Engineering Manual
Signalling and Control Systems

MN S 41604

Alstom ETCS Trackside Maintenance Manual

Version 1.0

Date in Force: 8 March 2019

Manual

Transport Sydney Trains

NSW GOVERNMENT

Approved by:	Stuart Tweedie A/Professional Head Signalling and Control Systems Engineering System Integrity	Authorised by:	Jonathon McKinnon Engineering Technical Publications Manager System Integrity

Disclaimer

This document was prepared for use by Sydney Trains or its contractors only.
All Sydney Trains engineering documents are periodically reviewed, and new editions are published, between editions, amendments may also be issued. It is the document user's sole responsibility to ensure that the copy of the document it is viewing is the current version including any amendments that may have been issued. Errors or omissions in this document should be reported to Sydney Trains.
Sydney Trains makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems or work or operation.

Document control

Version	Date	Author/ Prin. Eng.	Summary of change
1.0	8 March 2019	C. Darmenia	First issue based on TfNSW Alstom ETCS Trackside Maintenance Manual v2.0

Table of Contents

1 Introduction

ETCS trackside equipment from Alstom is being used to provide ATP functionality to the Sydney Trains rail network.

ETCS Level 0 trackside systems comprise of pairs of balises mounted on the track, for the purpose of providing a warning of any Big Metal Masses, for areas where ETCS fitted trains may operate over otherwise non-ATP fitted track.

ETCS Level 1 trackside systems primarily comprise of balises mounted on the track, balise junction boxes, Lineside Electronic Units (LEU's) and associated equipment, cabling between the balise and the LEU location and interface equipment between the LEU and the signalling system.

The LEU reads the information from the signal (interface between the signalling system and the LEU), and selects the correct telegram, according to the signal aspect and sends it to the 'controlled' balise.

'Fixed' balises contain fixed information such as track speed, gradients, etc.

When a train passes over a balise, the on-board system reads the telegram and the on-board computer (EVC) selects the information to be displayed on the Drivers (Driver Machine Interface) DMI, and appropriate braking reaction if necessary.

The procedures and processes described herein should only be carried out by qualified and authorised personnel who are familiar with the operation of the equipment.

2 Scope

This manual provides reference information and details how to carry out maintenance on ETCS Level 0 and Level 1 trackside signalling installations using Alstom equipment. It is applicable to all workers carrying out maintenance work at and near to ETCS equipment.

The procedures described in this document are specific to ETCS trackside signalling equipment and are to be adopted to inspect, isolate and repair an existing ETCS trackside installation.

The Signalling Safeworking Procedures set the safety requirements for maintenance actions.

This manual covers ETCS equipment mounted either on the track (in the four foot) or adjacent to the track, and ETCS signalling system interface equipment located at the signal location case or relay room. It does not cover train borne ETCS equipment.

Note: Refer to the M05-500 series of standard drawings within the virtual plan room for applicable hardware version numbers and Sydney Trains maintenance stock codes of operationally critical items of equipment.

2.1 Purpose

The purpose of this manual is to describe the maintenance, faulting and failure rectification of ETCS track mounted and trackside equipment.

2.2 Application

Where this manual does not address complex situations or where circumstances arise, causing doubt as to whether this manual satisfactorily controls the risk, the matter shall be referred to the Professional Head Signalling and Control Systems.

Caution: ATP equipment is Safety Critical Signalling Apparatus.

3 Reference documents

T HR SC 00003 ST	ETCS Standard Circuits (SG0602001)
T HR SC 00001 ST	Typical Circuits
PR S 41605	Alstom ETCS Trackside Equipment Set to Work Testing & Commissioning Manual
MN S 41607	BEPT G3 User Manual
SRA M05-500 to 599	ETCS Trackside Standard Drawings
PR S 45005	ETCS Data Management
	AMS Trackside Network Architecture Description
MN S 41611	Alstom - Micro-COBALT, Micro-coder and ALIS User Manual
MN S 41606	Alstom - Compact Eurobalise - Installation Constraints
MN S 41612	Alstom - Cobalt Micro-Coder and MIPS Mounting Instructions
PR S 41015 FM 123	(Balise) Site Certification Form template (SCF)
	RS900 User Manual
PR S 41015 FM124	ETCS IDF1 - ETCS Installed Data Form - Balise
PR S 41015 FM125	ETCS IDF2 - ETCS Installed Data Form – LEU Configuration Key
PR S 40004	Signalling Safeworking Procedure - Failures
PR S 40011	Signalling Safeworking Procedure - Renewals Work
PR S 40028	Signalling Safeworking Procedure - ATP Alstom ETCS Trackside Equipment
PR S 40032	Signalling Safeworking Procedure - Solid State Interlocking (SSI) and Smartlock 400T
PR S 47110	Inspection and Testing of Signalling
PR S 47113	Inspection and Testing Principles
PR S 47114	Inspection and Testing Procedures
PR S 47118	Typical Signal Support Procedures for Trackworks
SPG 0706	Installation of Trackside Equipment Construction Specification

4 Terms and definitions

The following terms and definitions apply in this document:

Anchor	A stainless steel female threaded device fixed into the concrete track sleeper or slab for the purpose of using a threaded bolt to secure an item to the track
AMS	Advanced train control Migration System
ASA	Asset Standards Authority (a division of TfNSW)

ASDO	Automatic Selective Door Operation (utilising the ETCS system)
ATP	Automatic Train Protection (utilising the ETCS system)
Balise	Alstom Compact Eurobalise (also known as a transponder)
Balise ID Plate	Identification name plate fitted to each balise (engraved circular plastic disc)
Balise Junction Box	Trackside ETCS junction box (JB)
Balise Location ID Plate	Identification name plate fitted to the track adjacent to each balise (rectangular stainless steel plate)
BEPT	Balise and Encoder Programming Test tool
Big Metal Mass (BMM)	A metal mass of sufficient size to directly impact on the on-board antenna self-test function, leading to an EVC system failure
BOL	Band of Lights
BRM	Balise Reference Mark (electrical centre of balise)
CAN	Condition Affecting the Network
CBI	Computer Based Interlocking
Contact Sensing	LEU inputs are detected from a relay contact
Controlled Balise	A track mounted ETCS transponder which includes a cable connected to an LEU
CRC	Cyclic Redundancy Checksum
Current Sensing	LEU inputs are detected from an in-line connection with the signal lamp
DMI	Driver Machine Interface. It is located in the train drivers cabin and used to display ATP information to the driver
EBI	Emergency Brake Intervention
ECR	Lamp proving relay
EoA	End of Authority
ETCS	European Train Control System (a specific type of ATP).
ETCS Balise Tail Cable	A cable between the balise and the balise junction box.
ETCS Level 0 (L0)	The ETCS application level used on unfitted or uncommissioned lines
ETCS Level 1 (L1)	The ETCS application level that uses balises to send information to trains, and which is overlaid on the pre-existing signalling system
ETCS Level 2 (L2)	The ETCS application level that uses radio to transmit movement authorities and other information to trains, and uses pre-existing signalling system methods to determine trains' positions
ETCS Tail Cable	A one or two pair cable between the ETCS LEU location and the balise junction box
EVC	European Vital Computer (on-board)
Fixed Balise	A track mounted ETCS transponder that does not include a cable to the LEU

Fuse/Fusing	In the context of this document, the term 'fuse' or ‘fusing’ can refer to a surge protection device for power or a software safety fuse within the Alstom LEU which permanently locks out (inhibited state) the LEU from working
Gold Key	A special LEU configuration key used to de-pair the key pairing configuration i.e. the pairing between the key and the LEU
HMI	Human Machine Interface
JDRMDR	Juridical Data Recorder Maintenance Data Recorder
JRU	Juridical Recording Unit
LEU Output	A single pair (Flamex) cable between the LEU output and the transient
Cable	protection/isolation device (located at the LEU location)
LED	Light Emitting Diode
LEU	‘Lineside Electronic Unit’. The term LEU is a generic descriptor. Alstom’s LEU product is the Cobalt ‘Micro-Coder’
LEU Configuration Key	Alstom device which contains the LEU configuration data.
LSp	Low Speed
Metronet	A Digital Train Radio System (DTRS) track mounted transponder Transponder
Micro-Coder	The name used for the LEU from Alstom
MIPS / MIPS200	Alstom Micro-Coder power supply unit (PSU). Also known as MIPS200 (200ms holdup time)
M_MCOUNT	Message Counter (8 bits). This enables detection of a change of balise group message
PPT	Programming Preparation Tool (computer application)
RIM	Railway Infrastructure Maintainer (Sydney Trains)
SBI	Service Brake Intervention
Spreader Beam	A mounting system for a balise using a glass fibre resin insulated beam fixed between rails (brand name Vortok)
TFM	Trackside Functional Module (SSI)
TMP	Technical Maintenance Plan
TSW	Temporary Speed Warning (balise group)
VRR	Trainstop Reverse Relay

5 ETCS Trackside Equipment Information

For the purposes of distinguishing between ETCS equipment mounted on the track and at the LEU location, the terms track mounted equipment and location equipment are used in this document.

5.1 ETCS Track Mounted Equipment

This section of the manual covers specific items of ETCS equipment which are mounted either on the track (in the four foot) or adjacent to the track, as follows:

- Balise: Alstom Eurobalise - yellow (Part No. TRVP061381000),
- Balise: Alstom Eurobalise - light grey (Part No. DTR0000273037),
- Vortok "on-sleeper" spreader beams
- Vortok Universal type “between-sleeper” spreader beams
- Balise ID (identification) plate,
- Balise location ID (identification) plate,
- Balise junction box,
- ETCS balise tail cable - 6m (Part No. DTR0000250635),
- ETCS balise tail cable - 12m (Part No. DTR0000250636),
- ETCS tail cable (two pair and one pair versions)
- ASDO Calibration Balise Marker Plaque

5.1.1 Balises

The Alstom balise can be used as either a controlled balise or a fixed balise. A balise becomes a controlled balise by the addition of a cable interface between the balise socket and a nearby LEU. If a balise is used as a fixed balise, the electrical socket must be fitted with a cover to prevent dust and water ingress.

Balises are bolted down in the four foot and are light grey in colour.

Some yellow coloured balises might be installed, although grey balises are much more common. Both yellow and grey are acceptable. Eventually both the yellow and the grey coloured balises will become darkened from ballast dust, coal dust, etc. over time. Colour fading and build-up of surface dirt does not require the balise to be replaced.

Figure 1 - Alstom Grey Balise

Figure 2 - Identification of Balise Serial Number and Version (Revision)

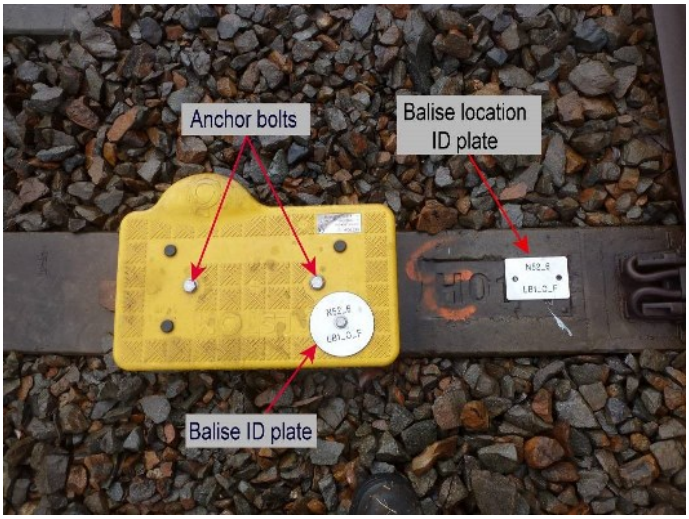


Figure 3 - Alstom Fixed Balise Mounted to a Concrete Sleeper Showing ID Plates

Note: ETCS balises are distinguished from Metronet transponders by their distinctive shape and size. Metronet transponders are smaller and oval in shape. Refer to photo below.

Figure 4 - Metronet Transponder with Base Glued to a Concrete Sleeper

5.1.1.1 Balise Operation

The balise is a track mounted device that does not transmit data in the absence of a train antenna, however as a train's antenna passes over it, the antenna induces enough downlink energy into the balise to enable the balise to send information up to the same train antenna (uplink).

When placed on top of a balise, the Balise and Encoder Programming Test tool (BEPT) (see Section 10) also operates in a similar manner as the train's antenna but at much lower energy levels.

Note: There is no data transmitted from the train to the balise.

Caution: Train antenna systems (ETCS and Metronet) must be powered down before accessing underside of train.

Each balise has a default telegram stored in its internal memory. This is the only telegram sent by a fixed balise, and is the telegram sent by a controlled balise when the LEU / balise interface is faulty or disconnected.

5.1.1.2 ASDO Balise Operation

Some balises incorporate Automatic Selective Door Operation (ASDO) functions.

ASDO balises, in conjunction with the onboard ASDO equipment fitted to specific trains, will permit only those doors which are on the platform to open. This allows passenger trains with power doors to be used safely on platforms which are shorter than the trains.

Only New Intercity Fleet (NIF) stopping pattern platforms will be fitted with ASDO balises. Some platforms may not be fitted with a calibration balise depending on the design requirement.

For each direction of travel, ASDO trackside system consists of a:

- Platform Information BG (consists of two balises) on approach to the platform.

- Calibration BG (consist of one balise) at a defined distance from the Car Marker for the longest stopping train.

The calibration balise position along the track is critical to the correct functioning of ASDO. An ASDO Calibration Balise Marker Plaque is fitted on the platform vertical surface at the design position in order to aid the maintainer in checking that the calibration balise is aligned within tolerance. A specific laser tool shall be used (placed on the rail) to check the balise alignment.

Refer to section 5.1.2.5 for information on the ASDO identification plate and plaque.

5.1.2 Balise Mountings And Fixings

Other than for direct fixing (see Figure 9), balises are screwed to their Vortok beam using two M12 hex head screws and either a 10 mm spacer (for use with Universal beams) or a load distribution plate (for use with FastClip and eClip beams). Serrated washers are used under the bolt heads. It is important to check that the washer is in place when removing or installing the balise hold-down bolts.

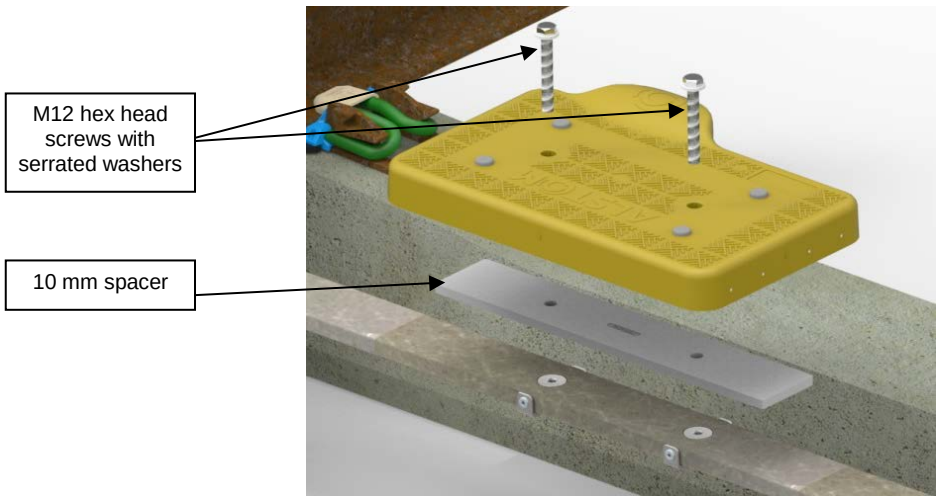


Figure 5 - Balise Installation
(Showing Spacer for Use with Universal Beam)

The majority of balises are installed using Vortok spreader beams. There are two categories of Vortok spreader beams for the mounting of balises:

- On-sleeper beams, and
- Universal beams (installed between sleepers).

A small number may be directly fixed to sleepers as shown in Figure 9 further below.

Caution: Beams must be properly secured at both ends to prevent them coming loose and being damaged by passing trains.

5.1.2.1 On-Sleeper Beams

The majority of ETCS balises will be installed using on-sleeper beams. On-sleeper beams are available to suit the following rail fixings:

- eClip, and

- FastClip

Figure 6 - Balise Mounted on a Vortok eClip Beam

When disturbing an eClip, always check that the plastic biscuit is not damaged or missing. Replace any missing or damaged biscuits before fitting Vortok beam.

Figure 7 - Balise Mounted on a Vortok FastClip Beam

When disturbing a FastClip, always check that the plastic tip is not damaged or missing. Replace any missing or damaged tips before fitting Vortok beam.

Caution: Rail clips must only be installed or removed using the correct designed tool. Gloves and eye protection are to be worn when installing or removing on-sleeper beams. eClips may become dangerous projectiles if not installed or removed correctly.

Figure 8 - Using a Pandrol Pulling Tool for FastClips

On-sleeper beams use the standard rail fixing clips to secure the beam to the track. Where a Benkler Joint is installed at guard rails using eClips fit the appropriate colour eClips that are supplied with the Benkler Joint kit (blue for insulators with concrete sleepers and brown for base plates with timber sleepers).

A clip puller/insertion tool(s) must be used to remove and install the clips. Details of part number for Pandrol Tools are as follows:

- Installation Tool Wide FastClip – Part No: RTFC PP140157
- Extraction Tool Wide FastClip - Part No: RTFC PP140164
- Installation Tool Narrow (ARTC) FastClip - Part No: RTFC PP140142
- Extraction Tool Narrow (ARTC) FastClip - Part No: RTFC PP140143
- Installation / Extraction Tool eClip - Part No: RTE PP140036)

Wide FastClips are normative on Sydney Trains passenger lines, however narrow FastClips exist at some locations, particularly ARTC interfaces.

Sydney Trains stock codes for critical equipment are shown on the applicable M05-500 series standard drawings.

5.1.2.2 Direct Fixing

Balises may be directly fixed to sleepers in areas where Vortok beams would not be suitable or practical, e.g. on some slab track or in tunnels.

Figure 9 - Balise Mounted Directly Onto a Sleeper

When installing a direct fixed balise, always check that the serrated washers are fitted. Replace any missing washers before fitting balise.

5.1.2.3 Universal (Between Sleeper) Beams

Balises mounted on Vortok Universal type spreader beams (between sleeper) will generally only be applicable to temporary installations such as for Temporary Speed Warnings (TSWs). Spreader beams may sometimes be used for a permanent balise mounting where other balise mounting methods are unsuitable e.g. on slab track where there may be a dish drain down the centre of the four foot.

Figure 10 - Balise Mounted on a Vortok Universal Type Spreader Beam

5.1.2.4 Balise Identification (ID) Plates

A balise ID plate is an identification name plate made of plastic construction, fixed to each balise using an M8 stainless steel bolt. Refer to drawing M05-546 for balise ID plate manufacturing details.

A balise location ID plate is an identification name plate made of stainless steel construction, fixed to the track adjacent to each balise in accordance with drawings M05-524 and M05-544.

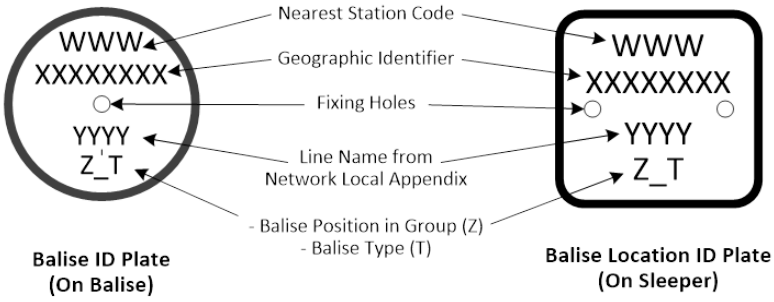


Figure 11 - Balise ID Plates

5.1.2.5 ASDO Calibration Balise

The ASDO calibration balise is identified by means of an additional circular ID plate on the balise, as shown in Figure 12 below.

Figure 12 – ASDO Calibration Balise ID Plate

Refer to the Signalling Plan for details of what should be written on each balise ID plate and balise location ID plate.

5.1.2.6 ASDO Calibration Balise Marker Plaque

The ASDO Calibration Balise Marker Plaque is fitted on the platform vertical surface to identify the exact design position of a ASDO calibration balise. The marker plaque is of a similar size and material as the standard survey plaque. There are two versions available, a horizontally mounted version for platforms on legs, and a vertical version as shown in Figure 13 below.

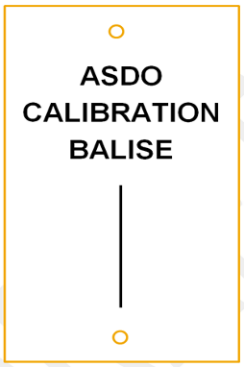


Figure 13 – Example ASDO Calibration Balise Marker Plaque

5.1.3 Alignment of ASDO Calibration Balise with Marker Plaque

A laser tool is available in order to transfer the vertical line (on the platform mounted plaque), to the nearest running rail. The tool consists of a standard COTS battery operated builders cross hair laser, fixed to a short section of aluminium angle.

Instructions for using the tool include for a quick calibration check before use, and will be included on the applicable M05-500 series manufacturing drawing. A brief description of how to use the tool is included in the following paragraphs.

Note: If bright sunlight causes difficulty in observing the laser line, the target area should be shaded with the hand etc.

5.1.3.1 Calibration Check:

A pre-use calibration alignment check is required before each measurement transfer. An alignment check requires the tool to be held firmly against the smooth outer face of each rail (not running faces), so that it is parallel with the rail.

The pre-use alignment check is carried out as follows, the user shall:

1) place the laser tool against one rail,

2) turn on the laser,

3) mark the rail via the slot in the laser tool angle as well as the opposite rail where the beam strikes it,

4) move the laser tool to the opposite rail so that it is centred over the previously marked rail (with the beam projecting towards the opposite rail) and

5) check if there any offset between the previously marked rail and the beam

Note: If the offset is more than the value specified (on the applicable M05-500 series drawing), then the tool will need to be returned for repair. If the tool cannot be repaired or replaced immediately, the tool can still be used, by taking the known offset into account.

5.1.3.2 Measurement Transfer Procedure:

Usage of the tool for measurement transfer requires it to be held firmly against the smooth running face of the nearest rail, so that it is parallel with the running rail.

The user shall:

1) slide the tool along the closest rail until the projected vertical line is in alignment with the vertical line on the target plaque

2) mark the rail head by means of a notch in the aluminium angle; this mark on the rail is the exact perpendicular centre position of the ASDO Calibration Balise BRM along the rail

5.1.4 ETCS Cables

Controlled balises are connected to an LEU via a dedicated cable. To cater for the various environments and use of the cable, the cable is separated into three different sections and corresponding cable types as shown in Figure 14 below:

- The LEU output cable (Type A or B) is a short 'internal' single pair flexible cable inside the location where the LEU is situated, from the LEU to the cable terminations.
- The ETCS tail cable (Type C) is a 1 or 2 pair 'external' cable between the balise and the LEU location.
- The ETCS balise tail cable (Type D) is a relatively short single pair 'external' cable between the balise and the balise junction box, which is located next to the track at the balise location.

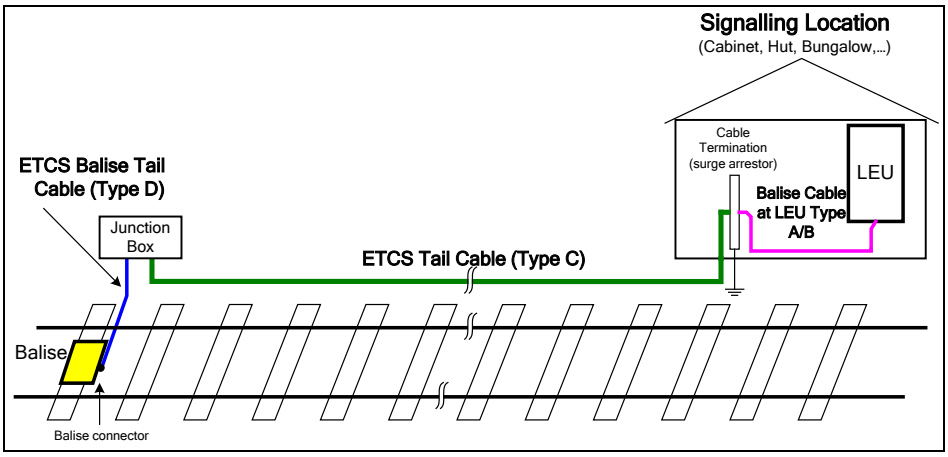


Figure 14 - Different Types of Balise Cables

5.1.4.1 ETCS Tail Cables (Type C)

An ETCS tail cable is a one or two pair cable which connects the balise junction box to the LEU location, via enclosed cable route. Both types of cable are armoured.

The cable does not require a plug on either end as it is terminated in a conventional manner in the balise junction box and the LEU location.

The maximum permitted length of the approved tail cables for the Alstom compact balise is 1000m.

5.1.4.2 ETCS Balise Tail Cables (Type D)

An ETCS balise tail cable is an armoured, single twisted pair cable which connects the balise junction box to the balise. The tail cable is run within orange PVC flexible conduit (see drawings M05-509 and M05-510).

The ETCS balise tail cable is usually a pre-assembled cable with a plug on one end. Pre-assembled cables are available in standard lengths of 6m and 12m (refer to standard drawing M05-510 for part numbers and details), which will suit the majority of situations however, occasionally a longer cable might be needed.

The maximum permitted length of a balise tail cable is 30m. A cable exceeding 12m in length up to a maximum of 30m, is not available as a pre-assembled item, and is cut from a roll of cable and requires a balise plug to be fitted (refer to standard drawing M05-552 for details).

Figure 15 - Typical Balise Tail Cable, Surface Laid Inside a PVC flexible conduit

Figure 16 - Balise Tail Cable Plug with SAIB Locking / Unlocking Key

5.1.5 Balise Junction Boxes

A balise junction box is a small cable termination housing typically mounted on a post adjacent to the site of a controlled balise, and connects the ETCS balise tail cable to the ETCS tail cable. The balise junction box is secured using a Falcon 8 padlock.

The above ground balise junction box is manufactured and assembled to standard drawing M05-511, examples shown in photos below.

The below ground (tunnel) style balise junction box is manufactured and assembled to standard drawing M05-567.

Figure 17 - Above Ground Balise Junction Box on a Standard Post.

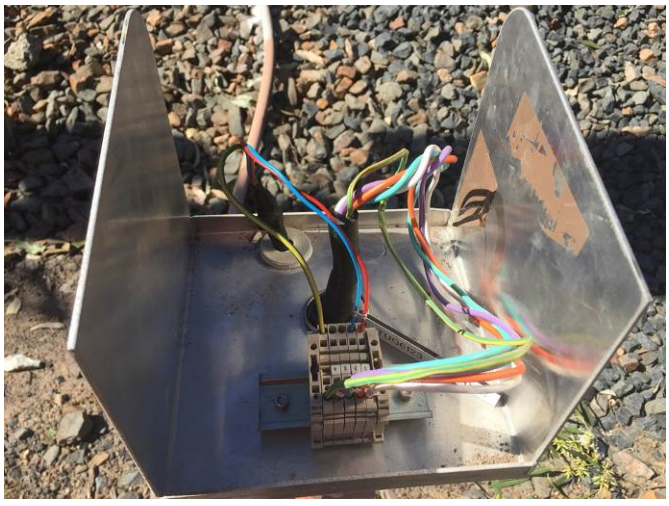


Figure 18 - Above Ground Balise Junction Box with Lid Removed.

5.1.6 Balises at Guard Rails

Balises located within guard rails require a special mechanical isolation joint to be installed in each guard rail adjacent to the balise. This product is described as an 'ETCS mechanical isolation joint'. The ETCS mechanical isolation joint used at these locations is a modified insulated Benkler joint as detailed in drawing M05-558.

Some rail plate designs are common to both the guard rail and the running rail (e.g: Delkor style ALT1). Note that the guard rail is insulated from the running rail. In the case of the Delkor ALT1 plate, the guard rail is insulated from the plate by means of plastic pads and plastic biscuits.

Refer to standard drawing M05-558 for additional information regarding balise mounting at guard rail locations, and ETCS mechanical insulation joint details.

5.1.7 Temporary Speed Warning (TSW) Balises

A TSW balise group is located at Temporary Speed Restriction warning sign(s) (i.e. the sign with the blue light). The TSW balise group consists of two fixed balises in order to provide the applicable directional functionality to a train. It is therefore critical that the pair of balises on the track are in the correct order for the direction of running.

TSW balise groups are installed and removed by Sydney Trains Civil/Track discipline and it is important that a damaged balise group is reported to ICON Infrastructure.

TSW balises must not be confused with other ETCS balises, which will all have white coloured balise ID plates. The TSW balise ID plates are distinctly colour coded, as follows:

- Blue balise ID plate for first TSW balise of the group, and
- Amber (yellow) balise ID plate for the second TSW balise of the group positioned along the track in the normal direction of running.

These colours match the Temporary Speed Sign coloured lights in the same direction.

TSW balises are fitted to the track using a Vortok Universal spreader beam mounting system (see Section 5.1.2.3, and refer to standard drawing M05-565 for assembly, placement and fitment details).

5.2 ETCS Location Equipment

This section of the manual includes for the ETCS signalling system interface equipment located at the signal location enclosure, as follows:

- LEU - Alstom Micro-Coder (see section 5.2.1.4 for applicable part numbers),
- LEU configuration key (Part No. TRVP066233000),
- 120Vac / 24Vdc power supply - Alstom MIPS200 power supply (Part No. DTR0000252238),
- 150 ohm resistor (contact sensing locations only),
- Terminals (isolation, fuse, bypass, earthing),
- Network interface equipment (where fitted),
- LEU output transient protection module,
- 120V EMC filter module (locations including current sensing),
- Toroidal transformer 120V/12V (contact sensing locations only.

LEU equipment may be located within existing signalling locations (huts, buildings, location cabinets) or in small cabinets known as ETCS annexe cabinets (a compact custom enclosure which houses only ETCS equipment, and not relays).

ETCS annexe cabinets are secured using a Falcon 4 padlock.

ETCS annexe cabinets contain an LED strip light mounted vertically, typically down the right hand side. These are controlled by a door operated micro-switch, but may also include an ON/OFF switch. The switch on the light fitting should be left in the ON position when leaving the site.

5.2.1 Lineside Encoder Units (LEUs)

5.2.1.1 General Information

One LEU corresponds to the ETCS equipment used for one signal. The LEU and its signalling interfaces consist of the following:

1 or 2 LEU modules (or exceptionally 3), indicated as LEU-A and LEU-B (and possibly LEU-C).

1 or 2 MIPS PSU's (or exceptionally 3). There is 1 MIPS for each LEU module (the LEU is powered by a MIPS200 power supply to be able to guarantee a 200ms uninterrupted power hold up time). This is normally indicated as PSU-A and PSU-B, corresponding to LEU-A and LEU-B respectively.

Input interface circuits:

- Isolation terminals,
- Toroidal transformer (contact sensing only),
- Power resistors (150 Ohms, contact sensing only),
- Bypass terminals (current sensing only).

Output interface circuits:

- LEU output cable (Flamex). Refer to standard drawing M05-542 for details,

- Transient protection/isolation module,
- Tail cable leaving the LEU location into the field to the balise junction box.

LEU configuration key attached with cord.

Network interface:

- Network cable(s): in case of two LEU modules: directly between the modules. Refer to drawings M05-527 for details,
- Network switch: only used for networked LEU's (or in case of three LEU modules per signal). Refer to drawings M05-527 for details.

Other equipment:

- Earthing/braids,
- ID plates (labels).

Refer to the Circuit Design Standards T HR SC 0001 ST, T HR SC 0003 ST and SG0602001 for the generic wiring details. Refer to the ETCS standard M05-500 series of drawings for repair/replacement details.

Figure 19 - 2 LEUs (2 MicroCoders and 2 MIPS200 PSUs) Installed in a Location

5.2.1.2 LEU Interfaces

Refer to Figure 20 and Table 1 below for a description of the Alstom LEU Micro-Coder external features:

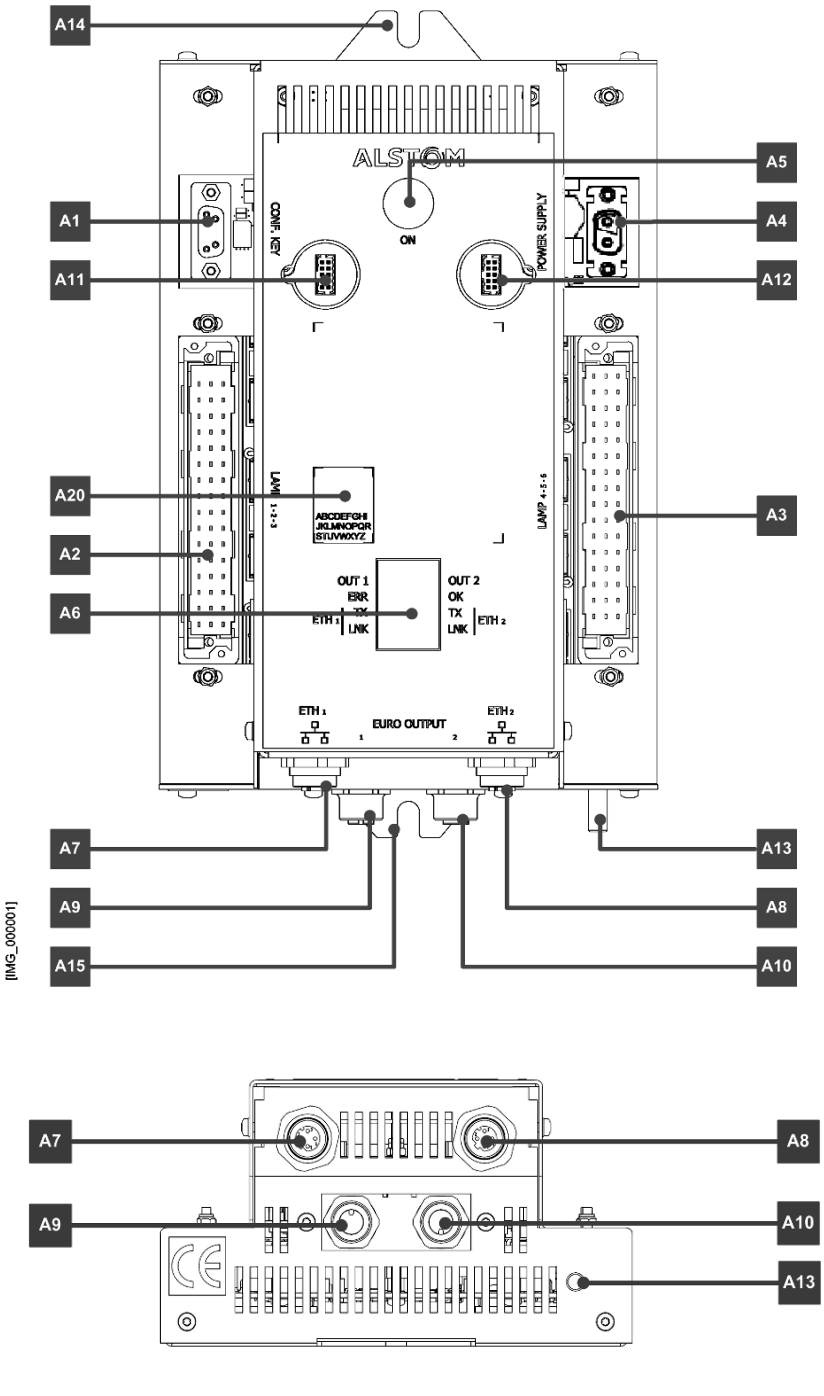


Figure 20 - LEU Interfaces

Note: Refer to Legend in Table 1 below.

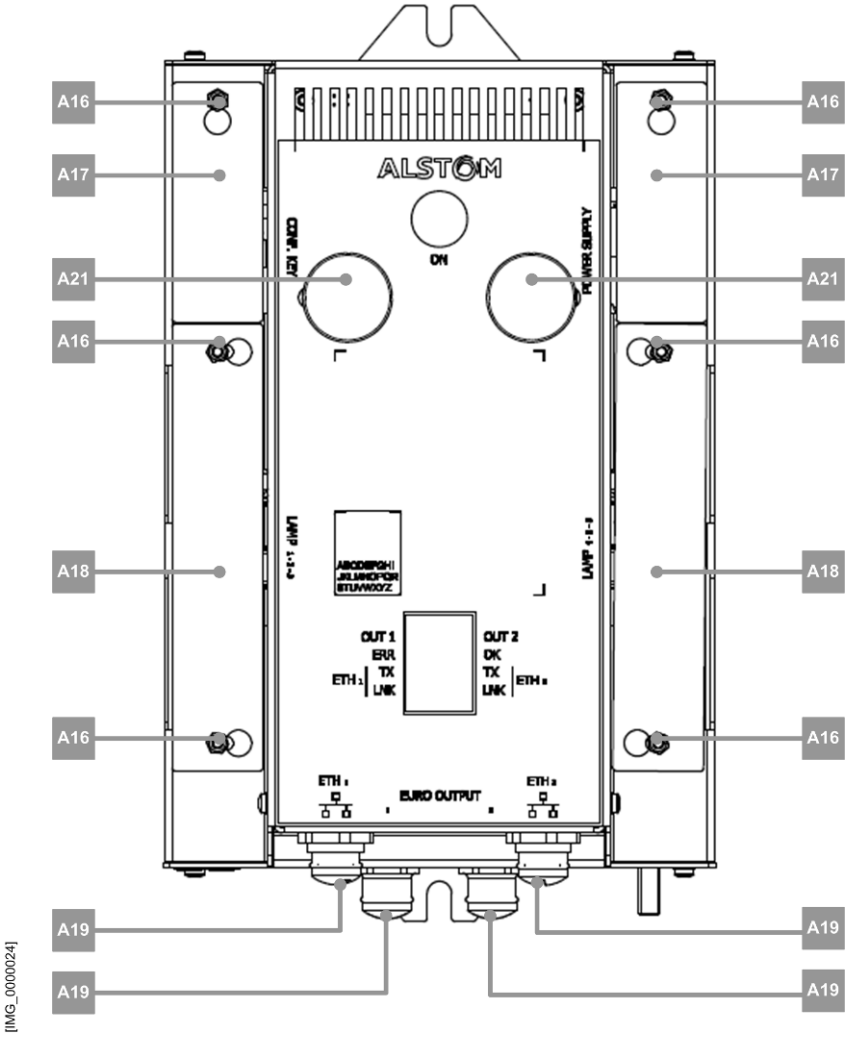


Figure 21 - LEU Interfaces – Part 3

Note: Refer to Legend in Table 1 below.

Label	Description
A1	LEU configuration key (Sub-D9)
A2	LEU vital plug coupler - Lamp inputs (F48) 1, 2 and 3
A3	LEU vital plug coupler - Lamp inputs (F48) 4, 5 and 6
A4	Power supply connector (Sub-D2)
A5	Power supply status
A6	LEU status window (example display shown)
	Ethernet link (M12-D)- ETH1 (Reserved for BEPT)
A8	Ethernet link (M12-D)- ETH2
A9	Eurobalise output (M12-A) – Number 1
A10	Eurobalise output (M12-A) – Number 2
A11	JTAG connector (HE)- Channel A (not used)
A12	JTAG connector (HE)- Channel B (not used)
A13	Ground/Earth stud
A14	Mounting bracket
A15	Mounting bracket
A16	Screw for cover retention
A17	Power supply & LEU configuration key connector's cover
A18	Lamp input connector's cover
A19	Ethernet and balise connector's caps
A20	Product label
A21	JTAG connector's cover

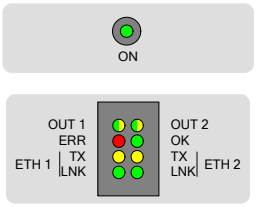


Table 1 - LEU Interfaces – Legend

Note: Connector ID's in brackets are as identified in circuit books.

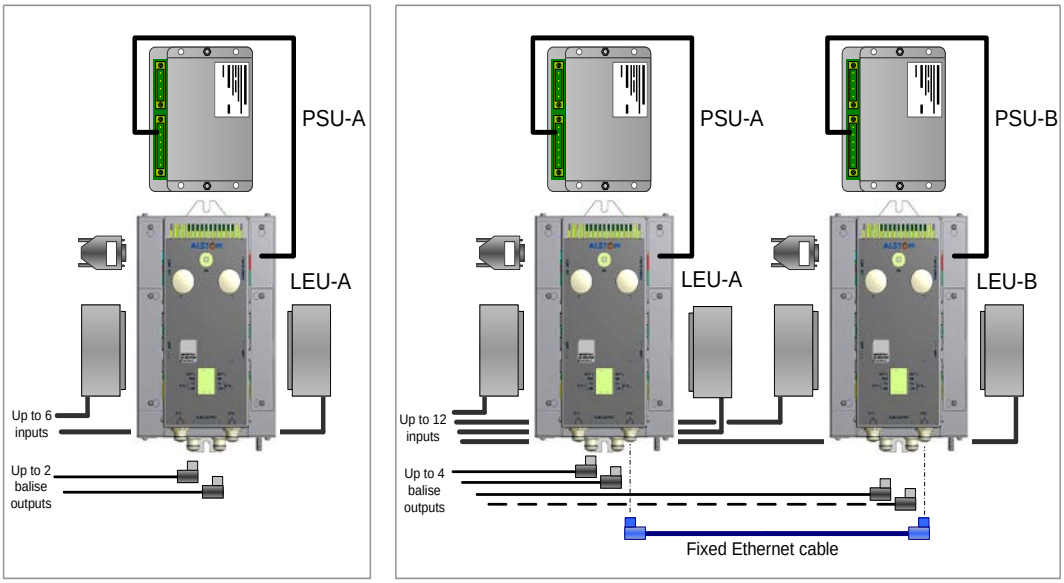
Refer to the standard circuits for the generic wiring details.

Refer to the ETCS standard M05-500 series of drawings for repair or replacement details, in particular, drawings:
M05-525, M05-527, M05-528, M05-529, M05-530, M05-531, M05-532, M05-533, M05-536, M05-538, M05-542, M05-549, M05-556, M05-557 and M05-560.

Caution **The LEU shall not be submitted to strong magnetic fields. Permanent magnets, including magnetised tools, shall be kept at a distance of at least 200mm from the LEU.**

5.2.1.3 Common LEU Configurations

The LEU configurations for LS use mostly one or two LEU's per signal as shown below:



Configuration using a single Micro-Coder

Configuration using two Micro-Coders

Figure 22 - Common LEU Configurations

The LEU measures the currents at its inputs by means of Hall Effect sensors to derive the status of the signalling installation. The status plus additional fixed data is compiled into telegrams that are selected and sent to the controlled balise(s) in the four foot. The telegram from the LEU and the telegram from the fixed balise are separate. When a train reads all the telegrams, this makes up a complete message.

5.2.1.4 LEU Identification

Earlier versions of LEU's are identified by both hardware and software (firmware) versions. More recent versions are identified by a single version letter (see Note 1)

LEU part numbers and versions which have been type approved are detailed in Table 2 below. Later versions may also be type approved.

Alstom Part Number	Hardware Version Letter	Software Version Number	Version
DTR2000003567 (See Note 1)	N/A	N/A	B
DTR0000245619 (See Note 2)	U	V431	N/A
DTR0000245619 (See Note 2)	T	V431	N/A
DTR0000245619 (See Note 2)	S	V431	N/A

Table 2 - Approved LEU Part Numbers and Versions

Note 1: Alstom part number DTR2000003567 incorporates both hardware and software. A separate hardware label DTR0000245619 and software label V431 may also

be included. If either the hardware or the software changes, the version letter will change.

Note 2: Part number DTR0000245619 is hardware only, with software identified separately.

Refer to the photo below for details of identification of LEU ID stickers.

Note: Some LEU's have two hardware part numbers labels (see Figure 23 below). If this is the case, then the label with the Part Number DTR2000003567 is the later and is the label to use. In this example, Serial Number is: 62 and Version is: B.

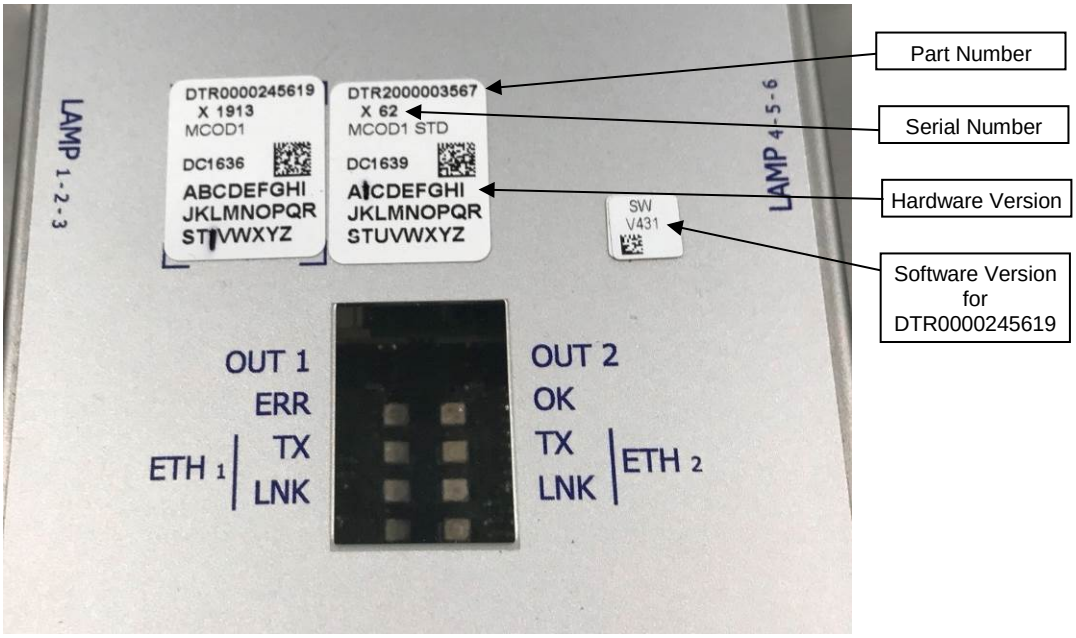


Figure 23 - Identification of LEU Models and Versions

5.2.1.5 LEU Indications

The LEU "Power ON" indicator LED is located on the upper half of the front panel. The HMI window, on the lower half of the LEU front panel, uses 8 indicator LED's. In normal operating conditions, the LEU shows the following typical or normal LEU indications:

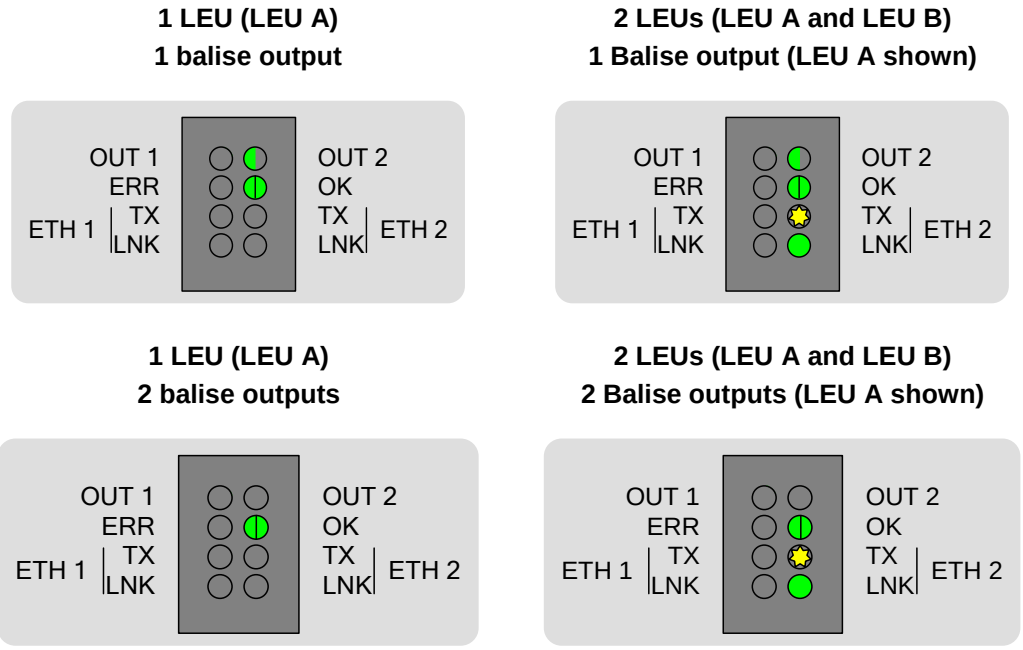


Figure 24 - LEU Indications in Normal Operation

Further information on interpreting these indications and identifying errors is in Section 8.2.3 of this document.

5.2.2 LEU Output Transient Protection

LEU output transient protection is provided at the interface where the LEU output cable changes to the external tail cable (within and towards the base of the LEU location enclosure). This device is kept as close as practical to the tail cable entry point in order to minimise any coupling effect between the tail cable and other components within the cabinet. The transient protection module is pluggable enabling LEU output isolation.

The transient protection module is the Elsafe type 216680 cassette (graphite in colour).

Figure 25 - Elsafe Transient Protection Cassette and Base

Refer to standard drawing M05-531 for product details.

Pigtails or unnecessary bends on the tail cable armour drain wires terminated at the transient protection are to be avoided and wires to be kept as short as practical.

Refer to Appendix C for LEU output transient protection device test procedure.

When isolating the LEU from the controlled balise, it is not necessary to power down the LEU.

5.2.3 LEU Configuration Keys

The LEU configuration key is a small 'dongle' like device with a DB connector, which contains the site specific configuration data for the LEU to function correctly.

Figure 26 - LEU Configuration Key Showing Tether Cord

The LEU reads the LEU configuration key content at start up, checks the parameters, downloads the data and 'pairs' with the LEU configuration key (see below) if there are no errors.

The LEU configuration key is provided with a short tether cord. The purpose of the tether cord is to avoid misplacement of the LEU configuration key.

The tether cord must be tethered at a permanently fixed point near to the LEU and not on the LEU. The tether point must be located such that the key cannot be plugged into a wrong LEU.

5.2.3.1 LEU Pairing

A safety code called a CRC (Cyclic Redundancy Checksum) is computed every time an LEU configuration key (or balise) is programmed. The LEU is paired with the LEU configuration key data CRC at start-up (if it hasn't already been paired). Where an LEU has already been paired with an LEU configuration key with different data, the LEU configuration key data CRC will not match that on the LEU, and the LEU will not be able to re-start, and will go into 'boot failed' mode, and the controlled balise, will send a default telegram.

An LEU that has previously been paired with a different LEU configuration key, will need de-pairing using a Gold Key (see Section 5.2.3.1 below).

LEUs supplied by Alstom (Micro-Coders) will be supplied unpaired (even after repair).

Caution **If an LEU configuration key containing different data is inserted, and the LEU is not re-booted, the LEU may continue to function until the first power interruption, at which point the LEU will go into "Boot Failed" mode.**

In addition to the start-up pairing mechanism, an LEU module also detects a change of configuration key during normal operation. This check is carried out every 10 minutes. In case of a failure (the LEU configuration key has been unplugged or its content has changed), the user is warned by the way of the LEU indications (see Section 8.2.3.4), but the LEU module will remain operational. If the LEU configuration key is then plugged back into the LEU module, the failure indication will not change (only a module reset will reset the indications).

5.2.3.1 Gold Keys

LEU's (and balises) are programmed by means of the Balise and Encoder Programming Test tool (BEPT). Each BEPT kit includes a Gold Key.

A Gold Key is an LEU configuration key with special data that instructs the LEU to de-pair. The Gold Key is a similar physical part to the LEU configuration key, except that it is programmed with special data.

Figure 27 - LEU Gold Key, Showing Label and Storage Box

Refer to Section 9.2.2 for de-pairing procedure.

Refer to standard drawing number M05-562 for Sydney Trains stock code for the Gold Key.

5.2.4 LEU Interfaces

The two main LEU interfaces are:

- LEU / signalling interface (LEU input), and
- LEU / balise interface (LEU output).

The LEU / signalling interface can be configured in two ways. These are described as:

- 'contact sensing' (sensing of a fixed resistor load switched via a relay contact).
- 'current sensing' (direct lamp load current sensing).

Note: Some LEU's may contain a combination of contact and current sensing inputs.

5.2.4.1 Contact Sensing Inputs

Contact sensing is where the LEU input is connected to relays located at the signal control relay location. Spare volt free contacts are used to provide the LEU inputs.

Where the signalling interface is via relay contacts, an external resistor is provided to convert the external voltage (nominal 12Vac) into a current when the relay contact is closed.

Contact sensing is not compatible with solid state switched outputs of certain CBIs (such as SSI and Westrace). Some CBI interlockings (Microlok in particular) have a relay output interface and therefore are compatible with contact sensing.

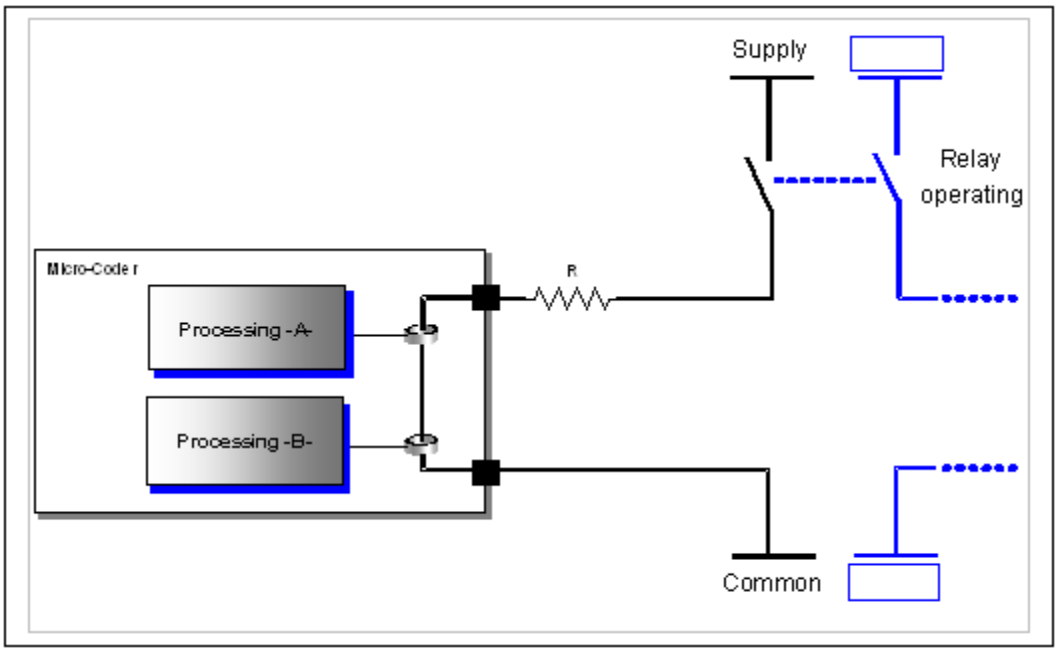


Figure 28 - Contact Sensing Generic Configuration

The LEU reads the signalling information via the contacts of the signalling relays by means of an auxiliary a.c. supply (BX12/NX12; the actual voltage can vary between 11V and 15V depending on primary voltage and load) and series resistors of 150 Ohms resulting in an input current when operating normally of about 90mA (between 65 and 115 mA is acceptable). Such installations can be readily recognised by the presence of the toroidal transformer(s) and the resistor holders (see photos below).

The transformer input and output terminals are isolatable and are provided with banana jacks for voltage measurement purposes (see Figure 29). The transformer has two separate parallel connected windings on the primary and secondary.

For normal operation, ensure that all transformer isolator terminals are fully pushed in.

Refer to standard drawing M05-531 for transformer product details.

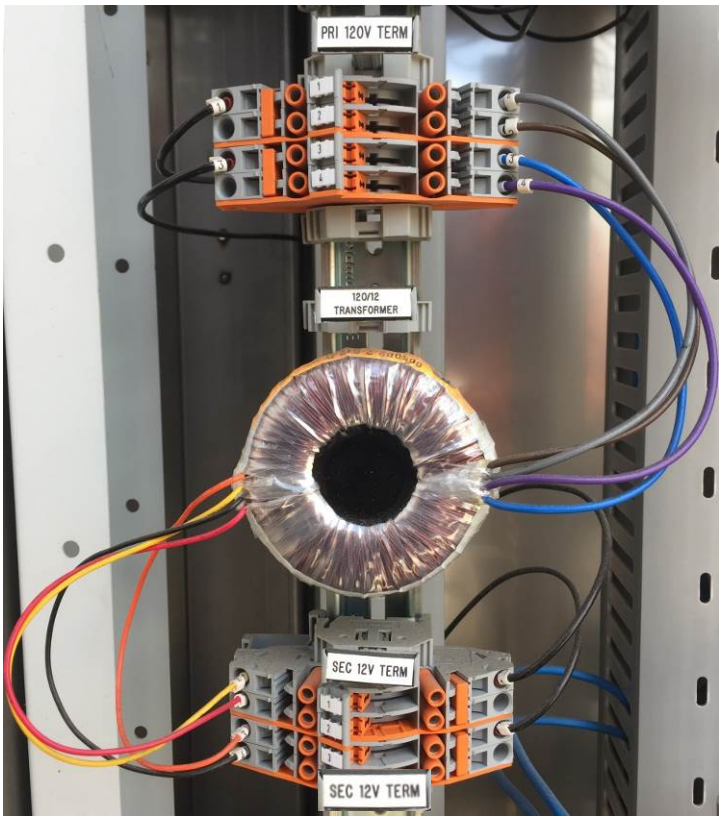


Figure 29 - Toroidal Transformer Installed In Location

Figure 30 - Detail of 150 Ohm Resistor Module

5.2.4.2 Current Sensing Inputs

Current sensing (also sometimes called lamp sensing) of signal lamps can be used to provide an input to the LEU for SSI type interlockings (SSI, Westrace, Westlock and Smartlock), where the lamps are usually directly driven.

The LEU current sensor is placed directly in line with the circuit to the signal lamp and monitors the actual current drawn by the lamp (irrespective of whether the interlocking intended to generate the aspect).

The current depends on the lamp type (LED, SL35, etc). These installations can be recognised by the absence of the toroidal transformer, the absence of resistor holders and the presence of bypass terminals. See example of bypass terminals (white isolator tabs) in the photos below:

Figure 31 - Example of LEU Bypass Terminals

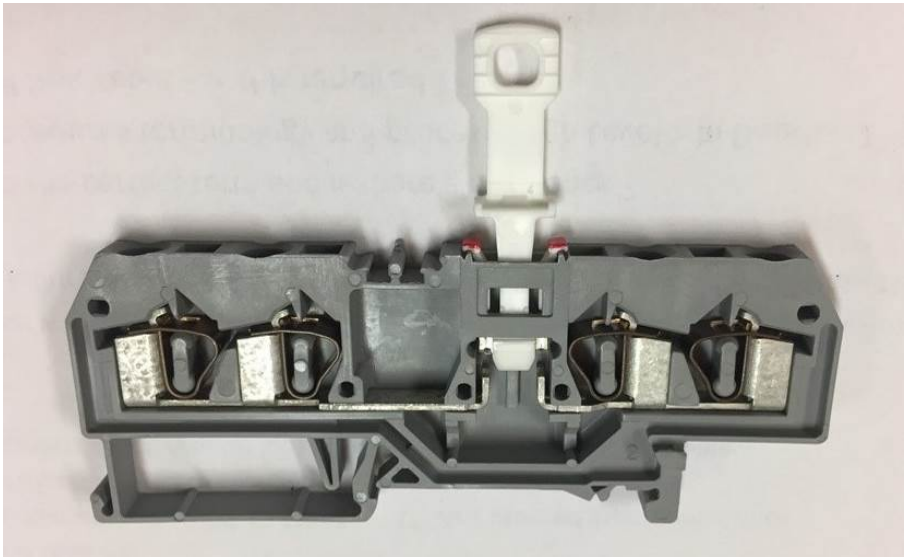


Figure 32 - Detail of LEU Bypass Terminal

Caution
With current sensing installations, the signal indications could be affected if the bypass terminals are operated incorrectly when the LEU is unplugged. Refer to Section 9.2.3.2 for replacement procedures.

Note 1: In the case of SSI, the bypass terminals are normally located close to the TFM rather than located at the LEU.

Note 2: The Alstom Micro-Coder LEU is not presently approved for use with DC lamp loads in the Sydney Trains environment.

Note 3: Mixed installations (current and contact sensing) may exist at the boundary of a current sensing and contact sensing area. Occasionally there could be situations where the same LEU uses contact sensing on some inputs and current sensing on others.

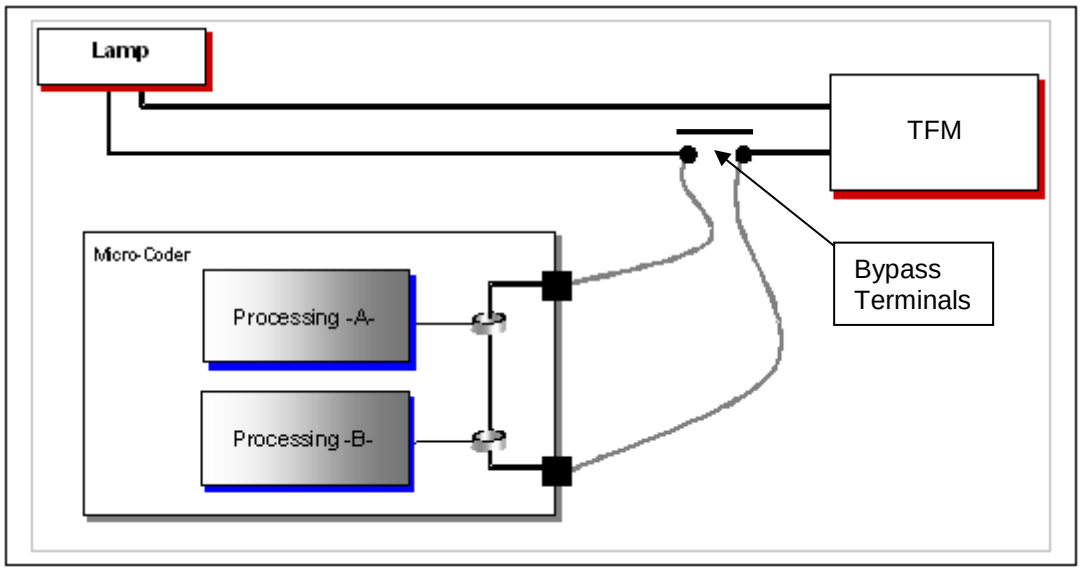


Figure 33 - Current Sensing Generic Configuration

5.2.5 ETCS Power Supplies

5.2.5.1 120V Power Supply

The LEU and associated equipment are powered from the signalling floating 120Vac supply. The expected voltage range for the nominal BX120/NX120 supply is between 105Vac and 127Vac however, the ETCS Level 1 equipment is able to operate in the range 96Vac to 132Vac.

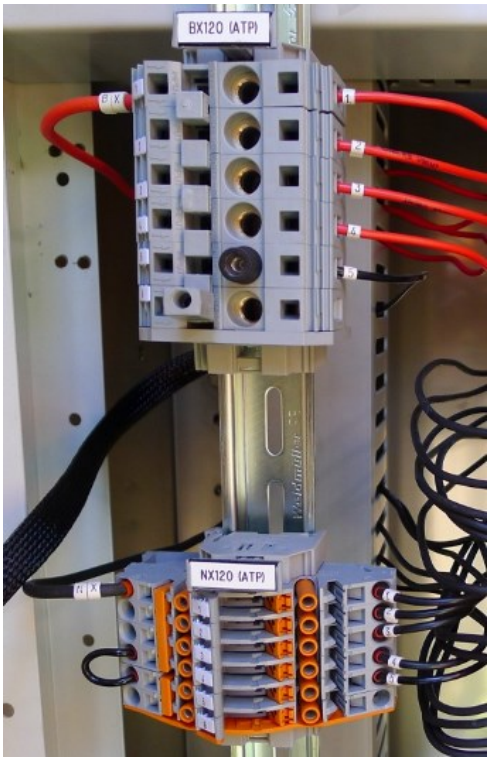


Figure 34 - Example of BX/NX120 Fuse and Terminations

Power supply terminals are provided with banana jacks for voltage measurement purposes.

Isolation of individual circuits is achieved by opening the appropriate NX120 isolator and removing the BX120 fuse.

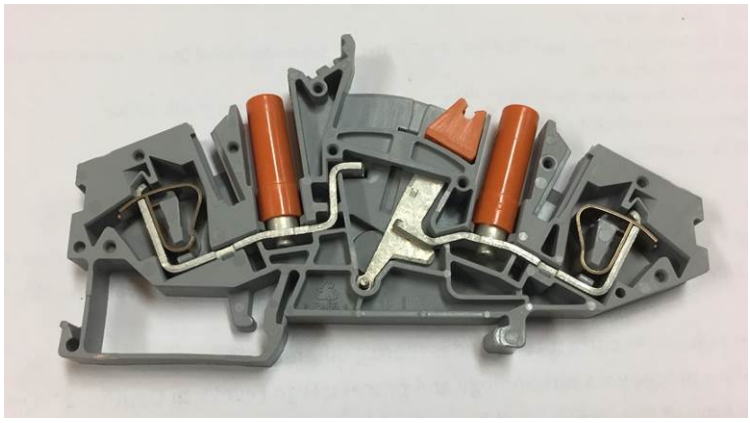


Figure 35 - Detail of NX120 Isolation Termination showing Banana Jacks

5.2.5.2 24Vdc Power Supply

The MIPS200 is a regulated power supply provided by Alstom to power the LEU.

The MIPS200 is also suitable for powering 24Vdc Ethernet equipment such as the RS900 Ethernet switch. One MIPS200 can power both an LEU and an RS900 simultaneously.

The MIPS200 has a small LED between its two power connectors. This LED is ON (green) when the nominal 120Vac power is available at its input. See section 8.2.5.

The expected output voltage range for the MIPS200 power supply is 24Vdc with dynamic voltage regulation limits constrained to +/-2V. In practice, a voltage variation of less than +/-0.5V is expected.

Note: The LEU can operate in the range of 18Vdc to 36Vdc.

A MIPS200 will draw between 12 to 18W per LEU module depending on how many balises are connected.

For details of the 24Vdc output power cable and wired connections, refer to standard drawing M05-520.

For details of the 120Vac input power cable and wired connections, refer to standard drawing M05-522.

Figure 36 - MIPS200 Power Supply

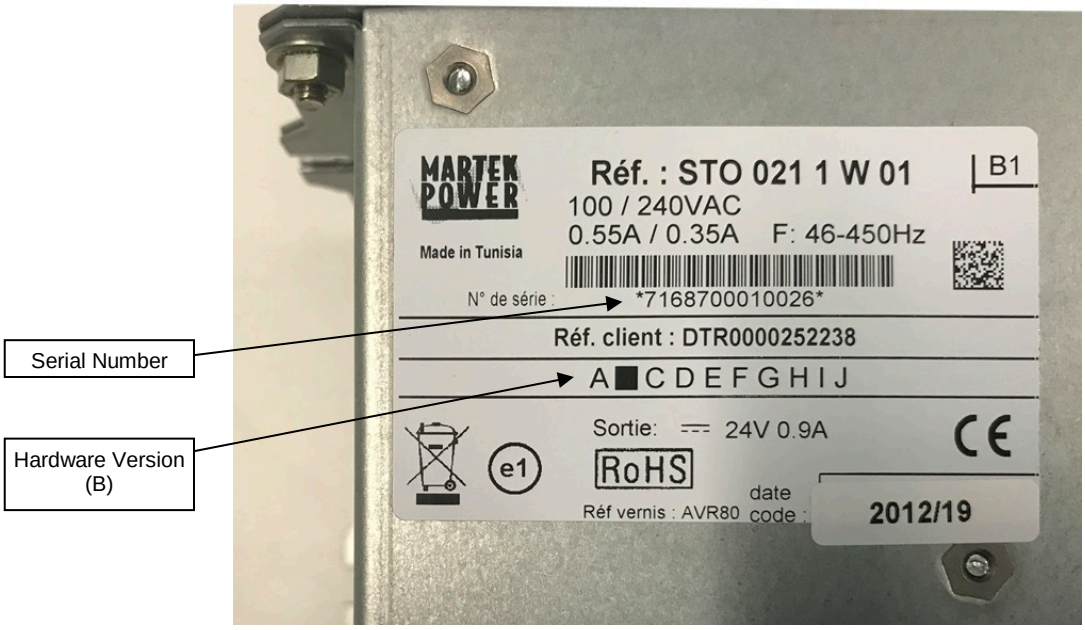


Figure 37 - MIPS200 Power Supply Serial Number and Hardware Version

For details not covered by this manual, refer to the '*Alstom - Cobalt Micro-Coder and MIPS Mounting Instructions*' manual.

5.2.5.1 Power Supply 120Vac Input EMC Filter Module

A Schaffner electromagnetic noise filter module must be fitted to the MIPS200 input at all LEU locations incorporating current sensing. This includes MIPS200 power supplies used in contact sensing areas, but which are on the same 120V feeder that has an LEU with current sensing.

Refer to drawings M05-531 and M05-563 for materials details.

Note: It is not practical to functionally test a power filter module in the field.

Figure 38 - 120/24V Schaffner LEU Power Supply Filter Module

5.2.5.1 120V Power Transient Protection

A transient protection module is provided at the signalling 120V supply to the ETCS location equipment.

Where the existing signalling location 120V bus (to which the LEU equipment has been connected) has not been fitted with transient protection, the DEHN type DRMOD-150 (red in colour) module is normally retro-fitted. Refer to standard drawing M05-560 for product details.

For an ATP annexe mounted on the side of an existing location case or relay room, the 120V transient protection module is located within the existing location case / relay room. For an ATP annexe or new location case mounted remotely from the source of the 120V supply, the 120V transient protection is mounted within the new ATP annexe / location case.

The DEHN type 120V transient protection device has a colour indicator bar showing green if the module has not failed. Replace the module if the indicator bar has changed to red or the module is short circuited between line to line or line to earth.

Figure 39 - 120V Transient Protection - Colour Indicator Bar Showing Green (OK)

5.2.6 LEU Networking

LEU's connected together (using the Ethernet 2 port) will be on an isolated network, and will use IP addresses in the private range.

5.2.6.1 Physical and MAC Layers

The LEU Ethernet physical and Medium Access Control (MAC) layers use the "Ethernet II" protocol. Data rate is 100 Mbit/s in full duplex with auto-negotiation capability to support 10 Mbit/s traffic.

5.2.6.2 IP Network layer

The Alstom Micro-Coder LEU uses IPv4 for its IP network layer.

Ethernet port 1 of the LEU is used for connection with the BEPT, Ethernet port 2 is used for networking.

The IP address of LEU Ethernet port 2 is set during the data preparation process and will be included in the LEU configuration key data. When an LEU is replaced, the IP address is set once the new LEU pairs with the existing LEU configuration key.

The IP addresses for the LEU Ethernet 2 ports as well as for the RS900 Ethernet switches where used, are configured from within the range 192.168.11.1 to 192.168.20.253, i.e. 10 consecutive subnets, each subnet containing 254 addresses, (except for the last subnet, see below).

Port 1 (BEPT connection):

All LEU Ethernet 1 ports shall be configured using the same IP address: 192.168.20.254.

Port 2 (LEU to LEU or RS900 connection):

LEU Ethernet 2 ports shall be configured with the following IP addresses:

- LEU module 'A' IP address: 192.168.11.1
- LEU module 'B' IP address: 192.168.11.2
- LEU module 'C' IP address: 192.168.11.3 (if required)

Notes:

- IP addresses ending on 0 and 255 are reserved and shall not be used.
- For 2 LEUs – networking is via a type J cable only – see Figure 43 and ETCS standard circuit SG0602001 – Sheet 32.
- For 3 LEUs – networking is via an RS900 interface – see Figure 46 and ETCS standard circuit SG0602001 – Sheet 33.
- For look-ahead – networking is via an RS900 interface – see Figure 47 *and ETCS standard circuit SG0602001 – Sheet 34.*
- *Refer to AMS Trackside Network Architecture Description for further details.*

Caution: If the Ethernet 1 ports of two LEUs are connected together, this will cause the LEUs to 'fuse', i.e. fail due to an IP address conflict.

5.2.6.3 RS900 Ethernet Network Switch

Some ETCS locations may include Ethernet networking equipment, where more than 2 LEUs are required at one signal, and for look-ahead in SSI interlocking type (current sensing) areas.

A RuggedCom RS900 Ethernet network switch is used with the Alstom LEUs. The RS900 does not need to be managed or configured for the ATP point to point (Look-ahead) applications.

For look-ahead, the LEU Ethernet 2 ports at the look-ahead signal shall be configured with the following IP addresses:

- LEU module ‘A’ IP address: 192.168.11.4 (look-ahead LEU)
- LEU module ‘B’ IP address: 192.168.11.5 (if required)
- LEU module ‘C’ IP address: 192.168.11.6 (if required)

RS900 Ethernet switches always use the default IP address: 192.168.0.1

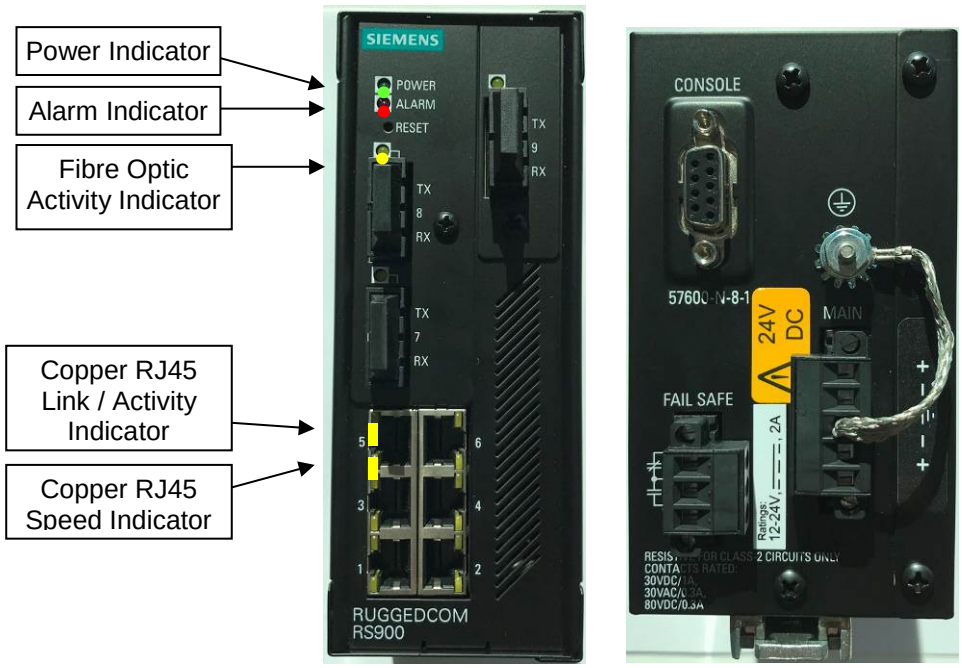


Figure 40 - RS900 Ethernet Network Switch - Front and Rear

5.2.6.4 RS900 Indications

In normal operating conditions, the RS900 shows the following typical or normal indications:

LED	State	Description
Link/Activity	Green (Solid)	Link established
	Green (Blinking)	Link activity
	Off	No link detected

Figure 41 - Explanation of RS900 Fibre Optic Activity Indicators

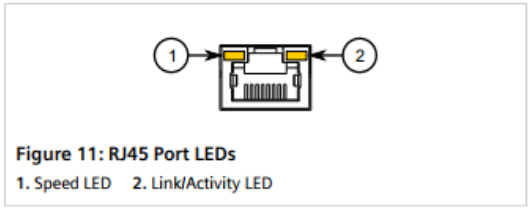


Figure 11: RJ45 Port LEDs
1. Speed LED 2. Link/Activity LED

LED	State	Description
Speed	Yellow	The port is operating at 100 Mbps
	Off	The port is operating at 10 Mbps
Link/Activity	Yellow (Solid)	Link established
	Yellow (Blinking)	Link activity
	Off	No link detected

Figure 42 - Explanation of RS900 RJ45 Activity Indicators

Further information on interpreting these indications and identifying errors is in Section 8.2.4 of this document.

Refer to specification drawing M05-527 for cabling/wiring general details.

Notes:

- The annexe cabinet or wall mounting plate equipment mounting options includes space allocated in the centre of the mounting plate (just below the LEU's) for possible future Ethernet networking equipment in the form of the RS900 Ethernet 'switch'. Refer to drawings M05-528 and 530.
- The annexe cabinet has free space allocated on the left hand vertical side for a future networking communications splice/patch panel (optical interface). Refer to standard drawing M05-536, and
- The annexe cabinet is provided with a short, capped-off buried cable conduit for future below ground communications cable access. Refer to standard drawing M05-536.

5.2.6.5 Two LEU Configuration

Installations with two LEUs utilise a local Ethernet cable between them. See below.

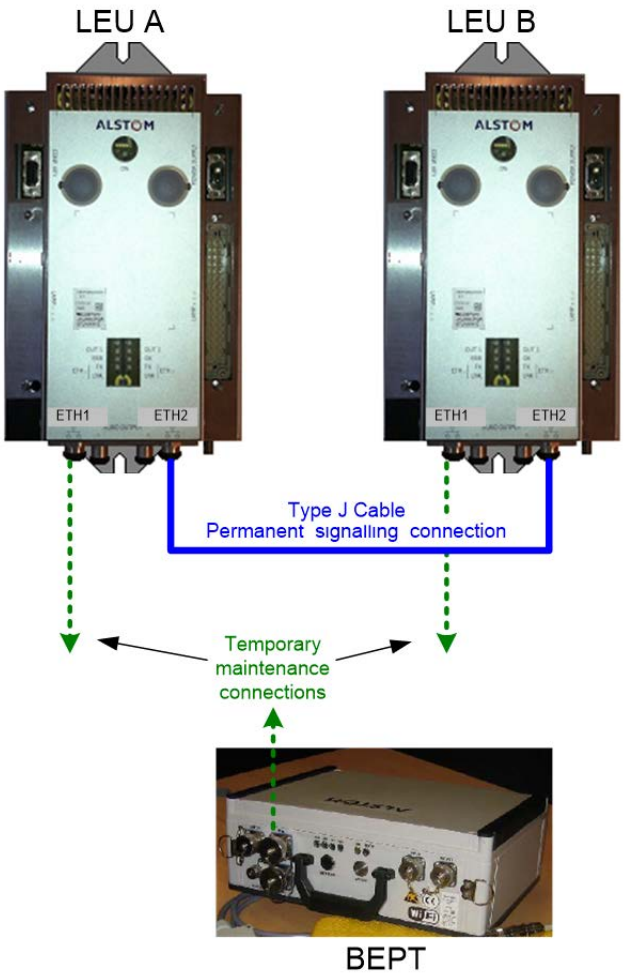


Figure 43 - Network Architecture for 2 LEU Configuration

In the above contact sensing example consisting of two LEU's, shunt routes will only be detected and the corresponding telegram transmitted by LEU A if the corresponding input information from LEU B is received via the local network connection (a cable in this case).

If Ethernet network data is used for telegram selection, a failed network will result in the default telegram being sent to the 'controlled' balise.

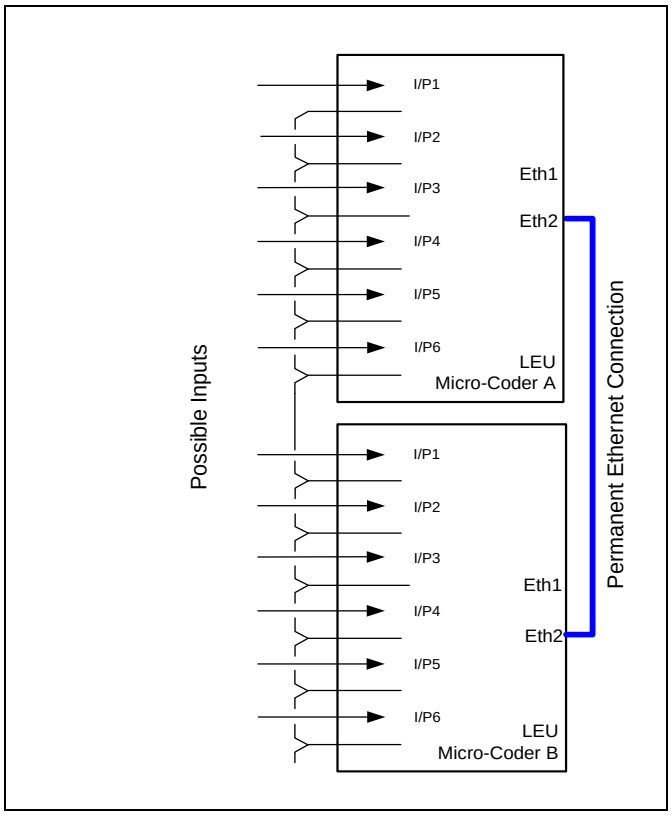


Figure 44 - Example of Local Network Ethernet Cable Between Two LEUs

Figure 45 - Detail of Type-J Fixed LEU to LEU Ethernet Cable

5.2.6.1 Three LEU Configuration

Installations with three LEUs cannot be linked directly via cables (as in the case of two LEU's) and require each LEU to be cabled to an Ethernet communications device in the form of an RS900 Ethernet network switch. See Figure 46 below.

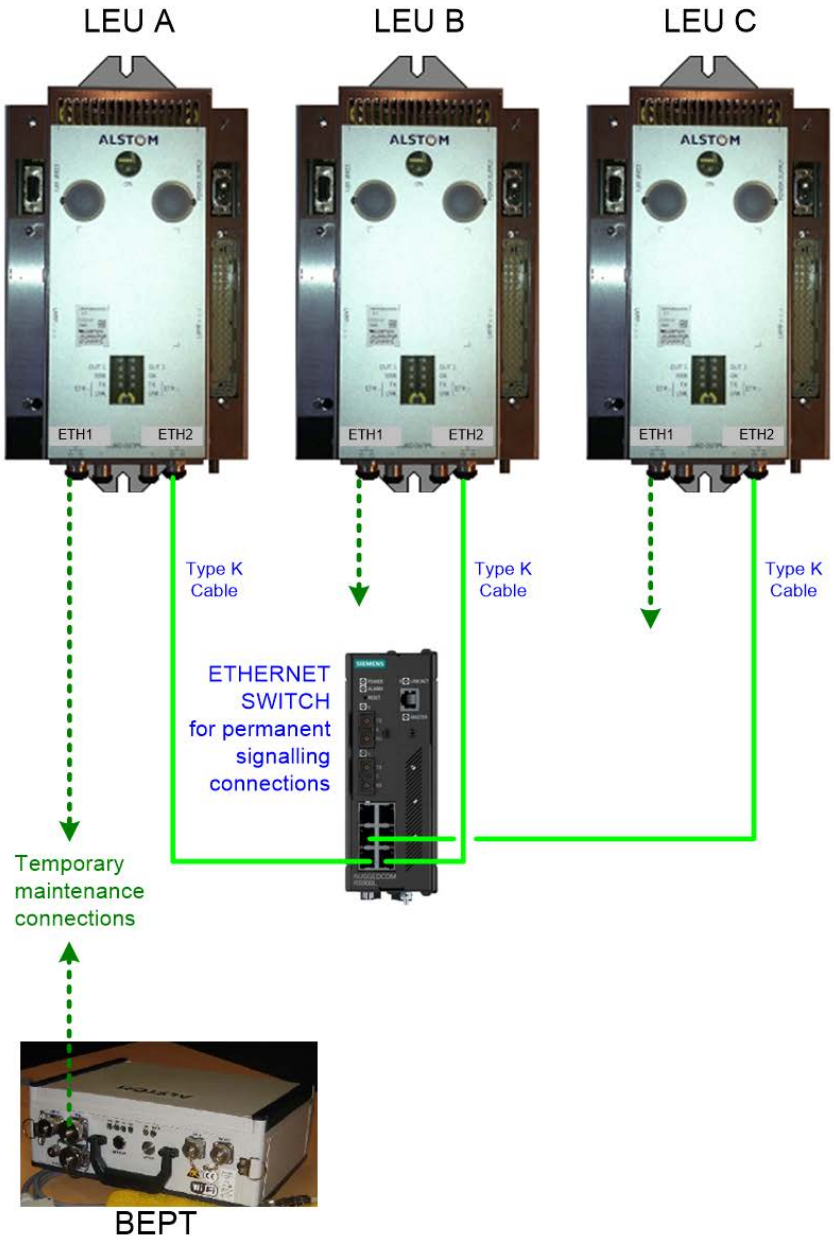


Figure 46 - Network Architecture for 3 LEU Configuration.

5.2.6.2 Look-Ahead Configuration

An RS900 Ethernet network switch can be provided where information from the track ahead is required (e.g.: look-ahead) using a data network (optical fibre). This is normally used in current sensing areas, as look ahead in contact sensing areas is generally achieved using copper cabling and relay contacts. Look ahead in Microlok areas is typically achieved using a Microlok data change to achieve all necessary inputs at the location of the LEU. See ETSC standard circuits SG0602001 – sheets 5, 7, 10 and 17.

Note: A twisted pair solution has not been approved for use between locations. Only optical fibre networking should be used between locations.

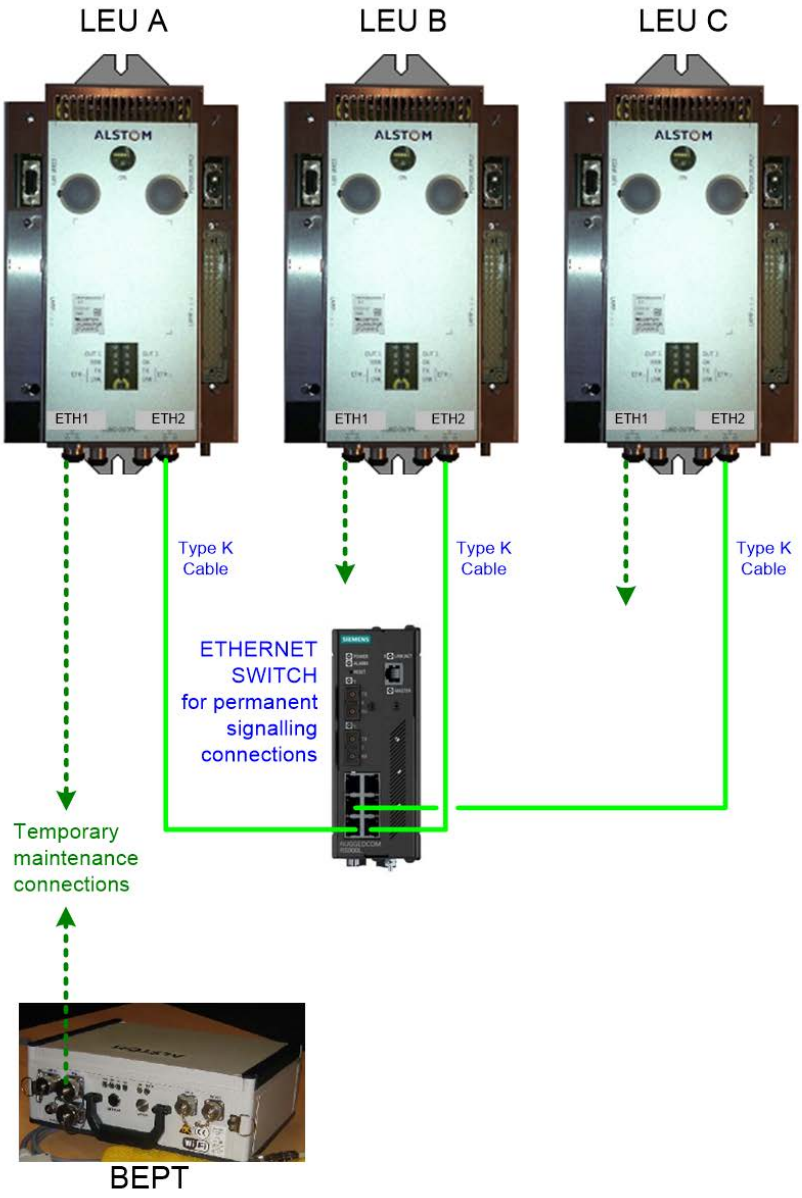


Figure 47 - Network Architecture for Look-Ahead Function Using an Optical Network Interface.

5.3 ETCS Materials Storage & Handling

5.3.1 ETCS Materials Storage

Stored ETCS equipment must be protected from environmental factors in accordance with manufacturers recommendations, in order to preserve the overall life span of the equipment and system. As a minimum:

- Balise, terminals, transformer, transient protection cassette, cable assemblies, balise junction box and the like, shall be stored in a dry facility which is free from rodents, excessive dust and direct sunlight.
- Electronic items such as LEU, DC power supply and LEU configuration key shall be stored in a dust free environment.

  Note: The original manufacturer's (where applicable) plastic packaging if unopened will be suitable for the purpose of excluding dust. If electronic products are missing their original anti-static plastic packaging, then a replacement anti-static bag will be required.

- Cables on the drum shall be stored in a facility which is free from direct sunlight, damage by moving machinery, rain and any potentially damaging debris.
- Spares shall be kept in their original packaging, stored in a dry location with expected temperature range of 0-50C and kept protected from the weather.

5.3.2 Handling of Equipment Removed from Service

Refer to PR S 40028, Section “Equipment Removed from Service” for details.

6 Routine Inspection And Maintenance

6.1 General Requirements

The objective of examining the ETCS equipment is to find and remove any potential failure conditions and ensure that as far as possible, the equipment will function satisfactorily until the next examination.

Any conditions likely to cause a defect or which could reduce the reliability of the equipment shall be dealt with immediately if practicable, or brought to the notice of the Maintenance Signal Engineer and dealt with as soon as possible.

Signalling personnel must be vigilant when visiting work site locations to ensure that in particular, the balises, cables and associated balise junction boxes have not been damaged.

Minimum preventative maintenance for track mounted and trackside equipment is generally a visual inspection combined with checking for loose items.

Apparatus inspections shall be carried out in accordance with the cycles specified by the Technical Maintenance Plan (TMP).

ETCS equipment should also be inspected for damage and misalignment whenever any work is carried out in the area that could affect it, e.g. if track work is undertaken.

6.2 ETCS Track Mounted Equipment

6.2.1 Balises

Balises are light grey in colour, although some yellow coloured balises might be installed, and both types are equally acceptable.

Routine scheduled balise inspections are required to inspect for debris and damage. Maintainers shall be observant for debris on and up against balises. Report and arrange to have debris removed. Where a regular build up of debris occurs, maintenance schedules should be arranged to ensure that the debris depth on top of the balise does not exceed the limits defined below:

- 100mm of water, ballast or ice,
- 10mm of coal dust,
- 300mm of snow,
- 20mm of sand,
- 10mm of salty mud,
- 50mm of mud without salt water,
- 20mm of Hematite iron ore,
- 2mm of Magnetite iron ore,
- 10mm of iron brake dust,
- 50mm of grease

Debris on the balise or built up against the balise shall be removed before the balise becomes buried.

Ballast shall not be placed over the top of, or built up against, a balise. Where ballast has been laid over a balise, it shall be immediately removed from within 100mm of the periphery of the balise (using hand tools), taking care not to damage the balise cable socket or socket where fitted.

Caution: When handling a balise that has been in service there is a risk that some of the glass fibres that make up the casing could come free. This may be due to long exposure to UV and rail contaminants. The grey coloured balise has been produced to reduce the likelihood over time of this hazard.

6.2.2 Balise ID Plates

If a balise is found with the ID plate missing or damaged, the procedure is as follows:

- Inspect the balise for any other obvious signs of damage. If the balise has more than minor damage, refer to Section 9.1.1.
- Identify the balise name from the adjacent location ID plate (if one of them is present and intact), or identify the balise name from the Signalling plan or *Balise Installed Data Form (ETCS IDF1)* if neither of the ID plates is present / intact.
- Read the balise data using a BEPT (see Section 11.2) to confirm the balise ID, check that the balise has not been moved, and check that it is working correctly.
- Once the balise ID is confirmed, write the correct balise ID onto the balise using a permanent (paint) marker. This will aid identification once a new label is available.
- Arrange for a new label to be produced and fitted.
- If the balise ID plate has been sheared off e.g. by dragging rails, the bolt and rubber Rawlplug is likely to be damaged. It may be necessary to remove the balise in order to replace the Rawlplug and bolt.

6.2.3 Balise Mountings And Fixings

Balise mountings and fixings are to be checked for damage and looseness. Checking of looseness may be achieved by attempting to move the item. Anchor screws/bolts should not be re-tightened unless obviously loose.

Fixings for Vortok beams (including Universal type spreader beams) shall be checked to ensure that both the connection to the rail and the balise is secure.

Balise cable fixings, plug and enclosure system (includes cable protector plates and hose) are to be checked for damage and looseness. Check the security of the cable termination cover on fixed balises. If this cover is missing or damaged, the balise is still good for service, but only as a 'fixed' balise, i.e. it should never be later used as a 'controlled' balise. To ensure this, only a new balise should be used as a ‘controlled’ balise.

Caution: Rail clips (at Vortok beams) must only be installed or removed using the correct purpose designed tool.

Caution: Vortok beams must be properly secured at both ends otherwise the beam may come loose and be struck by a passing train.

6.2.4 ETCS Cables

Routine insulation testing (Megger) must not be carried out on ETCS tail cables or ETCS balise tail cables. Any faults in these cables will be self-revealing and a cable fault will not cause an unsafe condition.

6.2.4.1 ETCS Balise Tail Cables

Routine scheduled inspections of the balise tail cable are to include inspection for the following:

- Damage (including UV degradation to exposed portions of the tail cable),
- Where the balise is fitted with a cable plug, the plug must be checked for looseness and signs of damage.

  Note: Loosening or tightening of the plug requires a special plastic key tool made by SAIB (SAIB Part number 084-001-01).

- Check for loose cable protector plates; check that the cable flexible conduit is well secured to the protector plates.

Caution: Gloves are to be worn when handling equipment located within and adjacent to the four foot. Refer to Hazard Risks in Appendix E.

6.2.4.2 ETCS Tail Cables

Routine scheduled inspections are to inspect for any signs of damage to the cable where it rises out of the ground at the balise junction box.

6.2.5 Balise Junction Boxes

Balise junction boxes shall be inspected for the following:

- Signs of external damage,
- Internally checked for signs of vermin infestation, corrosion or damage to terminations, and subsequently cleaned or repaired as necessary.
- Cables at the balise junction box are to be visually checked for damage where they enter the junction box.

Caution: When the cover is removed, the vertical side flanges may present an eye injury hazard. Standard PPE applies and in particular, eye protection should be worn. Refer to Hazard Risks in Appendix E.

6.2.6 Big Metal Masses

A Big Metal Mass (BMM) is defined as a metal mass of sufficient size to directly impact on the on-board antenna self-test function, leading to an EVC system failure.

Maintainers shall be observant for Big Metal Masses in the four foot on operational ETCS lines. If any of the items below are witnessed in the four foot, they should be reported to ICON Infrastructure and arrangements made to have them removed:

- More than 2 rails stored side by side,
- Two stored rails overlapped by more than 10m,
- Stored rail(s) within 1m of a balise,
- Surface laid cables (other than a balise tail cable) within 1m of a balise,
- A metal plate over the top of a balise.

6.2.7 Unlinked or Seldom Used Balises

Where installed ETCS balises are not regularly traversed by ETCS fitted rail vehicles during normal train operations, there becomes a risk that these balises may go unchecked by the ETCS system for extended periods of time. In these cases, the risk of the ETCS system not providing the intended protection due to balise removal or defect becomes realised.

Seldom traversed balises are typically located in the following situations:

- The last balise or balise group before a Buffer Stop or at the end of a line (in the run off area, past where a train would normally stop).
- Trip balise group (fixed train stop, fixed stop sign, fixed red light).
- Other specific balise identified as not regularly read by a train, such as at unused sidings, passing loops.

There are also some ETCS balise installations which are routinely operated over, but if they were failed or balises were missing, would not be reported by the train as they are not linked to a balise in rear. Unlinked balises are typically located in the following situations:

- The transition announcement balise group from a Level 0 to a Level 1 area.
- Yard Entry/Exit balise groups.
- TSW.
- VBC.

These unlinked or seldom used balises need to be periodically inspected and tested in accordance with the TMP and procedures detailed in Service Schedule SC 06 10 00 00 SS-02 Job No. S06002 (Unlinked/Seldom used Balise Examination). A Default Balise Telegram Test should be carried out on the balise by reading the telegrams using the BEPT to verify that the balise is working correctly (see Section 11.2.1).

6.2.8 Balises at Guard Rails

Where a balise is fitted in track with guard rails, the ETCS mechanical isolation joint installed in each guard rail adjacent to the balise location must be maintained free of any conductive debris which could bridge the joint.

Routine scheduled inspections are to inspect for bridging of the insulation gap by conductive debris. Where conductive debris is found on, or next to the joint, it shall be removed. If a galvanic isolation test is to be carried out, do not carry out an insulation test (i.e. Megger test) but rather, use an Ohm-meter.

Note: Insulation testing uses 500V or more, and may indicate a conductive path past the joint via the ground loop.

The existing Civil TMP includes for mechanical integrity checking of the ETCS mechanical isolation joint by means of routine scheduled inspections.

6.2.8.1 Guard Rail Height

The ERA standard (Subset-036 V3.0.0) states, that where a balise is located at guard rails, the guard rails must not be higher than the running rails (for a distance of at least 1.5m each side of the balise). The purpose of maintaining guard rail height at balises located in guard rails is one of a possible miss-read of a balise by the passing train.

Where the TMP requires checking and managing of the guard rails for height, this will be the responsibility of the Civil or Track disciplines.

Caution: Gloves are to be worn when handling equipment located within and adjacent to the four foot. Refer to Hazard Risks in Appendix E.

6.3 ETCS Location Equipment

6.3.1 Location Equipment General Requirements

Routine scheduled inspections are required to inspect for signs of vermin infestation or damage.

Stainless steel finish LEU cabinets should not be painted over. Any graffiti paint should be removed from the outside of a cabinet in order to maximise heat reflection away from the cabinet.

Caution: If using solvents to clean equipment, ensure that appropriate PPE is worn. Avoid breathing in vapours and do not use highly flammable solvents near ignition sources.

6.3.2 Enclosure Ventilation

Routine scheduled inspections are to inspect the cabinet ventilation grills to ensure adequate air circulation through the cabinet. Fine mesh may require cleaning. Cleaning should normally be carried out by using compressed air providing that the dirt is blown from the inside through the mesh to the outside of the cabinet.

Caution: If using compressed air to clean ventilation grills, ensure that the appropriate safety precautions are followed.

6.3.3 LEU

Routine scheduled inspections are required to inspect the LEU module to ensure that the air ventilation holes are not blocked.

The module may require cleaning. Cleaning should be carried out by using compressed air.

6.3.4 ETCS Power Supplies

Routine scheduled inspections are required to inspect the 24V power supply module to ensure that the air ventilation holes are not blocked.

The module may require cleaning. Cleaning should be carried out by using compressed air.

6.3.5 LEU Networking Equipment

Routine scheduled inspections are required to inspect the RS900 Ethernet network switch to ensure that the air ventilation holes are not blocked.

The module may require cleaning. Cleaning should be carried out by using compressed air.

7 Track Work Affecting ETCS Equipment

This section is applicable in general to all track personnel working near to ETCS equipment, but particularly applies to signalling staff working in support of trackworks, and should be read in conjunction with PR S 40011 - Precautions Associated with Renewals Work, and PR S 47118 - Typical Signal Support Procedures for Trackworks.

7.1 General Requirements and Precautions

As part of the Possession Planning process, track activities may need to be scheduled well in advance in order to ensure appropriate signalling and track resources are available.

Prior to track maintenance work which could potentially damage a balise or its cable (where fitted), all ETCS track mounted equipment shall be identified and marked. Ensure that the balise ID plate and balise location ID plate are not covered with paint.

When carrying out track work which involves the need to remove a balise or cable from the track, precautions shall be taken to ensure that the risks associated with the work are understood and appropriately controlled.

Ballast shall not be placed over the top of, or built up against, a balise. Where ballast has been laid over a balise, the Signalling Maintainers shall arrange for it to be removed to within 100mm of the periphery of the balise (using hand tools), taking care not to damage the balise cable plug or socket.

Balises, balise fixings and their cables may remain on the track during the following track maintenance activities as long as they have been clearly identified and notified to the machine operators:

- Ballast brushing/brooming. A rotating brush shall be raised or the rotation stopped before passing over a balise,
- Mechanical Tamping,
- Hand tamping with Kango's and measured shovel packing is acceptable with the balise in situ,
- Dynamic Stabilising at <40Bar compression,
- Rail Grinding, providing that a concentration of sparks will not cause damage to the balise plug, cable or balise socket cap (refer to Section 7.1.1).

Balises, balise fixings and their cables shall be removed from the track prior to the following track maintenance activities:

- Where a ballast plough is to be used,
- Resurfacing,
- Re-sleepering,
- Ballast cleaning,
- Re-railing,
- Plant movements in the 4 foot or on the ballast shoulder,
- Rail Grinding or welding (refer to Section 7.1.1).

Do not:

- drag a rail in the four foot, over or past a balise fitted on the track.
- run over a balise with vehicle wheels.
- step on a balise cable plug.

When storing rails in the four foot, do not:

- store more than two rails side-by-side Refer note below.
- encroach within 1m of a balise.
- allow the ends of a pair of stored rails to overlap by more than 10m Refer note below.
- overlap with guard rails or check rails by more than 10m. Refer note below.

Note: The additional metal mass may be detected by the on-board ETCS system resulting in an alarm and subsequent train braking application requiring a reset of the on-board ATP systems.

Where track work requires the removal of balises, Signalling Maintainers shall be arranged to remove such balises in accordance with the signalling procedures detailed in PR S 40011 Precautions Associated with Renewals Work and PR S 47118 Typical Signal Support Procedures for Trackworks. The re-instatement of balises shall include functional testing and re-certification of affected ETCS equipment and associated signalling before restoring the apparatus back into use. Refer to Section 7.2.6 of this document for testing and re-certification requirements.

Caution: When replacing balises, it is essential for the correct operation of the signalling system that special care is taken NOT to invert the order of balises within a group, as the incorrect order will trigger a service brake intervention.

Where a machine needs to drive over a balise and it is not practical to remove that balise, an approved design protector cover plate shall be used to protect the balise and cable (where fitted), such that the machines weight is not transferred to the balise (or cable). A competent person shall be in attendance to ensure that the cover plate(s) is installed correctly and removed after the track work has been completed.

Note: A purpose made cover has not yet been designed for this purpose.

Caution: It is essential for the correct operation of the signalling system that any metallic cover plate is removed from the top of a balise.

A balise does not necessarily need to be removed from the track where the driver of a rubber wheeled vehicle can straddle the running rail(s).

A ‘controlled’ balise does not necessarily need to be removed from the track where the outside set of wheels of an on track vehicle remains on the ends of the sleepers. This ensures that the outer wheels do not drive over the ballast shoulder where the cable is located.

Figure 48 - A Wide Tyred Dump Truck on the Track

Note: In this above photo example, a balise would need to be first removed from the track unless the wheels were to straddle the rail(s) such that there is no contact with the balise or a balise cable.

7.1.1 Grinding / Welding

A risk assessment will be necessary when rail grinding or welding to determine if the balise and/or cable needs to be removed from the track. If the heat generated from these activities is such that it would burn a cable/cable flexible conduit or balise, then the cable or balise (as applicable) shall be adequately shielded or removed from the heat source.

In general, rail grinding activities do not require a balise or cables to be removed providing that the sparks are not sustained on a single spot for any long period. For example: hand grinding down a rail weld next to a balise or cable would likely require removal of that balise and/or cable but rail grinding would not normally require the removal of a balise or cable.

Rail welding should not be carried out within 1.5m of a balise or balise cable unless appropriate mitigations (such as covers or the temporary removal of equipment at risk of damage) are put in place to prevent the ETCS equipment being damaged.

7.1.2 Replacement of Single Sleepers

Where a single sleeper which is fitted with a balise is to be replaced, the following simplified process for removal and replacement of the balise can be followed:

- Check and record the balise ID plate and balise location ID plate details on the *Balise Replacement Testing Form (ETCS M1).*
- Arrange for the position of the balise to be marked prior to removal of the sleeper (see Section 7.2),
- Arrange for the balise to be secured to the new sleeper, in accordance with the instructions detailed on the appropriate installation drawing(s) (M05-501, M05-502, M05-569).
- Arrange for the new sleeper to be fitted with either the old balise location ID plate, if it is still in good condition, or a new balise location ID plate in accordance with the instructions detailed on drawings M05-524 and M05-544. New balise location ID plates should be ordered in advance of the planned works. If the existing balise

location ID plate is not re-useable, and the new balise location ID plate is not available, write the balise ID name on the foot of the sleeper using a white paint pen or permanent marker. Register details of temporary arrangement in the Temporary Repair Register.

- Check the balise ID plate and balise location ID plate details to ensure a match and that they correlate with the Signalling Plan location, and
- Carry out the required balise testing in accordance with Section 7.2.6 of this document.

If the track is being disturbed to a greater extent than just a single sleeper (i.e. entire sections of track are being removed), the position of the balise is required to be measured from reference assets, in line with Section 7.2.2, and removal and replacement of the balise should follow the process in Sections 7.2.3 through to 7.2.6.

7.2 Balise Removal And Replacement

All balise removal activities shall be recorded on the Site Certification Form (SCF). All balise replacement activities shall be documented using the *Balise Replacement Testing Form (ETCS M1).*

7.2.1 Balise Location Identification Prior to Removal

Once a balise has been removed from the track, some track work such as re-ballasting and ballast cleaning can result in the balise location ID plate and/or the fixings being covered with dust and this can make the balise location difficult to identify particularly at night. Some track work may also require the sleeper with the balise location ID plate to be removed.

Prior to, or immediately after the removal of any balise from the track, if there is the likelihood that the balise location ID plate or balise fixings will be obscured by the track maintenance (e.g. ballast dumping), or that the balise ID plate will be removed (e.g. sleeper replacement) the balise location should be marked on the track to assist in identifying the exact replacement location after track work is complete, and to avoid the need to measure the balise location from first principles (see Section 7.2.2).

Marking the foot of the rails or the sleeper with the balise position (using a permanent marker or paint pen) is appropriate for track works which do not replace rails or sleepers. If sleepers and / or rails are being removed, then marking of the balise position outside of the four foot (using a stake or similar) may be necessary.

7.2.2 Geographic Measurement for Balise Position

A replaced balise will need to be measured from its reference asset if a balise position cannot be accurately marked prior to removal as Section 7.2.1. The 'as installed' distance to this asset should be documented on the Site Certification Form (SCF) for an ETCS balise. Refer to the Geographic Data for ATP guideline for the process of manual measurements and filling in of the SCF.

Measurement may be carried out using an insulated tape measure (50m and 100m tape measures are available), or where the distance is greater than 100m, a calibrated measuring wheel can be used.

Measuring wheels should be purpose designed for use with rails (incorporate side guards so as to stop them falling off the head of the rail) and calibrated for an accuracy which shall not exceed 1%.

A low power laser tool is available for transferring infrastructure reference survey marks and the ASDO Calibration Balise Marker Plaque, to the closest rail.

Measure along the rail which is laterally closest to the reference asset as shown in the example below (taken from the Geographic Data for ATP guideline).

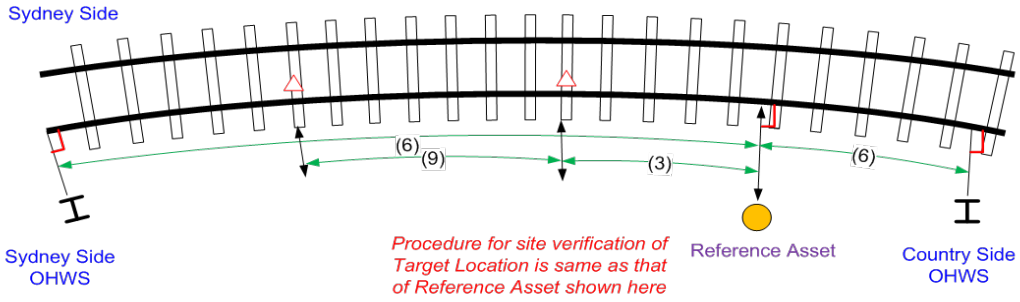


Figure 49 - Balise Measurement Example.

7.2.3 Balise Removal

Balises are largely secured to the rail using Vortok Spreader beams, as detailed in Section 5.1.2. In some cases balises may be directly fixed to the sleeper or track slab (see Section 5.1.2.2). Direct fixed balises are secured using either M10 bolts for concrete sleepers or 12mm coach screws for timber sleepers. In some situations such as slab track, threaded rod may also be used to fix the balise down.

Balises and their associated fixings etc. (Vortok beams, bolts, screws, nuts, washers, rubber pads, spacer blocks where fitted and balise cables) shall be carefully retained so as to be re-used where possible. Any damaged fixings should be replaced.

Note: The height of the balise is critical to correct functionality and plastic spacer plates (blocks) might be provided at some slab track locations to adjust for correct height below top of rail head.

Caution: During corrective maintenance, where possible avoid removing more than one balise of a group from the track at the same time so as to prevent a mix up in the order of balises.

7.2.3.1 Balise Removal Procedures

The balise removal procedures listed below are common to both ‘fixed’ and ‘controlled’ types of balise arrangements. Balises shall be removed as follow:

1) Prior to removing a balise, check and confirm that the balise ID plate and balise location ID plate details match. Mark the balise location on the rail web or sleeper, in line with Section 7.2.1. If there is any question over the identity of the balise, the signalling plan should be used to positively identify the balise, and the balise name clearly marked on the balise. This provides additional conspicuity if the ID location plate is missing or covered over

2) If the balise location ID plate, or the sleeper to which the balise location ID plate is fixed is being removed, measure the balise position from fixed infrastructure in opposite directions along the track (survey plates and/or signal posts), in line with Section 7.2.2 and record measurement details in the SCF.

3) Loosen off the two hold-down bolts (do not disturb the M8 bolt which secures the circular balise ID plate),

4) Remove the two fixing bolts and washers. If still serviceable, store items for later reuse. Take note of the order, type and the number of washers on the bolts/screws,

5) For Vortok beam mounted balises - if required, remove the beam using the appropriate tools (rail fastener install/removal puller tools). Note: if the beam is still serviceable and only the balise needs changing, then it is acceptable to swap out only the balise by means of the two M12 bolts,

6) Move the balise, Vortok beams, bolts/screws, washers, rubber pad and any spacer blocks to a location where they will not be damaged or lost. For directly fixed balises - take note of the number of spacer blocks required to adjust the height of the balise, and ensure that they are stored with the balise.

   Note: 'fixed' balises do not have a cable and may be removed from the track for storage (complete with all components) until the works have been completed,

7) For directly fixed balises - where an M10 threaded metal anchor is installed in a concrete sleeper or slab, screw a plastic grub screw into each anchor hole so that the top of the screw is just flush with the top of the anchor to protect the anchor threads from dirt ingress.

Consumables: Nylon threaded grub screw (for concrete substrate only; 2 per balise; refer to standard drawing M05-502) and permanent marker or paint pen for marking the balise position (in line with Section 7.2).

Tools: 5mm slot blade screwdriver (for concrete substrate only), grub screws, socket wrench, rail fastener removal/install tools.

7.2.3.2 Controlled Balise Cable Removal Procedures

The balise is a 'controlled' balise when it has a cable connecting it to a LEU (allowing it to interact with the signalling system).

Caution: The LEU output transient protection cassette must first be unplugged before disconnecting the balise.

Prior to ballasted track maintenance, where a 'controlled' balise needs to be removed from the track, it is preferred not to disturb the plug connection at the balise except however, when the cable or balise is to be replaced (due to a fault or damage).

In most circumstances it should be possible to remove a 'controlled' balise from the track with the balise tail cable still attached, by removing a small portion of sleeper crib ballast under the rail, cutting the cable protector plate nylon ties and disconnecting the cable at the junction box. Alternatively, in lieu of disconnecting the cable at the junction box, sometimes the balise can be slid under the rail. The balise with cable attached then carefully placed out of harms way prior to the track works. Typically, the 'controlled' balise cable would be wound around the balise junction box post and the balise placed adjacent to it. Removal of a 'controlled' balise by this means may only be done by a competent signalling person or a competent person under their supervision.

Where a faulty/damaged balise needs to be removed for replacement and not the cable, the Signalling Maintainer may disconnect by unplugging the tail cable at the balise. The replacement balise should be reconnected immediately so as to minimise the opportunity for any dust or water to enter the exposed plug end.

When it is required to disconnect the balise tail cable at the balise socket, this should be undertaken as follows:

1) First isolate the two active wires to the balise by means of unplugging the LEU output transient protection cassette.

   Note: That by unplugging the protection cassette, the cable earth (screen) is still connected to the LEU location signalling earth;

2) Carefully unplug the balise tail cable and remove it (where required) from the track;

3) Remove the balise.

   Note: A special (SAIB plug removal tool) tool is required to undo the plug at the balise.

When it is required to disconnect the tail cable at the balise junction box, this should be undertaken as follows:

1) First isolate the LEU from the balise by means of unplugging the LEU output transient protection cassette.

   Note: That by unplugging the protection cassette, the cable earth (armour) is still connected to the LEU location earth;

2) Disconnect the balise tail cable at the balise junction box terminals;

3) Loosen off the balise tail cable gland at the balise junction box;

4) Loosen off the half saddles on the post (where fitted);

5) Cut the cable ties on the cable protectors plates;

6) Carefully remove the balise and attached cable from the vicinity of the track work area, to a safe place for storage (ensuring that no excessive strain is applied to the balise cable plug), until the track works have been completed.

Additional Tools: Pelican Pick or similar hand tool to remove ballast (where ballasted track), slotted blade screwdrivers, side cutter, spanner, socket wrench and SAIB plug removal tool (only where the cable is to be replaced).

7.2.4 Balise Anchor Re-Installation – Direct Fixing Only

Prior to drilling for new anchors in concrete, where the original anchor holes are within 40mm of the proposed new holes, the original holes must be free of dust, dry and then filled with a suitable two part liquid epoxy resin (this stops the wall of the new hole collapsing into the old hole when being drilled and a mechanical-set type of anchor is used, and reduces the opportunity for the sleeper to crack). The resin must have cured before drilling and before a new mechanical anchor is installed adjacent to it. Only approved anchors listed on drawing M05-502 may be used unless approval has been obtained from the Sydney Trains Engineering Systems Integrity (ESI) Signalling and Control Systems Professional Head for an alternative anchoring system.

Where reinforcing is encountered in slab track, stop drilling and re-drill the holes at least 40mm distance longitudinally to the track.

Where existing direct fix balise anchors are damaged, the balise shall be fixed down as follows (in order of preference):

1) Where damage to the anchor thread is minor, clean up the anchor thread using a stud tap; however if the anchor is unrecoverable,

2) Drill and install new anchors laterally offset. Refer to Section 7.2.5.2 for details of maximum allowed offset, or

3) Drill and install new anchors into the next adjacent sleeper (approved signalling design may be required), or

4) Replace the sleeper and install new anchors, or

5) As a temporary solution, it is permitted to fit a Vortok Universal spreader beam. The beam is to be placed immediately adjacent to, and up against the original sleeper, on either side of it. Notify the Maintenance Signal Engineer regarding the use of a Vortork Universal spreader beam.

Figure 50 - Drilling of Concrete Sleeper In Preparation for Fitting of Anchors

Note: With concrete sleepers:

- It is not permitted to drill new holes longitudinally to the track, in the same sleeper,
- Generally only one additional pair of drill holes (laterally to track direction) is permitted in the lateral direction either side of the original holes. See sketch below. Refer to Section 7.2.5.2.1 for maximum lateral offset details.

Note: Unused holes are to be resin filled.

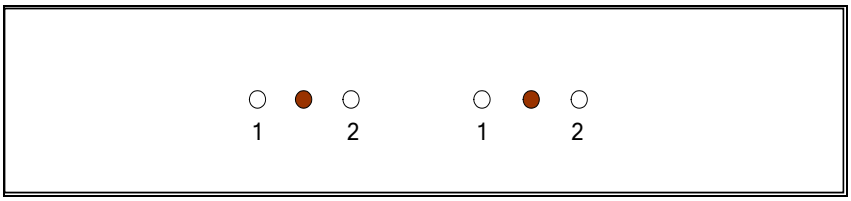


Figure 51 - Permitted Additional Drill Holes Either Side of Original Pair (Original pair shown filled in)

Figure 52 - Mechanically-Set (Knock-In) Anchors, Shown Prior to Fitment. (Note: the hole depth marker on the drill bit - drill depth is critical)

Note: With 'mechanically-set' anchors, both the drill hole diameter and the drill hole depth are critical.

Caution: Drilling concrete may present a dust and noise hazard. Refer to Hazard Risks in Appendix E.

7.2.4.1 Timber Sleepers and Transoms

Where the existing balise coach screw holes in timber are stripped, it is recommended to repair the holes using a suitable product such as 'Spikefast' by Imtram Pty, or where not practical, offset new holes.

Refer to Section 7.2.5.2.1 for details on permitted offsets.

Caution: Drilling timber may present a dust and noise hazard. Refer to Hazard Risks in Appendix E.

7.2.5 Balise Re-Installation

If the balise location ID plate has been disturbed, lost or is unreadable, the Signalling Plan shall be used to check that the correct balise has been re-installed back into the same location (unless approved changes were required). This will need checking by the Signalling Maintainer.

The *ETCS Installed Data Form - Balise (ETCS IDF1)* will provide balise location measurements (in meters) referenced from two trackside assets (normally overhead wiring stanchions).

When re-installing a balise, follow the balise installation procedures according to the appropriate standard drawing(s) and specifications as listed below:

- M05-501 for direct fix re-installing a balise onto timber,
- M05-502 for direct fix re-installing a balise onto concrete. It is very important to ensure that the bolt and anchor threads are clean and that Loctite 243 (or equivalent) is re-applied. This is to reduce the likelihood of the stainless steel galling up and to prevent the bolt coming loose,
- M05-503 for balise position acceptance tolerances,
- M05-558 for re-installing a balise at guard rails,
- M05-548 for between-sleeper Vortok beams,
- M05-569 for on-sleeper Vortok beams, and
- SPG 0706 Installation of Trackside Equipment.

Always inspect the fixings and replace or repair as necessary.

If a balise is required to be relocated from its 'as-designed' position for whatever reason, and the new proposed position falls outside of the tolerances specified in Section 7.2.5.2, then the new position must comply with the ETCS design principles, and advice should be sought from Signalling Design for the proposed updated location.

Caution: When replacing balises, special care is to be taken NOT to invert the order of balises within a group as the incorrect order will trigger a brake intervention.

Caution: Any removed balise must be replaced in exactly the same location. Moving a balise by even one sleeper increment can in some circumstances have an unwanted operational impact.

7.2.5.1 Balise Re-Installation Procedures

These re-installation procedures are common to both ‘fixed’ and ‘controlled’ types of balise. Balises shall be installed as follows:

1) If the balise location ID plate, or the sleeper to which the balise location ID plate was fixed was removed, measure the balise position from fixed infrastructure in opposite directions along the track (survey plates and/or signal posts), in line with Section 7.2.2 and check that the measurement details previously recorded on the SCF before disturbing the balise, match.

2) Brush any loose debris off the top of the fixing location and the balise location ID plate. Confirm that the details of balise ID plate, balise location ID plate and signalling plan, match.

3) For Vortok beam mounted balises - if the beam was removed, re-install the beam using the appropriate tools (eg: Pandrol pullers etc).

For directly fixed balises (items 4 through to 9):

4) Inspect anchors and bolts/screws for thread damage and straightness. If damaged, replace bolts. If re-using bolts, brush off the existing Loctite 243 thread locker (or equivalent) residue from the threads (using a stainless steel wire brush), so that the thread is clean.

Note: the standard M10 bolt is 90mm in length however, some bolts are longer than 90mm e.g., where spacer blocks are required under the balise.

5) Unscrew the protective M10 plastic grub screw (save for later reuse) from the anchors (concrete substrate only) in the track (recover for future re-use).

6) Blow out any dust from inside the anchors using compressed air (concrete substrate only).

Caution: Cement dust may present an airborne health hazard. Refer to Hazard Risks in Appendix E.

7) Assemble the bolts/screws, washers, rubber pad to the balise together with the exact same number and size of spacer blocks (where fitted) previously removed from track.

8) Check that the balise position, height and orientation in accordance with standard drawing M05-503 and specification *SPG 0706 Installation of Trackside Equipment,*

9) Apply Loctite 243 (or equivalent) to the thread of an anchor bolt,

Caution: Loctite products may present a health hazard. Refer to Hazard Risks in Appendix E.

For all balises:

10) Tighten the two balise hold-down bolts/screws in accordance with the required torque as specified on standard drawings as applicable (do not disturb the M8 ID plate bolt on the balise).

Note: When re-installing a balise, it could be possible to (inadvertently) install the balise 180 degrees from the original orientation. Whilst this will not have any operational impact, it is not desirable as balise ID labels are normally installed in the same orientation along the track to aid in reading the labels when walking the track.

Consumables (for direct fixing concrete substrate only): Nylon threaded grub screw (2 per balise, refer to standard drawing M05-502), Loctite 243 (or equivalent), spare bolts.

Tools (for direct fixing concrete substrate only): 5mm slot blade screwdriver, socket, torque wrench, broom or hand brush, stiff stainless steel wire brush.

7.2.5.2 Balise Installation Tolerances

After a balise has been re-fitted to the track, the balise shall be inspected to ensure that:

1) The correct balise is replaced back at the correct track location according to the *ETCS Installed Data Form - Balise (ETCS IDF1)*,

2) There has been no damage to the balise or cable (where fitted),

3) The balise is secure,

4) The balise ID plate and the balise location ID plate identifications match. Damaged or missing identification plates shall be recorded for later replacement,

5) The balise has been installed at the correct height relative to the top of rail, and

6) The balise lateral deviation does not exceed permitted tolerances. Refer to standard drawing M05-503 and the tolerance requirements listed below for details.

7.2.5.2.1 Balise Lateral Offset Tolerances

Note: This section applies to directly fixed balises only.

Where the balise needs to be replaced and relocated to one side of an unserviceable anchor, the maximum permitted offset from track centre is up to 40mm, providing that the track has a track radius of >1km otherwise a maximum 15mm offset is permitted. This lateral offset does not require engineering approval as it is within the accepted permitted tolerance.

The balise location ID plate on the track is not to be covered over.

In extreme cases, where the balise needs to be relocated more than 40mm laterally from track centre, a Vortok Universal type spreader beam should be used as a temporary measure until the permanent mounting can be resolved. The matter shall be referred to the Sydney Trains Engineering Systems Integrity (ESI) Signalling and Control Systems Professional Head for resolution.

Where a balise is located at guard rails, a lateral offset is not permitted. Refer to standard drawing M05-558 for details on restrictions at guard rails.

7.2.5.2.2 Balise Longitudinal Offset Tolerances

Note: This section applies to all balises.

Removed balises shall go back in their original design position. The following longitudinal (to the track) offsets are permitted from the original as-commissioned (design) position without engineering approval, as they are within the accepted permitted tolerance.

In extreme cases, where the balise needs to be relocated more than permitted in Table 3, engineering approval is required.

Balise Location	Maximum Longitudinal offset from original design location permitted without Engineering Approval
ASDO calibration balise	+/- 150 mm
All other balises	+/- one sleeper increment (nominal 600mm)

Table 3 – ATP Balise Function Location Tolerance

Note 1: A balise shall be no closer than 2.3m longitudinally along the track from another balise.

Note 2: All longitudinal distances for balises refer to the balise reference mark (BRM).

Note 3: Refer to standard drawing M05-507 for further details as to applicable balise positioning rules at a signal.

7.2.5.2.3 Balise Vertical Offset Tolerances

Note: This section applies to directly fixed balises only.

At the time of construction, the balise reference mark (BRM) must be positioned between 93mm and 193mm below top of rail. Refer to standard drawing M05-503 for further details as to applicable balise mounting height rules within the 93mm and 193mm range. In some cases, such as direct fixing on slab track, plastic spacer blocks may be fitted under the balise to ensure compliance.

Note: Should rail head wear bring the BRM to less than the above referenced minimum 93mm vertical distance, it will not have an operational or safety impact.

7.2.5.3 Controlled Balise Cable Re-Installation Procedures

Controlled balise cables shall be re-installed as per Section 7.2.5.1 above, and re-connected as follows:

1) Reconnect the balise tail cable to the balise using a plug locking / unlocking key (see Figure 16),
2) Attach the cable (in the orange PVC hose) to the yellow cable protector plates with black nylon cable ties,
3) Reinstall the LEU output transient protection cassette,
4) Power up the LEU (if powered down), and
5) Check that the LEU can control the balise (refer to Section 11).

Where the balise has been disconnected at the balise junction box:

1) Slide the cable through the balise junction box gland and re-tighten,
2) Re-secure the cable flexible conduit to the post using the half saddles (where fitted),
3) Re-terminate the cable inside the balise junction box,
4) Reinstall the LEU output transient protection cassette,
5) Power up the LEU (if powered down), and
6) Check that the LEU can control the balise (refer to Section 11).

Additional Tools: Pelican Pick or similar hand tool to scrap away ballast (where ballasted track), side cutter.

Additional Consumables: Black nylon cable ties at least 300mm long.

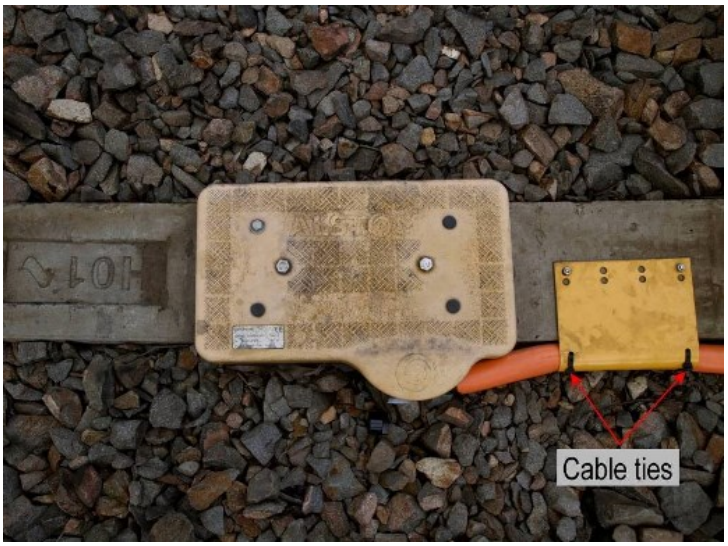


Figure 53 - Controlled Balise Showing Cable Protector Plate and Cable Hose (In this example, the original ID plate has been damaged and is removed for replacement)

7.2.6 Testing Following Balise Replacement

All fixed and controlled balises, once re-installed, require a Balise Telegram Test, as detailed in Section 11.2 of this document.

8 Failure Identification

8.1 Failure Reporting

Reports of ETCS equipment failures will generally occur as a result of the Driver either receiving an equipment failure message displayed on the DMI, or as a result of the Driver observing a discrepancy (a perceived or otherwise irregularity) between the information displayed on the DMI and a trackside signal/speed sign. Track maintenance crews are another possible source of damage reporting.

The definition of what is deemed to be a failure or an irregularity, and the requirements for reporting of ETCS failures are discussed in Safeworking Procedure PR S 40004 – Failures.

The initial steps in any failure investigation will depend on how the failure was first reported, the extent of any damage and the type of equipment affected.

Checking may consist of simple observations or a more thorough investigation using analytical tools such as the BEPT or reviewing historical log(s) of the train Juridical Recording Unit (JRU).

JRU log files can be requested in accordance with Sydney Trains Safety Management System, Operating Procedure 17: Train Data Management. During an incident investigation, ICON may request a copy of the logs on behalf of the investigator.

For the purposes of ETCS fault finding, simple observations are described as 'high level' or level 1 investigations and more complex tasks such as using special tools are referred to as 'in depth' or level 2 investigations, which can include correspondence and functional testing of ETCS using a BEPT. A level 3 investigation would involve escalating the issue to a higher level such as a technical support group, the design office or the equipment manufacturer.

A high level investigation would normally be the starting point whenever a fault is reported by a Driver and is often a useful means of quickly locating a problem site where the exact location may not be precisely known.

Where this document does not provide adequate information for resolution of trackside faults, the Alstom - Micro-COBALT, Micro-coder and ALIS User Manual may provide additional guidance. See note below.

Note: The explanation of all the possible information in the Sig events, Lamp events, System Stats, System events is detailed in Section 6.2.4.2 (Version J2) of the Alstom - Micro-COBALT, Micro-coder and ALIS User Manual. This information is provided in a computer programmer's style of presentation. The event tables and what they look like are explained in MN S 41607 BEPT user manual. This document is mostly focused on how to download them and not how to read them.

8.1.1 DMI Fault Messages

The trackside equipment fault messages which can be displayed on the Drivers DMI and which are reportable are listed in Table 4 below.

Item #	DMI Message	Log Fault Description	Error Message ID	Fault Trigger	Train Impact
1	Report_Balise fault type 1_Select Start to continue	EUROBALISE_VERSION_NOT_COMPATIBLE	25	Incorrect data	Trip (EB). Operational Delay.
2	Report_Balise fault type 2_Select Override to continue	BG_DATA_INCONSISTENCY	26	TS balise read	SB application to standstill.
3	Report_Balise fault type 3_Select Override to continue	LINKING_INCONSISTENCY	27	TS balise read	SB application to standstill.
4	Report_Balise fault type 4_Select Override to continue	TWO_CONSECUTIVE_BGS_NOT_DETECTED	92	2 consecutive BG not detected or missing	SB application to standstill.
5	Report_Balise fault type 5_Select Override to continue	CROSS_TALK_ERROR	93	Reception of 2 successive relocation BG (nearby interference)	SB application to standstill.
6	Report_Balise fault type 6_Select Start to continue	SUPERVISED_LEVEL_ENTRY_WITHOUT_MA	161	No MA available	Trip (EB). Operational Delay.
7	Report_Balise fault type 7_Select Start to continue	BG_IN_UNEXPECTED_DIRECTION	163	BG read in unexpected direction	Trip (EB). Operational Delay.
8	Report_Balise fault type 8_Select Override to continue	TWO_CONSECUTIVE_BGS_MISPLACED	173	2 consecutive BG misplaced	SB application to standstill.
9	Report_Balise fault type 9	TRACKSIDE_EQUIPMENT_MALFUNCTIONING	175	Packet 254 is received (default telegram)	Nil
10	Report_Balise fault type 10	BG_DATA_INCONSISTENCY_WITHOUT_REACTION	177	BG data inconsistency (Incorrect data)	Nil
11	Report_Balise fault type 11	LINKING_INCONSISTENCY_WITHOUT_REACTION	178	Linking inconsistency (BG not found within expectation window)	Nil

Table 4 - Reportable Trackside DMI Messages

Note 1: Column 2 is the DMI text message displayed to the driver.

Note 2: 'SB application to standstill' means train will be brought to a stand irrespective of any driver actions.

Note 3: 'Trip (EB)' means train will be brought to a stand irrespective of any driver actions.

Note 4: Messages information for on-board faults are available from the JDRMDR.

8.2 Level 1 Investigation

A Level 1 investigation would normally consist of observing the condition of the equipment for any obvious signs of damage, and may include simple supply voltage checks.

Some examples of problems which can often be quickly detected by this sort of investigation are:

- At the balise location; a cut cable or an externally damaged balise junction box, a damaged or missing balise, are all likely to be noticeable to an observer.
- At the balise location; metal (including metallic foil) or swarf built up on top of a balise could cause an on-board misread. This build up of material would likely be immediately noticeable to an observer.
- At the LEU location; the LEU equipment status indicators will provide useful information on the more common failures. Refer to Section 8.2.3.4 for more information on LEU status indications under common fault conditions.
- At the LEU location; power supply failures can also be easily and quickly detected by observing the equipment status indicators and sometimes the pop-out fuse indicators. In the case of contact sensing, carefully touching the outer insulated casing may for example indicate if resistors or transformer(s) are cold. A volt-meter will also enable a quick check of power supply voltage availability.

After having carried out a high level investigation along the corridor within the area where the fault message was initially reported to be located, if no indication of a fault is found, contact the Signaller to arrange for passing trains to check and report any DMI trackside fault messages in the area to further track down the problem. It may be that the problem is localised to a particular train or it may be that the fault actually lies outside of the trackside area initially reported.

Where a fault is reported intermittently by several trains but at one trackside location (i.e. a possible intermittent trackside fault), and the fault cannot be found from trackside investigation, it may be necessary to review the SigEvent and SysEvent logs from the LEU (see Appendix B), or JRU logs from affected trains.

Note: As a general rule, if a fault is reported by one train, but in several locations, it is likely that the fault is on the train. If a fault is reported at one location, but by several trains, it is likely that the fault is at trackside (or on track).

If following trains confirm a problem outside of the area previously checked, expand the area for high level investigation, to suit.

8.2.1 Track Mounted Equipment

The following Level 1 checks can be carried out on track mounted equipment that has been identified as the possible cause of a failure:

- Check that the cabling from an LEU to a controlled balise is in good condition and shows no sign of being cut, crushed or otherwise damaged.

  Note 1: The connections to the balise are not polarity sensitive and inadvertent swapping of the two conductors will have no safety or operational impact.

  Note 2: Shorting together of the two conductors will not normally cause damage to the LEU or the balise but will cause the ‘controlled’ balise to generate its default telegram message.

  Note 3: An open circuit of the two conductors will not cause damage to the LEU or the balise.

8.2.2 Location Equipment

The following Level 1 checks can be carried out on track mounted equipment that has been identified as the possible cause of a failure:

- Check the LEU status indications (see Section 8.2.3.1 for a description of the normal indication status for an LEU). When an LEU output is connected to a balise then the corresponding output LED (OUT1 and / or OUT2) should be OFF. If the indicator for a connected balise is lit, then there is likely to be a connection problem, in which case it is recommended to check all cables connections starting at the plug at the 'controlled' balise working back to the LEU.

  Note: Refer to Section 8.2.3.4 for a summary of the more common fault indications which might be displayed on an LEU.

- Check the primary power supply (BX120/NX120) as the problem could be related to a blown fuse or a wiring problem.
- Check the signalling power supply equipment indications as per Section 8.2.5 below.

8.2.3 LEU Indications

8.2.3.1 Normal Operation

Power ON indicator LED on the upper half of the front panel. The HMI window, on the lower half of the LEU front panel, uses 8 indicator LED's. In normal operating conditions, the LEU shows the following typical or normal LEU indications:

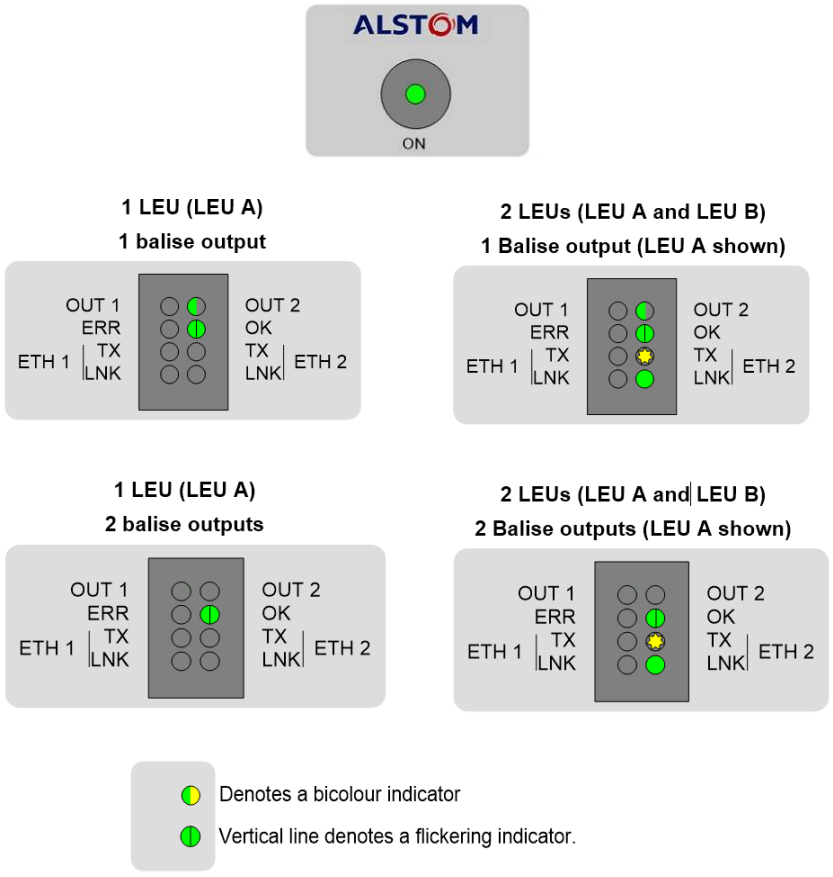


Figure 54 - LEU Indications in Normal Operation

Explanation Notes for Indications:

ETH1 port is reserved for the BEPT. When the BEPT is connected, the corresponding LED's (i.e. the TX and LNK) will become active.

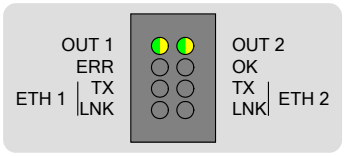
The OUT1/2 indications displaying OFF (indicating a successful connection to a balise) is not a failsafe indication as the LED indicator might have failed.

The OUT1/2 indications displaying OFF (indicating a successful connection to a balise) does not guarantee that the train will be able to successfully read a 'controlled' balise as a balise might for example, be muted via the BEPT or muted via a metal balise cover left in place.

When the train passes and excites the balise, the output (OUT1 or OUT2) LED will blink once. This is also the case when reading a balise with the BEPT via the air gap interface.

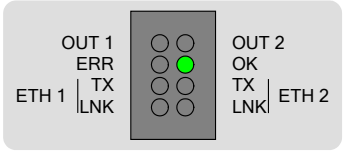
8.2.3.2 LEU Indications - Detailed Information

OUT1 and OUT2



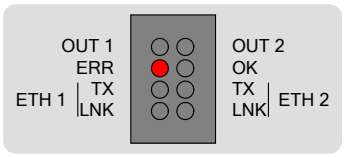
Colour	Green and Yellow (bi –colour)
Description	• ON (green): detection of a train presence on the corresponding output. The ON state duration is 0.5s. • Slow FLASH (green): corresponding output in MUTE mode (output not used). No production of telegrams. (Slow flashing: period 2 seconds / duty cycle 50%) • Fast FLASH (green): corresponding output in COMMISSIONING mode. Exclusive production of commissioning telegram (Fast flashing: period 0.5 second / duty cycle 50%) • ON (yellow): output in **fault** and inhibited. • **OFF**: product in Nominal mode, i.e. output producing telegram (when product is online)

OK



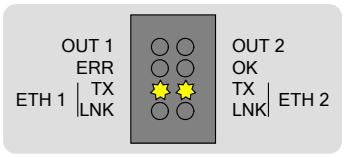
Colour	Green
Description	• ON (fixed): product in starting mode. • **ON (high frequency flickering)**: product in Nominal mode. • OFF: product **not** in nominal mode.

ERR



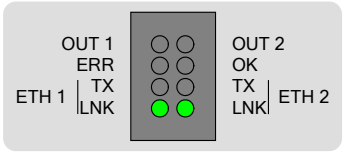
Colour	Red
Description	• ON: product in major fault (except during initialisation phase). • **OFF:** no major fault detected. • FLASH: Problem with the LEU configuration key. The product is in the BOOT_FAILED mode (Bad configuration file or pairing mismatch)

TX - ETH1 and ETH2



Colour	Yellow
Description	Transmission activities on Ethernet network (1 LED per connector) • FLASH: Blinking behaviour indicates transmission activities. • OFF: no transmission.

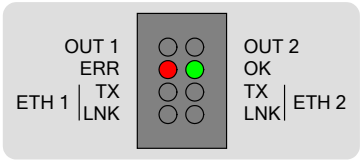
LNK – ETH1 and ETH2



Colour	Green
Description	Cable present on Ethernet port (1 LED per connector) • ON : a cable is detected. • OFF: no cable detected.

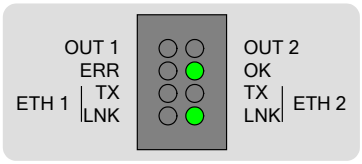
8.2.3.3 Indications During Start-up Sequence

(After reboot i.e. power off/power on)



Step 1.

During one second, both LED ERR and OK are lit on together.

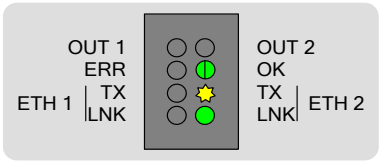


Step 2.

The system is starting.

The OK LED is ON (steady).

The TX of Ethernet links may flash intermittently.



Step 3.

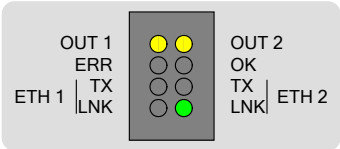
The system is started.

The OK LED is ON with high frequency flickering.

Note: Total duration of the start-up sequence (Step1+Step2) is about 70 seconds.

8.2.3.4 LEU Indications During Common Problems

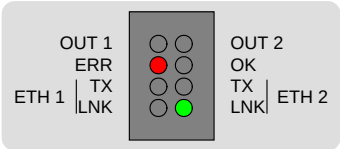
Below are some typical faults and the most plausible corresponding troubleshooting action.



OK is OFF : FAILURE mode

An error has been detected in the applicative part of the configuration file.

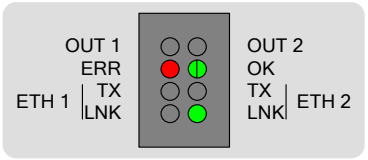
→ LEU configuration key must be reconfigured. Refer to Section 10.9.1 for further information.



ERR is ON and OK is OFF: LEU inhibited

LEU has “fused” (LEU product mode INHIBITED state). Refer to *Alstom - Micro-COBALT, Micro-coder and ALIS User Manual* for details. LEU must be returned to Alstom for assessment and possible repair. Refer Note 2.

→ LEU must be replaced. The LEU configuration key can normally be kept unchanged.

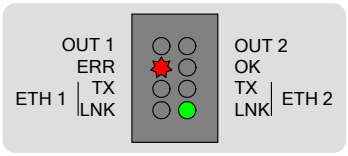


ERR is ON and OK is ON: LEU configuration key bad replacement

An inconsistency between the internal configuration and the LEU configuration key has been detected. The product is still operational.

This state could be due to the removal of the LEU configuration key after a correct start-up or when updating the LEU configuration key without having the LEU rebooted.

→ Check LEU configuration key and reboot LEU.



ERR is blinking (and OK is OFF): BOOT_FAILED mode

An error has been detected in the LEU configuration key. This could also be because the key pairing is activated.

First check why this would happen e.g.: wrong key being plugged in. If there is a valid explanation e.g.: due to a second hand LEU, and there is no safety impact, then de-pair using the Gold Key and reboot. Refer to Section 5.2.3.1 for further information.

→ LEU configuration key must be reconfigured or replaced.

Note 1: This list of LEU indications is not comprehensive and where the indications encountered are not described in this manual, reference should be made to the Alstom - Micro-COBALT, Micro-Coder and ALIS User Manual which provides further fault finding information.

Note 2: In case of doubt, e.g. unclear or contradictory indications, or ‘fusing’ (inhibited state) of the LEU, the LEU must be replaced and sent to Alstom for verification/repair. Refer to Section 5.3.2 for returns procedure. When an LEU has ‘fused’ it begins to create what is known as a dump file, this allows Alstom to analyse the cause of the failure. The creation of the dump file can take a few minutes. If an LEU is ‘fused’ (inhibited) wait 5mins (to ensure that the dump files are successfully created) then disconnect the LEU and send it off to Alstom.

8.2.4 RS900 Indications

There are multiple alarms that can cause the red “Alarm” LED on the RS900 Ethernet network switch (see Section 5.2.6) to be lit, the more common causes are as follows:

- Loss of optical cable link between two RS900s (light will be lit on both units),
- Loss of LEU copper link at one end (light will be lit at that end),
- Inconsistent speed on a port.

If the cause of the alarm is not immediately evident, the Signalling Maintainer should log into the RS900 (via the web interface / console cable) and navigate to [Diagnostic] > [Configure Alarms] to see the list.

This is explained in more detail in the RS900 User Manual, Section 4.6 on page 117.

8.2.5 Power Supply Indications

Absence of power to the LEU is clearly visible as its power-on indicator would not be lit (nor would any other indicator LED’s on the LEU).

Figure 55 - LEU Power-On Indicator

The MIPS200 has a small LED between its two power connectors. This LED is ON when the nominal 120Vac power is available at its input.

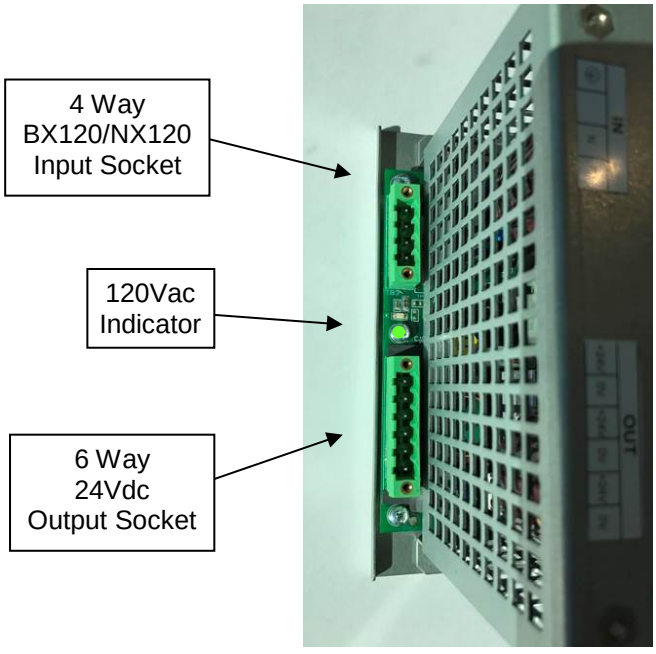


Figure 56 - MIPS200 Power Supply Indicator Light

(**Note:** the indicator is shown lit, on the above photo)

8.2.5.1 120V Power Transient Protection

The DEHN 120V transient protection device has a colour indicator bar showing green if the module has not failed. Replace the module if the indicator bar has changed to red or the module is short circuit between line to line or line to earth.

8.3 Level 2 Investigations

If a failure cannot be resolved by the use of the high level investigation techniques discussed in Section 8.2 above, then more in-depth checking, possibly including functional checking of the ETCS data (using the BEPT) may be required.

An in depth or “Level 2” investigation is a more detailed analysis when the high level assessment has either not yielded quick results or a more comprehensive analysis is required. In depth checking would normally include the use of electronic tools to; view logs, read balise messages, measure voltages and currents, etc.

When attending a reported fault, the logical order of equipment inspection may depend on initial proximity of the Signalling Maintainer to the equipment or ease of safe access to track, at the time of arrival at the site. It is however, generally preferable to first carry out a high level visual inspection before proceeding to an in depth investigation in order to rule out any obvious problems. However, the Signalling Maintainer may for example, choose to include additional investigative tests such as using the BEPT to determine if a ‘fixed’ or ‘controlled’ balise is faulty. Refer to the Appendix B for details on how to use the BEPT to undertake SigEvent and SysEvent record analysis.

The following are some of the minimum test equipment usually required for in depth checking:

- Approved calibrated multimeter to be used for voltage, resistance and current measurements,
- Approved calibrated contactless 'tong' tester / clamp meter suitable for AC and DC current measurements down to the mA range, and
- BEPT (with associated adaptors, MMI, cables and connectors) – see Section 10.

8.3.1 Track Mounted Equipment

The following Level 2 checks can be carried out on track mounted equipment that has been identified as the possible cause of a failure:

1) Measure the voltage appearing at the balise junction box terminals, to confirm continuity of the cabling from the LEU to the balise. The voltage appearing at the balise junction box terminals is typically around 10Vac when measured with a typical Digital Multimeter (DMM) and with a balise connected. Without the balise connected, the voltage should be approximately half.

2) Check that the balise is in the correct location according to the *ETCS Installed Data Form - Balise (ETCS IDF1)* and is installed in the correct order within a balise group (according to the signalling plan), and

3) Check that the balise mounting height is within the limits defined in standard drawing M05-503.

4) Continuity test any suspect cabling by first isolating the cable at each end (unplug the cable at the balise, unplug the Elsafe transient protection cassette at the LEU, disconnect at the balise junction box).

Note 1: Routine insulation testing must not be carried out on ETCS tail cables or ETCS balise tail cables, however any faults will be self-revealing and a fault on an external cable will not cause an unsafe condition.

Note 2: There is no need to isolate the tail cable armour and shield, and this can remain connected to the signalling location earth.

8.3.1.1 Balise Cable Disconnections

The LEU monitors the balise interface for failures or output cable disconnections / misconnections. Physical output disconnection may occur during failure but may also be caused by routine maintenance operations.

If the LEU is powered up when the disconnection / failure occurs, this would be captured in the LEU log files (see Appendix B) as follows:

- SYS_EVENTS: The output mode changes to "MUTE" and the output fault information changes to "C_INTERFACE_ERROR",
- SYS_EVENTS: System events #21 (output mode changes to MUTE) and #187 (detection of C1 or C6 failure) are recorded.

The Micro-coder then checks every 5 seconds whether the balise interface is functional. While the balise interface is detected non-functional, the balise interface mode remains MUTE with no new events.

When the balise interface is detected functional (cable is re-connected), the Micro-coder detects it within 5 seconds and waits 5 seconds to confirm that the balise interface is functional (5-second filter) before switching the output mode back to its original mode.

Note: There is no risk of damage to the LEU if the balise (directly at the balise or disconnected/broken circuit in the cable somewhere) is disconnected while the LEU is powered up, however, what will happen in this case is a situation where the impedance in the cable will build to a level where the LEU detects that an output load is connected (pseudo/fake balise) then dissipate again rapidly (balise disconnected). This would be captured in the LEU log files as follows:

- SYS_EVENTS: listing “output mode MUTE”, "Output mode ONLINE” repeated continuously approximately every second. The event tables will quickly fill with these events and start erasing older events once the events reach 2,000 events.
- SIG_EVENTS: listing “Train presence”, repeated continuously approximately every half second. The event tables will quickly fill with these events and start erasing older events once the events reach 10,000 events.

Refer to the Appendix B – LEU Log Record Analysis for details.

Caution: Before disconnecting (open circuiting) a balise cable, it is necessary to disconnect the balise at the LEU location (and preferable to power down the affected LEU). This avoids the risk of filling up the log.

8.3.2 Location Equipment

Caution: The LEU shall not be submitted to strong magnetic fields. Permanent magnets, including magnetised tools, shall be kept at a distance of at least 200mm from the LEU.

Note: Some multi-meters are known to incorporate magnets for the purpose of hands-free attachment. The magnets in these meters shall not be placed within 200mm of an LEU. Most locations will be provided with a steel plate on the inside of the door for the purpose of attaching a meter.

The following Level 2 checks can be carried out on location equipment that has been identified as the possible cause of a failure:

- Check that the signalling power supply equipment is operating correctly, as per Section 8.3.3 below.
  - is at the correct voltage for LEU operation.

    Note 1: The expected voltage range for the nominal BX120/NX120 supply is between 105 Vac and 127 Vac however, the ETCS Level 1 equipment is able to operate in the range 96 Vac to 132 Vac.

    Note 2: Input terminals are provided with banana jacks for voltage measurement purposes.
- Check that the signalling interface voltages and currents are correct as per Section 8.3.4 below.

8.3.3 ETCS Power Supplies

8.3.3.1 24Vdc Power Supply

The expected output voltage range for the MIPS200 power supply is 24 Vdc with dynamic voltage regulation limits constrained to +/-2V. In practice, a voltage variation of less than +/-0.5 V is expected.

Note 1: That the LEU can operate in the range of 18 Vdc to 36 Vdc.

A 24 Vdc voltage measurement may be carried out by applying meter probes to terminals A and B (refer standard drawing M05-520) of the 6- way plug.

Note 2: It is important to be aware that the negative (zero) 24 Vdc is permanently connected to ground within the LEU.

Current measurement is to be carried out using a contactless ‘tong’ tester / clamp meter.

A MIPS200 will draw between 12 to 18 W per LEU module depending on how many balises are connected.

For details of the 24 Vdc output power cable and wired connections, refer to standard drawing M05-520.

For details of the 120 Vac input power cable and wired connections, refer to standard drawing M05-522.

8.3.3.2 Power Supply 120Vac Input EMC Filter Module

Note: It is not practical to functionally test a power filter module in the field.

There should be very little voltage drop across the module (typically 0.2%) and if more than a 1.8% (as advised by manufacturer), replace the module.

8.3.3.3 LEU Output Transient Protection

Pigtails or unnecessary bends on the tail cable armour drain wires terminated at the transient protection device are to be avoided and wires are to be kept as short as practical.

Refer to Appendix C for LEU output transient protection device test procedure.

8.3.4 Signalling Interfaces

Where an LEU cannot build a valid telegram table due to a problem with the measured lamp states e.g. input(s) are out of range, unstable, an invalid signalling input combination or a problem with information using the Ethernet interface, then the output to the 'controlled' balise will be a default telegram.

Note: This is not a fault of the LEU but rather a problem with the signalling system. In this case an LEU Telegram Input Correspondence Test (see Section 11.5) should be carried out to confirm that lamp currents are within correct thresholds and produce the correct LEU output.

Pulsing inputs may need to be checked for frequency and duration cycles.

Note: Wherever possible, use a contactless 'tong' tester / clamp meter to measure the current.

8.3.4.1 Contact Sensing Inputs

Where the signalling interface is via relay contacts, an external resistor is provided to convert the external voltage into a current when the relay contact is closed.

Contact sensing installations can be readily recognised by the presence of the toroidal transformer(s) and the resistor holders. The transformer input and output terminals are isolatable and are provided with banana jacks for measurement purposes. The transformer has two separate parallel connected windings on the primary and secondary.

A primary winding (120V) going short circuit will likely become evident by blowing the input fuse.

One open winding may not be self-evident or detectable by simple voltage measurement.

If the output voltage is out of range consider replacing the transformer.

Before suspecting a transformer fault, check first the presence of the primary power (BX120/NX120), as the problem could be related to a blown fuse or a wiring problem or a high resistance terminal connection. For normal operation, ensure that all transformer isolator terminals are fully pushed in.

Refer to standard drawing M05-531 for transformer product details.

8.3.5 ETCS Functional (Data) Checking

The following Level 2 checks will require the use of the BEPT (see Section 10) and should only be undertaken once all other level 1 and level 2 checks have been exhausted:

1) Check that the balise is not "muted" (see Section 10.7.2).

2) Carry out Balise Telegram Testing (see Section 11.2) to check if a fixed or controlled balise is transmitting its default telegram. The M_MCOUNT value should be 255 for fixed balises or 254 for controlled balises.

   Note: For a controlled balise, the default telegram is the telegram that is sent by the balise when the LEU / balise interface is faulty or disconnected.

3) For a controlled balise, carry out ETCS Functional Testing (see Section 11.2.2) using the BEPT on top of the balise to ensure that the M_MCOUNT is not "254" (default telegram), and that the M_MCOUNT changes as the aspects change (for a controlled balise only), and is "1" when the signal is at Stop.

   Note 1: Refer to ETCS LEU tables for correspondence between signal aspects vs expected M_MCOUNT's.

   Note 2: Where it is not practical to carry out a BEPT test on top of the balise due to the risks involved with working on a live track, connect the BEPT to the LEU using the supplied Ethernet cable and carry out the above testing this way.

4) Check that the LEU clock is synchronised to the correct time in the BEPT (see Section 10.8.1).

   Note 1: The LEU clock should be checked each time it is connected to a BEPT.

   Note 2: The LEU clock is automatically reset to 1 Jan 1984 whenever the LEU is powered up. LEU clocks are to be set to Eastern Standard Time (EST).

   Note 3: The LEU / BEPT clocks are not to be adjusted due to daylight savings time changes.

5) For a controlled balise, carry out LEU Configuration Key Data Checking (see Section 11.4) to confirm that the LEU Configuration Key is programmed correctly.

6) Download and analyse the SigEvent and SysEvent logs for the LEU (see Appendix B). The LEU is able to log the following signalling events: change of inputs / change of outputs / detection of a passing train.

   Note: A log is generated separately for each LEU output channel with storage for 10,000 events before they are written over. When a LEU is reset (powered off and then powered on again), the new log entries will commence at 00:00 1st January 1984.

   Note: The Programmer must first log in under the Programming Manager profile ('ertms') in order to set the BEPT clock. Once the clock has been set, the programmer shall log out of 'ertms'.

Refer to Alstom - Micro-COBALT, Micro-coder and ALIS User Manual TRV1340003990 for further details on log file retrieval, event identifiers and error codes.

Caution: Interrogating a balise using the BEPT tool may interfere with the actual telegram contents and therefore this interrogation should not be done when trains could be running over a nearby balise in case the wrong balise is being interrogated.

9 Failure Rectification & Repair

9.1 ETCS Track Mounted Equipment

9.1.1 Balises

A balise with more than minor damage must be scheduled for replacement.

Minor damage of a balise is defined as outer surface scuffing, nicks or gouging of the casing which has not penetrated the outer surface of the balise by more than 3mm.

Caution: During corrective maintenance, never remove all balise of a group at the same time.

If a faulty controlled balise is being replaced and the tail cable and plug are not considered faulty, it is OK to unplug the balise tail cable from the balise (using a plug locking / unlocking key, see Figure 16). It should be ensured that the exposed end of the plug is maintained free of water / mud / other contaminants during the balise replacement.

Immediately after the removal of a balise; fit an identification tag to the removed balise. The tag shall include the following minimum details:

- Balise ID nameplate information,
- Balise serial number (where legible), and
- Reason for removal.

Caution: The tag must remain on the balise as long as the balise contains configuration data.

Where operational or safety implications do not permit immediate access to the four foot in order to re-fix a balise to the sleeper or slab due to an unserviceable anchor, then the balise may be mounted on a Vortok Universal type spreader beam as a temporary measure (see Section 5.1.2.3).

Balises temporarily mounted using a spreader beam shall be fixed down to the track in the normal manner at the earliest opportunity.

The serial number and ID details of a replacement balise must be logged and uploaded to the appropriate asset management database.

Procedures for removal and reinstallation of a balise are discussed in Sections 7.2 of this document.

When a balise has been replaced, it will be necessary to programme the balise in accordance with Section 10.7 of this document.

All fixed and controlled balises, once re-installed, require a Balise Telegram Test, as detailed in Section 11.2 of this document.

9.1.1.1 Balise Mounting Tolerances

When re-installing a balise on the track, the position must comply with the installation constraint rules defined by standard drawing M05-503 and specification *SPG 0706 Installation of Trackside Equipment* for vertical and horizontal alignment for the affected location.

Balises must be re-installed exactly as they were originally, or as permitted in accordance with the tolerances detailed in Sections 7.2.5.2.1 to 7.2.5.2.3 above, unless changes have been approved.

Caution: Correct positional placement of the balise is critical to the reliable operation of the ETCS system.

Moving a balise outside of these tolerances would normally require a data change. Failure to follow this requirement could result in trains reporting a trackside failure, particularly for linked balises (i.e. the majority of balises).

9.1.1.2 Spreader Beam Mounting

Where a Vortok spreader beam is found to be damaged and not fit for service, it shall be replaced.

Mark the position of the beam on the track, in line with Section 7.2. If the balise is fit for service, it shall be removed from the damaged beam and fitted to the new replacement beam. A balise location ID plate is not required to be installed for temporary installations (e.g.: Temporary Speed Warning) however, if the beam is being temporarily used in place of a damaged balise anchor, the location ID plate must be retained.

Refer to standard drawing M05-548 for balise re-mounting instructions using the Vortok Spreader Beam kit.

9.1.1.3 ID Plates

A balise ID plate or a balise location ID plate with more than minor damage is to be scheduled for replacement. Minor damage of an ID plate is defined as all characters readable and the plate still well secured in place.

ID plates which are missing or unreadable due to damage are to be replaced at the earliest opportunity.

Refer to drawings M05-524 and M05-546 for ID plate manufacturing and fixing details.

Refer to the Signalling Plan for name plate details.

9.1.1.3.1 Balise ID Plate

The balise ID plate shall not be removed from any balise, except in a circumstance where a balise is to be replaced, as described below.

When replacing a balise the following identification replacement procedure(s) shall be adhered to:

- Where the existing balise ID plate is recoverable, the balise ID plate shall be transferred to the replacement balise.

- Only one balise shall have the ID plate removed at a time, to ensure that plates cannot be mixed up. The replacement balise serial number and ID shall be logged and the information recorded and uploaded to the appropriate asset management database.
- Where the existing balise ID plate is not recoverable and a replacement ID plate is not available, then the replacement balise shall be clearly marked with a permanent marker as an interim solution with the balise ID details. A new balise ID plate must be manufactured and fitted at the earliest opportunity.

9.1.1.3.2 Balise Location ID Plates

Balise location ID plates are to be bolted down during the construction initial installation phase but may be glued down during the maintenance phase.

9.1.1.4 Balises at Guard Rails

Where the mechanical insulation at the block joint (Benkler joint) has failed, the failure shall be reported to the Track Maintainer for immediate rectification.

9.1.2 ETCS Cables

Caution: The transient protection cassette at the LEU must always be first removed before carrying out a cable replacement or cable repair.

Caution: The tail cable screen may be at a significantly different potential (up to 70V and higher) between the local earth or rails and the LEU signalling location earth. When working on these cables near to the track, care must be taken if the cable shield/armour is still connected to the LEU location earth.

9.1.2.1 ETCS Balise Tail Cables

A balise tail cable with more than minor damage is to be scheduled for replacement.

Minor damage of a balise tail cable is defined as the outer sheath cut but armour braid not significantly torn or balise plug scuffed but not cracked.

A damaged balise tail cable should be replaced with a new cable assembly except in exceptional circumstances where a replacement is not available, in which case the cable assembly may be temporarily repaired.

Whenever a cable has been detected as damaged, in addition to checking that the balise is still electrically connected to the LEU, the balise plug/socket interface shall be inspected for damage as follows. Check that the:

- Plug securing screw and matching socket thread in the balise are not stripped.
- Electrical connections are not damaged.
- Plug moulding is not cracked.
- Tail cable has not been pulled out of the plug cable gland.

If the armour/shield is exposed, first isolate the cable earth in the balise junction box before working on the balise tail cable.

9.1.2.1.1 Cable Repair

Minor damage to the outer sheath may be repaired using melt-glue thick-wall heatshrink or, 3M Scotch Self Amalgamating tape (to hermetically seal the cable) then an outer layer of mechanical protection tape (e.g.: PVC).

It is not necessary to disconnect the LEU in this scenario.

9.1.2.1.2 Temporary Cable Repair

Where the temporary repair consists of in-line jointing, the cable is to be joined in accordance with accepted TfNSW Signalling cable jointing procedures. This is a temporary solution only, until the entire cable assembly can be replaced at a suitable opportunity.

In-line jointing repairs to the cable should be carried out with the cable fully disconnected from the balise junction box.

The Signalling Maintainer shall repair the balise tail cable in accordance with the following procedures:

1) First remove the transient protection cassette at the LEU (the LEU should also be powered down by removing the BX fuse(s) and opening the NX isolator terminal(s)),
2) Fully disconnect the cable at the balise junction box,
3) Loosen off the cable flexible conduit saddles on the post (where fitted),
4) Loosen off the cable gland and slide the cable through the balise junction box gland,
5) Unplug the cable plug at the balise using the SAIB tool,
6) Cut the cable ties at the cable protector plates,
7) Remove the cable (with hose) from the track,
8) Join the cable,
9) Replace the cable in the reverse order,
10) Re-terminate the cable inside the balise junction box,
11) Check all cables connections starting at the plug at the ‘controlled’ balise and working back to the LEU.
12) Re-install the transient protection cassette at the LEU,
13) Power up the LEU (if powered down) by fitting the BX fuse(s) and closing the NX isolator terminal(s),
14) Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.

9.1.2.1.3 Temporary Plug Repair

Where a plug has been pulled from the balise, the thread of the centre securing screw of the plug or the balise socket or both, will have likely been stripped. Where the pair of electrical connections are not damaged and the securing screw threads are still sufficient

to be able to resecure the plug, the plug may be re-inserted using a thread securing compound such as Loctite 243 (or equivalent) until the complete tail cable and or balise can be replaced.

If a wire has been snapped off the lug terminal inside the plug it may be repaired until the complete tail cable can be replaced.

A plug repair shall be carried out with the cable fully disconnected from the balise junction box.

The Signalling Maintainer shall repair a plug in accordance with the following procedures:

1) First remove the transient protection cassette at the LEU (the LEU should also be powered down by opening the NX isolator terminal(s) and removing the BX fuse(s)),
2) Fully disconnect the cable at the balise junction box (includes the earth wire),
3) Loosen off the cable flexible conduit saddles on the post (where fitted),
4) Loosen off the cable gland and slide the cable through the balise junction box gland,
5) Unplug the cable plug at the balise using the SAIB tool,
6) Cut the cable ties at the cable protector plates,
7) Remove the cable (with hose) from the track,
8) Repair the plug,
9) Replace the cable in the reverse order,
10) Re-terminate the cable inside the balise junction box,
11) Check all cables connections starting at the plug at the ‘controlled’ balise and working back to the LEU.
12) Re-install the transient protection cassette at the LEU,
13) Power up the LEU (if powered down) by fitting the BX fuse(s) and closing the NX isolator terminal(s),
14) Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.

9.1.2.1.4 Cable Replacement

A replacement balise tail cable shall be of the same length as the original cable with no excess length. Cable length slack shall not allow the wrong connection of a balise.

The Alstom pre-assembled pluggable cable is available in standard lengths of 6m and 12m. Refer to standard drawing M05-510 for part numbers. The 6m and 12m long cables suit the majority of situations however, occasionally a longer cable might be required. The maximum permitted length of a balise tail cable is 30m.

A cable exceeding 12m in length up to a maximum of 30m, will require cutting from a roll and the balise plug fitted to the cable. Refer to standard drawing M05-552 for details.

Note: The balise tail cable is cut to length at the balise junction box, when terminating on site.

The Signalling Maintainer shall replace the balise tail cable in accordance with the following procedures:

1) First remove the transient protection cassette at the LEU (the LEU should also be powered down by opening the NX isolator terminal(s) and removing the BX fuse(s)),

2) Disconnect the damaged cable at the balise junction box,

3) Loosen off the cable flexible conduit saddles on the post (where fitted),

4) Loosen off the cable gland and slide the cable through the balise junction box gland,

5) Unplug the cable plug at the balise using the SAIB tool,

6) Cut the cable ties at the cable protector plates,

7) Remove the cable (with hose) from the track,

8) Replace the cable in the reverse order,

9) When assembling a non-standard length balise tail cable (i.e. >12m and less than 30m long), the cable must be bell checked for continuity before connection,

10) Re-terminate the cable inside the balise junction box,

11) Check all cables connections starting at the plug at the 'controlled' balise and working back to the LEU.

12) Re-install the transient protection cassette at the LEU,

13) Power up the LEU (if powered down) by fitting the BX fuse(s) and closing the NX isolator terminal(s),

14) Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.

Note: If the existing protective flexible conduit is still serviceable it should be re-used.

9.1.2.2 ETCS Tail Cables

Where the portion of the tail cable protruding up from the ground underneath the balise junction box has been damaged, it may be possible in some cases to pull through excess cable from a pit, to enable the damaged end to be cut off and the cable re-terminated. Alternatively, the damaged portion of the cable can be cut away at a nearby cable pit and jointed in-situ using an approved jointing kit.

ETCS tail cables may be in-line jointed as a temporary measure until the jointed cable can be replaced at the earliest suitable opportunity. An emergency replacement of a tail cable less than 100m long may be surface laid as a temporary measure until it can be re-run permanently into the protected cable route at the earliest suitable opportunity.

Repairs to the cable must be carried out with the cable fully disconnected from the balise junction box and at the LEU end. Isolation at the LEU end may be achieved by unplugging the transient protection cassette and disconnecting and insulating the cable

shield and armour from the earth grid. The cable armour and shield shall not be allowed to come into contact with the rails or any other metal trackside structures.

The Signalling Maintainer shall replace the faulty tail cable in accordance with the following procedures:

1) First remove the transient protection cassette at the LEU (the LEU should also be powered down by opening the NX isolator terminal(s) and removing the BX fuse(s)),

2) Disconnect the cable at the LEU location,

3) Disconnect the cable at the balise junction box,

4) Loosen off the cable gland and slide the cable out through the balise junction box by pulling back into the cable pit or re-enterable cable route,

5) Loosen off the cable gland and slide the cable out from the LEU location by pulling back into the cable pit or re-enterable cable route,

6) Remove the cable,

7) Replace the cable in the reverse order,

8) Re-terminate the cable inside the balise junction box,

9) Check all cables connections starting at the plug at the 'controlled' balise and working back to the LEU,

10) Re-install the transient protection cassette at the LEU,

11) Power up the LEU (if powered down) by fitting the BX fuse(s) and closing the NX isolator terminal(s),

12) Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.

The repair or jointing of a tail cable is to follow the above step by step procedure however, depending on the extent of the repair it may not be necessary to remove the existing cable.

Note 1: The Alstom balise has a two wire interface which is not polarity sensitive.

Note 2: If only one pair of a two pair cable is damaged, or where a spare cable is available, the spare pair may be used as an interim measure until repairs or replacement can be implemented.

Note 3: Cables may be surface laid in some cases as a temporary measure (where it is not practical to install the cable within the cable route immediately).

Caution: Some existing types of cast cement cable troughing and other infrastructure materials may contain asbestos fibres. Care is to be taken when disturbing this infrastructure not to breath in fibres or contaminate clothing etc.

Caution: Insulation (Megger) testing must not be carried out on ETCS tail cables or ETCS balise tail cables.

9.1.3 Balise Junction Box

A balise junction box with more than minor damage is to be scheduled for replacement.

Minor damage to a balise junction box is defined as the case being distorted such that it does not permit rain to enter and components contained therein are not damaged or visible or accessible from outside the case.

Where a balise junction box is showing signs of external damage, the cables internal and external to the box shall be inspected.

Where a cable has been caught up in dragging machinery or pulled by vandals, the wire terminations and the terminals shall be inspected. Terminals shall be replaced where damaged.

If a balise junction box is damaged beyond recovery, it should be replaced immediately. A severely damaged or destroyed junction box may be replaced with a temporary suitable alternative junction box as a temporary measure. In exceptional circumstances where the balise is operationally critical and a replacement balise junction box is not available immediately, the balise tail cable may be in-line jointed to the tail cable until such time as it is possible to replace the balise junction box.

The Signalling Maintainer shall replace a balise junction box in accordance with the following procedures:

1) First remove the transient protection cassette at the LEU (the LEU should also be powered down by opening the NX isolator terminal(s) and removing the BX fuse(s)),
2) Disconnect the cables at the balise junction box,
3) Loosen off the cable gland for the tail cable,
4) Unbolt and carefully slide the balise junction box up and off the cables,
5) Carefully replace the balise junction box in the reverse order,
6) Re-terminate the cables inside the balise junction box,
7) Check all cables connections starting at the plug at the ‘controlled’ balise and working back to the LEU,
8) Re-install the transient protection cassette at the LEU,
9) Power up the LEU (if powered down) by closing the BX fuse(s) and closing the NX isolator terminal(s),
10) Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.

Refer to standard drawings M05-511 (above ground) and M05-567 (tunnel) for balise junction boxes cable termination and assembly details.

Caution: The tail cable screen may be at a significantly different potential (up to 70V and higher) between the local earth or rails and the LEU signalling location earth. When working on these cables near to the track, care must be taken if the cable shield/armour is still connected to the LEU location earth.

9.2 ETCS Location Equipment

9.2.1 LEU

This section outlines the detailed procedures for the replacement of defective LEU's.

Document the replacement of an LEU using the *LEU Replacement Testing Form (ETCS M2).*

Important Note: Prior to replacing an LEU, first check that the new LEU is of an approved hardware and firmware version.

Important Note: Prior to replacing an LEU, first check that the new LEU is un-paired. Refer to Section 5.2.3.1 LEU Pairing for information.

a) Disconnecting the defective LEU

- If it's not already done, disconnect the corresponding MIPS200(s) from the primary power (BX120/NX120) by first opening the NX isolator terminal(s) and then removing the BX fuse(s). In the case of a signal using two (or more) LEU modules (LEU-A and LEU-B present), all LEU modules associated with the signal must be switched off even if only one LEU module needs replacement.
- If more than one LEU module needs to be replaced, then they must be replaced one at a time, i.e. disconnect, replace and reconnect before moving to the next LEU module.

Caution: For current sensing installations only, undertake the following, in the order shown

1. **Power down all LEU modules**
2. **Close (i.e. fully push in) all the bypass terminals related to the LEU. Use a flat tip screwdriver to ensure that the pin is fully home**
3. **Open ETCS/signal interface isolation terminals associated with the LEU to be disconnected**
4. **Disconnect input plug connectors (A2/A3) from LEU**

Caution: With current sensing installations, the signal indications could be affected if the bypass terminals are operated incorrectly when the LEU is unplugged.

Caution: Do not push in bypass terminal(s) when the LEU is powered up. Failure to observe this warning may lead to 'fusing' of the LEU (Inhibited State). See Note 1 below.

Note 1: A short circuit on the LEU input is detected by the self-test function, as a fault.

Note 2: If an LEU with current sensing inputs is removed for an extended period, a suitable tag shall be fitted to the bypass terminals of that LEU warning that 'LEU removed – Do not operate bypass terminal'.

- Use a flat tip screwdriver to unscrew the Sub-D Power 2-pin connector (A5) of the LEU to be replaced.
- Use a flat tip screwdriver to unscrew the LEU configuration key (A1). Pull the LEU configuration key from the LEU, but keep its tether cord attached to the frame/cabinet.
- Use a flat tip screwdriver to unscrew the LEU vital plug couplers (A2/A3). Make sure not to stress the attached wires by keeping the plugs hanging as close as possible to their original positions.
- Disconnect the Ethernet cable on the bottom side (A7/A8) if there is one.
- Disconnect the balise cable(s) on the bottom side (A9/A10) as applicable.
- Use a tubular socket wrench to unscrew the M6 screw nut on the ground bolt on the bottom end (A13) of the LEU and disconnect the earthing braid from the defective LEU. Retain order of washers.

b) Removing an LEU

Caution: No more than one LEU module or LEU configuration key is to be removed at a time.

- Prior to, or immediately after removal; fit an identification tag to the LEU. The tag shall include the following minimum details:
  - LEU ID Nameplate information,
  - LEU Serial number, and
  - Reason for removal.

Caution: The tag must remain on the LEU module as long as the LEU is paired with configuration data.

- Use a Phillips pan-head screwdriver #2
  - Unscrew the upper M6 screw (A14) first
  - Then loosen the lower M6 screw (A15)
- Remove the LEU from the cabinet/frame.

c) Replace protecting covers on the defective LEU

- After extracting the product from its mounting support, replace the protecting covers as indicated below.

  Note: the covers and caps from the new LEU could be used for this, in which case step d) should be done before step c).

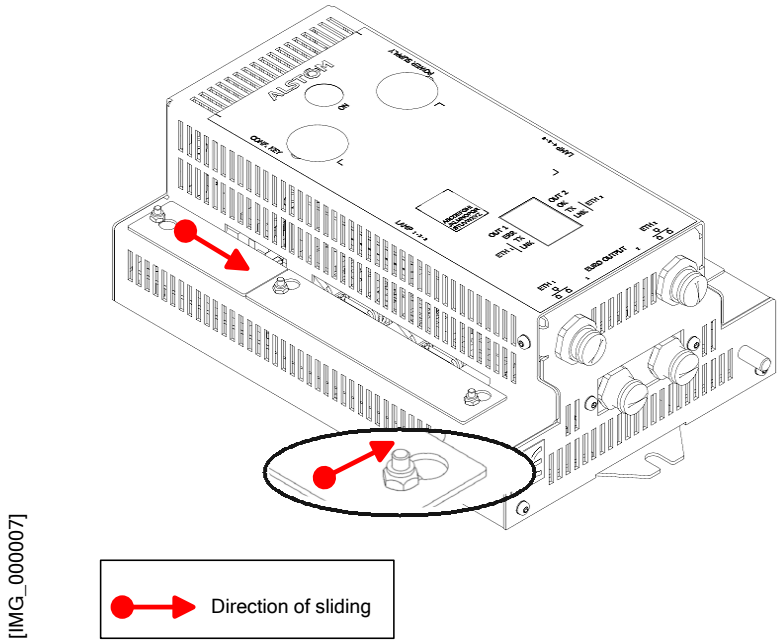


Figure 57 - LEU Covers – Part 1

- There are 4 metal covers: (up to) two covers for the vital inputs, one for the power supply and one for the LEU configuration key (see A17 and A18). Using a M5.5 tubular socket wrench:

- Loosen the 2 screws (A16) slightly (about 1 mm) to allow to insert the cover,
- Insert the cover vertically,
- Slide the cover towards its end position (following the red arrow), and
- Tighten the 2 screws.

– Screw caps on the balise outputs and Ethernet connectors and tighten them gently.

Note: In case only one LEU vital plug coupler is being used, the protecting cover on the other side should still be present. Similarly caps of unused balise outputs or Ethernet connections should have been kept in place.

Caution: Take care when loosening the cover screws to prevent them from falling inside the LEU.

d) Remove protecting covers from the new LEU

– After extracting the new LEU from its packaging, remove the protecting covers as described below.

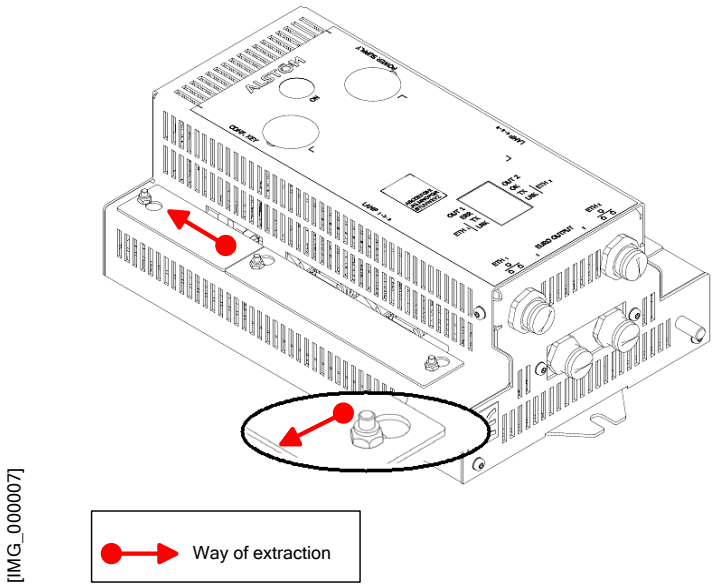


Figure 58 - LEU Covers – Part 2

– There are 4 metal covers: (up to) two larger covers for the vital inputs, one smaller for the power supply and another smaller for the LEU configuration key (see A17 and A18). Using a M5.5 tubular socket wrench:

- Loosen the 2 screws (A16),
- Slide the covers following the red arrows,
- Extract the cover vertically, and
- Tighten the 2 screws.

– Remove Screw cap(s) on the balise output(s) and Ethernet connector(s) (A19).

– Unscrew only the caps from the connectors that require connection

Note: These covers play a role in the EMC protection of the product. The covers and screw caps could be re-used for the defective LEU.

Note: The protecting covers and caps, if not used on the defective LEU, shall be retained for future use.

Note: the case only one LEU vital plug coupler is to be used, the protecting cover on the other side shall be kept in place.

Caution: Take care when loosening the cover screws to prevent them from falling inside the LEU.

Caution: Ensure that only the covers that are to be used are removed. All unused lamp input, Ethernet and balise connectors should have the cover / cap retained in place.

e) Check connectors

- Before mounting the product in the cabinet or onto the frame, check for cleanliness and for signs of damage of the following interfaces where applicable:
  - The lamp inputs connector (A2 and A3),
  - The power supply connector (A4),
  - The LEU configuration key connector (A1),
  - The Ethernet connector(s) (A7 and/or A8),
  - The balise output connector(s) (A9 and A10),
  - The ground/earth stud (A13). See Note below

  Note: Where an LEU has been replaced, the earth connection consisting of copper braid strap and contact washers must be replaced in accordance with standard drawing M05-532.

f) Installing the LEU

- This is the opposite of step b)
- Hold the LEU at the intended location and use a Phillips pan head screwdriver #2
  - secure the lower M6 screw (A15) first,
  - then secure the upper M6 screw (A14).
- Tighten both screws.

g) Re-connecting the LEU

- This is the opposite of step a)
- Make sure the associated MIPS(s) are disconnected from their primary power source,
- Connect first the earthing braid to the LEU's ground/earth stud (A13) ensuring that the correct washers are fitted and the nut is tightened in accordance with standard drawing M05-532,

- Depending on the installation and if applicable, connect one or two balise cables on the bottom side (A9/A10),
- If applicable, connect the Ethernet cable on the bottom side (A8),
- Depending on the installation insert the one or both LEU vital plug couplers (A2/A3) and use a flat tip screwdriver to secure them,
- De-pair the new LEU using the gold key step (refer to Section 9.2.2),
- Connect the LEU configuration key (A1) on the LEU and use the flat tip screwdriver to secure it.

Caution: For current sensing installations only. Before powering up an LEU:

1. **Make sure that both LEU vital plug couplers are fitted to the LEU,**
2. **Make sure all isolation terminals are fully closed, then,**
3. **Open all bypass terminals related to the signal of the affected LEU (i.e. fully pulled out) and are showing the red mark,**
4. **Connect the Sub-D Power 2-pin connector (A4) and use a flat tip screwdriver to secure it.**

Caution: Items (A7) to (A10) are M12 style of plug connectors and care must be taken with re-installation. Ensure that the plug is gently inserted with the correct orientation (connectors are keyed) and that the securing ring is not cross threaded or stripped by excessive force.

Caution: Failure to pull out all bypass terminals before powering up the LEU may lead to 'fusing' of the LEU (inhibited state).

Note: A short circuit on the LEU input is detected by the self-test function, as a fault.

h) Power-up and visual check

- Re-connect the MIPS200(s) to their primary power source (BX120/NX120) by first inserting the fuse(s) and then closing the disconnect terminal(s). This shall be done for the one or both LEU modules (LEU-A and LEU-B) as applicable.
- Check for the 1 or 2 affected LEU modules that they are operational after 70 seconds with the correct indications as explained in Section 8.2.3.1.
- **For current sensing installations only:** Make sure all bypass terminal tabs related to the signal (LEU-A and LEU-B if two LEU modules are being utilised) are first fully pulled out (open) before powering up the LEU modules. Check that the lamp signal aspect is as expected.

i) LEU clock synchronisation

- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

j) Tests

- Using the BEPT, Perform an LEU Telegram Input Correspondence Test for at least one proceed aspect. Refer to Section 11.5 for details.

- Check the voltage at the outgoing side of the transient protection cassette for approximately 10Vac with the cassette installed.
- If two balises are connected to one LEU, or more than two LEU's exist at the location, correlate the LEU output to the balise output cable using the labels on the cable to the transient protection cassette ID label. Test as follows:
  - o remove LEU output 1 transient protection cassette and correlate to the output 1 LEU indication slow flashing green,
  - o restore the transient protection cassette and correlate to the output 1 LEU indication extinguished.

Note: This is conducted to ensure that balise output cables have not been crossed over on installation of the new LEU.

k) Administration

- The serial number and ID details of a replacement LEU shall be logged and uploaded to the appropriate asset management database.

9.2.2 De-Pairing of an LEU with a Gold Key

The pairing of an LEU with an LEU configuration key can be erased (de-pairing) by using a Gold Key. A Gold Key is an LEU configuration key with special data that instructs the LEU to de-pair.

The procedure for de-pairing an LEU is as follows:

1) Remove the LEU configuration key,
2) Plug in the Gold Key,
3) Reboot the LEU (by powering down and re-powering up),
4) Remove the Gold Key, and
5) Synchronise the LEU clock (see Section 10.8.1).

During the boot up sequence, the LEU will exhibit the indication sequence detailed in Section 8.2.3.3.

Where an LEU consists of 2 or more LEU modules, each LEU module to be de-paired will need to be de-paired separately by following the above sequence.

9.2.3 Replacement of Terminals & LEU Interface Equipment

9.2.3.1 LEU Vital Plug Couplers

The LEU vital plug coupler is the means of inputting the signal information to the LEU. The LEU vital plug coupler pins/sockets are relatively fragile. Care must be taken with re-connecting these plugs to the LEU.

Refer to standard drawing M05-516 for LEU vital plug coupler hardware details.

Before removing an LEU vital plug coupler, the LEU must be shut down.

Caution: In the case of an LEU with current sensing inputs, the LEU must be shut down and isolated according to a strict procedure defined in this manual.

Faulty LEU vital plug couplers or individual affected sockets should be replaced as follows:

a) Removal of LEU Vital Plug Coupler

- Follow procedures detailed in Section 9.2.1 for powering down the LEU,
- Proceed with replacement(s).
- Only remove one plug coupler at a time.

b) Replacement of LEU Vital Plug Coupler

- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Using the BEPT, carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) to confirm all aspect inputs and complete the *LEU Replacement Testing Form (ETCS M2*).

9.2.3.2 By-Pass Terminals (Current Sensing Only)

By-pass terminals are only fitted at current sensing input locations.

Before operating a by-pass terminal, the LEU must be shut down and isolated according to a strict procedure.

By-pass terminals are fitted in the output circuit of the TFM and are typically located near to the TFM. Before replacing a by-pass terminal, the LEU and TFM must be shut down and isolated (refer to PR S 40032 for shutting down of a TFM).

Failed by-pass terminals should be re-terminated where only the connection is at fault, or where the terminal itself is faulty, should be replaced as follows.

a) Removal of By-pass Terminal

- Follow procedures detailed in Section 9.2.1, for powering down the LEU, operating the isolation terminals and operating the by-pass terminals,
- Power down the TFM by first opening the NX isolator terminal and then removing the BX fuse,
- Proceed with replacement(s)/repairs.

b) Replacement / Re-Termination of By-pass Terminal

- Follow procedures detailed in Section 9.2.1, for powering up the LEU, operating the isolation terminals and operating the by-pass terminals,
- Follow procedures detailed in PR S 40032 for powering up the TFM,
- Check that the TFM is functioning in accordance with PR S 40032,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) for all inputs using the BEPT.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.3 Isolation Terminals (Current Sensing)

Isolation terminals are fitted into current sensing circuits and are typically located near to the LEU.

Before operating an isolation terminal, the LEU must be shut down and isolated according to a strict procedure.

Failed isolation terminals should be re-terminated where only the connection is at fault, or where the terminal itself is faulty, should be replaced as follows:

a) Removal of Isolation Terminal

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Proceed with replacement(s)/repairs.

b) Replacement of Isolation Terminal

- Follow procedures detailed in Section 9.2.1, for powering up the LEU, operating the isolation terminals and operating the by-pass terminals,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Carry out an LEU Telegram Input Correspondence Test (see Section 11.5) for all inputs using the BEPT.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.4 Isolation Terminals (Contact Sensing)

Isolation terminals are provided to isolate signal inputs from relay contacts.

Failed isolation terminals should be re-terminated where only the connection is at fault, or where the terminal itself is faulty, should be replaced as follows:

a) Removal of Isolation Terminal

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Proceed with replacement(s).

b) Replacement of Isolation Terminal

- Rectify any found LEU equipment or wiring faults,
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) test for all inputs using the BEPT.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.5 LEU Output Transient Protection

If as a result of carrying out fault finding procedures and rectifying any equipment damage, the Elsafe type 216680 transient protection cassette is found to have failed, the cassette should be unplugged and replaced with a new cassette, as follows:

a) Disconnecting a Transient Protection Device

- Check the LEU and associated equipment and wiring for a fault,
- If the Elsafe transient protection cassette has failed, unplug, replace and dispose of it the faulty cassette.
- If the Elsafe transient protection base needs to be replaced, first power down the LEU associated with the faulty transient protection equipment. Power down the LEU as described in Section 9.2.1,
- Proceed with replacement(s).

b) Re-Connecting a Transient Protection Device

- Rectify any found LEU equipment or wiring faults,
- Plug in a new Elsafe transient protection cassette,
- Power up the LEU (if powered down) as described in Section 9.2.1,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.6 Types A or B Cable at LEU

Types A or B cables are pluggable flexible LEU output cables (see Section 5.1.4 for use). Refer to ETCS Standard Circuits and M05-500 series standard drawings for details.

A failed cable should be repaired (see Section 9.2.1) or replaced as follows:

a) Disconnecting a Type A or B Cable

- Follow procedures detailed in Section 9.2.1, for powering down the LEU, Unplug the Elsafe transient protection cassette,
- If the cable is faulty unplug it, destroy and dispose, or repair,
- Proceed with replacement(s).

b) Re-Connecting a Type A or B Cable

- Rectify any found LEU equipment or wiring faults,
- Plug in new cables. Note that these cables will need to be fabricated,
- Plug in the Elsafe transient protection cassette,
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.7 Toroidal Transformer

The 120V/12V transformer is only used for LEU installations containing ‘contact’ sensing inputs. A blank *ATP Power Supply Maintenance Testing Form (ETCS M4)* should be used to document the testing of a new toroidal transformer.

Caution: Some LEU's may contain a mixture of contact and current sensing inputs.

Failed or out of specification transformers should be replaced as follows (refer to Section 9.2.5 for pass / fail criteria):

a) Disconnecting a Transformer

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Open the transformer primary and secondary isolation terminals,

Caution: There is a risk of electric shock if the transformer is not isolated prior to disconnection.

- Disconnect the transformer input wires and output wires,
- Remove from the DIN rail, destroy and dispose of transformer.

b) Re-Connecting a Transformer

- Orient the new transformer such that the primary and secondary wires line up with the corresponding terminals above and below,
- Clip the replacement transformer onto the DIN rail,
- Connect the transformer input wires and output wires,
- Close the primary terminals,
- Check that the open circuit output voltage is within acceptable limits. Record the voltage on the *ATP Power Supply Maintenance Testing Form (ETCS M4)*,
- If the voltage range for both of the output windings is within normal limits, close the secondary terminals,
- Check that the voltage on the output is still within acceptable limits during normal operation of the LEU. Record the voltage on the *ATP Power Supply Maintenance Testing Form (ETCS M4)*,
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- If a BEPT is available, carry out an LEU Telegram Input Correspondence Test (see Section 11.5) for a limited number of inputs as per Section 11.5.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.3.8 150 Ohm Resistor Module

A 150 Ohm resistor is installed on each 'contact' sensing input to the LEU (refer to standard drawing M05-531 for product details).

If a resistor has failed or the resistor (or module) is showing signs of heat damage or the resistor is out of specification (150 Ohms +/-5% 24 W), the resistor module should be replaced as follows:

a) Disconnecting a Resistor Module

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Isolate the transformer BX12/NX12 by opening the NX isolator terminal and removing the BX fuse,
- Remove the protective plastic cover(s) from the front of the resistor block,
- Disconnect the resistor module input wires,
- Remove the defective module from the DIN rail, destroy and dispose of module.

Note: Only disconnect (and re-connect) one resistor at a time.

b) Re-Connecting a Resistor Module

- Clip the replacement resistor module onto the DIN rail,
- Connect the resistor module input wires,
- If the voltage range is within normal limits, replace the BX12 fuse and then close the NX12 isolator terminal,
- Check that the voltage on the transformer output is still within acceptable limits during normal operation of the LEU,
- Where practical, check that the current flow through the resistor is within normal limits (current will depend on primary voltage and load),
- Re-fit the protective plastic cover(s) over the resistor block,

Caution: Resistors may be hot to the touch.

- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Carry out an *LEU Telegram Input Correspondence* Test (see Section 11.5) for all inputs using the BEPT.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.4 LEU Configuration Key

Requirements for programming are:

- A BEPT with the specific configuration data loaded (or available on an approved USB memory stick).
- A blank *Configuration Key Replacement Testing Form (ETCS M3).*

The LEU configuration key must be programmed and verified, independently by two separate authorised personnel in accordance with Section 10.9.

Refer to *PR S 45005 ETCS Data Management*, for procedures for the control, update and issue of ETCS data.

Caution: No more than 1 LEU or LEU configuration key is to be removed at time.

a) Removing an LEU Configuration Key

- The LEU does not need to be powered down for the LEU configuration key to be removed. The LEU will continue to function with its current configuration in the absence of an LEU configuration key however, an alarm will be raised.
- Use a flat tip screwdriver to loosen both of the securing screws,
- Unscrew the two screws the rest of the way by hand, and remove the key from the LEU.

b) Programming an LEU Configuration Key

- If the LEU configuration key program needs to be updated or programmed, use the BEPT to program the LEU configuration key in accordance with Section 10.9.1.
- When programming an LEU configuration key, the key must first be unplugged from the LEU and plugged into the BEPT via an LEU configuration key cable adaptor.

Note: his is a special process and can only be carried out by trained certified persons.

c) Installing an LEU Configuration Key

- Ensure that the LEU configuration key tether cord length and fixing point prevents the key from being plugged into the wrong LEU,
- Insert the key into the LEU socket and gently tighten up the two screws by hand,
- Use a flat tip screwdriver to gently nip up the two screws.
- Where a key is to be replaced, the length of the tether cord of a new key shall be modified (shortened) in accordance with standard drawing M05-551 to ensure that the key cannot reach a wrong LEU socket.
- Power off and power back on the LEU. Check that the LEU starts up correctly by reading the LED indicators on the LEU.

d) LEU Configuration Key Pairing Error

- Upon restart of the LEU with a replaced LEU configuration key, if the ERROR LED is flashing, it means that there is a problem with the LEU configuration key (bad configuration file or a pairing mismatch).
- In the case of an error, the CRC of the new LEU configuration key data (as programmed from BEPT) must be independently verified with the CRC recorded on the software release notes for the ETCS data from the specific maintenance ETCS data files' storage location in the ETCS database. This is to ensure that the BEPT, *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)* and Maintenance ETCS database are the same version.
- Should an error persist, try de-pairing the LEU with a Gold Key, next the data programming and verification process should be repeated with the same LEU configuration key, then if still unsuccessful, try a new LEU, and finally a new LEU configuration key.
- Replacement of the LEU configuration key with the same data does not require de-pairing as the LEU is paired with the configuration data (software) and not the physical key.

- If the LEU configuration key fails whilst the LEU is operational (i.e. periodic check fails), the LEU remains operational but shows this through the HMI.
- After the key is replaced like for like, a restart is required to remove the HMI warning displayed (but no de-pairing is required).
- The LEU must not be de-paired unless it is verified that the data CRC on the LEU configuration key is identical to that recorded on the maintenance ETCS database.
- An alternative to de-pairing is to replace the paired LEU with an unpaired LEU. Once again, if an LEU configuration key has been changed (or reprogrammed with the same data), then an unpaired LEU may only be used if it is verified that the data CRC on the LEU configuration key is identical to that recorded on the maintenance ETCS database.

e) LEU clock synchronisation

- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

f) Correspondence Testing

- Refer to Section 11.5 for details.

9.2.5 ETCS Power Supplies And Equipment

9.2.5.1 MIPS200 24VDC Power Supply

The power supply installed for LEUs is the MIPS200. A blank *ATP Power Supply Maintenance Testing Form (ETCS M4)* shall be used to document the testing of a new MIPS200 power supply.

Caution: In some installations (typically at annexe cabinets and wall mount plates); the MIPS200 power supply is located behind the LEU. In these cases the LEU module must be first temporarily removed in accordance with Section 9.2.1 of this document.

a) Disconnecting the defective MIPS200

- If it's not already done, disconnect the MIPS200 from the primary power (BX120/NX120) by first opening the NX isolator terminal(s) and then removing the BX fuse(s),
- Use a flat tip screwdriver to unscrew both connector plugs, i.e. the 4 and 6-pole terminal blocks, from the MIPS to be replaced.

b) Removing the defective MIPS200

- Using a Phillips pan-head screwdriver #2:
- Unscrew the upper M5 screw first,
- Then unscrew the lower M5 screw.
- Remove MIPS from the cabinet/frame

c) Installing a new MIPS200

- Hold the new MIPS at the intended location and use a Phillips pan-head screwdriver #2:
  - o secure the lower M5 screw first,
  - o then secure the upper M5 screw.
- Tighten both screws.

d) Re-connecting the MIPS200

- Make sure the MIPS is disconnected from the primary power source.
- Use a flat tip screwdriver to screw both terminal blocks onto the new MIPS (reconnect the 6 pole plug first).

  Note: If the MIPS is located behind an LEU, the LEU must be re-installed in accordance with Section 9.2.1.

e) Power-up and visual check

- Measure and check that the input 120 Vac voltage is acceptable.
- Re-connect the MIPS to the primary power source (BX120/NX120) by first inserting the fuse and then closing the disconnect terminal(s).
- Check that the 24 Vdc LED is lit between the two MIPS power supply connectors (4 and 6-pole terminal blocks).
- Measure and check that the output 24 Vdc voltage is within acceptable limits.
- Complete the *ATP Power Supply Maintenance Testing Form (ETCS M4).*

f) Tests

- Check that the LEU is operational after 70 seconds with the correct indications as explained in Section 8.2.3.1.

g) LEU clock synchronisation

- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

h) Administration

- The serial number and ID details of a replacement MIPS200 must be logged and uploaded to the appropriate asset management database.

9.2.5.2 Power Supply 120Vac Input EMC Filter Module

A blank *ATP Power Supply Maintenance Testing Form (ETCS M4)* should be used to document the testing of a new EMC filter module. A failed or out of specification EMC filter module should be replaced, as follows:

a) Disconnecting a Filter Module

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Disconnect the module from the BX/NX120 by opening the fuse and terminals at the 120V busbars,

Caution: There is a risk of electric shock if the filter module is not isolated prior to disconnection.

- Disconnect the module input wires and output wires (the module is fitted with push-on electrical spade connectors),
- Remove from the DIN rail, destroy and dispose of module.

b) Re-Connecting a Filter Module

- Ensure that the module is oriented correctly on the DIN rail (refer to caution note further below),
- Reconnect the earth, input and output wire(s),
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Check that the voltage to the MIPS200 is within normal limits,
- Complete the ATP Power Supply Maintenance Testing Form (ETCS M4).
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

Caution: Care needs to be taken to ensure that a replacement noise filter module is connected the correct way around. It is physically possible to install the module the wrong way around and the MIPS200 will still work, but in this case the filter module would not function properly.

Standard drawing M05-563 shows the correct orientation

9.2.5.3 Isolation Terminals (Power)

Isolation terminals are provided for general power supply isolation.

Failed isolation terminals should be re-terminated where only the connection is at fault, or where the terminal itself is faulty, should be replaced as follows:

a) Removal of Isolation Terminal

- Follow procedures detailed in Section 9.2.1, for powering down LEU(s),
- Power down other equipment as required,
- Proceed with replacement(s).

b) Replacement of Isolation Terminal

- Rectify any found equipment or wiring faults,
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Power up other equipment as required,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.5.4 120V Power Transient Protection

The DEHN type DRMOD-150 (Sydney Trains stock code 2090751) transient protection cassette is a pluggable device.

A failed transient protection module should be replaced, as follows:

a) Disconnecting a Transient Protection Device

- First disconnect all the ETCS BX120/NX120 sources from the ETCS equipment by first opening the NX isolator terminals and then removing the BX fuses,
- Check the ETCS 120 V equipment and wiring for a fault,
- If the DEHN type DRMOD-150 transient protection cassette has failed, unplug it, destroy and dispose of module.

b) Re-Connecting a Transient Protection Device

- Rectify any found ETCS 120 V equipment or wiring faults,
- Check the upstream supply fuse/breaker, confirm that the power is available,
- Check that the open circuit output voltage is within acceptable limits,
- Plug in a new DEHN type DRMOD-150 transient protection cassette,
- Progressively, apply 120V power to each ETCS device by first installing the BX fuses and then closing the NX isolator terminals,
- Check that each LEU is operational after 70 seconds with the correct indications, and that the LEU(s) can detect the applicable balise as explained in Section 8.2.3.1.
- Synchronise each LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.6 LEU Networking Equipment

9.2.6.1 LEU Indications

Where an Alstom LEU consists of two separate LEU (Alstom Micro-Coder) modules, an Ethernet copper cable is used to link the two LEU modules. Where either of the two LEU modules has been replaced or the Ethernet cable has been disturbed, check that the Ethernet link indicators are lit steady or blinking. Refer to Section 8.2.3.1 for details.

Where an Alstom LEU consists of three LEU modules, an RS900 Ethernet network switch is used to connect the three LEU modules. An RS900 is also used for networking (via fibre optic cable) to an LEU at another location (typically for look-ahead functionality).

If a networking device (including Ethernet switch device and/or power supply) has been replaced or an Ethernet cable has been disturbed, ensure that the equipment is functioning correctly.

A failed or out of specification RS900 Ethernet network switch should be replaced, as follows:

Precautions when working with fibre-optic cabling and equipment:

- Personal safety precautions in accordance with PR S 40042 - Safety Issues for Signalling Personnel.

- Care should be taken when handling fibre optic patch cords to avoid excessive bending that may lead to damage of the glass fibres.
- Unconnected fibre optic ports and plugs must be covered.
- Plugs should be cleaned with alcohol prior to making.

Caution: It may be a health hazard to stare directly into an optical fibre

9.2.6.2 RS900 Ethernet Network Switch Power Supply

Where an RS900 Ethernet network switch is used for connection of three LEU modules, the RS900 switch will likely be powered from the same MIPS200 used for powering one of the three LEU modules. Refer to the circuit book for exact configuration.

Where an RS900 Ethernet network switch is used only for an optical network e.g.: look-ahead function and is not used for connection of three LEU modules, the RS900 will likely be powered from an independent MIPS200. Refer to the circuit book for exact configuration.

9.2.6.3 RS900 Ethernet Network Switch Replacement Procedure

Ensure that the RS900 Ethernet network switch is of the correct type.

9.2.6.3.1 Installation of Replacement RS900 Ethernet Network Switch

Isolate power to the RS900 and all LEU modules interfaced to the same signal as follows:

a) Disconnecting an Ethernet Device

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Power down the RS900 Ethernet network switch by first opening the NX isolator terminals and then removing the BX fuses on the 120 Vac supply feeding the MIPS200 powering the RS900,
- Disconnect the RS900 Ethernet cables and power plug,
- Remove the RS900 from the DIN rail.

b) Re-Connecting an Ethernet Device

- Check the ETCS 24Vdc MIPS200 and wiring for a fault,
- Check that the open circuit output voltage is within acceptable limits,
- Install the new RS900 Ethernet network switch.

  Note: The RS900 does not need to be managed or configured for ATP.

- Ensure that network cables from the RS900 Ethernet network switch are connected to the LEU Ethernet Port 2 only as detailed in Section 9.2.6.
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Power up the MIPS200 for the RS900 (if powered down) by first installing the BX fuses and then closing the NX isolator terminals,
- Confirm that the LEU's Ethernet link indicators are lit steady or blinking. Refer to Section 8.2.3.1 for details,

- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Confirm that the RS900 Ethernet network switch indicator(s) status is not showing a fault. Refer to Section 5.2.6.4 for RS900 indicator status details,
- Follow the functional checking procedures detailed in Section 11.5 to confirm that the correct output telegrams are being generated by the LEU.
- Where the look-ahead function is being used, and data is being transmitted from this location to another, the LEU location receiving the data must also have a check carried out to ensure the correct telegrams are being generated.

9.2.6.4 Replacement of Networking Cables

9.2.6.4.1 Ethernet Cables Types J or K

Cables types J and K allow LEUs to communicate. Types J or K cables are pluggable devices. Refer to standard drawing M05-527 for mechanical details.

The voltage of these cables is in the extra low voltage range and does not present a personnel hazard under normal conditions.

A failed cable should be replaced, as follows:

a) Disconnecting a Type J or K Cable

- Check the LEU(s) and associated equipment and wiring for a fault,
- If the cable needs to be replaced, follow procedures detailed in Section 9.2.1, for powering down the LEU(s),
- Proceed with replacement(s).

b) Re-Connecting a Type J or K Cable

- Rectify any found LEU equipment or wiring faults,
- Plug in new cables. Note that these cables will need to be fabricated,
- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Carry out RS900 Ethernet network switch checks as detailed in Section 9.2.6.

9.2.6.4.2 Optical Ethernet Cables

Where look-ahead functionality is being implemented via an optical Ethernet interface, a redundant optical interface is provided between the pair of RS900 Ethernet network switches.

The optical fibres for the RS900 Ethernet network switches are single mode with a wavelength of 1310nm. This is in the infrared spectrum range and is not visible to the human eye.

Caution: It may be a health hazard to stare directly into an optical fibre.

Operational Technology are responsible for maintaining the optical cables.

The RS900 Ethernet network switch also has fault diagnostics that can be used to determine whether there is a fault with the fibre link (see Section 8.2.4).

Where the fibre or signal quality is suspect, an optical power level meter will be required to determine the quality of the optical signal.

Individual Fibre Damage

Twelve fibres are terminated at the patch panel. Four out of the twelve are required for the redundant interface between a pair of RS900 Ethernet network switches. These fibres are all in the same cable.

Where it is suspected that damage has occurred to the optical cable and not all the terminated fibres are severed or a fibre has degraded, it may be possible to find sufficient viable fibres by re-assigning optical patch cords (one at a time) to spare terminated connections provided on the patch panel.

Note: When re-assigning a patch cord, a matching re-assignment is required at the opposite end of the cable.

Record details in the temporary repair register.

After re-assigning patch cords, check that the LEU can detect the controlled balise and that there are no fault indications showing on the LEU's or the RS900 Ethernet network switches.

Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) on both LEU's using the BEPT.

Arrange for the cable to be repaired if viable, or replaced at the soonest opportunity.

Note: a non-redundant optical link arrangement (i.e. two fibres) is permitted for a short time, until the cable can be repaired.

Repair of Optical Cable

After a cable has been repaired:

- Check the fusion splice test report to ensure that the loss for each terminated fibre is within the acceptable range for the RS900 Ethernet network switch,
- Ensure that the patch cords are all assigned correctly in accordance with the circuit book,
- Check that the LEU can detect the controlled balise and that there are no fault indications shown on the LEU's or the RS900 Ethernet network switches, refer to Sections 8.2.3 and 8.2.4.
- Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) on both LEUs using the BEPT.

9.2.6.4.3 Copper Look-Ahead Cables

Look-ahead may be implemented at some locations by hard wiring between LEU's using a signalling copper multi-conductor cable.

a) Disconnecting conductors

- Follow procedures detailed in Section 9.2.1, for powering down the LEU,
- Arrange for the cable to be repaired if viable, or replaced.
- Where spare viable conductors are available, move LEU inputs across to spare conductors. Record details in the temporary repair register.

b) Re-Connecting conductors

- Reconnect wire(s),

- Follow procedures detailed in Section 9.2.1, for powering up the LEU,
- Check that this LEU is operational after 70 seconds with the correct indications, and that the LEU can detect the balise as explained in Section 8.2.3.1.
- Check that the voltage to the MIPS200 is within normal limits,
- Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) on both LEUs using the BEPT.
- Synchronise the LEU clock to the BEPT system time as explained in Section 10.8.1.

9.2.7 Other ETCS Equipment

9.2.7.1 Replacement of Annexe Cabinet LED Lamp

The light fitting is powered from the BX120/NX120 source. Refer to standard drawing M05-547 for wiring details.

The light fitting is not repairable and a faulty lamp should be replaced, as follows:

a) Disconnecting a Light Fitting

- The supply to the light fitting should be powered down by isolating the BX120/NX120 source by opening the NX isolator terminal and removing the BX fuse,
- Unplug the cable at the base of the light fitting,
- Carefully remove the existing light fitting from the plastic mounting clips.

b) Re-Connecting a Light Fitting

- Remove as much as practical of the previously applied adhesive from the mounting clips and apply a small quantity of silicone adhesive to the mounting clips to re-secure the light fitting in place,
- Plug the cable back into the base of the light fitting,
- Replace the BX120 fuse and close the NX120 isolator terminal,
- Test and confirm the functionality of the light and switch by opening and closing the door,
- Leave the isolation switch in the ON position,
- Destroy/dispose of the faulty lamp.

10 Using the Balise Encoder Programming Tool (BEPT)

10.1 General

The Alstom Balise and Encoder Programming Tool (BEPT) is the Programming and Test Tool for the Alstom balise (Eurobalise) and LEU (Encoder). The tool is for use with Programming and Test & Commissioning processes. To carry out those activities, the tool uses mission files and LEU / balise configuration data files provided by a competent ETCS Data Design team. Mission files are imported into the BEPT via an approved USB memory stick.

The Programming Preparation Tool (PPT) is the software tool used by the Data Design team on a PC (or Algiz7 tablet) to create the Verification Report, Validation Report and is also used to convert the balise files into the format for programming (mission creation).

The BEPT consists of a kit including the following two main components:

- the BEPT Core, including all hardware, adaptor cables, charger and software needed for programming, and
- the handheld BEPT terminal, which is a wireless remote display providing a safe human machine interface to the user. The BEPT terminal is the ALGIZ7 tablet and includes a 12Vdc power charger.

Figure 59 - (Left to Right) LEU, Handheld Terminal and BEPT Core (Placed on a Balise)

Only trained certified persons are permitted to carry out any programming or interrogation activities. Refer to *PR S 40028 Alstom ETCS Trackside Equipment*.

The BEPT is used to program, read data, read logs, change configurations etc, of a balise and an LEU. It is also used for maintenance and fault finding.

Caution: The Handheld ALGIZ7 Windows 7 Tablet is the approved device for use with the BEPT Core. Use of other Windows PC shall require assessment and approval.

Caution: The BEPT Core does not include any anti-virus software.

Only official, approved ATP USB mass storage units (memory sticks/keys) are to be used with the BEPT. In order to ensure that the USB mass storage units are virus-free, they must be:

- checked on a regular basis, at least 6 monthly.
- programmed only from the approved Alstom supplied PC Tablets which are not to be connected to open public networks with open internet access.

If the BEPT Core is suspected of having a viral contamination, the base software (as a complete image including the OS) is to be wiped and restored by using the BEPT 'USB booting key' (which is to be kept secure). Where a BEPT Core has required the reloading of its software, then a record shall be kept on file by the person responsible for the BEPT. The record is to contain the following information as a minimum:

- Date
- BEPT serial number
- USB Booting Key serial number
- Area responsible for the BEPT (e.g. Network base, business unit, company, etc.)
- Programmer (i.e. person who performed reboot of software)
- Reason for rebooting

A copy of the activity record is to be forwarded to Signal Engineering.

The test equipment 'kit' is known as the BEPT, and comprises the following items in Table 5 - BEPT Test Equipment Kit below. Items 2b, 2c, 2d 2e, 3, 4, 5, 6, 7, 8 and 9 are to be stored in the Back Pack (2a) and the Back Pack is to be kept with the BEPT Core unit (Item 1). All items except for items 8 and 9 are supplied by Alstom. Refer to standard drawing M05-572 for further details of components making up the BEPT kit.

Item	Item Description	Part Number
1	BEPT G3 Core Type 1 with charger (240V)	TRVP065626000 (DTR0000214702)
2	BEPT G3 accessories (see list of items included in accessories kit below)	EESL066032000 (DTR0000214733)
2a	Back pack	DTR0000179263
2b	Balise adaptor cable	TRVP065902000
2c	AutoTest C adaptor cable	TRVP066113000
2d	Cigarette lighter adaptor	TRVS339771000
2e	Main power supply adaptor for BEPT (240V)	DTR0000182590
3	BEPT 'USB Booting Key'	DTR0000297539
4	BEPT (G3) terminal type 2 (ALGIZ7) with charger (240V)	DTR0000282483
5	MicroCoder balise adaptor cable	DTR0000234204
6	LEU/BEPT adaptor cable	DTR0000234203
7	LEU configuration key adaptor and USB cable	DTR0000282030
8	512MB USB Memory Stick (for transferring configuration mission files from storage medium to BEPT). Manufacturer: ATP Electronics Incorporated	AF512UFNDNC(I)-OEM
9	Pelican case with foam insert to house BEPT 'USB Booting Key' (Item 3).	Model 1010 case with foam insert

Table 5 - BEPT Test Equipment Kit

Each BEPT Core has a unique serial number. Each BEPT (kit) includes a BEPT CCore, BEPT Terminal (Algiz7), USB Flash Memory Stick, Backpack (for adaptors etc), USB Booting Key and each are tagged with the same serial number as the BEPT Core in the kit.

The BEPT is used for:

- Testing (reading) a balise,
- Erasing a balise,
- Downloading data configuration to a balise,
- Testing an LEU,
- Interrogating an LEU (e.g.: access the historical events tables),
- Downloading data configuration to an LEU configuration key, and
- Erasing an LEU configuration key.

Caution: The BEPT Core must not be left on top of a balise in the four foot when a train passes over the balise.

10.2 BEPT Core

The BEPT Core is not user accessible and shall not be opened by the user.

Figure 60 - BEPT G3 Core Type 1

The BEPT Core batteries need to be kept charged up when the BEPT is not in use. Batteries should be replaced once a year as a minimum. The BEPT Core shall be returned to Alstom for replacement of batteries.

For long term battery autonomy, it is recommended that the BEPT is generally not used when connected to the power supply. The batteries should never be allowed to fully drain during use, as there is no Auto-Shutdown feature enabled.

The BEPT does not require periodic calibration.

Caution: BEPT Core batteries can NOT be replaced in the field.

Unauthorised entry to the BEPT Core internal components will result in the warranty being voided. In case of battery failure, or loss of capacity, the BEPT must be sent back to Alstom repair services.

10.2.1 BEPT Long Term Storage

Storage conditions will affect the charge retention of the BEPT battery. For long term storage (up to 1 year), it is recommended that the battery is kept with at least a 30% charge, and that it is stored in a dry and cool place (i.e. less than 30 degrees Centigrade).

10.2.2 BEPT Clock

The clock in the BEPT Core must be manually checked and set prior to each programming session (mission creation). Station LED clocks, mobile phones with automatic update enabled and TfNSW office networked PCs with synchronised clocks can be used as a time reference.

Note: The Programmer must first log in under the Programming Manager profile ('ertms') in order to set the BEPT clock. Once the clock has been set, the programmer shall log out of 'ertms'.

The time and date on the BEPT Core clock is set as follows:

1) Under the [BEPT Management] menu, select the [Set Date and Time] function:

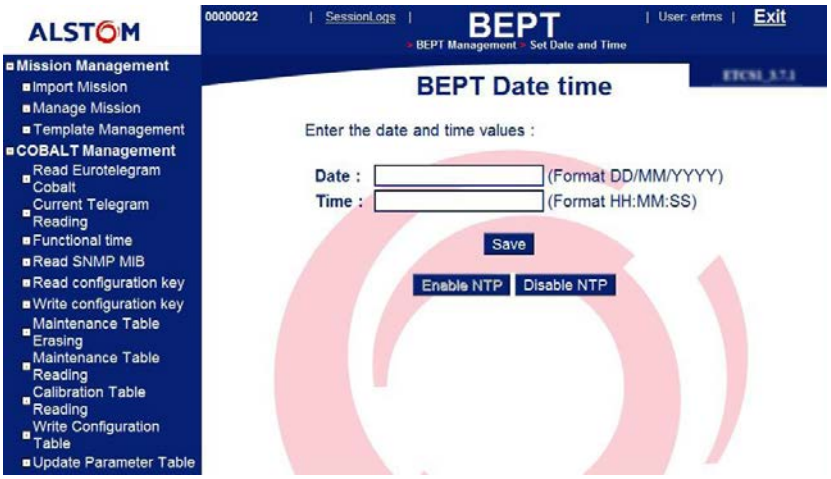


Figure 61 - BEPT Management Menu

2) Fill the [Date] field with a valid date in the “DD/MM/YYYY” format.

3) Fill the [Time] field with a valid time in the “HH:MM:SS” format.

4) Select [Enable NTP] to enable the communication with the COBALT Encoder according to the IP address (the COBALT Encoder identifies the BEPT as the primary NTP server) or select “Disable NTP” to allow the BEPT to disable its server NTP.

5) Press the [Save] button.

Note: If the setting of the date or time has failed, the message “BEPT system time update failed” is displayed. If the setting of the date or time has been successful, the message “BEPT system time update succeeded” is displayed.

10.2.3 Re-loading BEPT Software

If the BEPT Core needs to be re-loaded with the applicative software, it is necessary to install the DUO software stored in an USB boot key that comes with each BEPT kit. Follow the instructions in Section 10.2.3.1 below, for reloading the base software.

Note: After reloading the software, the IP addresses in the BEPT Core for accessing the LEU will be lost and will need to be re-configured. See Section 10.2.3.2 for details on resetting the handheld interface terminal IP addresses.

10.2.3.1 Reloading Application Software

To reload the BEPT Core software, the following actions must be performed:

- Make sure that the BEPT Core is switched OFF
- Plug the USB boot key (with the appropriate software version) in the USB port (A1)
- Switch-on the BEPT Core
- After the booting delay (about 90 sec), the green LED PC Ready [A5] is flashing quickly (programming mode)
- After the complete programming (an additional 90 sec), the green LED PC Ready [A5] is flashing slowly (BEPT Core never switches off automatically)

- Switch off the BEPT Core by releasing the power ON/OFF button "O/I" [A8] (ON/OFF indicator [A4] is off after about 40 sec)
- When all LEDS are off, unplug the USB boot key
- Switch-on the BEPT Core
- After the booting delay, PC Ready indicator [A5] is lit
- BEPT Core is now ready to be used .

First use or after rebooting the BEPT Core, the following page will be displayed on the handheld interface terminal as shown in Figure 62 below.

Figure 62 - Reboot Screen Shot

10.2.3.2 Interfacing the BEPT Core with the LEU

After re-loading the BEPT Core software, the LEU IP address fields revert back to default values and will need re-configuring.

Login as ‘programming manager’.

Using the handheld interface terminal, select ' Advanced Encoder Settings' then select 'Ethernet_Network_Paremeters' from the drop down menu.

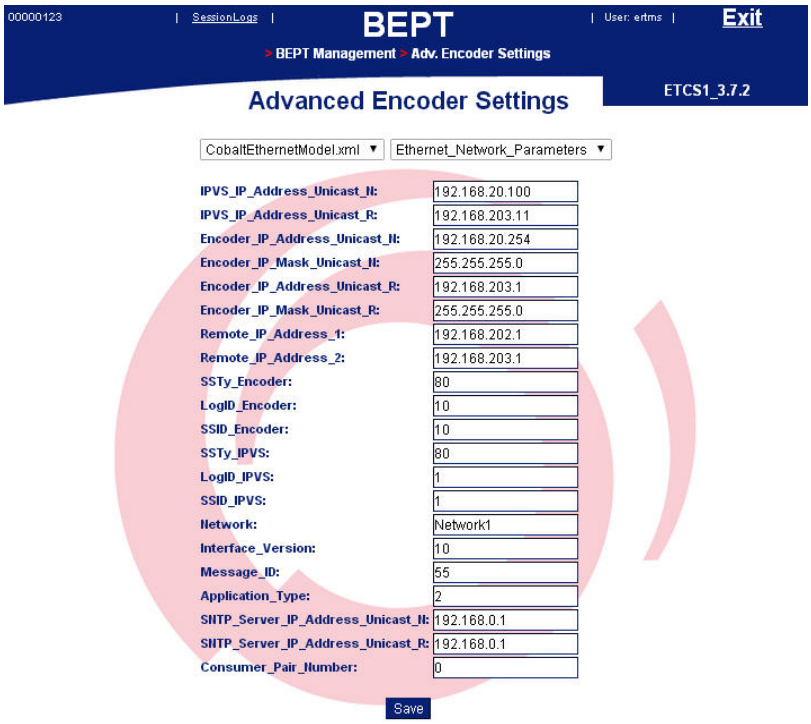


Figure 63 - LEU IP Addresses Screen Shot

Set the IP addresses shown in Table 6 below:

Connection Method	LEU IP address
IPVS_IP_Address_Unicast_N:	192.168.20.100
Encoder_IP_Address_Unicast_N:	192.168.20.254
Encoder_IP_Mask_Unicast_N:	255.255.255.0

Table 6 - LEU IP Addresses

Press the [Save] button ('Save' must be selected before changes are implemented).

Note: Other user defined IP address settings displayed are not required for LEU maintenance purposes (N/A).

10.3 BEPT Core Interface Terminal

10.3.1 General

The Handheld ALGIZ7 Windows 7 Tablet is the approved BEPT Core interface terminal.

Caution: The Handheld ALGIZ7 Tablet is not to be used for any purpose other than for ETCS use. No attempt should be made to update the operating system to a later version.

The ALGIZ7 is a wireless ruggedised water and dust resistant tablet PC which uses the Windows 7 operating system.

The BEPT terminal is used to interface with the embedded BEPT Core web server via a WiFi connection in order to carry out in-field operations such as programming or testing LEU's and balises. It works using Mobile Internet Explorer to display the BEPT website. No other specific piece of software is required.

The BEPT terminal allows the operator to program and test balises installed on the track from a safe location up to within around 20m from the BEPT Core.

The BEPT terminal shall not be used for any purpose other than interfacing with the BEPT and no other software shall be loaded on to the terminal.

Replacement ALGIZ7 terminals for use with the BEPT shall only be sourced from Alstom.

10.3.2 Batteries

The BEPT terminal is supplied with hot-swappable dual battery packs which permit changing of batteries (one at a time) without shutting the terminal down.

Caution: Fully charge the batteries in advance of operating the BEPT Terminal for the first time. It takes approximately 3 hours to fully charge batteries from empty.

The BEPT terminal batteries need to be kept charged up when the BEPT terminal is not in use. The BEPT terminal is designed to work with two removable battery packs placed inside the battery pack compartment. The fully charged standard (2600 mAh) battery packs will provide several hours of battery life, which can further be extended by using power management features through the BIOS setup. The power management software allows the battery to accurately report the amount of charge percentage left in the battery.

Note 1: Power Saving is set up by pushing the F1 button, selecting 'Performance' and then 'Power Saving'.

Note 2: A vehicle charger pack and extended run time batteries are available (5200 mAh) as accessories, if required.

10.3.3 Interface Sockets

The ALGIZ7 terminal interface sockets are located behind four rubber hinged access panels, two at each end of the BEPT terminal. The panels hinge up and are pushed open using your fingers/thumbs. Tools must not be used to open a rubber panel and doing so will likely damage the terminal.

The power charging socket is accessed behind a rubber protector panel on the lower right hand end of the terminal.

The waterproof USB 2.0 port is accessed behind a rubber protector panel on the lower left hand end of the terminal.

10.3.4 Display

The BEPT terminal features a 7-inch wide screen touch display which includes auto adjusting brightness in outdoor conditions including direct sunlight. A Screen Guard should be used to protect the screen. A generic brand product may be used to suit 7" screens.

As the product has a touch-screen interface, care needs to be taken so as not to scratch or otherwise damage the screen or the pressure sensitive control keys.

Only use either your finger or the Stylus Pen attached, on the touch screen. Do not use other implements as these may scratch the screen.

10.3.5 BEPT Terminal Controls

Figure 64 - ALGIZ7 BEPT Terminal Front Controls

1) Power ON button - Push for 4 seconds to turn the BEPT terminal on (turn OFF by via the shutdown option from the desktop).

2) LED Indicators – Shows Power Status, HDD Status, Left & Right Batteries Status and Wireless Status.

3) Menu – Push Menu to show brightness, Volume, Battery Status and Wireless Enable/Disable.

4) F1-F3 Hotkey - Programmable hot-key functions.
Note: F1 (short tap) will turn on help menu.

5) Up/Down/Left/Right/OK Buttons – Use the Up, Down , Left, Right and Enter keys to navigate.

Item	Indication
Power mode	Green: System is On. No Light : System is Off
Battery Status	No Light: fully charged or power on with AC adapter Orange Light: on charging Red Light: Low Battery warning < 3% , or dead battery. No Light: fully charged or power on with AC adapter
Storage Status	Blinking green Light: HDD is reading/writing data
Wifi status	Green Light blinking: Wifi is using No Light: Wifi is not working

Table 7 - LED Indications

10.3.6 BEPT Terminal Initial Setup

10.3.6.1 General

First time use of the ALGIZ7 (tablet) terminal requires prior charging of the batteries and an initial setup. Charging socket is located behind lower right rubber cover.

The waterproof USB socket is located behind lower left rubber cover.

Do not reconfigure the Algiz7 terminal desktop to suit individual preferences, as all Algiz7 terminals in the TfNSW rail network supplied for use with the Alstom BEPT should remain with a standard format.

A Screen Guard is supplied with a new terminal and should be fitted to protect the screen.

Note: Refer to the Handheld Group ALGIZ7 manual (available on the Internet) for further details on the product including how to change batteries and general instructions.

Note: Quick start guides are provided in the BEPT kit for both the Algiz7 terminal and the BEPT.

10.3.6.2 Language

Prior to delivery, Alstom shall set the terminal to English. If an ALGIZ7 terminal is displaying in French, the following procedure is required. After powering up:

- Arrow down to the line showing *'Demarrer windows normal lement'* (Start Windows Normally) and select OK,
- The terminal will now start up as per normal.
- Select the Windows icon (far bottom left corner), and select '*Panneau de configuration'* (Control Panel),
- Select *'Horloge, lange et region'* (Clock, Language, and Region),
- Under *'Choisissez une langue d' affichage'* (Choose a display language), select English,
- Select OK.

- *Select 'Fermer* la session maintenant' (Close the session now), to restart the terminal.

After re-starting, the terminal screen will now display in English.

Under ‘Control Panel’, select ‘Clock, Language, and Region’, Select 'Region and Language':-

- Select 'Location' tab and change location to 'Australia'
- Under the ‘Location’ tab, change location to Australia.
- Under the ‘Formats’ tab, ensure that the Short Date is selected to: dd/MM/yyyy format and Short Time is selected to HH:mm format. Select English.
- Under the ‘Keyboards and Languages’ tab select, under the 'Choose a display language' heading select English. Under the 'Change keyboards ..' heading select 'General' and choose English. Select 'Ok'.
- Under the 'Administrative'; tab, select 'Change system locale' and change Current system locale to: English (Australia). Select 'Copy Settings' heading and tick the two check boxs at the bottom of the screen under the heading 'Copy your current settings to'.
- Select 'Ok'.
- Restart the terminal.

10.3.6.3 Touchscreen Calibration

If the touch screen alignment needs re-calibrating; this is achieved by means of opening the ‘Tablet PC Settings’ icon (located on the desktop), and via the ‘Display’ tab, select ‘Calibrate’. See screen shot below.

Follow the instructions, save and select OK.

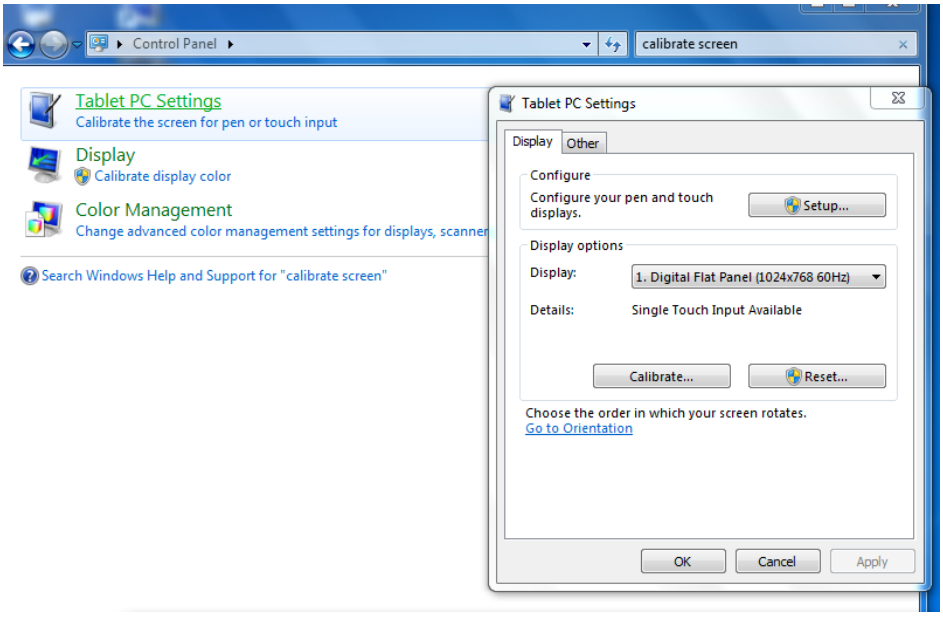


Figure 65 - ALGIZ7 BEPT Terminal – Touchscreen Calibration

10.3.6.4 Keyboard Setup

For the BEPT/Terminal interface to work properly, the keyboard must be embedded (virtual keyboard) into the Alstom application, as shown in Figure 66 example below.

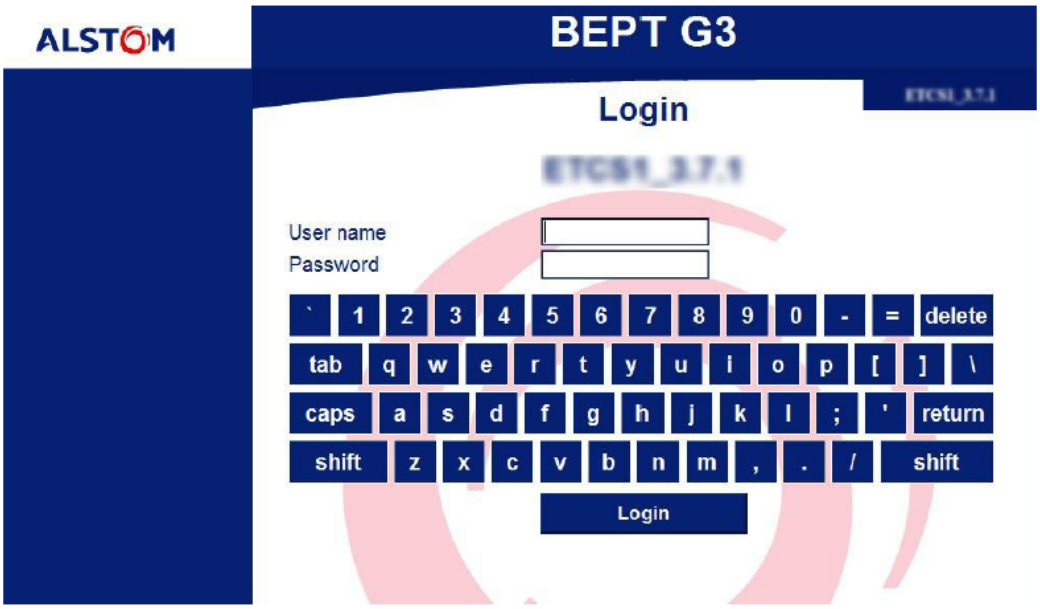


Figure 66 - Login Page Showing Embedded Keyboard

If the display is not embedded, then click on the 'Compatibility View' icon in the address bar shown in Figure 67 below.

Figure 67 - Keyboard Compatibility View Icon

10.3.7 Interfacing the Terminal with the BEPT Core

The BEPT Core is accessed via an internet browser using a BEPT handheld interface terminal. The handheld interface terminal presently used for maintenance is the ALGIZ7. Establishing a connection between the BEPT and BEPT Terminal can be achieved via two methods:

- WIFI or
- Ethernet hardwire connection.

10.3.7.1 Setting up the BEPT Terminal

Setting up the BEPT Terminal requires configuration of the TCP/IP properties. When connecting via WiFi, the static IP will be required to be set to 192.168.10.XX where XX is a number greater than 1, and the subnet mask set to 255.255.255.0. Refer to example in Figure 68 below.

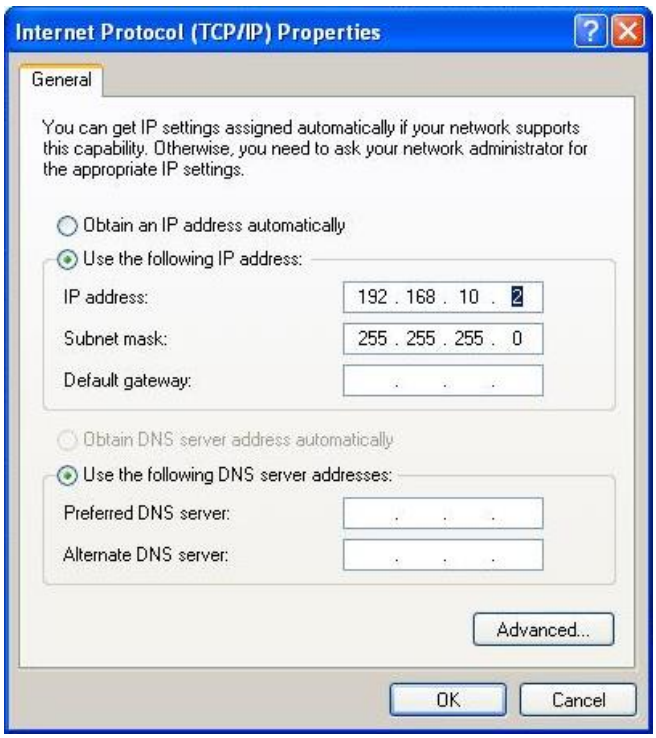


Figure 68 - Setting IP Address

- Under WiFi Connections, select BEPT Core and connect.
- Once connected, the following login page will be displayed

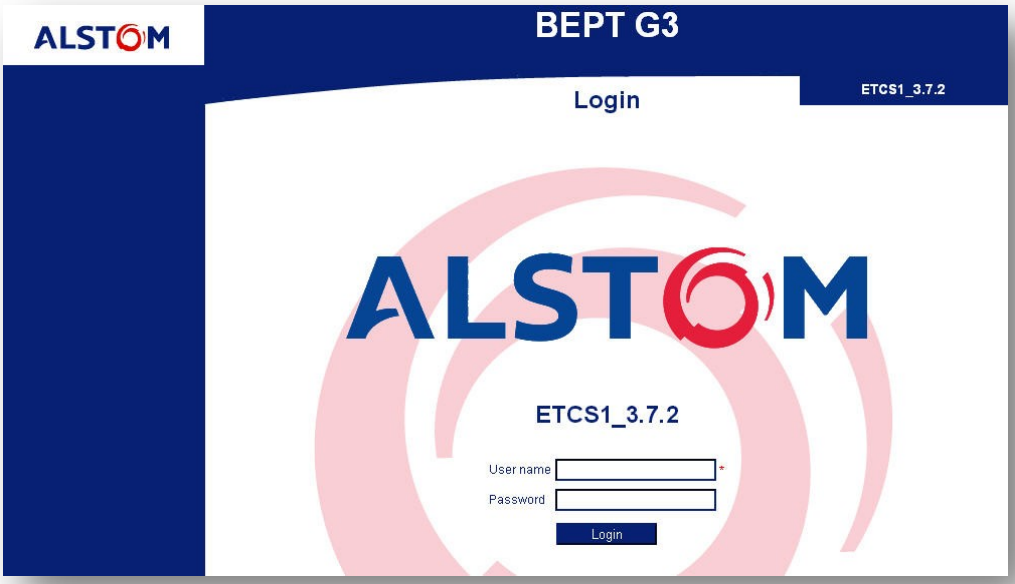


Figure 69 - Example Login Screen

Note: If the shortcut to the BEPT Core is not showing on the PC, the following steps can be used to connect:

1) Open 'Network and Sharing Centre',
2) 'Change Adaptor Settings' (shown towards top left of screen),
3) 'Wireless Network Connection 10 Status'. Select 'Properties',
4) Select TCP/IPv4. Select 'Properties',
5) Type IP address: 192.168.10.x where x is >1,
6) 'Ok' and close out,
7) Launch the internet browser on the BEPT Terminal,
8) Select the BEPT Core from the browser line.

10.3.7.2 BEPT Core Address

BEPT Core addresses are as per Table 8 below.

Connection to the BEPT web server will be dependent on the connection method.

Connection Method	BEPT IP address	URL to access BEPT webserver http://*(BEPT_IP_address)*/BEPT
WiFi	192.168.10.**1**	http://192.168.10.1/BEPT
Ethernet Port 1	192.168.100.**100**	http://192.168.100.100/BEPT
Ethernet Port 2	192.168.101.**101**	http://192.168.101.101/BEPT

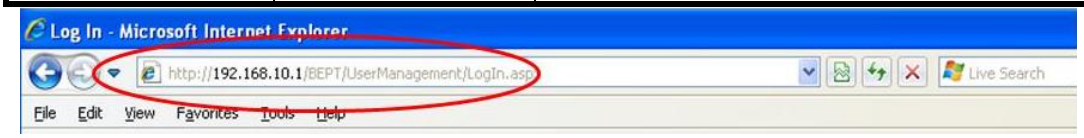


Table 8 - Parameters For BEPT Connection

10.4 Logging into the BEPT

Several roles are required in order to carry out ETCS data programming and verification activities. Independence between different roles is required for process integrity, and hence different user profiles are created within the BEPT with different menus and different levels of access rights appropriate for the role.

BEPT users shall log in to the BEPT as per the authority level relevant to the task being undertaken.

The following User Profiles and Logins are available:

User Profile	Description	Login
Programming Manager	Primarily to be used for the mission creation process. This could be undertaken by either the ETCS data design team or the ETCS installation team. The Profile is also used for importing missions, setting the BEPT clock and setting the LEU IP address fields.	ertms
Programmer	Used during the programming of a balise or LEU configuration key.	prog
Verifier	Used during the testing of the data programmed into a balise or LEU configuration key.	ver
Validator	Although this is not a BEPT login, this person plays a key role in the validation of the data programmed into a balise or LEU configuration key.	N/A
Eraser	Used when erasing balise data. **Note:** This function cannot be used to erase LEU date. A Gold Key is required to de-pair an LEU from its Configuration key.	eraser

Table 9 - BEPT User Profiles and Logins

10.5 Importing Missions & Data Into the BEPT

The term 'mission' refers to a data file containing a consolidated set of pre-defined data programming or verification activities, pre-prepared by the RIM's competent ETCS data design team (design office activity) ready for downloading from the RIM's secure data network by field maintenance staff.

A mission is executed by the BEPT user, and prevents errors in the data programming and verification by limiting these activities to those which are pre-defined, and associated with the correct balise or LEU data.

Mission files are stored alongside the data files for each balise or LEU configuration key for which they apply, as well as the associated Balise and LEU Installed Data Forms *(ETCS IDF1 and 2),* and are accessed by the maintenance staff for importing into the BEPT, using an approved USB memory stick.

One data programming mission and one data verification mission is required for each LEU or balise. Associated maintenance testing forms for the on-site activities are also required.

Note: The Programmer must first log in under the Programming Manager profile ('ertms') in order to import missions into the BEPT. Once the missions have been loaded into the BEPT, the programmer shall log out of 'ertms'.

Note: Licensed signalling personnel (electricians) are permitted to import missions into a BEPT.

The process for importing missions into the BEPT is as follows:

Items Required for Mission importing:

- Approved USB memory stick with the pre-prepared missions.
- BEPT and handheld terminal.

Importing a Mission into the BEPT:

1) Log in to the BEPT as the *Programming Manager* [“ertms”].

2) Erase all existing missions and data from the BEPT. To do this, under the [Mission Management] menu, select the [Manage Mission] function, select the missions to be deleted (or use [Select All]) and select [Delete]. If the mission erasing was successful, a message of confirmation will appear below the [Delete] button.

   Note: this process will also delete all associated LEU / Balise data files.

3) Connect the USB memory stick containing the required mission and data files to the USB port on the BEPT.

4) Under the [Mission Management] menu, select the [Import Mission] function.

5) Use the [Browse] function to select the USB memory stick folder containing the mission files and LEU / balise data files to be imported, and select the [OK] button.

6) Select the missions to be imported (or select [All Files]) and select [Import]. The missions and corresponding LEU / balise data files will be save into the BEPT. If the mission importing was successful, a message of confirmation will appear below the [Import] button.

   Note: each XML file should contain on programming (.Pro) mission and one verification (.Ver) mission for each installation.

7) Log out of the Programming Manager profile.

10.6 Importing Balise / LEU Data Only Into the BEPT

The data files for each balise or LEU configuration key are stored (in the RIM's secure data network) alongside the missions which apply to them (as discussed above), and are accessed by the maintenance organisation for importing into the BEPT, using an approved USB memory stick.

Normally the pre-prepared mission files will be available along with the configuration data files. The process for importing balise or LEU configuration key data (only) files into the BEPT is as follows:

1) Connect the USB memory stick containing the required balise and LEU files to the USB port on the BEPT.

2) Under the [BEPT Management] menu, select the [Import Data] function.

3) Under [Choose Equipment] Select either [Balise] or [Cobalt], depending upon whether the mission to be created is for a balise or an LEU.

4) Specify the directory in which the configurations files are located on the USB memory stick.

5) Select the individual files to import, or use [Select All], and select the [Import] button.

6) An error message will be shown by the BEPT if all of the files needed to program a single balise (OGM and UDF files) or LEU (BIN, GID and PRM files) are not located within the same directory, or if for some reason not all of the files could be imported. If the importing of data was successful, a message of confirmation will appear below the [Import] button.

10.7 Using a BEPT with Balises

The BEPT is used to interrogate or program an Alstom balise via a wireless radio loop (air gap interface). The BEPT is required to be placed directly on top of the balise.

Note: that the BEPT is also capable of connection directly to the balise via a cable connection but generally this will not be used for day to day maintenance and definitely not on track.

10.7.1 Erasing Data from a Balise

A balise that has previously been programmed for another location may generate errors in the programming process, and erasing the balise memory is necessary if the balise is required to be re-programmed. Erasing a balise is carried out as follows:

Items Required for Balise Erasing and Re-Programming:

- BEPT and handheld terminal.

Erasing a Balise Memory:

1) Place the BEPT on top of the balise (programming is carried out via the air gap interface).

Figure 70 - Placement of BEPT on to balise

2) Log in to the BEPT as the Eraser [“eraser”].

3) Under the [Balise Management] menu, select the [Write Eurotelegram] function.

4) Under [Interface], select [Compact].

5) Under [Directory], select [Browse] to specify the directory in which the file ‘Reset_Balise_ID.tgm’ is located on the BEPT or USB memory stick.

6) Under [File] select the file ‘Reset_Balise_ID.tgm’.

7) Select the [Write] button to execute the mission for erasing the balise data. If the erasing of the balise data was completed successfully, a message of confirmation will appear below the [Write] button.

10.7.2 Un-Muting a Balise

Balise have the ability to be internally "muted". Although this is not used by TfNSW, balises should be checked to ensure that this function is not set.

Un-muting a balise is carried out as follows:

1) Place the BEPT onto the balise;

2) Log in to the BEPT as the Verifier [“ver”];

3) Under the [Balise Management (AF)] menu, select the [Operating Mode] function;

4) A new [Operating Mode] window / screen will appear. Under [Mode], select [Functional] and select [Set]. If the balise was successfully set to a ‘Functional’ operating mode, a message of confirmation will appear below the [Set] button.

10.7.3 Programming a Balise

Caution: Programming a balise with altered data is considered to be a commissioning, and the procedures described in the Alstom ETCS Trackside Set To Work Manual must be followed.

Items required for Balise programming:

- BEPT and handheld terminal.

- A blank *Balise Replacement Testing Form (ETCS M1).*

Programming a Balise:

1) Determine the balise data configuration file from the *ETCS Installed Data Form - Balise (ETCS IDF1)*.

2) Ensure that the required missions and balise configuration data are imported into the BEPT to be used for data installation (see Section 10.5).

3) If the programming is done at trackside, check the identity of the balise (using the circular balise ID plate affixed to the balise and rectangular balise location ID plate affixed to the sleeper) to ensure that it is the correct balise to be programmed.

   If balise programming was done off site or prior to installation:

   – ensure that the balise has its balise ID plate affixed to identify it at the time of trackside installation

   – read the balise telegram (NID_C, NID_BG and N_PIG) and check the balise identity matches the balise ID and balise ID plate identifications

4) Copy the serial number from the balise label onto the specific *Balise Replacement Testing Form (ETCS M1)*.

5) Place the BEPT on top of the balise (programming is carried out via the air gap interface).

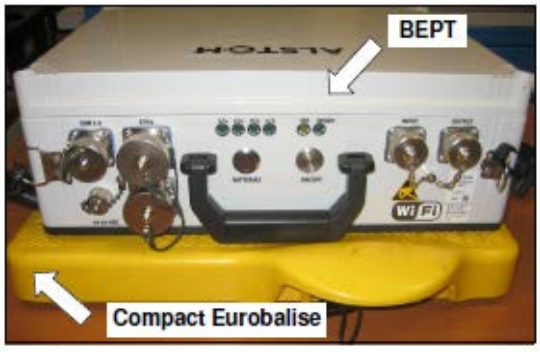


Figure 71 - Placement of BEPT on to balise

6) Log in to the BEPT as the *Programmer* ["prog"].

7) Under the [Mission Management] menu, select the [Execute Mission] function.

8) Under [Equipment] select [Balise], as the mission to be executed is for a balise.

9) Select the required mission by selecting the Green Arrow to the right of the mission name to enter the balise "Select Part Number" page.

10) Under [Select Balise Interface], select [Compact], select the [Run] button to enter the "Write Eurotelegram" page and select the [Write] button to execute the mission for programming the balise data. If the mission was executed successfully, a message of confirmation will appear below the [Write] button.

11) Select the [Read] button. A new screen / window will appear with the "End of Mission" status, the name of the mission, the balise serial number and a link to the PDF report generated.

12) The next screen / window will appear with the configuration parameters and the software to be read. Select the [Read] button to check that it was properly programmed.

13) Log off as the Programmer, so that the Verifier can use the BEPT for balise data testing / verification.

10.7.4 Verifying the Programming for a Balise

Caution: The person conducting the verification process must be independent of the data installation activities i.e. the programmer.

Note: Licensed signalling personnel (electricians) are permitted to verify balise data.

1) Log in to the BEPT as the Verifier ["ver"].

2) Under the [Mission Management] menu, select the [Execute Mission] function.

3) Under [Equipment] select [Balise], as the mission to be executed is for a balise.

4) Select the required mission by selecting the Green Arrow to the right of the mission name to enter the balise "Select Part Number" page.

5) Under [Select Balise Interface], select [Compact], select the [Run] button to enter the "Telegram Memory Reading" page and select the [Read] button to execute the mission for verifying the balise data. If the mission was executed successfully, a message of confirmation will appear below the [Read] button, and the BEPT will display the header parameters and the CRC, as shown below;

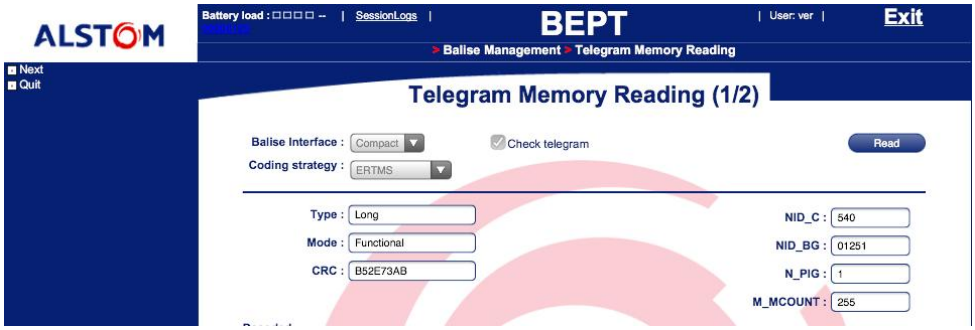


Figure 72 - BEPT Telegram Memory Reading Function

6) Enter the CRC obtained from the BEPT onto the *Balise Replacement Testing Form (ETCS M1).*

7) Contact the Validator ask them to read the expected CRC from the *ETCS Installed Data Form - Balise (ETCS IDF1)*, and confirm that the CRC that was obtained from the BEPT is correct. Note the name of the Validator and the CRC from the *ETCS Installed Data Form - Balise (ETCS IDF1)* on the *Balise Replacement Testing Form (ETCS M1)*;

8) Select the [Next] button. A new screen / window will appear with the "End of Mission" status, the name of the mission, the balise serial number and a link to the PDF report generated.

9) Carry out Balise Telegram Testing using the BEPT air-gap interface (see Section 11.2). The M_MCount should be 254 for a controlled balise or 255 for a fixed balise.

10) If this is a controlled balise, connect the balise tail cable to the balise, then plug in the LEU output transient protection cassette for that balise.

11) Carry out an ETCS Functional Test (see Section 11.3) using the BEPT air-gap interface and confirm that the telegram for at least one signal aspect has an M_MCount other than 254.

12) Once the balise data has been installed and verified using the BEPT, it is essential that all trackside configuration data and missions are deleted from the BEPT, the Handheld ALGIZ7 Tablet and the USB Memory Stick, to prevent incorrect data being used for future tasks.

13) Complete the *Balise Replacement Testing Form (ETCS M1)* by ticking "OK", and arrange for the form to be submitted to the Maintenance Signalling Engineer.

Note: The commissioning of the balise is not considered complete until the validation activities are undertaken.

10.7.5 Validating Balise Data

Caution: The person conducting the validation process must be independent of the data installation and verification activities.

Caution: Only Signalling Engineers or ICON Infrastructure are permitted to validate the balise data. Note the validator may be remote and need contacting via telephone.

1) Check the signal / balise name against the reported failure and access the *ETCS Installed Data Form - Balise (ETCS IDF1)* for the failed balise.

2) Validate the CRC that was obtained from the BEPT by the verifier (i.e. ensure that it is the same as that listed on the *ETCS Installed Data Form - Balise - ETCS IDF1).*

10.8 Using a BEPT with Lineside Encoder Units (LEU's)

An LEU is programmed (or paired) by the plugging in of an LEU configuration key. Interrogation of an LEU is achieved by plugging the BEPT into a hardwired Ethernet interface port. The Ethernet port 1 of the BEPT is to be connected to the Ethernet port 1 of the LEU.

Caution: Never connect the BEPT to the LEU Ethernet 2 port, as this may cause the LEU to 'fuse'.

The BEPT is plugged into the LEU Ethernet 1 port to access:

- the events tables (4 different tables are available),
- static information,

- dynamic information.

When extracting the LEU maintenance tables & logs, refer to Appendix B – LEU Log Record Analysis, for procedures. Refer to the Alstom - Micro-COBALT, Micro-Coder and ALIS User Manual for further details.

10.8.1 LEU Clock Synchronisation with the BEPT

The process for synchronising an LEU clock with the BEPT clock, is as follows:

1) Under the [Encoder Management] menu, select the [Functional Time] function.

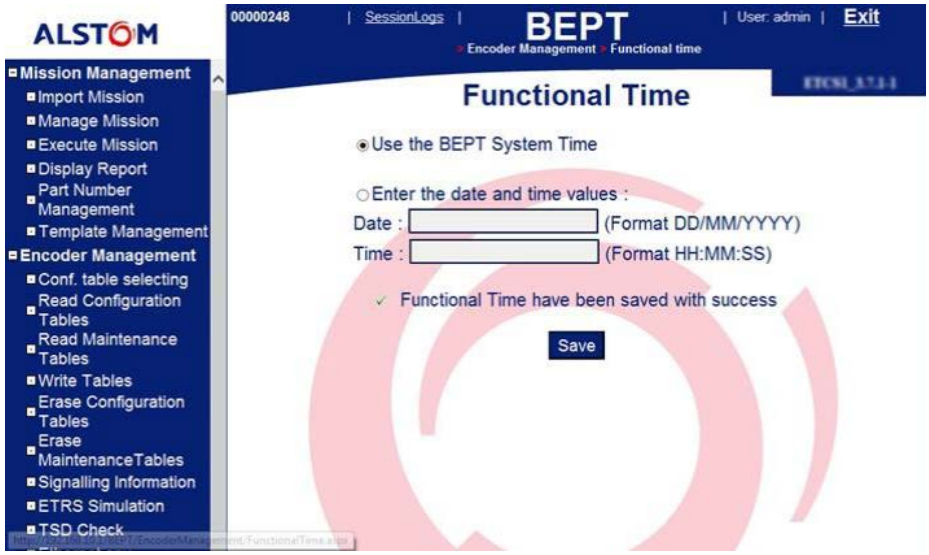


Figure 73 - BEPT Functional Time Function

2) Choose the mode to [Use the BEPT System Time].

3) Press the [Save] button.

Note: Operation has been carried out successfully if the message “Functional time have been saved with success” and “✓” symbol are displayed.

10.9 Using a BEPT with LEU Configuration Key

If the LEU configuration key needs to be programmed (or the LEU configuration key data needs to be updated), the BEPT is used. When programming an LEU configuration key, the key must be plugged into the BEPT via an LEU configuration key cable adaptor.

10.9.1 Programming an LEU Configuration Key

Caution: Programming an LEU configuration key with altered data is considered to be a commissioning, and the procedures described in the Alstom ETCS Trackside Set To Work Manual must be followed.

Note: Licensed signalling personnel (electricians) are permitted to install LEU configuration key data.

The trackside configuration data for an LEU is programmed into an LEU configuration key, which is connected to the corresponding LEU. This avoids the need to re-programme the LEU data in the case of a failed LEU. The configuration data for an LEU is loaded on start-up, as long as the LEU configuration key is attached.

Items required for LEU Configuration Key programming:

- LEU configuration key adaptor.
- BEPT and handheld terminal.
- A blank Configuration Key Replacement Testing Form (ETCS M3).

Programming an LEU Configuration Key:

1) Determine the LEU configuration key data configuration file from the *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)*.

2) Ensure that the required missions and LEU configuration data are imported into the BEPT to be used for data installation (see Section 10.5).

3) If the programming is done at trackside, check the identity of the LEU (LEU ID plate) to ensure that it is the correct LEU to be programmed. If the programming is done offsite, ensure that the LEU configuration key has a suitable temporary label to identify it at the time of trackside installation. Label shall include details of: LEU name, date of programming, programmers name and configuration file version.

4) Copy the serial number from the LEU label onto the specific *Configuration Key Replacement Testing Form (ETCS M3).*

5) Connect the LEU configuration key to be programmed to the BEPT via the LEU configuration key adaptor as shown in the diagram below.

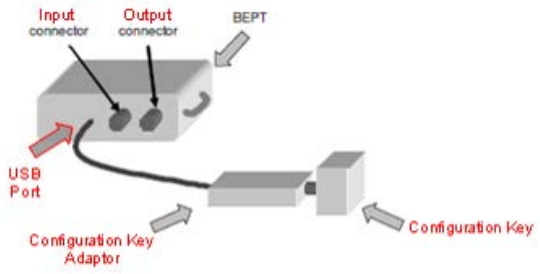


Figure 74 - Programming an LEU Configuration Key Connection

6) Log in to the BEPT as the *Programmer* [“prog”].

7) Under the [Mission Management] menu, select the [Execute Mission] function.

8) Under [Equipment] select [Cobalt], as the mission to be executed is for an LEU.

9) Select the required mission by selecting the Green Arrow to the right of the mission name.

10) Select the [Run] button to enter the “Write Configuration Key” page, and select the [Write] button to execute the mission for programming the LEU configuration key data. If the mission was executed successfully, a message of confirmation will appear below the [Write] button.

11) Select the [Read] button. A new screen / window will appear with the “End of Mission” status, the name of the mission and a link to the PDF report generated.

12) The next screen / window will appear with the configuration parameters and the software to be read. Select the [Read] button to check that the data was installed correctly.

13) The BEPT will automatically launch the read function and will display the header information.

14) Log off as the *Programmer*, so that the *Verifier* can use the BEPT for LEU data testing / verification.

10.9.2 Verifying the Programming for an LEU Configuration Key

Caution: The person conducting the data verification process must be independent of the data installation activities.

Caution: Only Signalling Engineers are permitted to verify the LEU configuration key data.

1) Log in to the BEPT as the *Verifier* [“ver”].

2) Check that the Programming mission pdf. report was completed successfully.

3) Under the [Mission Management] menu, select the [Execute Mission] function.

4) Under [Equipment] select [Cobalt], as the mission to be executed is for an LEU.

5) Select the required mission by selecting the Green Arrow to the right of the mission name.

6) Select the [Run] button to enter the “Read Configuration Key” page, and select the [Read] button to execute the mission for verifying the LEU configuration key data. If the mission was executed successfully, a message of confirmation will appear below the [Read] button, and the BEPT will display the CRC, as shown below;

Figure 75 - BEPT Read Configuration Key Function

7) Enter the CRC obtained from the BEPT onto the *Configuration Key Replacement Testing Form (ETCS M3)*.

8) Contact the Validator, ask them to read the expected CRC from the *ETCS Installed Data Form*, and confirm that the CRC that was obtained from the BEPT is correct. Note the name of the Validator and the CRC from the *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)* on the *Configuration Key Replacement Testing Form (ETCS M3)*.

9) Select the [Next] button. A new screen / window will appear with the "End of Mission" status, the name of the mission and a link to the PDF report generated.

10) Carry out an *LEU Telegram Input Correspondence Test* (see Section 11.5) for at least one signal aspect. Using the BEPT over the airgap interface, read the balise telegram for the current signal aspect and confirm that it is correct.

11) 1Once the LEU configuration key data has been installed and verified using the BEPT, it is essential that all trackside configuration data and missions are deleted from the BEPT, the Handheld ALGIZ7 Tablet and the USB Memory Stick, to prevent incorrect data being used for future tasks.

12) Complete the *Configuration Key Replacement Testing Form (ETCS M3)* by ticking "OK", and arrange for the form to be submitted to the Maintenance Signalling Engineer.

Note: The commissioning of the LEU configuration key is not considered complete until the validation activities are undertaken.

If the programming and verification was undertaken on-site:

1) Connect the LEU configuration key to the equipment frame of the signalling location case or relay room, adjacent to the associated LEU, using the tether cord.

2) Re-start the LEU to pair it with the LEU configuration key and to load the site configuration data.

Note: If the LEU was previously paired with another LEU configuration key, the LEU will go into BOOT_FAILED mode, with the red ERROR LED flashing. In this case, a Gold Key (a special LEU configuration key with specific data to remove the permanent pairing between the LEU and the LEU configuration key data) must be used before the newly programmed LEU configuration key can be used.

10.9.3 Validating LEU Configuration Key Data

Caution: The person conducting the validation process must be independent of the data installation and verification activities.

Caution: Only Signalling Engineers or ICON Infrastructure are permitted to validate the LEU configuration key data. Note the validator may be remote and need contacting via telephone.

1) Check the signal / LEU name against the reported failure and access the *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)* for the failed LEU or LEU configuration key.

2) Validate the CRC that was obtained from the BEPT by the verifier i.e. ensure that it is the same as that listed on the *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)*.

11 ETCS Functional (Data) Testing

This section describes the functional testing required following the rectification of failures (Section 9) or following track works (Section 7), to prove that the equipment is re-installed and programmed correctly and operates in accordance with specified requirements. Table 10 below summarise the requirements which are detailed in the remainder of this section.

Task	Check Indications	Default Telegram	Stop Aspect	Any Proceed Aspect	All Aspects
Replacing balise (fixed)		**B**			
Replacing balise (controlled)	**LEU**	**B**	**B or B**		
Re-installing balise following trackworks (fixed)		B			
Re-installing balise following trackworks (controlled)	LEU	B	B or B		
Replacing balise tail cables (controlled)	LEU	B	B or B		
Replacing failed LEU	**LEU**			**L**	
LEU vital plug coupler – one wire *3			L	L *1	
LEU vital plug coupler – more than one wire			L		L
LEU vital plug coupler – entire unit			L		L
LEU isolation terminals			L	L *1	
LEU bypass terminals			L	L *1	
Toroidal transformer (contact sensing only)	See Section 9.2.3.7.				
150 Ohm resistor module			L	L *1	
LEU signalling look-ahead circuits (multi-Core)			L	L *2	
Replacing failed RS900 Ethernet network switch	RS900		L	L *2	
Replacing failed optical patch panel	RS900		L	L *2	
Replacing failed optical patch cords	RS900		L	L *2	
Replacing failed LEU configuration key	**LEU**				**L**
Replacing failed LEU power supply (MIPS 200)	LEU/PSU				
Replacing failed LEU power supply fuse	LEU				
Replacing failed LEU power supply transient protection (Schaffner)	LEU				

Table 10 - ETCS Functional Testing Requirements

Table Notes:

*1 - test the proceed aspect related to changed input wire

*2 - test all proceed aspects which require look-ahead information (check LEU tables)

*3 - If wire is unplugged and can be replaced, at Wago terminal end only

“L” = Testing to be undertaken at LEU

“B” = Testing to be undertaken at balise.

Important: Testing following the replacement of equipment 'downstream' of the LEU, including the LEU itself, requires testing to be done at the balise air interface (BEPT placed on top of the balise).

Testing of equipment 'upstream' of the LEU (including the signalling interface and power supplies) can be done by plugging the BEPT directly into the LEU. This will reduce the exposure time in the 4 foot for maintenance staff

11.1 Equipment Required for Function Tests

The following is the minimum equipment required by the set-to-work team:

- Multimeter (approved and calibrated) - for voltage and current measurements (True RMS AC and DC).
- Current clamp or Amp meter (approved and calibrated) - for current measurements (True RMS AC and DC). Must be able to read in the mA range.
- BEPT with LEU/BEPT adaptor cable.

Note: Testers must follow the PR S 40040 for the use of Wi-Fi, radios and mobile phones near the electronic equipment.

Caution: Before commencing the test, the ETCS surge arrestors (LEU Output) of the signal under test must be removed to prevent any telegram being sent from the LEU to the balise.

Note MN S 40000 is applicable at all times, and this manual does NOT supersede it under any circumstances.

11.2 Balise Telegram Testing

Balise Telegram Testing is used to verify that a balise is programmed and operating correctly. In order to be able to complete the Balise Telegram Testing, the balise needs to have been programmed with its specific trackside application data.

The *Balise Replacement Testing Form (ETCS M1)* should be used to document the testing procedures below, and must be returned to the Maintenance Signalling Engineer following completion of testing.

11.2.1 Default Balise Telegram Testing

The default balise telegram is tested as follows:

1) Identify that the balise to be tested is the correct one. This can be done by checking the balise ID plate and balise location ID plate against the Signalling Plan (if available) or the *Balise Installed Data Forms (ETCS IDF1).*

2) For a controlled balise, ensure that the balise is disconnected from the LEU (this may be done by removing the surge arrestor cassette at the LEU location);

3) Place the BEPT on top of the balise;

4) Log in to the BEPT as the Verifier ["ver"];

5) Under the [Balise Management] menu, select the [Telegram Memory Reading] function;

6) A new [Telegram Memory Reading] window / screen will appear. Select the [Read] button to read the default balise telegram;

7) Compare the M_MCOUNT and CRC (Checksum) read with the data recorded on the *ETCS Installed Data Form - Balise (ETCS IDF1).*

8) Note: The M_MCOUNT value should be 255 for fixed balises or 254 for controlled balises.

9) Repeat items 1 and 7 above, for each balise within the associated balise group;

10) If any part of the Balise Telegram Testing cannot be successfully completed, the following actions should be carried out in the order shown to rectify the failure:

    a) Attempt to read the balise again;

    b) Replace and re-program the balise (see Section 9.1.1). Remove and quarantine the faulty balise in accordance with the requirements of PR S 40004 and PR S 40028.

11) Where practical, it should be confirmed with the signaller, that the driver of the first train over the balise group reported no trackside fault messages.

11.2.2 Controlled Balise Telegram Testing

Following the Default Balise Telegram Testing detailed above, a controlled balise should be tested as follows:

1) Ensure that the balise is connected to the LEU (by replacing the surge arrestor cassette at the LEU location);

2) Place the BEPT on top of the balise;

3) Log in to the BEPT as the *Verifier* [“ver”];

4) Under the [Balise Management] menu, select the [Telegram Reading] function;

5) A new [Telegram Reading] window / screen will appear. Select the [Read] button to read the default balise telegram;

6) Compare the M_MCOUNT and CRC (Checksum) read with the data recorded on the *ETCS Installed Data Form - Balise (ETCS IDF1).*

   Note: The M_MCOUNT value should be "1" if the signal is at stop, and something other than "254" if the signal is displaying a proceed aspect.

7) Remove the surge arrestor cassette at the LEU location for the controlled balise; observe the correct output indication flashes in the associated LEU and 0 Vac at the associated junction box terminals.

8) Restore the surge arrestor cassette for the controlled balise; observe the correct balise output indication extinguishes in the associated LEU and approximately 10 Vac at the associated junction box terminals.

9) If any part of the Balise Telegram Testing cannot be successfully completed, the following actions should be carried out in the order shown to rectify the failure:

a) Attempt to read the balise again;

b) Replace and re-program the balise (see Section 9.1.1). Remove and quarantine the faulty balise in accordance with the requirements of PR S 40004 and PR S 40028.

10) Where practical, it should be confirmed with the signaller, that the driver of the first train over the balise group reported no trackside fault messages.

11.3 ETCS Functional Testing

ETCS Functional Testing is used to verify the complete communication from the signalling system to a controlled balise and hence prove that both the Signalling to LEU interface and the LEU to balise interface are working. The Balise Replacement Testing Form (ETCS M1) shall be used to document this testing procedure, and must be returned to the Maintenance Signalling Engineer following completion of testing.

ETCS Functional Testing is carried out as follows:

1) Identify the controlled balise to be tested, check that the LEU ID plate, the LEU output number and the circular balise ID plate name conform to the balise information shown on the SCF and Signalling Plan;

2) Place the BEPT on top of the balise;

3) Log in to the BEPT as the *Verifier* ["ver"];

4) Arrange with the Signaller for the signalling to display a valid proceed aspect;

5) Under the [Balise Management] menu, select the [Telegram Reading] function;

6) A new [Telegram Reading] window / screen will appear. Select the [Read] button to read the default balise telegram;

7) Record on the *Balise Replacement Testing Form (ETCS M1)* the following information from the header content of the telegram read:

   - NID_BG;
   - N_PIG;
   - NID_C;
   - M_MCOUNT (subject to signal indication, cannot be '254')

8) Ensure that the LEU is sending information to the correct balise. This can be accomplished in two different ways:

   a) Using the BEPT on the balise, and breaking the circuit between the LEU and balise;

      - Under the [Balise Management] menu, select the [Telegram Reading] function, and check that the values correspond to the signal aspect;
      - Break the connection from the LEU to the balise at any point (e.g. by removing the surge arrestor at the LEU), and check that the above values correspond to the default telegram;
      - **Note:** Make sure that the [Telegram Memory Reading] function is NOT used to carry out this test.
      - Re-connect the LEU to the balise and check the values again;

- All readings must have the same values for NID_C, NID_BG, and N_PIG. The only value which should change is the M_MCOUNT.

b) Using only the BEPT on the balise,

- Read the default ETCS telegram by using the [Telegram Memory Reading] function under the [Balise Management] menu;
- Read the current ETCS telegram by using the [Telegram Reading] function under the [Balise Management] menu (which must correspond to the current signalling aspect);
- Both readings must have the same values for NID_C, NID_BG and N_PIG, and different values for the M_MCOUNT.

9) If any part of the ETCS Functional Testing cannot be successfully completed, the following actions should be carried out in the order shown to rectify the failure:

a) Carry out Balise Telegram Testing in accordance with Section 11.2

b) Replace the LEU (see Section 9.2.1). Remove and quarantine the faulty LEU in accordance with the requirements of PR S 40004 and PR S 40028.

c) Replace the LEU configuration key (see Section 9.2.4). Remove and quarantine the faulty LEU configuration key in accordance with the requirements of PR S 40004 and PR S 40028.

10) Where practical, it should be confirmed with the signaller, that the driver of the first train over the balise group reported no trackside fault messages.

11.4 LEU Configuration Key Data Checking

The version of the data programmed in the LEU configuration key must be checked before it is connected to the LEU.

The *Configuration Key Replacement Testing Form (ETCS M3*) shall be used to document this testing procedure, and must be returned to the Maintenance Signalling Engineer following completion of testing.

LEU configuration key data checking is carried out as follows:

1) Connect the BEPT to the LEU configuration key to be tested, via the LEU configuration key adaptor as shown in the diagram below;

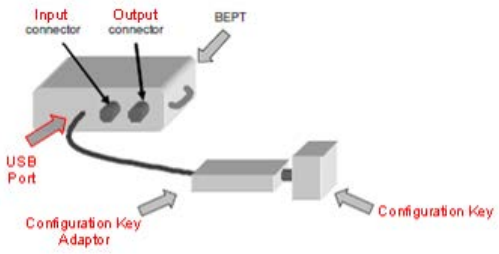


Figure 76 - BEPT Configuration Key Replacement Configuration

2) Log in to the BEPT as the *Verifier* [“ver”];

3) Under the [Cobalt Management] menu, select the [Read Configuration Key] function;

4) A new [Read Configuration Key] window / screen will appear. Select the [Read] button. If the LEU configuration key is read successfully, a message of confirmation will appear below the [Read] button, and the BEPT will display the CRC as shown below;

Figure 77 - BEPT Read Configuration Key Function

5) Check the CRC against the relevant *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2)* for the specific LEU to confirm that this is the correct LEU;

6) If the CRC read by the BEPT is different from the CRC written on the relevant *ETCS Installed Data Form - LEU Configuration Key (ETCS IDF2*), check again that this is the correct LEU, and if the discrepancy is confirmed, remove and quarantine the LEU configuration key and replace it with a new one. This will require the LEU configuration key to be programmed in accordance with Section 10.9 of this manual.

7) Connect the LEU configuration key to the corresponding LEU;

8) Re-start the LEU to pair it with the LEU configuration key and to load the site configuration data. Check that the LEU starts up correctly by reading the LED indicators on the LEU, which should be displayed as follows:

- "LED ON" – Green Steady;
- "OUTPUT" – Slow flashing green for both balise outputs (where not connected or ETCS surge arrestor is disconnected);
- "ERROR" – OFF;
- "OK" – rapidly green flash (after approximately 1 minute of being powered ON);
- "Eth 1" – OFF (no BEPT connected to any LEU);
- "Eth 2" – depends on the number of LEUs required for the signal (OFF if only one LEU and green / ON if the signal has more than one LEU).

Note: If the "Error" LED is flashing, it means that there is may be problem with the LEU configuration key (bad configuration file, pairing mismatch or a Gold Key is connected).

9) If the LEU indications show a different state to those listed above, the following actions should be carried out in the order shown to rectify the failure:

a) Attempt to read the LEU configuration key again;

b) Use the Gold Key to reset the LEU, if there is a pairing mismatch (see Section 9.2.2) before starting the LEU again with the correct LEU configuration key;

c) Re-program the LEU configuration key (see Section 10.9);

d) Replace the LEU (see Section 9.2.1);

e) Replace the LEU configuration key (see Section 9.2.4).

11.5 LEU Telegram Input Correspondence Testing

The LEU Telegram Input Correspondence Test is to prove that telegrams sent from the LEU to the balise(s) correspond correctly with the associated signalling aspect inputs shown in the as-built circuit book control table. Each signalling state described in the ETCS LEU Tables will need to be set and the corresponding telegram transmitted by the LEU should be read by the BEPT using the LEU Ethernet interface. This may require the signaller to set routes and track circuits to be operated by the pulling of fuses or by dropping of track circuits locally.

The appropriate *Replacement Testing Form (ETCS M2 or M3)* shall be used to document this testing procedure, and must be returned to the Maintenance Signalling Engineer following completion of testing.

Before commencing the LEU Telegram Input Correspondence Tests, the ETCS surge arrestors need to be connected to permit the LEU to send information to the balise.

This testing is undertaken from within the signalling relay room, location case or the ETCS LEU cabinet with the BEPT connected to the LEU using an LEU/BEPT adaptor cable, and requires the LEU to be connected to the signalling according to the circuit book, and powered up;

1) If the signal has a current sensing interface, check the type of lamp that is installed for the signal against those shown in the circuit book. Operate the bypass terminals and the LEU isolation terminals.

2) Connect the BEPT to Ethernet port 1 (the maintenance port) of the LEU to be tested, using the LEU/BEPT adaptor cable (this has a standard RJ45 connector on one end and M12 connector on the other end), as shown below;

Figure 78 - Connecting BEPT to Ethernet Port 1 of LEU

3) Log in to the BEPT as the *Programming Manager* [“ertms”];

4) To facilitate the analysis of the LEU records during testing, under the [Cobalt Management] menu, select the [Maintenance Table Erasing] function;

5) If the Cobalt type is not pre-selected, under the “Cobalt Type Detection” window / screen, select [OK];

6) Select all of the boxes ([SysEvent], [SigEvent] and [LampEvent]) and select the [Erase] button. If the maintenance tables were successfully erased, a message of confirmation will appear below the [Erase] button;

7) Under the [BEPT Management] menu, select the [View Date and Time] function, to check that the system time of the BEPT is correct (acceptable accurate sources are detailed in the *Alstom ETCS Trackside Maintenance*);

8) If the time is incorrect, under the [BEPT Management] menu, select the [Set Date and Time] function to update the time and date to an acceptable reference source;

9) Under the [Cobalt Management] menu, select the [Functional Time] function, to set the time of the LEU;

10) Select [Use BEPT System Time], then select [Write]. If the system time was successfully updated, a message of confirmation will appear below the [Write] button;

11) Arrange with the Signaller for the signalling to display the required aspects as per the process in this manual for the replaced component;

12) Under the [Cobalt Management] menu, select the [Current Telegram Reading] function;

13) Select [Output 1], then select [Read]. If the current telegram was successfully read, a message of confirmation will appear below the [Read] button;

14) Record on the appropriate *Replacement Testing Form (ETCS M2 or M3)* the following information from the header content of the telegram read, and if available, compare them against the values on the *ETCS LEU Tables*:

- NID_BG;
- N_PIG;
- M_MCOUNT (subject to signal indication, cannot be '254').

15) Repeat items 12, 13 and 14 above for [Output 2], where applicable;

16) Under the [Cobalt Management] menu, select the [Calibration Table Reading] function;

17) Select [SysConfig], then select [Read], to read the status of the inputs. If the inputs were successfully read, a message of confirmation will appear below the [Read] button;

18) If the signal has a current sensing interface, using a digital multimeter, measure and record the RMS current value of each input, and compare these to those displayed in the [SYSCONF] box on the BEPT;

19) Repeat items 11 to 18 above, for each signalling input state listed on the *ETCS Balise and LEU Tables*;

20) To confirm that networked LEU(s) which themselves are not connected to a balise are communicating correctly, connect the BEPT to each of these LEUs, using the Ethernet port which is to be used for LEU networking (Ethernet port 2). Under the [Cobalt Management] menu, select the [Calibration Table Reading] function, and retrieve the 'SYSCONF' information as described in items 14 and 15 above. A successful retrieval of logs is proof that the Ethernet port is communicating correctly;

21) Following the completion of the testing, download the SigEvent log from the LEU using the BEPT (it is recommended that this is done on a daily basis);

Note: When the SigEvent Log is downloaded, it is recommended to also download the SysEvent, LampEvent and SysStats Logs. Those logs are not required to be analysed but they could help when looking for events or to analyse a particular event if it is needed.

22) Analyse the SigEvent log to verify that no incorrect telegram was transmitted. For each signalling input state detailed on the ETCS Balise and LEU Tables, ensure that the LEU inputs remained unchanged for at least 30 seconds (in the case of an arrangement which contains LEU networking, this should be increased to 2 minutes);

23) If any part of the LEU Telegram Input Correspondence Testing cannot be successfully completed, the following actions should be carried out in the order shown to rectify the failure:

a) Replace the LEU (see Section 9.2.1). Remove and quarantine the faulty LEU in accordance with the requirements of PR S 40004 and PR S 40028.

b) Replace the LEU configuration key (see Section 9.2.4). Remove and quarantine the faulty LEU configuration key in accordance with the requirements of PR S 40004 and PR S 40028.

24) If the LEU Telegram Input Correspondence Testing cannot be successfully completed, the equipment should be left in a safe state, by carrying out one of the following actions:

a) Power off the LEU by opening the NX isolation, and removing the LEU BX fuse; or

b) Disconnect all ETCS output surge arrestors; or

c) For current sensing, bypass the LEU inputs by operating the LEU bypass terminals to the ‘Bypass’ position (i.e. pushed in) and opening the LEU input isolators;

25) Where practical, it should be confirmed with the signaller, that the driver of the first train over the balise group reported no trackside fault messages.

Note 1: For signals with a current sensing interface, prior to any disconnection, the LEU must be switched off and the LEU bypass terminals operated to the ‘Bypass’ position (i.e. pushed in). Closing the LEU bypass terminals alone does not isolate the ETCS equipment.

Note 2: For signals with a current sensing interface, every time the LEU bypass terminals are operated to the “Not Bypassed’ position (sending the lamp current through the LEU), a complete LEU Telegram Input Correspondence Test must be done to ensure the correct functionality of the terminals.

Appendices

Forms:

Appendix A ETCS Forms

- ETCS M1 - Balise Replacement Testing Form
- ETCS M2 - LEU Replacement Testing Form
- ETCS M3 – Configuration Key Replacement Testing Form
- ETCS M4 - ATP Power Supply Replacement Testing Form

Fault Finding:

Appendix B LEU Log Record Analysis

Seldom Used Procedures:

Appendix C LEU Output Transient Protection Cassette Testing

Appendix D Balise Tail Cable Assembly Instructions

Background Information:

Appendix E Personnel Hazard Risk Table – Inspection / Installation / Removal of ETCS Track / Trackside Mounted Equipment

Appendix A ETCS Maintenance Forms

PR S 40028 FM01 Balise Replacement Testing Form (ETCS M1)

The 'Balise Replacement Testing Form' is to be used whenever a balise is replaced following a failure, suspected failure or damage, or when removing, replacing or relocating of sleepers during track works. It should also be used to document the completed testing whenever the data in the balise is tested during failure investigations.

PR S 40028 FM02 LEU Replacement Testing Form (ETCS M2)

The 'LEU Replacement Testing Form' is to be used whenever an LEU is replaced, following a failure or suspected failure. It is also to be used when an LEU vital plug coupler is replaced or has been disturbed.

PR S 40028 FM03 Configuration Key Replacement Testing Form (ETCS M3)

The 'Configuration Key Replacement Testing Form' is to be used whenever an LEU configuration key is replaced following a failure or suspected failure. It should also be used to document the completed testing whenever the data in an LEU / LEU configuration key is tested during failure investigations.

PR S 40028 FM04 ATP Power Supply Maintenance Testing Form (ETCS M4)

The 'ATP Power Supply Replacement Testing Form' is to be used whenever an LEU MIPS 200 power supply is replaced following a failure or suspected failure. It should also be used to document the completed testing during failure investigations.

Sample Balise Replacement Testing Form (ETCS M1)

Transport Sydney Trains NSW GOVERNMENT

PR S 40028 FM01
Balise Replacement Testing (ETCS M1)

	Completed By:		**Date:**	/ /	**BEPT Serial No:**	
	Location ID		**Line Name**		**Signal Name**	If applicable

PART A	Installation Tests	1st Balise PIG:	0/1	2nd Balise PIG:	0/1
	Serial Number / Version (Revision)	V XXXXX	X	V XXXXX	X
	Balise ID Plate (on Balise)	WWW XXXXXXXX YYYY Z_T		WWW XXXXXXXX YYYY Z_T	
	Balise Location ID Plate (on Sleeper)	WWW XXXXXXXX YYYY Z_T		WWW XXXXXXXX YYYY Z_T	
	Horizontal distance from balise side to rail (in each corner) are equal +/- 10mm (direct fixed balises only).	**OK** ☐		**OK** ☐	
	Vertical distances from top of the balise to highest part of the rail are equal +/- 10mm (direct fixed balises only).	**OK** ☐		**OK** ☐	
	No other cable within 400mm of Balise.	**OK** ☐		**OK** ☐	
	Where Balise Location ID Plate is missing, measure & record distances from As Built SCF reference asset .	Asset 1 Distance		Asset 1 Distance	
	Tick "OK" for balise location within permitted tolerance (+/-600mm for ATP and +/-350mm for ASDO Calibration Balise)	**OK** ☐		**OK** ☐	
	Mounting Type (circle mounting type): (Universal Beam / eClip / FastClip / Direct / Guardrail installation / ASDO calibration)	Details	**OK** ☐	Details	**OK** ☐

Note: Other than for necessary track works, only 1 balise should be removed and replaced at any one time

PART B							
		Programming performed? (If no go to testing section)	Y/N		Y/N		
	Prog.	Configuration file name including Version (#_#_#)		#_#_#		#_#_#	
	Prog.	Programming mission executed successfully (from BEPT)	**OK** ☐		**OK** ☐		
	Verifier	Verification mission executed successfully (from BEPT)	**OK** ☐		**OK** ☐		
	Verifier	Write CRC (from BEPT)	XXXX XXXX		XXXX XXXX		
	Verifier	Request Validator to confirm CRC and file Version match and record the response	Yes / No		Yes / No		
	Verifier	If match confirmed, write CRC and file Version (#_#_#) from Validator	XXXX XXXX	#_#_#	XXXX XXXX	#_#_#	

☐ **Tick "OK" for each test or check completed successfully**

PART C		Balise Telegram Testing	1st Balise		2nd Balise	
	Verifier	Balise Group ID (NID_BG)	Default	Connected	Default	Connected
	Verifier	Position in Group (N_PIG)	Default	Connected	Default	Connected
	Verifier	Country Code NID_C				
	Verifier	M_MCOUNT	Default	Connected	Default	Connected
	Verifier	Matches Balise ID Plate information	**OK** ☐		**OK** ☐	

Note: For a controlled balise, readings from the BEPT should be taken with the cable disconnected and again with the cable connected.

PART D				
	***Programmer**	Name	Signature	/ /
	Verifier	Name	Signature	/ /
	***Validator**	Name	Signature	/ /

Note: *Only required if programming has occurred
- Maintenance activities - copy of form to be sent to the maintenance signal engineer.

Sample LEU Replacement Testing Form (ETCS M2)

Transport Sydney Trains NSW

PR S 40028 FM02
LEU Replacement Testing (ETCS M2)

Completed By:		**Date:**	/ /	**BEPT Serial No:**	
Location ID		**Signal Name**		**LEU ID**	
LEU Serial No.	X_____	**LEU Hardware Version**		**LEU Software Version**	

1	LEU Configuration Key tether cord length 190mm (+/- 10mm)	**OK** ☐
2	LEU Configuration Key secured (screws not loose)	**OK** ☐
3	LEU Hardware and Software is approved version	**OK** ☐
4	LEU Vital Plug Coupler(s) secured (screws not loose)	**OK** ☐

☐ Tick "OK" for each test or check completed successfully

NID_BG	N_PIG	M_MCOUNT

Enter values read from BEPT

Proceed Aspect	State (ON/OFF)	Mode	Fault (Yes/No)	Current (mA)	Signal Name
Lamp 1					
Lamp 2					
Lamp 3					
Lamp 4					
Lamp 5					
Lamp 6					

Check any one (1) proceed aspect. Enter all values shown on BEPT 'Calibration Table Reading' screen

Note: The above level of testing is only valid where the configuration key has not been altered. Where the configuration key has been altered required testing is recorded on PR S 40028 FM03.

5	Voltage at the outgoing side of the transient protection cassette for approximately 10V a.c. with the cassette installed.	**OK** ☐
6	Where two balises are connected to one LEU, or more than two LEU's exist at the location, LEU output to the balise output cable correlated	**OK** ☐
7	LEU Clock Set	**OK** ☐

☐ Tick "OK" for each test or check completed successfully

Certified by	Name	Signature	/ /
Maintenance Signalling Engineer	Name	Signature	/ /

This form is to forwarded to the maintenance signal engineer for review and filing

Sample Configuration Key Replacement Testing Form (ETCS M3)

Transport Sydney Trains NSW

PR S 40028 FM03
Configuration Key Replacement Testing (ETCS M3)

Completed By:		**Date:**	/ /	**BEPT Serial No:**	
Location ID		**Signal Name**		**LEU ID**	WWW XXXXXXXX YYYY

Prog.	Configuration file name including Version (#_#_#)		#_#_#		#_#_#
	Programming mission executed successfully (from BEPT)	**OK** ☐		**OK** ☐	
Verifier	Verification mission executed successfully (from BEPT)	**OK** ☐		**OK** ☐	
	Write CRC (from BEPT)	XXXX XXXX		XXXX XXXX	
	Request Validator to confirm CRC and file Version match and record the response	Yes / No		Yes / No	
	If match confirmed, write CRC and file Version (#_#_#) from Validator	XXXX XXXX	#_#_#	XXXX XXXX	#_#_#

☐ **Tick "OK" for each test or check completed successfully**

ETCS Input Correspondence Testing													**From BEPT**		
Aspect	**LEU A**						**LEU B (Look-Ahead)**						**NID BG**	**NID PIG**	**M_M Count**
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**			

Enter "1" or "0" corresponding to a high or low input — Enter values read from BEPT

Note - All aspects used for the particular location need to be tested and compared with the values shown in the as-built circuit book control table.

Programmer	Name	Signature	/ /
Verifier	Name	Signature	/ /
Validator	Name	Signature	/ /
Maintenance Signalling Engineer	Name	Signature	/ /

Sample ATP Power Supply Maintenance Testing Form (ETCS M4)

Transport Sydney Trains NSW

PR S 40028 FM04
ATP Power Supply Maintenance Testing (ETCS M4)

Completed By:		Date:	/ /	Multimeter Serial No:	

Location ID		LEU ID		MIPS200 Serial No.		MIPS200 Hardware Ver.	

MIPS200 Power Supply Testing					
	Signal / LEU	Voltage Measured	Acceptable Range	Volts to Earth Active / Positive	Volts to Earth Com. / Negative
Input 120Vac (No Load)		Vac	96 / 132 Vac	Vac	Vac
Busbar 120Vac (Lights etc.)		Vac	96 / 132 Vac	Vac	Vac
PSU 1 Output (No Load)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc
PSU 1 Output (Loaded)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc
PSU 2 Output (No Load)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc
PSU 2 Output (Loaded)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc
PSU 3 Output (No Load)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc
PSU 3 Output (Loaded)		Vdc	24 Vdc (+/- 5%)	Vdc	Vdc

NOTE: In the 24 V circuit, the negative is connected with the earth (design of the equipment)

Contact Sensing (Toroidal Transformer) Power Supply Testing			
Toroidal Transformer ID:	Volts (Vac)	Acceptable Range	Current (mA)
Input 120Vac (No Load primary)		96-132 Vac	
Busbar 120Vac (on load)		96-132 Vac	
Transformer Secondary 1 (12Vac)		10.6-15.7 Vac (8.5:1 ±5%)	
Transformer Secondary 2 (12Vac)		10.6-15.7 Vac (8.5:1 ±5%)	
Transformer Current Balance		Currents within 10% (of each other)	OK / Not OK

Remarks:

Tester	Name	Signature	/ /
Maintenance Signalling Engineer	Name	Signature	/ /

Appendix B Log Record Analysis

LEU Logs:

An LEU has an internal memory log to record the changes of state of LEU inputs balise telegrams produced. The last 10,000 “signalling events” and "system events" are stored, and these can be retrieved and analysed using a text editor such as Windows Notepad.

Downloading SigEvent and SysEvent Logs:

1) Connect the BEPT to Ethernet port 1 (the maintenance port) of the LEU to be analysed, using the supplied LEU/BEPT adaptor cable (this has a standard RJ45 connector on one end and M12 connector on the other end). The cable should be connected to Ethernet port 1 on the LEU, as shown;

2) Log in to the BEPT as the *ETCS Programming Manager* or *Programmer* or *Verifier*

3) Under the [Cobalt Management] menu, select the [Maintenance Table Reading] function.

4) Under [Directory] select the desired file location on the USB memory stick for downloading the SigEvent and SysEvent logs.

5) If the Cobalt type is not pre-selected, under the “Cobalt Type Detection” window / screen, select [OK].

6) The [Cobalt Type] should be detected and displayed as [µCoder]. If the Cobalt type [????????] is displayed, check the Ethernet connection as above, and select [Refresh].

7) Select [SigEvent] and / or [SysEvent] as the tables to be uploaded, and under [Upload Type] select either [Total] or [Partial], depending on how many records you need to analyse.

8) Select the [Read] button to start the upload operation. When the upload operation is complete and there is no error, a message of confirmation will appear below the [Read] button.

9) The downloaded SigEvent and SysEvent Logs can be read on the BEPT by selecting the required log file from the drop down box under the [Read] button and message of confirmation, or the USB memory stick can be removed and the log files read using a PC and Windows Notepad.

Interpreting the SigEvent Log:

One binary (BIN) file and one text (TXT) file will be created for each LEU output (i.e. each balise controlled by the LEU), containing all events from the corresponding SigEvent table. These files will be created with the following name format, where (n) is either “1” or “2” depending upon the LEU output / balise:

- “YYYY_MM_DD_HH_MM_SS_SIGEVENT(n).txt”.

The text file can be opened and read in any text viewer, such as Windows Notepad.

Below is an example of an exported SigEvent Log file opened in Windows Notepad, showing the results when the LEU was reset (the date and time is reset to midnight on 01/01/1984 and parameter data to 0):

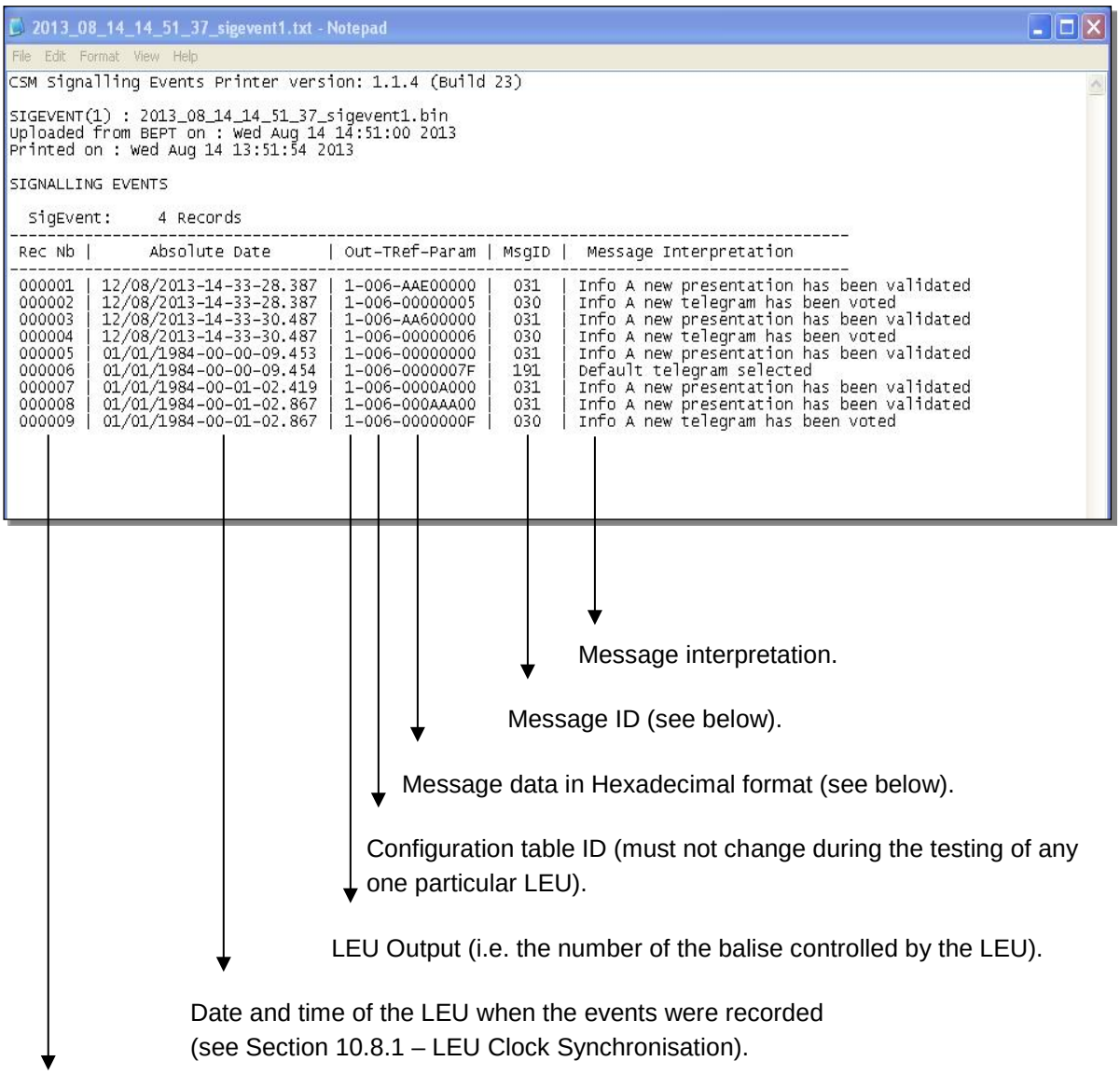


Figure 79 - Exported SigEvent Log File

Value	Gravity	Description	Additional Data
3	Information	Maintenance command to erase signalisation table	
4	Information	Maintenance command to erase lamp table	
22	Information	A train has been detected via the C4 interface.	
30	Information	A new telegram has been produced and sent to the balise.	Message data contains the index number of the telegram produced in hexadecimal format.
31	Information	New input combination received by LEU and validated.	Message data contains the state of LEU inputs in hexadecimal format.
36	Information	A new lamp state has been validated.	Current lamp state. See Table 82 in the Alstom MicroCoder User Manual for content.
191	Error	Default telegram selected	Current telegram table reference.

Table 11 - LEU Message ID Interpretation

Notes for Analysing The SigEvent Log:

1) MsgID31 is shown in hexadecimal. When converted to binary you will get 32 bits (16 LEU inputs, 2 bits per input). Inputs not used (and not programmed in data) will be shown as 00 (faulty aspect). The possible combinations of bits per input are:
   - 11 – input ON
   - 10 – input OFF
   - 01 – input FLASHING
   - 00 – Faulty
2) MsgID 30 is shown in hexadecimal. When converted to binary, the value corresponds to the telegram sent by the LEU (M_MCOUNT) as shown in the LEU Control Tables. It is important to check that no changes to message data occur during testing except for those caused by a signal aspect change.
3) MsgID 22 is shown when the balise is read (by a train or by the BEPT). Ensure that it only appears under these conditions.
4) To analyse the record, check that only one MsgID 31 and MsgID 30 is shown for each signalling input status change.
5) Check the time (as set during the LEU Input Correspondence Test - see Section 11.5) for every input status change. Every transient telegram could occur at the time of a route change, but should not occur when the route is not changing. Each message change shall be justified and reported.

Notes regarding diagnostic logs in general:

Trackside:

Refer to the Alstom MicroCoder User Manual (TRV1340003990) for further information regarding SigEvents, System Stats, SysEvent logs, event identifiers and error codes.

Also refer to the Alstom BEPT User Manual (TRV1235000156) for explanations of the event tables. T&C and maintenance training will bring these two reference docs together.

On-board System Logs:

Alstom has provided the following:

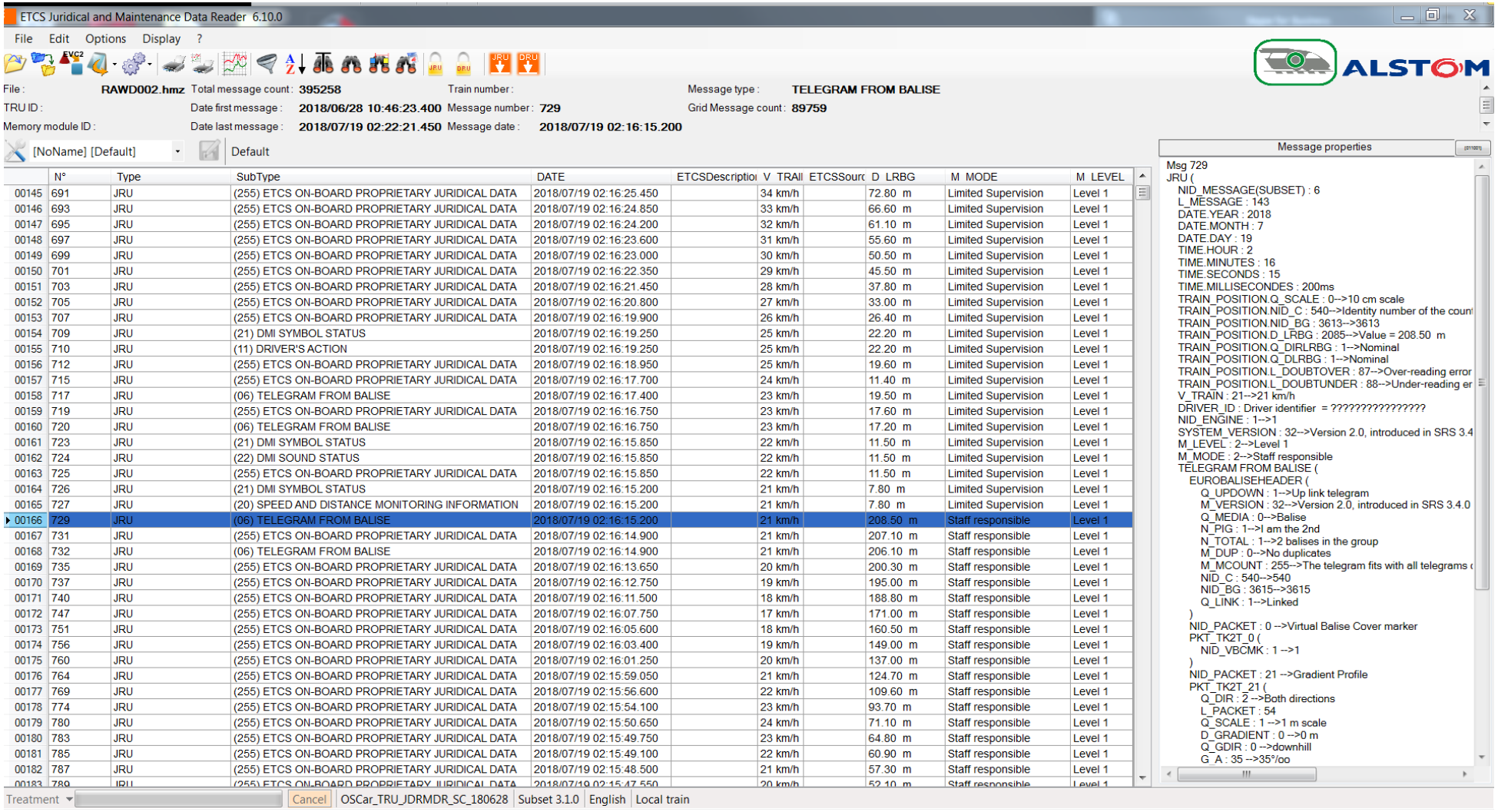
- Software (JDRMDR tool) and manual (TRV1184EL0030_VP) to interpret on-board ATP logs.
- Diagnostic code list which includes trackside.

Note: These documents are part of generic maintenance manuals for on-board and hence some fault codes may not be applicable to ATP as rolled out to TfNSW.

Figure 80 and Figure 81 are examples of screenshots of the Alstom ATP maintenance tool (JDRMDR) displaying JRU logs.

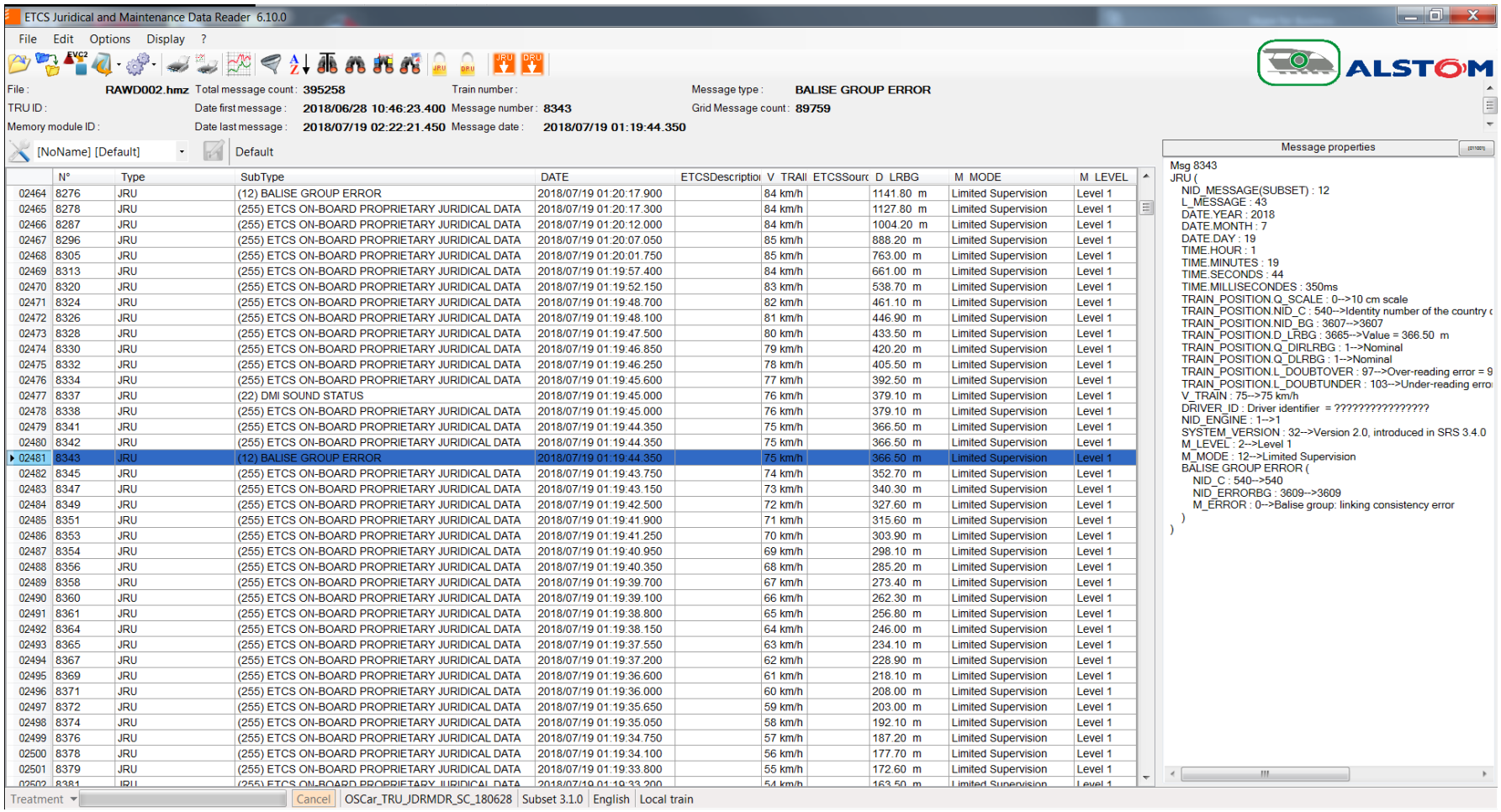
Figure 80 is displaying a Balise that has been read by an Oscar train and is displaying the data contained within the balise.

Figure 81 is a balise error message (NID Message 12), which shows the Balise group at fault and the type of fault.



	N°	Type	SubType	DATE	ETCSDescriptio	V_TRAIl	ETCSSourc	D_LRBG	M_MODE	M_LEVEL
00145	691	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:25.450		34 km/h		72.80 m	Limited Supervision	Level 1
00146	693	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:24.850		33 km/h		66.60 m	Limited Supervision	Level 1
00147	695	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:24.200		32 km/h		61.10 m	Limited Supervision	Level 1
00148	697	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:23.600		31 km/h		55.60 m	Limited Supervision	Level 1
00149	699	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:23.000		30 km/h		50.50 m	Limited Supervision	Level 1
00150	701	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:22.350		29 km/h		45.50 m	Limited Supervision	Level 1
00151	703	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:21.450		28 km/h		37.80 m	Limited Supervision	Level 1
00152	705	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:20.800		27 km/h		33.00 m	Limited Supervision	Level 1
00153	707	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:19.900		26 km/h		26.40 m	Limited Supervision	Level 1
00154	709	JRU	(21) DMI SYMBOL STATUS	2018/07/19 02:16:19.250		25 km/h		22.20 m	Limited Supervision	Level 1
00155	710	JRU	(11) DRIVER'S ACTION	2018/07/19 02:16:19.250		25 km/h		22.20 m	Limited Supervision	Level 1
00156	712	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:18.950		25 km/h		19.60 m	Limited Supervision	Level 1
00157	715	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:17.700		24 km/h		11.40 m	Limited Supervision	Level 1
00158	717	JRU	(06) TELEGRAM FROM BALISE	2018/07/19 02:16:17.400		23 km/h		19.50 m	Limited Supervision	Level 1
00159	719	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:16.750		23 km/h		17.60 m	Limited Supervision	Level 1
00160	720	JRU	(06) TELEGRAM FROM BALISE	2018/07/19 02:16:16.750		23 km/h		17.20 m	Limited Supervision	Level 1
00161	723	JRU	(21) DMI SYMBOL STATUS	2018/07/19 02:16:15.850		22 km/h		11.50 m	Limited Supervision	Level 1
00162	724	JRU	(22) DMI SOUND STATUS	2018/07/19 02:16:15.850		22 km/h		11.50 m	Limited Supervision	Level 1
00163	725	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:15.850		22 km/h		11.50 m	Limited Supervision	Level 1
00164	726	JRU	(21) DMI SYMBOL STATUS	2018/07/19 02:16:15.200		21 km/h		7.80 m	Limited Supervision	Level 1
00165	727	JRU	(20) SPEED AND DISTANCE MONITORING INFORMATION	2018/07/19 02:16:15.200		21 km/h		7.80 m	Limited Supervision	Level 1
00166	729	JRU	(06) TELEGRAM FROM BALISE	2018/07/19 02:16:15.200		21 km/h		208.50 m	Staff responsible	Level 1
00167	731	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:14.900		21 km/h		207.10 m	Staff responsible	Level 1
00168	732	JRU	(06) TELEGRAM FROM BALISE	2018/07/19 02:16:14.900		21 km/h		206.10 m	Staff responsible	Level 1
00169	735	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:13.650		20 km/h		200.30 m	Staff responsible	Level 1
00170	737	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:12.750		19 km/h		195.00 m	Staff responsible	Level 1
00171	740	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:11.500		18 km/h		188.80 m	Staff responsible	Level 1
00172	747	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:07.750		17 km/h		171.00 m	Staff responsible	Level 1
00173	751	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:05.600		18 km/h		160.50 m	Staff responsible	Level 1
00174	756	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:03.400		19 km/h		149.00 m	Staff responsible	Level 1
00175	760	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:16:01.250		20 km/h		137.00 m	Staff responsible	Level 1
00176	764	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:59.050		21 km/h		124.70 m	Staff responsible	Level 1
00177	769	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:56.600		22 km/h		109.60 m	Staff responsible	Level 1
00178	774	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:54.100		23 km/h		93.70 m	Staff responsible	Level 1
00179	780	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:50.650		24 km/h		71.10 m	Staff responsible	Level 1
00180	783	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:49.750		23 km/h		64.80 m	Staff responsible	Level 1
00181	785	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:49.100		22 km/h		60.90 m	Staff responsible	Level 1
00182	787	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:48.500		21 km/h		57.30 m	Staff responsible	Level 1
00183	789	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 02:15:47.550		20 km/h		52.10 m	Staff responsible	Level 1

Figure 80 - Telegram from Balise Example



	N°	Type	SubType	DATE	ETCSDescriptio	V_TRAI	ETCSSourc	D_LRBG	M_MODE	M_LEVEL
02464	8276	JRU	(12) BALISE GROUP ERROR	2018/07/19 01:20:17.900		84 km/h		1141.80 m	Limited Supervision	Level 1
02465	8278	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:20:17.300		84 km/h		1127.80 m	Limited Supervision	Level 1
02466	8287	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:20:12.000		84 km/h		1004.20 m	Limited Supervision	Level 1
02467	8296	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:20:07.050		85 km/h		888.20 m	Limited Supervision	Level 1
02468	8305	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:20:01.750		85 km/h		763.00 m	Limited Supervision	Level 1
02469	8313	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:57.400		84 km/h		661.00 m	Limited Supervision	Level 1
02470	8320	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:52.150		83 km/h		538.70 m	Limited Supervision	Level 1
02471	8324	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:48.700		82 km/h		461.10 m	Limited Supervision	Level 1
02472	8326	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:48.100		81 km/h		446.90 m	Limited Supervision	Level 1
02473	8328	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:47.500		80 km/h		433.50 m	Limited Supervision	Level 1
02474	8330	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:46.850		79 km/h		420.20 m	Limited Supervision	Level 1
02475	8332	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:46.250		78 km/h		405.50 m	Limited Supervision	Level 1
02476	8334	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:45.600		77 km/h		392.50 m	Limited Supervision	Level 1
02477	8337	JRU	(22) DMI SOUND STATUS	2018/07/19 01:19:45.000		76 km/h		379.10 m	Limited Supervision	Level 1
02478	8338	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:45.000		76 km/h		379.10 m	Limited Supervision	Level 1
02479	8341	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:44.350		75 km/h		366.50 m	Limited Supervision	Level 1
02480	8342	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:44.350		75 km/h		366.50 m	Limited Supervision	Level 1
02481	8343	JRU	(12) BALISE GROUP ERROR	2018/07/19 01:19:44.350		75 km/h		366.50 m	Limited Supervision	Level 1
02482	8345	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:43.750		74 km/h		352.70 m	Limited Supervision	Level 1
02483	8347	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:43.150		73 km/h		340.30 m	Limited Supervision	Level 1
02484	8349	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:42.500		72 km/h		327.60 m	Limited Supervision	Level 1
02485	8351	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:41.900		71 km/h		315.60 m	Limited Supervision	Level 1
02486	8353	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:41.250		70 km/h		303.90 m	Limited Supervision	Level 1
02487	8354	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:40.950		69 km/h		298.10 m	Limited Supervision	Level 1
02488	8356	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:40.350		68 km/h		285.20 m	Limited Supervision	Level 1
02489	8358	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:39.700		67 km/h		273.40 m	Limited Supervision	Level 1
02490	8360	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:39.100		66 km/h		262.30 m	Limited Supervision	Level 1
02491	8361	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:38.800		65 km/h		256.80 m	Limited Supervision	Level 1
02492	8364	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:38.150		64 km/h		246.00 m	Limited Supervision	Level 1
02493	8365	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:37.550		63 km/h		234.10 m	Limited Supervision	Level 1
02494	8367	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:37.200		62 km/h		228.90 m	Limited Supervision	Level 1
02495	8369	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:36.600		61 km/h		218.10 m	Limited Supervision	Level 1
02496	8371	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:36.000		60 km/h		208.00 m	Limited Supervision	Level 1
02497	8372	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:35.650		59 km/h		203.00 m	Limited Supervision	Level 1
02498	8374	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:35.050		58 km/h		192.10 m	Limited Supervision	Level 1
02499	8376	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:34.750		57 km/h		187.20 m	Limited Supervision	Level 1
02500	8378	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:34.100		56 km/h		177.70 m	Limited Supervision	Level 1
02501	8379	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:33.800		55 km/h		172.60 m	Limited Supervision	Level 1
02502	8381	JRU	(255) ETCS ON-BOARD PROPRIETARY JURIDICAL DATA	2018/07/19 01:19:33.200		54 km/h		163.50 m	Limited Supervision	Level 1

Figure 81 - Balise Group Error Example

Appendix C LEU Output Transient Protection Cassette Testing

Elsafe Transient Protection Cassette model SAM 216680 testing procedure.

The arrestor module does not have an external status indicator. If the device is suspected as being faulty, the following test may assist in fault finding.

Note: That this process only checks for short circuits internally, it does not test if the surge protection components are still functioning correctly.

SERIES RESISTANCE TEST PROCEDURE:

PRELIMINARY:

Check the **D**igital **M**ulti**M**eter (DMM) lead resistance as follows:

1. Switch the DMM to **Ω** ('ohms')
2. Connect the DMM leads together and check resistance is **less than < 0.5 Ω**

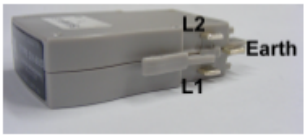
PROCEDURE:

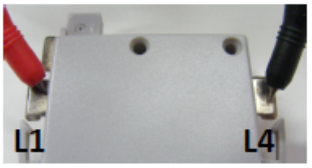
1. Connect the DMM between the combination of SAM pins shown below, and check the resistance is as specified.

PINS	RESISTANCE MEASUREMENT
L1 –L 2	OPEN CIRCUIT
L3 – L4	OPEN CIRCUIT
L1 – Earth	OPEN CIRCUIT
L2 – Earth	OPEN CIRCUIT
L1 – L4	SHORT CIRCUIT (LESS THAN 0.5 **Ω**)
L2 – L3	SHORT CIRCUIT (LESS THAN 0.5 **Ω**)

(for a guide to the pins see below schematic diagram)

PICTURE





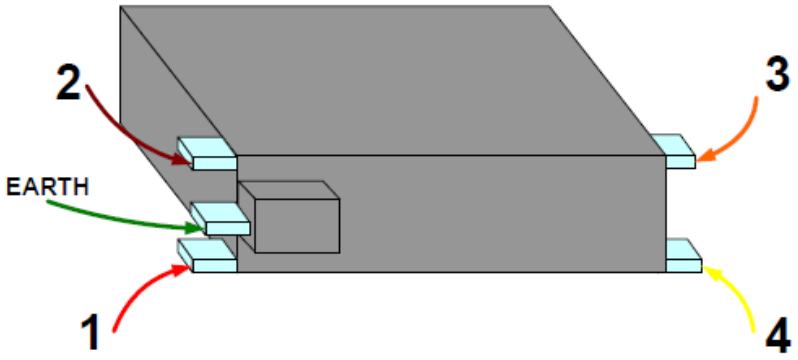


Figure 82 - Series Resistance Test Procedure

Appendix D Balise Tail Cable Assembly Instructions

Female Plug 90 degree 2 pin. Refer to standard drawing M05-552 for details.

NECESSARY TOOLING FOR MOUNTING

Specific SAIB tooling

• Necessary

Description	SAIB PN	ALSTOM PN	
CRIMPING CLAMP (M22520/1-01) for red contacts Ø 3 — code 12-11-02	084-000-01		
TURRET	084-024-01		
CRIMPING GAGE (M22520/1-01)	084-000-02		
INSERTION TOOL Mounting of the contacts into the insulator	083-103-02	24519	
DISMANTLING TOOL of the joining ring	083-105-01	24623	

Other tooling

- Cutting plier
- "Jokari" cable stripper
- Stripping pliers "SES" -MK1F/D ou "TRIPAX"
- Screw driver (pozidriv) "FACOM" AEFD-0 x 75
- 2 end wrenches 24 mm (tightening cable gland PG 13)

Figure 83 - Balise Tail Cable Tooling

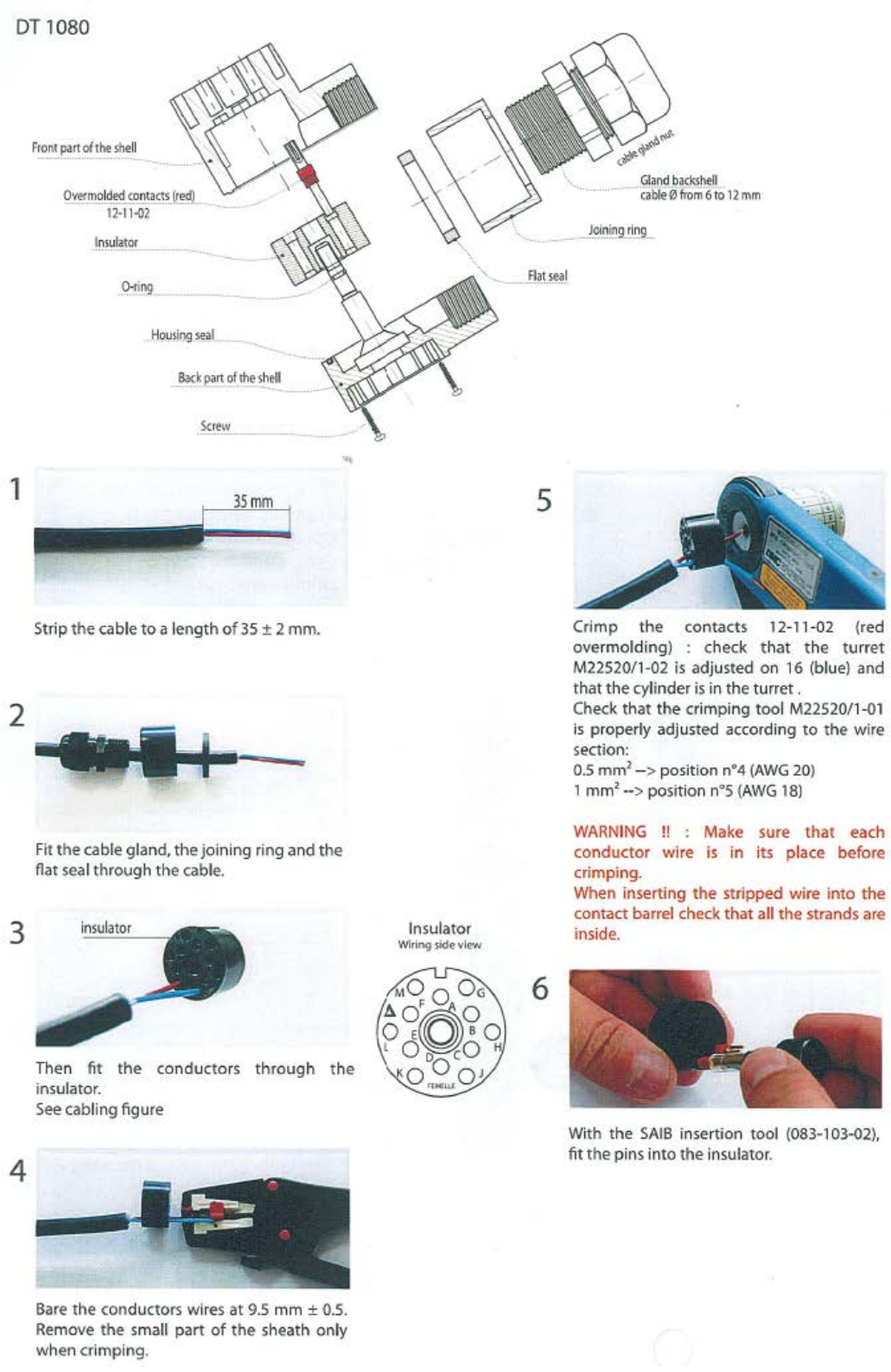
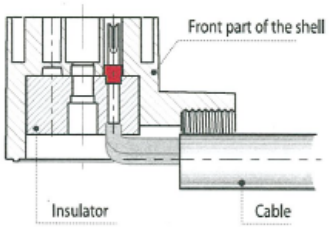


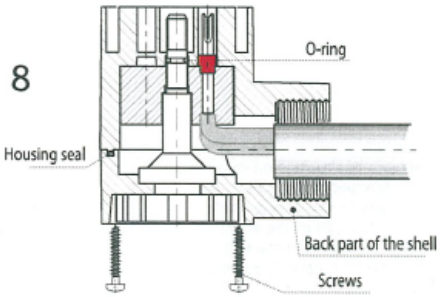
Figure 84 - Balise Tail Cable Crimping – Part 1

7



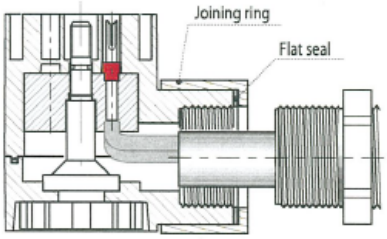
Fit the insulating assembly into the front part of the shell.
The positionning part must be in its place inside the groove of the insulator.

8



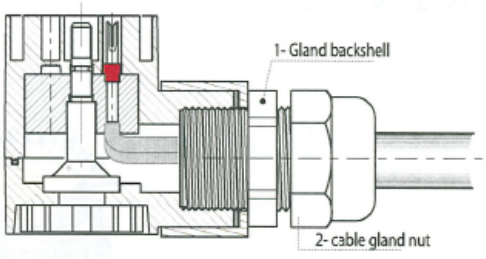
Check that the o-ring is in its place before assembling the back part of the shell.
Fit and screw alternatively the 4 cap screws.
Tightening torque : 0.5 Nm

9



Fit the flat seal and the joining ring on the body.

10



1-Screw the body of the cable gland onto the assembled body with an open end wrench.
Tightening torque : 7 Nm.

2-Tighten the cable gland nut.
Tightening torque : 7 Nm.

Δ WARNING !! : to disassemble the cable gland nut from the cable glanc, maintain the body of the cable gland with a second open end wrench.

Figure 85 - Balise Tail Cable Crimping – Part 2

Appendix E Personnel Hazard Risk Table - Inspection/Installation/Removal of ETCS Track/Trackside Mounted Equipment

Risk Assessment of:	**ETCS Trackside Maintenance**	**Workplace(s):**	**All track work**
Context/scope of assessment:	Examination and maintenance procedures for track mounted and associated trackside ETCS equipment.	**Assessment Ref No:**	N/A
Assessor's name(s):	*Jason Firmstone (Technical Manager – ATP Design)*	**WHS Risk Register consulted:**	☒ Yes ☐ **No**
Persons consulted: *Narelle Stoll (Manager Project Safety Interfaces)*		**Date of assessment:**	27-05-13
		Date of review:	14-09-17

This personnel hazard risk assessment complies with TfNSW 'Guide to Safety Risk Criteria' SMS-06-GD-2143 (Safety Risk Ranking Matrix).

This hazard risk assessment does not cover equipment located at the LEU location.

TfNSW 'Guide to Managing Construction Hazards' SMS-06-GD-2066 was used in identifying hazards that might arise from the work. The persons responsible for complying with the various hazards are listed in the table below.

Table updated 2016 to include glass fibres from balise mounting beams and optical cable.

Hazard number	Hazard (what could cause harm?)	Risk (what could happen)	Likelihood	Consequence	Risk ranking	Control	Likelihood after controls	Consequence after controls	Risk ranking after controls	Position responsible	Reference documents
1	Work on or near rail corridor – person in path of rail vehicle	Struck or crushed by train	L2	C4	C	Adhere to approved worksite protection. Ppe: high visibility vest.	L1	C4	D	Worker, supervisor and protection officer	Sms-06-gd-2066 s.2.20 traffic management
2	Loss of balance	Slips, trips, falls.	L4	C2	C	Awareness of terrain. Ppe: safety boots and helmet.	L3	C2	D	Worker and supervisor	Sms-06_gd-2066 s.2.7 falls and falling objects
3	Manual handling	Hand injury (including by needle stick, optical glass fibres or other sharp objects), muscular strain.	L4	C2	C	Secure handling. Use correct tools for the task. Following correct bending and lifting techniques. Keep back straight, elbows in, load close to the body and bend at the knees. Avoid over-reaching and stretching. Training on the use of rail clip installation/removal tools. Ppe: use appropriate gloves.	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.11 hazardous manual tasks

Hazard number	Hazard (what could cause harm?)	Risk (what could happen)	Likelihood	Consequence	Risk ranking	Control	Likelihood after controls	Consequence after controls	Risk ranking after controls	Position responsible	Reference documents
4	Struck by airborne object arising from power tool	Flying debris from drill or hammer strike	L4	C2	C	Individual competent to use tools. Ensure tool in good condition (pre-start checks). Use a tool only for purpose for which it is designed. Secure handling. Ppe: safety glasses or goggles, gloves, helmet.	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.16 plant
5	Exposure to moving parts	Apparel or adornments caught in drill	L4	C2	C	Individual competent to use tools. Ensure tool in good condition (pre-start checks). Use a tool only for purpose for which it is designed. Keep hands, apparel, adornments away from moving parts. Ppe: wear proper apparel with no loose clothing. Tie back long hair. Ensure gloves are suited to the purpose.	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.16 plant

Hazard number	Hazard (what could cause harm?)	Risk (what could happen)	Likelihood	Consequence	Risk ranking	Control	Likelihood after controls	Consequence after controls	Risk ranking after controls	Position responsible	Reference documents
6	Direct exposure to hazardous substances	Contact with threadlock chemical, solvent, cleaner, glue. Contact with fibreglass from balise or balise mounting beams.	L4	C2	C	Avoid contact with eyes, skin and clothing. Ensure access to water and soap including eye wash. Wash hands thoroughly after working with chemicals. Cleaner and primer are flammable materials. Do not use near flames. Do not use near ignition sources. Refer to msds. Ppe: safety glasses, protective gloves (especially when handling glass fibre products)	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.10 hazardous chemicals

Hazard number	Hazard (what could cause harm?)	Risk (what could happen)	Likelihood	Consequence	Risk ranking	Control	Likelihood after controls	Consequence after controls	Risk ranking after controls	Position responsible	Reference documents
7	Airborne exposure to hazardous substances	Absorb threadlock, solvent and cleaner fumes and/or breath in dust/fibreglass particles via lungs	L4	C2	C	Cleaner and primer are volatile materials. Cement/ballast dust and fibreglass particles from balise may become airborne. Ensure access to water and soap including eye wash. Ppe: dust mask where required depending on outcome of risk assessment. Goggles.	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.11 hazardous materials
8	Fatigue	Injury to self or others due to reduced judgement	L4	C2	C	Persons responsible for managing or rostering worker to undertake training and manage the risks.	L3	C2	D	Worker and manager	Sms-06-gd-2066 s.2.8 fatigue
9	Noise	Noise induced hearing loss	L4	C2	C	Purchase/hire quieter equipment. Refer to machine specific noise risk assessment. Ppe: wear hearing protection that complies with as1269:2005.	L3	C2	D	Worker and supervisor	Sms-06-gd-2066 s.2.15 noise

Hazard number	Hazard (what could cause harm?)	Risk (what could happen)	Likelihood	Consequence	Risk ranking	Control	Likelihood after controls	Consequence after controls	Risk ranking after controls	Position responsible	Reference documents
10	Electrical	Electrocution, burns, ventricular fibrillation, neurological effects, arc-flash	L5	C2	C	Only “authorised” persons may approach to within 0.5m of live electrical equipment exceeding 50vac. Only “licenced” persons may work on live electrical equipment exceeding 50vac in accordance with the nsw electricity act.	L3	C2	D	Worker and supervisor	Sms-11-gd-0244 personnel certifications – electrical authorisations (clause 9.19) and sms-06-gd-0268. Electricity (safety) act, 2004, nsw.
11	Radiation (non-visible spectrum)	Eye damage	L3	C2	D	Do not look into end of optical fibre. Equipment is Class 1 and compliant to PR S 40042	L3	C2	D	Worker and supervisor	PR S 40042