इरिसेट
गाड़ी डिटेक्शन प्रयोगशाला
प्रयोग सं : टी डी एल - 31

IRISET
TRAIN DETECTION LABORATORY
EXPERIMENT NO: TDL – 31

नाम
Name : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुक्रमांक
Roll No : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

प्राप्तांक
Marks Awarded :

पाठ्यक्रम
Course : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

दिनांक
Date : _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

अनुदेशक के आद्यक्षर
Instructor Initial :

Train Protection & Warning System (ANSALDO Make)

(RDSO/SPN/183/2012 version 2.3)

INTRODUCTION

Train Protection and Warning System assures higher level of safety during train operation. It allows safe movement of trains under its supervision. It enables automatic train protection and prevents collision, like situation. It facilitates to run the train at maximum permitted speed by providing the indication to the driver 500 m in advance of signal and higher average speed of train. The Entire system provides assistance to the Driver and can be called as an aid to the Driver.

EQUIPMENTS

TPWS basically consists of:

1. **CAB equipment (**to be maintained by ELECTRICAL dept**)**
2. **Trackside equipment (**to be maintained by S&T dept**)**

- **CAB equipment: (On-Board equipment)**

It consists of the following units

(i) On-Board Computer (OBC)
(ii) Balise Transmission Module (BTM)
(iii) BTM Antenna
(iv) Simplified Driver Machine Interface (SDMI)
(v) Wheel Sensors
(vi) Brake Interface
(vii) Health indication Panel cum Emergency Brake (EB) counter
(viii) Audio Buzzer unit
(ix) Isolation switch

- **Trackside equipment:**

It consists of the following:

1) (LEU) Line side Electronic unit

2) BALISES:

(i) **Switchable Balises**
(ii) **Infill Balises**
(iii) **Fixed Balises**

WORKING PRINCIPLE

It is a Microprocessor based 2 out of 2 architecture systems, works in conjunction with the On Board Cab Equipment and the Track side Line Equipment. Track side data i.e. Information of the signalling aspect is transmitted to the on-board cab equipment via Balise.

SEQUENCE OF OPERATION

- LEU picks up the Signal Aspect.
- Aspect information passed on to the Balise.
- BTM Antenna picks up the Information from Balise.
- BTM decodes the data and sends to OBC.
- OBC processes this information and generates the required commands (such as Braking or Warning). These actions take place depending up on the current signal aspect and actual speed of the train.

SYSTEM DESCRIPTION

On Board Computer have 2 out of 2 architecture Microprocessor Based systems, with the **functional requirement** as under:

1) Receives data from Euro balise and processing the received track messages
2) Speed sensing and calculation of Dynamic Speed profiles, Release speed.
3) Audio Visual warnings
4) Dynamic speed monitoring
5) Linking of Euro balise and Recording of Data

a) Balises (Switchable / Infill / Fixed): Balise is a transmission device, which can transmit telegrams to the on Board Cab Equipment, by using Magnetic Transponder Technology. It becomes active due to the downlink electromagnetic wave signal at 27.095 MHz, received from the on Board Antenna fitted at the bottom of the Cab. It transmits 4.234 MHz up link signal by FSK transmission of 565.4 KHz up to 1023 bit telegrams.

1) **Switchable Balise:** Connected to the Signal and Placed at the foot of the Signal.
2) **Infill Balise**: Additional Balise placed at a distance of 500m in rear of the Signal is called Infill Balise and is connected to the Signal in Advance through Data Cable. Provision of infill Balise improves the Section Capacity.
3) **Fixed Balise:** Used to reset the tachometers, to announce the entry, exit, changes in level etc and is not having any electrical connection with the LEU

b) Line side Electronic Unit (LEU):

This unit work as an **I**nterface between the Signalling data and the Balise for Communication of Signalling Aspects, through digital inputs, which generates suitable message (telegrams) to Balise based on the Signal Aspect.

A telegram is a set of well-defined packets. Telegrams are normally stored in LEU. One Telegram is stored in balise also, which is called the default balise telegram, which will be transmitted to on-board in case LEU output is not reaching the balise (due to defective LEU or cable cut between LEU to balise). The default balise telegram will result in train coming to a stop.

LEU can drive up to four Balise, from a distance of 3 to 5 KM. and can read Max 10 input. This is again a 2 out of 2 design, and the two processors say A & B communicate their result at an regular predetermined time interval. Each LEU is having different I.D.

LEU is associated with the following modules:

1. POWER SUPPLY PACK Coverts 110 V AC to

a) 48 V DC for LEU Operation.

b) b) 24 V DC to read ECR Contacts.

1. PFSK MODULE:

This module is an interface between LEU and Balise. (Output for Balise is connected through this Module). It can feed up to 4 Balises. PFSK is a protection module that protects the LEU Module against any over voltage from the Frequency Shift Keyed Eurobalise interface.

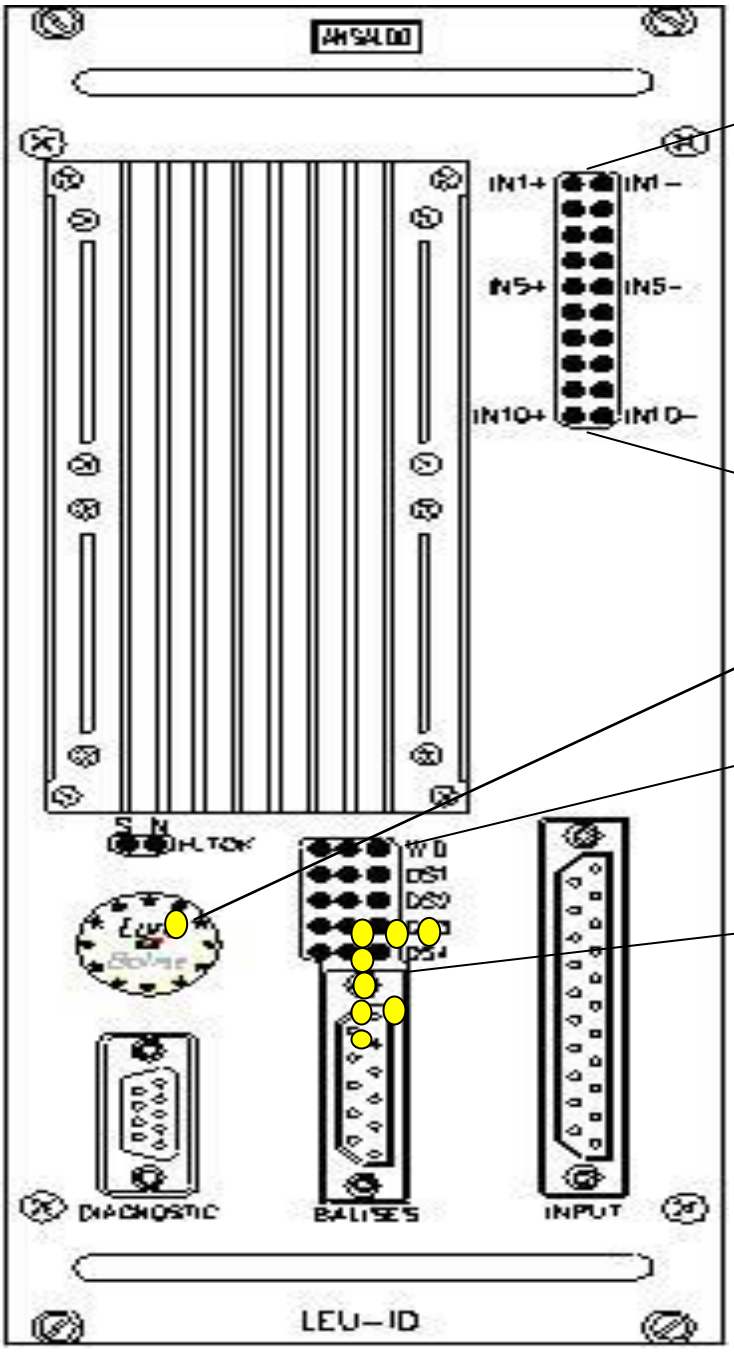
2. PIND MODULE:

This module is an interface between ECR's contact to LEU and can read up to 10 input channels. PIND is a protection module that protects the LEU module against any over voltage from the field to the digital inputs in the LEU.

Observe the following Indication in LEU: -

Sl. No.	**1st Signal Aspect**	Observe the Indications on LEU Module
1	Green	Input Indication -1 lit
2	Double Yellow	Input Indication -2 & 3 lit
3	Yellow	Input Indication -3 lit
4	Red	Input Indication -4 lit
5	Red with 'A' Marker	Input Indication -4 & 5 lit
6	Red with calling ON	Input Indication -4 & 6 lit
7	Yellow with Route	Input Indication -7 lit
	2nd Signal Aspect	
8	Green	Input Indication -8 lit
9	Yellow	Input Indication -9 lit
10	Red	Input Indication –10 lit

LEU Healthy Indication ☼ ☼ H.T OK



Signal-1 Signal-2	
1.DG	-
2.HHG	-
3HG	-
4.RG	-
5.A marker	-
6.CO	-
7.Route	-
8.DG	-
9.HG	-
10.RG	-

System healthy Indication

Maintenance LEDs

0 V 1	0 R 2	WD 3
0 Ch1 4	0 5	0 6
0 Ch2 7	0 8	0 9
0 Ch3	0 11	0 12
0 Ch4	0 14	0 15

1 V – Indicates that the equipment is powered

2 R - Redundant configuration

3 WD - Watch Dog active

4,7,10 & 13- Indicates the Status for 4 FSK channels (Ch1-Ch2-Ch3-Ch4, one LED for each channel) **ON**: channel is active.

OFF: channel is inactive.

BLINKS: In case of a fault.

5 - **ON**: All Balises are transmitting the Encoder default telegram.

OFF: At least one Balise is sending a telegram other than the Encoder default telegram.

6-Flashes for 5 seconds at telegram changeover.

8- **ON**: one or more inputs are unstable.

OFF: all inputs are stable

9 - Indicates a connection to other devices

11-Always **ON** for LEU ID

12- **ON**: start-up ,

OFF: system on

14, 15 -Not used.

Procedure for Starting the train in TPWS section in "level "0" (To be done in SDMI):

1) After turning BL Key, **COMMS STATUS** icon starts flashing and STANDBY icon is lit. Press **"START"** button. Press **"LEVEL 0"** button. "**L0**" will display.
2) Now press **"START"** button. Level 0 is transmitted to OBC and "**SO**" (Send Operating Level) will display.
3) To select train mode now press **"START"** button-"**SA**"(Select Train Mode)displays which later changes to "**SS**" (Start of Mission sent successfully).
4) Again press" **START"** button and then press flashing **"UNFITTED"** button.
5) The flashing "**UNFITTED"** button becomes steady.
6) Now the train is ready to start in **"Level 0** - **UNFITTED"** Mode.

Now the TPWS on board system is ready in Unfitted mode.

Switching ON Trackside Equipment

1) Measure 110 V AC at the AC input terminal
2) Measure 24 V DC at the relevant terminal
3) Switch on the switch provided in 110 V AC/48V DC PSU.
4) Observe the indications in the LEU Module
5) Observe the Input LED indication according to the aspects displayed

SUMMARY of Modes of On Board:

1) NP – No Power – The system is in "power off" condition. (All levels).
2) IS – Isolation-Though system is "ON" but the isolation switch is in by-pass position (All levels).
3) SB – Stand By mode. It is the default mode when the system is switched ON.
4) UN – Unfitted mode. It will allow driver to start in level "0" (only level 0)
5) SR – Staff responsible mode. It will allow driver to start is level "1" at his own responsibility.
6) FS – Full supervision when the train is under full control of system (Level1).
7) OS – On Sight mode. When automatic signal is passed at danger or on passing Calling On signal (Level1).
8) TR – Trip mode. When the train passes end of authority (manual signal at danger) results in "EB" & bring train to stand still the brakes are released only after acknowledgement.
9) PT – Post Trip mode. On acknowledgement of tripping at 0 Kmph the system automatically enters into Post Trip mode.
10) SH – Shunt Mode. Allows driver to do shunting.
11) SL – Sleeping Mode. When the BL key is removed the system goes to sleeping mode.
12) SF - System Failure. In case of system failure, SF is displayed on DMI.

Testing of Scenarios

A) Testing of FS Mode: (Full Supervision)

1) Select “Y” aspect and pass the train over the Balise.
2) On passing the Balise observe “FS” mode in SDMI and Level 1 litting.
3) Observe the Actual Speed in SDMI.

B) Infill scenario:

1) Select “Y” aspect and pass the train over the Balise.
2) On passing the Balise observe “FS” mode in SDMI and Level 1 litting.
3) Observe the Actual Speed in SDMI.
4) Observe Target speed and Target distance.
5) After passing over the Infill Balise.
6) Observe the updating of Movement authority.

C) SPAD Scenario: (Signal Passing At Danger)

1) Select “Y” aspect and train has passed over the Balise.
2) On passing the Balise observe “FS” mode in SDMI and Level 1 litting.
3) Observe Target speed and Target distance.
4) When the Target distance is around 40m pass the train over the Switchable Balise (Second signal displaying Red aspect).
5) Observe the TRIP reaction from SDMI.
6) Observe the EB counter reading.
7) Acknowledge the Trip icon in SDMI and observe the Post trip icon lit.
8) Then press START button twice and observe the SR mode.
9) Acknowledge SR mode Button and Observe the updating of Movement authority.

D) Over speed Scenario:

1) Increase the Actual speed more than permitted speed (Permitted speed + 5 Kmph) and observe the OVERSPEED icon litting and Service Brake application in SDMI. Also Observe traction cut-off indication in SDMI Panel. Now reduce the Actual speed slowly and observe the withdrawal of service brake command when the actual speed is less than the permitted speed.
2) Increase the Actual speed more than permitted speed (Permitted speed +10 Kmph) and observe the OVERSPEED icon litting and Emergency Brake application in SDMI. Also Observe traction cutoff indication in SDMI Panel. Now reduce the Actual speed slowly to Zero speed (Standstill) and observe the withdrawal of Emergency brake command when the actual speed is brought to Zero speed.
3) Observe the EB counter reading.
4) Observe the Release speed, Target speed and Target distance

E) EOA (End of Authority) Override Procedure:

1) Select “Y” aspect and pass the train over the Balise.
2) On passing the Balise observe “FS” mode in SDMI and Level 1 litting.
3) Observe the Actual Speed in SDMI.
4) Observe Target speed and Target distance.
5) Pass the train over the Balise fixed at the Second Signal displaying Red aspect after getting proper authority, duly pressing EOA-Override Button.
6) Observe the litting of EOA-Icon, SR icon and Permitted speed (15 Kmph).
7) Observe the Extinguishing EOA-icon.
8) Observe the status of SR icon and Permitted speed. MPS (In SR mode the SDMI will display Maximum permitted speed and the Motorman has to follow GR&SR procedures).

F) On- Sight Mode

1) Select “Red” aspect with “A” marker lit or “CO” lit and pass the train over the Balise.
2) On passing the Balise, observe “OS” mode in SDMI and Level 1 litting.
3) Observe the Actual Speed in SDMI.
4) Observe the maximum permitted speed in SDMI. (15 Kmph)
5) Observe the Release speed, Target speed and Target distance.
6) Observe the reaction of On-Board by increasing the Actual speed.

a) MPS + 0 to 5 Kmph, b) MPS + 5 Kmph c) MPS + 10 Kmph

Power Supply Module of LEU(110 V AC)

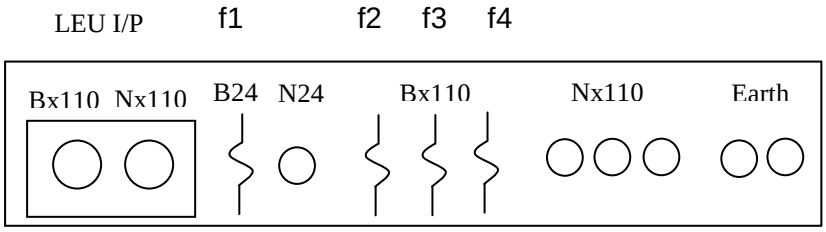
Sl. No.	Status of Power Supply module	Indication	Remarks
1	Back up	White	always should lit
2	48V DC Output	Green	always should lit
3	110V AC Input	Red	always should lit
4	Battery Charging	White	always should lit
5	Battery under voltage	White	Normally blank

Note: When Input 110 VAC is cut off, ‘Back up’ indication only appears with Lithium ion (Li^+) Battery (27 V, 1.2 AH) This backup is for 3 minutes only and after 3 minutes this LEU will switch OFF.

READINGS (LEU Module)

Power Supply Readings Measurements			
	Terminals	Range	**Actual reading**
110 V AC LEU	INPUT	**80 to 140 V AC**	
24 V DC PSU	INPUT	**80 to 140 V AC**	
	OUTPUT	**18 to 35 V DC**	

Aspect Readings Measurements 24 V DC (Range 18 V DC - 35 V DC)				
	INPUT	Indication	Terminals	Voltage
1st Signal	1	Green	1&2	24 V DC
	2	Double Yellow	4&5	24 V DC
	3	Yellow	7&8	24 V DC
	4	Red	10&11	24 V DC
	5	'A' Marker	13&14	24 V DC
	6	Calling ON	16&17	24 V DC
	7	Route	19&20	24 V DC
2nd Signal	8	Green	22&23	24 V DC
	9	Yellow	25&26	24 V DC
	10	Red	28&29	24 V DC



Details	Voltage	Particulars
Bx110 & Nx110	110 V AC	To LEU Input
Fuse 1	24 V DC	To Power Supply Modules
Fuse 2	110 V AC	To Signal Cable
Fuse 3	110 V AC	To 24V DC PSU
Fuse 4	110 V AC	To Fan Tray

EXERCISE

1. Draw block diagram of Basic architecture of TPWS ?

2.How many types of balises are there, and Write briefly about various balises ?

3. Draw the functional diagram of LEU and explain PIND PFSK and LEU module ?

4 write down the types of brakes and when it applied?

5 write down the indications available in the LEU ?

Date: **Signature of the Trainee**