings (tightening torque 70 Nm).

5.24 Confirm while doing so that the plug protection is not moved out of place.

Registering the EPOS unit

5.25 If you are not already logged into the "Satellite Management UI" system, open the EPOS configuration by double-clicking on the icon and logging in when the login window appears.

5.26 The new EPOS-Unit (SLSC module) appears automatically in the "unregistered sensors" area at the top as soon as it is plugged in.

5.27 Assign the new EPOS-Unit (SLSC module) to the previous function (measurement position) by following steps:

a) Open the “at slot” drop-down list as shown in Figure 10, and select the measurement position.

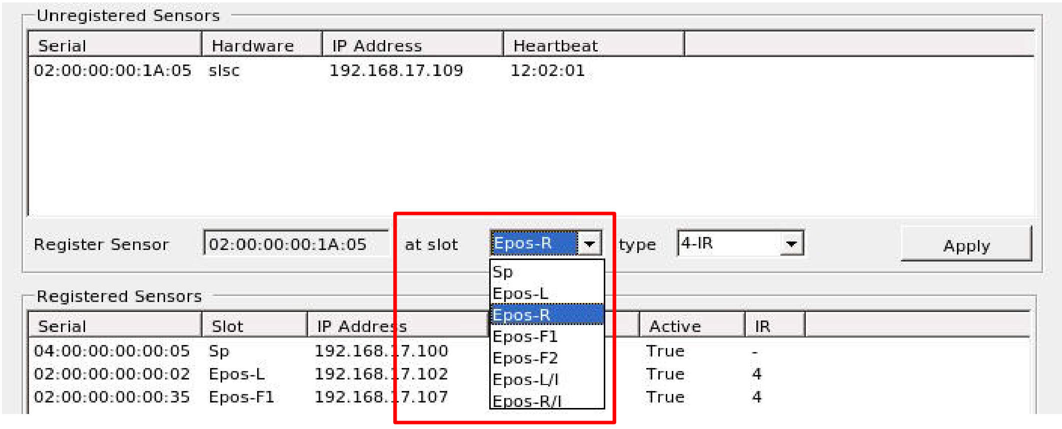


Figure 10 - Assigning the EPOS-Unit to a measurement position

b) If necessary, change the detector type (4 or 8 elements) using the "Type" drop-down list.

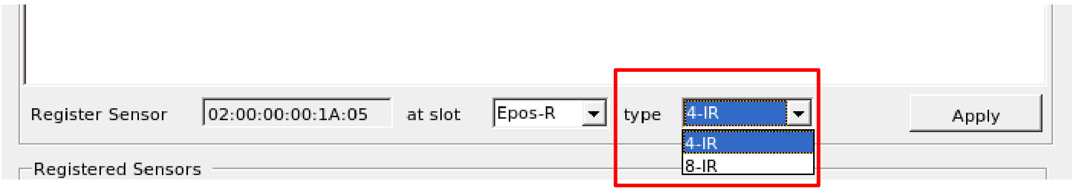


Figure 11 – Selecting the detector type

c) Mark the new EPOS-Unit (SLSC module).

d) Click on the "Apply" button (item (1) in Figure 12).

5.28 The new EPOS-Unit disappears from the "unregistered sensors" area at the top and now appears in the "registered sensors" area at the bottom.

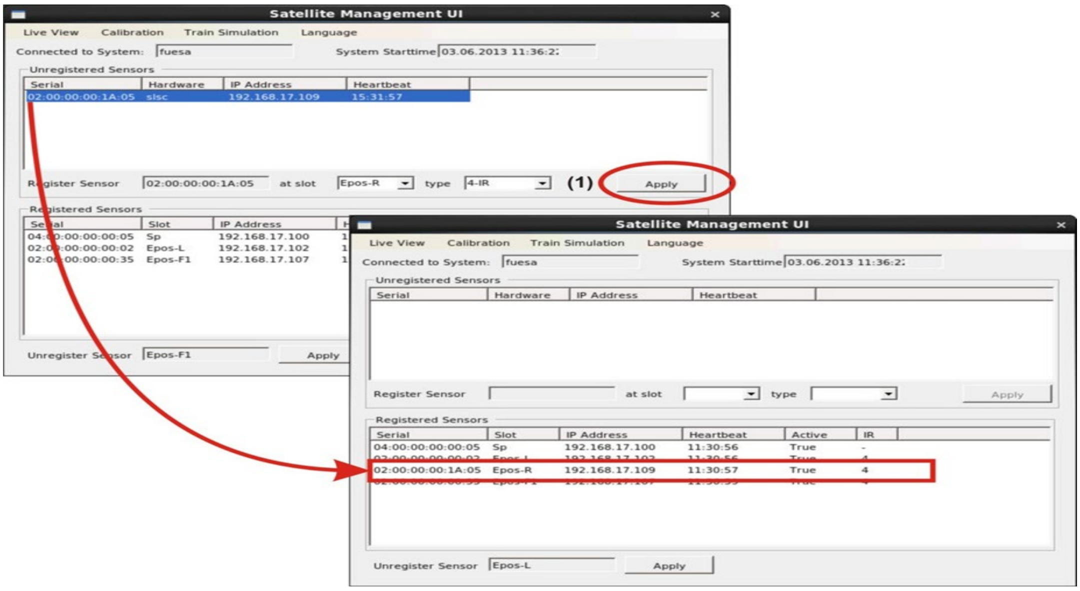


Figure 12 - Logging in the new EPOS-Unit

5.29 The new EPOS-Unit (SLSC module) is now registered in the FUES-EPOS system.

5.30 Check the connection status of the EPOS-Unit in the "Active" column. If "True" appears in this column, the connection is OK.

<u>Transferring calibration data of the new EPOS-Unit</u>

5.31 Open the EPOS configuration by double-clicking on the icon. The "EPOS configuration" window opens:

The following actions can be reproduced in the screen shown in Figure 13.

a) Click on the "Calibration" menu.

b) A pull-down menu opens.

c) Move the mouse pointer to the "Read Curve from Satellite" menu item.

d) A pull-down list for selecting an EPOS-Unit opens simultaneously.

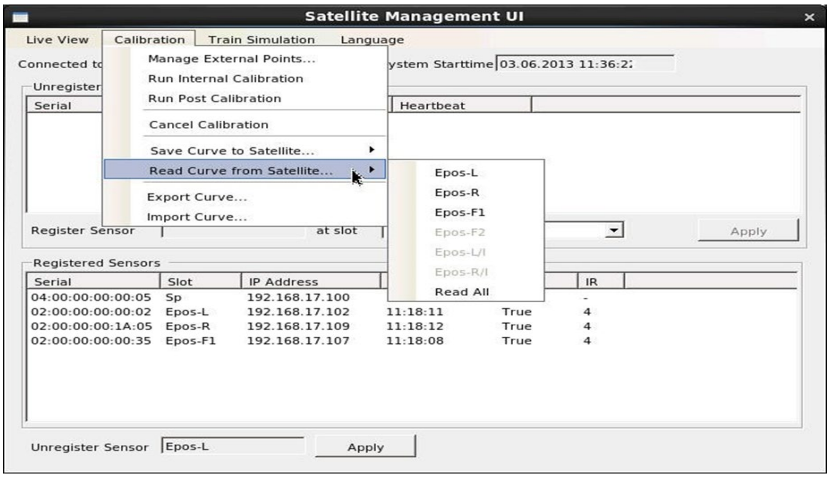


Figure 13 - "Internal Calibration" pull-down menu

5.32 Move the mouse pointer to the EPOS-Unit you want in the pull-down list and start the calibration data transfer with a mouse click.

The progress of data transfer is displayed.

Figure 14 - Data transmission progress display

All the calibration data of the new EPOS-Unit has now been transferred to the system database.

5.33 Carry out NR/SMS/PartB/Test/180 (EPOS - Manual Post Calibration Test).

6. Wheel sensor RSR123

6.1 Remove the wheel sensor in the following order:

a) Loosen connector flange and remove connection cable.

b) Mark the exact position of the rail clamp on the rail.

c) Dismantle the rail claw together with the wheel sensor from the rail.

d) Remove the fastening screws of the wheel sensor.

6.2 Re-installing the wheel sensor in the following order:

a) Attach the new wheel sensor to the rail claw.

b) Tighten the fastening screws according to the installation instructions for the wheel sensor manufacturer.

c) Screw the wheel sensor together with rail claw on the previously marked position on the rail.

d) Perform position control of the wheel sensor at the rail.

e) Re-mount the connection cable and the connector flange.

6.3 Carry out NR/SMS/PartB/Test/184 (EPOS – RSR123 Wheel Sensor Voltage Adjustment).

6.4 Carry out NR/SMS/PartB/Test/181 (EPOS - Wheel Sensor Occupancy Detection Capability Test).

END

1. Replacement Sequence

1. Before removal of the old circuit controller, check that the machine is placed into the approximate mid-stroke position.

2. Check that each wire is identifiable as it is removed. If this is not the case, check the installer correctly marks/identifies the unidentifiable wires as they are removed.

3. Check that the installer unlocks the two locking plates, removes the four bolts securing the machine and lifts the circuit controller clear of the machine.

4. Check that the installer removes the ballscrew cover and uses the datum marks on the machine driveslide, located under the ballscrew cover, to confirm that the machine is in mid-stroke (Figure 1).

5. Check that the installer identifies the space between teeth 16 and 17 of the toothed rack (counting from either end) and makes a mark from the rack to the edge of the case of the machine (which can be seen once the circuit controller is offered up).

6. Check that the installer inserts two new pushrods into the circuit controller with the step faces uppermost and the large washers outside the controller chassis.

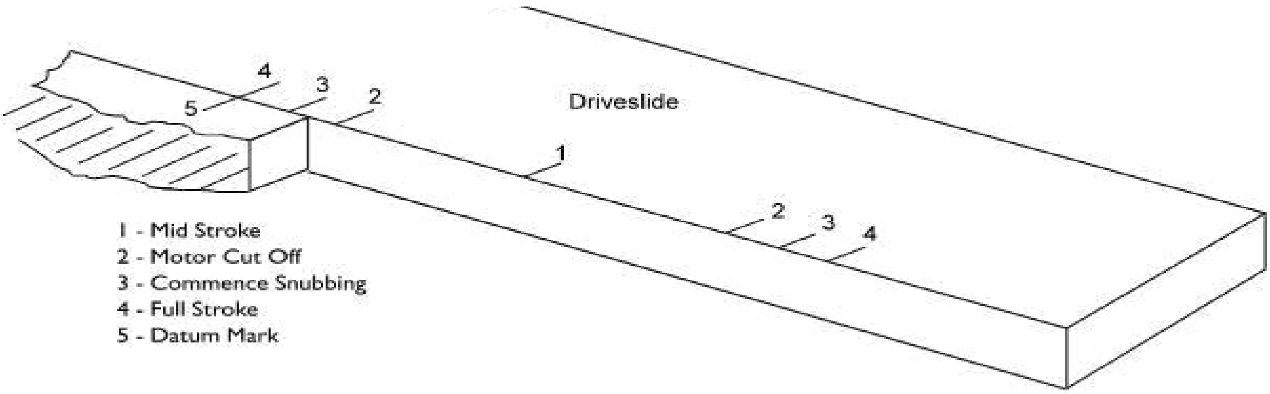


Figure 1 – Drive Slide Position Points

7. Check that the installer rotates the shaft on the controller.

__NOTE:__ the moulded arrowhead mark on the rim of the nylon gear wheel is positioned at 6 o'clock with the gear wheel just clear of the toothed rack.

8. Check that the installer inserts the two pushrod ends into their respective operating levers and moves the circuit controller sideways to compress the detector pushrod springs.

__NOTE:__ The moulded arrowhead mark on the gear wheel is directly above the marked space between teeth 16 and 17 on the rack.

9. Check that the installer lowers the controller onto its support pillars and replaces the four bolts using new locking plates.

10. Before the installer finally tightens the bolts, check that the moulded arrowhead mark on the gear wheel is aligned with the mark next to the rack.

    Check both the detector pushrods can be freely pushed into the circuit controller and that their return springs operate correctly.

    NOTE: *the pushrods sticking indicate improper alignment with the rotary lock detection segments. Remedy is by slacking off the four bolts and moving the circuit controller slightly sideways within the tolerance/clearance permitted between the four bolts and the holes in the circuit controller chassis through which they pass.)*

11. Check the installer tightens the bolts and turns up the locking plates.

12. Crank the machine to one end of its stroke and check that the pushrod roller is resting on the bottom of the detector blade notch, clear of the sloping cam face.

13. Insert 2mm gauge (Figure 2) between the roller and the bottom of the detector blade. Check the detection contacts just break. If necessary, adjust the nuts on the pushrod.

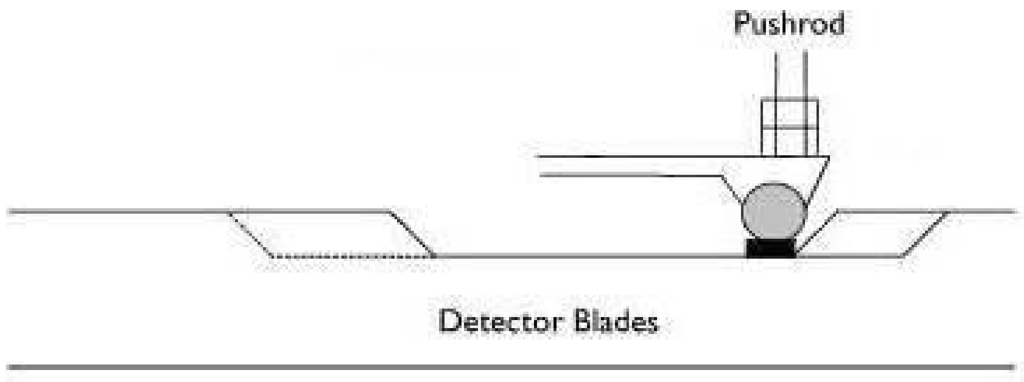


Figure 2 – Positioning of the 2mm Gauge

14. Crank the machine to the other end of its stroke and repeat steps 16 and 17.

15. Check that both nuts on each pushrod are fully tightened.

16. Crank the machine to mid-stroke.

17. Check the nominal 1mm gap on the quick acting motor cut-off contact (Figure 03).

18. If adjustment is required, loosen the 0BA nuts of the stud terminals and slide the moveable contacts as necessary.

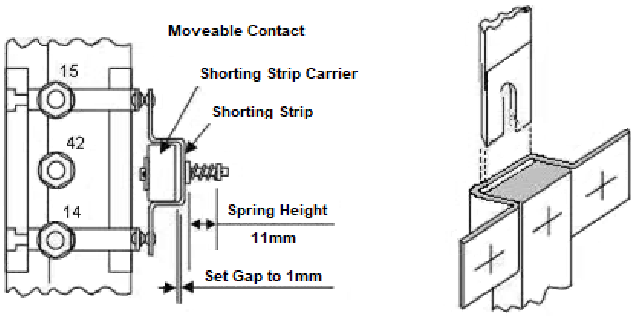


Figure 3 – Cut Off Motor Contact Details

19. Previous circuit controller changes have not always resulted in marks 2 and 3 on the driveslide of the machine being altered.

    However, the mid-stroke mark 1 is correct. The following process allows for the marks 2 and 3 not necessarily being in the correct place.

20. Check that mid stroke to motor cut-off (mark 1 to 2) is 93.5mm to 95mm and motor cut-off to snubbing (mark 2 to 3) is 1.5mm minimum to 3.0mm maximum.

    If the marks are incorrect, make your own marks with pencil or felt tip and use those marks in steps 21 to 24.

    Always crank the machine from mid-stroke towards the setting marks to eliminate gearing backlash.

21. Align mark 2 with mark 5. Check that the motor cut-off contact is just broken.

22. Align mark 3 with mark 5. Check that the snubbing control contact is just made.

    There should be a quarter to half a turn of the crank handle between the cut-off breaking and the snubbing contact making.

23. Check that the lock proving, and detection contacts do not make until 97mm from mid-stroke.

24. Check that the lock proving, and detection contacts are open at least 2mm throughout the whole travel.

25. Repeat steps 21 to 24 for the opposite lie of the machine.

    The detection on the machine is arranged so that the closed switch furthest from the machine is always detected by the roller/pushrod nearest the track, and vice versa

26. Crank the machine to the end of its stroke to close the switch furthest away from the machine. Check that the switch rails are fully closed.

27. Insert a 3.5mm gauge between the pushrod roller and the cam face of the detector blade notch (Figure 4). Adjust the ¾" nuts on the detector rod until the correct detector contacts are just broken.

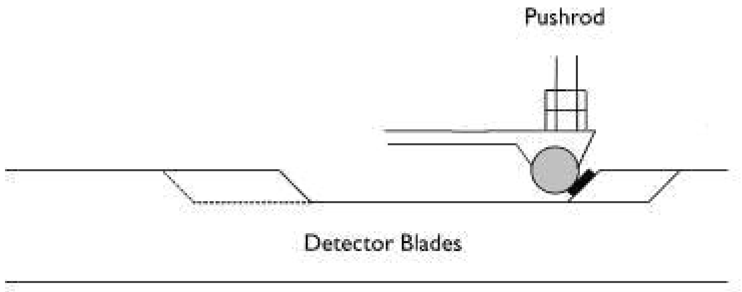


Figure 4 – Positioning of the 3.5mm Gauge

28. Substitute a 2mm gauge, and check that the correct detector contacts remain made.

29. Substitute a 5mm gauge and check that the detection contacts are open by at least 2mm.

No adjustment of the detection contacts is possible. A new circuit controller shall be fitted.

30. Crank the machine to the opposite end of its stroke. Check the switch rails are fully closed. Repeat steps 27 to 29 for the other pushrod and detector contacts.

31. Check that all relevant nuts are tightened and ballscrew cover replaced.

END

Includes:	Siemens TRAINGUARD FUTUR 2500 Series E Radio Block Centre (RBC) Cubicle
Excludes:	All other type of RBC/RBC Cubicles

GENERAL

Before undertaking any work within an existing/operational RBC cubicle, the Signaller needs to be informed before doing so.

The ESD wrist strap should be worn while carrying out tasks within the RBC Cubicle.

The integrated RBC system is housed in a cubicle with all the associated equipment (Figure 1).

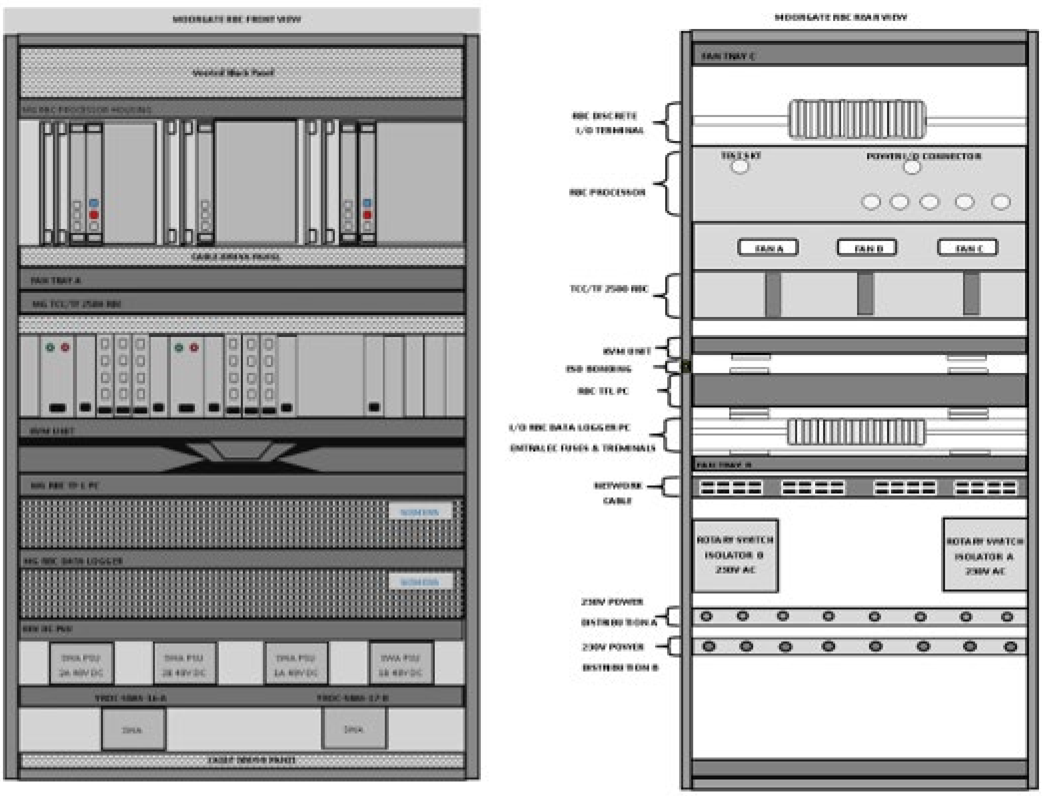


Figure 1 – RBC Cubicle Front and Rear

The TRAINGUARD FUTUR 2500 RBC cubicle is composed of the following elements:

Control Elements:

a) 1 RBC Processor MKII.

Cooling Elements:

a) 3 FAN Tray Modules (1 at the front; centre of the cubicle, 2 at the rear, one at the top, one at the bottom).

Maintenance Elements:

a) 1 KVM. The KVM is made up of:

- 1 KVM Switch.
- 1 KVM Rack Console

b) 1 Keyboard

c) 1 Patch Panel

d) Dual TCC Info - The TCC comprises two of each:

- Power Supply Unit.
- Processing Card.
- Quad Fast Ethernet Interface.
- Memory Card Carrier.
- ISDN Board.

e) RBC Common Technicians Facility (CTF) – Blue Chip C110 PC.

f) Dual Power Supply Unit (PSU) 48V.

g) 2 Network Switches (SWITCH A and SWITCH B).

h) Dual Power strip 230V AC PSUs – A and B supply.

i) 3 Fan Modules.

j) Moorgate RBC Data Logger PC Blue Chip C110.

RBC RIF:

The RBC-RIF is part of the WESTCAD-E(SS) architecture and is co-located in the ECML South Cubicle and includes the Temporary Speed Restriction (TSR) functionality.

The RBC-RIF will also handle the RBC arming process by passing indications to the Control Centre operator.

RBC Processor:

The RBC Processor is built on Ethernet IP Network (LAN/WAN). This provides flexibility to the system and an easy way to connect the RBC to other vital modules

KVM Switch:

The 'KVM Switch' interconnects the TCC with the 'KVM Rack Console' and the 'Keyboard'.

TCC :

The TCC receives messages from the RBC Processor through the Ethernet interfaces and sends them to the train through the ISDN module.

In addition, it receives messages from the train through the ISDN modules and transmits these messages to the RBC Processor using the LAN network.

The TCC comprises two of each:

- Power Supply Unit
- Processing Card
- Quad Fast Ethernet Interface
- Memory Card Carrier
- ISDN Board

The Server is dual-redundant (CPU A and CPU B), and it is fault tolerant.

Each CPU has got an ISDN Board mounted. "ISDN A" is housed in "CPU A" and "ISDN B" is housed in CPU B.

Common Technicians Facility

This is a local Technician's workstation comprising of a Blue Chip C110 PC loaded with the CTF software. The local TF application is automatically executed when the PC is turned on. The CTF is a diagnostic tool that offers the user fault indications of the system and replay functionality.

Check the name, the software version, the version of the resources and the active username appear in the frame of the main window.

Check the data base has an MDB format and belongs to the installation in which the replay is to be carried out.

Check the main window is configured by, the installation bar, the status bar, the mode selection bar, the replay bar, the action bar and the buttons. These bars enable access to the application functionality.

Power Supplies:

A Dual Power supply Unit (48V) is provided as a back-up to the RBC and Network Switches.

The cubicle is supplied by two 230V AC supplies. Each 230V supply comes into the cubicle via a rotary isolator switch. From the rotary switch, each supply feeds a 230V AC IEC Power Strip (Power Distribution A and B).

The 230V AC Supplies the TF, TCC, Fan Units and the PSUs. The PSUs transform/rectify the 230V AC voltage to 48V DC that supplies the RBC Processors and the Cisco Network Switches. To isolate the 230V AC equipment, the IEC C14 plug should be disconnected from the power distribution units as per application design.

CISCO 16 Port Network Switches SWA and SWB:

This connects with the RBC Cubicle and provides remote communication from YROC

Datalogger (Test tool)

A data-logger will be attached to the RBC via the Network Switches in the same cubicle. This is a test tool and no maintenance is needed to be provided.

NOTE: *When the RBC or CIP is powered down, the ETCS Enable button will need to be pressed as part of the arming process.*

This will be done as per instruction from the Signaller Shift Manager as part of the NCL RBC Start up Process - 156905-SIR-NOT-ESG-000001

END