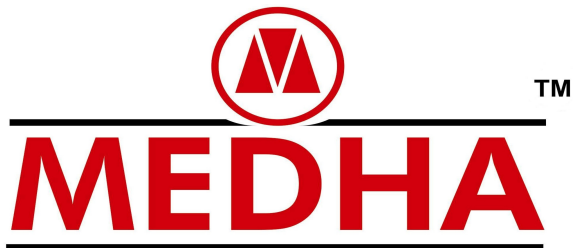

MAINTENANCE INSTRUCTION MANUAL

MICROPROCESSOR BASED LOCOMOTIVE CONTROL SYSTEM MEP 660 FOR DIESEL ELECTRIC LOCOMOTIVES

As Per
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P- 4 / 5 B, I.D.A NACHARAM
HYDERABAD 500 076
Ph. No. 040- 2717 3990 Fax. 040 2717 4908
Email: marketing@medhaindia.com URL: www.medhaindia.com

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1. INTRODUCTION

The Diesel Electric Locomotives of Indian Railways, driven by DC traction motors, employ AC/DC Power Transmission System. The MEP-660 Medha Excitation and Propulsion system is a Microprocessor Based Locomotive Control System. The system provides a superior control mechanism, protection to traction equipment, fault diagnostics, and adaptability to different engine types. The Microprocessor based Locomotive Control System Type MEP-660 control the entire locomotive. There are four-sub control systems like

- Engine and loco propulsion
- Auxiliary generator / Battery charging
- Excitation.
- Wheel Slip control

There are no mechanical sequential interlocks between inputs and output devices of the engine cranking and loco propulsion system. As per the operational requests by the driver, the MEP-660 directly energizes the required output devices. The sequential / safety interlocking and the required timings are provided through software which is loaded in the micro controller.

The Microprocessor based Locomotive Control System MEP 660 continuously monitors the train line signals (MU signals) and controls the excitation of the Alternator based on the operating requests of the Driver. It monitors various analog and digital feedback signals from the traction equipment and controls the excitation in such a way as to maintain constant Horse Power of the Diesel Engine.

The MEP 660 system controls the excitation of the Auxiliary Generator so as to maintain constant output voltage for Battery Charging as well as control circuits in spite of variation in the engine speed from Idle to the 8th notch.

Being a Microprocessor based system; the MEP 660 has Fault Diagnostic capabilities. The System continuously monitors various operational parameters and checks for abnormalities in the functioning of various traction equipments. In case a fault is identified, an appropriate action by way of isolating a sub system or limiting the power, etc is taken to prevent further damage to the equipment and other connected equipments. The fault is also displayed on a Display Unit along with the restrictions imposed because of fault, for the information of the Driver. The fault code along with Real Time and Date stamp is logged in the Error Log Memory.

The MEP 660 Control System displays various operating parameters on the Display Unit continuously from the selected predefined groups for the benefit of the driver and maintenance staff.

All the functions described above are implemented in the Microprocessor based Locomotive Control System MEP 660, which is designed with number of sub assemblies for ease of maintenance and reducing the amount of cabling required. The Microprocessor based Locomotive Control System MEP 660 consists of the following sub assemblies.

- | | |
|-----------------------------|--------------|
| ➤ Control Unit | Type MEP 660 |
| ➤ Display Unit | Type MDS 733 |
| ➤ Analog Distribution Units | Type MDB 701 |
| ➤ RPM Distribution Unit | Type MDB 702 |
| ➤ Current Sensors | Type MCS xxx |
| ➤ Voltage Sensors | Type MVS 8xx |

➤ Temperature Sensors	Type MTS 815x
➤ Pressure Sensors	Type MPS 8xx
➤ Altitude Sensors	Type MPS 843
➤ Speed Sensors	Type T815/T817
➤ Resister Unit	Type MRP 703
➤ XD23-XC13 assembly unit	Type MDA 751
➤ Memory Freeze cum / VCD Disable	Type MMF 705
➤ CGR/PGR Resistor unit	Type MRP 706
➤ Engine Speed Sensor Interface unit	Type MSI 761
➤ HLD Relay Module	Type MRA 710
➤ Field Control Panel (FCP)	Type SFCP- 25
➤ VCD Magnet Valve	Type 3332-10-4G

The Interconnection Diagram of all the above sub assemblies of MEP-660 is given in **Annexure – 1**. All these sub assemblies are interconnected through plug in type MS Connectors for ease of installation and maintenance. These sub assemblies are described below. Please refer the electrical schematics of Microprocessor based control system MEP-660, document No. ED100 or ED1001, for the details of individual connecting cables and their pin Numbers.

2. CIRCUIT DESCRIPTION

Please refer 'Hand Manual' on Microprocessor Based Loco Control system MEP-660, document No. IM 39 for detailed circuit explanation.

3. CONTROL UNIT TYPE MEP 660

Description:

This is main control equipment of the Microprocessor system. The control unit consists 18+1(spare) plug in module type cards in dust proof enclosures. These modules are provided with proper identification number both on the module and as well on the control unit of each slot. The unit is engineered for quick replacement of any plug in card. These plug in cards are functionally separated in to modules of the main system. The backplane of the control unit is designed in such a way that insertion of a module can be done only at its earmarked position. The complete unit has a Transparent cover with a lock. The lock provides protection against unauthorized opening. With transparent cover, the indication LED's provided on some of the individual modules can be seen from outside. These LED's can give information about the status of various signal inputs as well as proper functioning of the concerned modules. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for Dimensional Drawing and mounting details of the control Unit.

All the external connections to this control unit are done through MS circular connectors. These connectors are earmarked and similar identification markings are provided on the cables, which are connected, to these connectors. These connectors are also polarized to avoid wrong insertion of connectors in service.

The block diagram of interconnections of all these modules through the back plane is given in **Annexure – 2**

Maintenance: There are no user serviceable components available in the control unit base. The connectors are wired to the back plane PCB directly. No preventive maintenance is required to the base up to M48 schedule as there are no passive components in the base unit. Only external blowing and cleaning of dust is required from M4 schedule onwards.

Running maintenance on loco:

All the MS connectors on the control unit are polarized. Insert the male/female connectors of the cable in a proper direction and into the right female/male connector on the control unit while reconnecting.

Ensure tightness of external connectors once in M4 schedule. Press the connector of the cable and then tighten the connector. Repeat the process till the connector is completely tight.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Ensure all connectors are fixed and are tight. The following are the Cable connectors connected to MEP-660 control unit. A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z,AA,AB,AC,AD,AE,AF,AG,AH,AI,AJ,AK,AL,AM,AN,AP,AQ,AR,AS,AT,AU,AV,AW,AX,AY,AZ,BA,BE,BF,BG,BH,BI,BJ,BK,BL,BM,BN,BO,BP,BU.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the MS connectors.
5.	M12	
6.	M24	
7.	M48	Unload the base from locomotive: Clean the external dust with a dry cloth. Use medium size vacuum cleaner to suck the dust accumulated on the back plane of the base. Do not use compressed air to blow out the dust Any dust entry into female sockets can cause bad contact of the connector. Check for any physical damages to the connectors on the control unit. Replace the damaged connectors of same type numbers. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED 1000 / ED1001 for connector details.
8.	M96	Same as M48

3.1. **Control Card MEP_CC**

The MEP_CC card is the main control card having a micro controller along with its programmed software, various peripheral circuits and interface circuits. All the digital, analog and frequency inputs are connected to this card after processing to the required level through their respective cards.

This card is built in a rugged enclosure with a cover to protect it from dust and EMI noise. There are no user serviceable components available in the card.

Warning:

Handle the card very carefully and do not store near magnetic fields. Static electricity of human body / heavy magnetic fields may destroy the components inside the module. Do not drop down the card.

Maintenance:

There are no adjustable components on this card. The card does not require any preventive maintenance schedule and calibration, unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screws. Do not drop down the card into the base unit. Check the tightness of the card fixing screws on the control unit.
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.2. Control Card MAU_CC

The MAU_CC card is the second control card having a micro controller along with its programmed software, various peripheral circuits and interface circuits. This card controls the Auxiliary Generator field current to regulate the terminal voltage at $72\pm 1V$ (set limit). This card is built in a rugged enclosure with a cover to protect it from dust and EMI noise. There are no user serviceable components available in the card.

Warning:

Handle the card very carefully and do not store near magnetic fields. Static electric city of human body / heavy magnetic fields may destroy the components in side the module. Do not drop down the card.

Maintenance:

There are no adjustable components on this card. The card does not require any preventive maintenance schedule and calibration, unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screw. Do not drop down the card into the base unit. Check the tightness of the card fixing screw on the control unit
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.3. Control card MWS_CC

The MWS_CC card is the third control having a micro controller along with its programmed software, various peripheral circuits and interface circuits. This card detects the wheel slip and communicates to the MEP_CC card to control the power during wheel slip.

This card is built in a rugged enclosure with a cover to protect it from dust and EMI noise. There are no user serviceable components available in the card.

Warning:

Handle the card very carefully and do not store near magnetic fields. Static electric city of human body / heavy magnetic fields may destroy the components in side the module. Do not drop down the card.

Maintenance:

There are no adjustable components on this card. The card does not require any preventive maintenance schedule and calibration, unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit
2.	T1, T2	-
3.	M2	-
4. 5.	M4, M8 M12	Check the tightness of the card fixing screws on the control unit Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screw. Do not drop down the card into the base unit. Check the tightness of the card fixing screw on the control unit
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.4. Digital Input Cards (MDIP16 / MIDIP16)

These digital input cards consist the hardware required for converting the high voltage signals of nominal 72V DC from the locomotive circuits to isolated low voltage signals of 5V DC required for the microprocessor of the system. Each card can process 16 input channels. The Green color LED's provided on this card indicates presence of 72 VDC voltage on that particular channel. The Yellow LED's indicate the signal being sent to Micro controller after isolation and signal conditioning. Thus at any stage, both the LED's of a particular channel either OFF or ON indicate the correct functioning of card.

There are 5 such digital input cards accommodated from slot 9 to slot 13. These cards MDIP16 / MIDIP16 can be swapped in between them. The list of channel wise digital inputs that are connected to these cards is given as [Annexure-3](#)

Maintenance:

There are no adjustable components on this card. The card does not require any preventive maintenance schedule and calibration, unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	
4.	M4, M8	Conduct manual digital input test on loco as per the procedure. Kindly refer the 'Manual Test for Inputs' explained in 'System Manual' document No. IM 08. Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screw. Do not drop down the card into the base unit. Check the tightness of the card fixing screw on the control unit Conduct manual digital input test on loco as per the procedure. Kindly refer the 'Manual Test for Inputs' explained in 'System Manual' document No. IM 08.
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

Testing and Trouble shooting: The functionality of these cards can be tested on the locomotive through Display Module even with engine not running. Kindly refer the 'Manual Test for Inputs' explained in 'System Manual' document No. IM 08 and 'Trouble Shooting Manual' document No. IM51 for Microprocessor Based Loco control system MEP-660. The test procedure of individual digital input is given as [Annexure-4](#) These cards can be tested on the locomotive to their functionality from M24 schedule on wards.

3.5. Digital Output Cards (MLSD16 & MHSD16 / MIHSD16)

The digital output card converts 5V digital signals generated by the micro controller system (MEP_CC card) to 72VDC power signals required for driving relays, contactors, solenoids, indication lamps etc in the locomotive circuit. These cards provide electrical isolation, between locomotive circuits and micro controller circuits. Each card can process 16 out put signals. There are 2 types of Digital Output cards.

3.5.1. Medha High Side drive Card MHSD16 / MIHSD16

The High Side Drive Card (MHSD16 / MIHSD16) drives an output device (Solenoid / LED) when switched ON through the MEP system, by providing positive supply to the device. The negative supply is directly connected to the device.

3.5.2. Medha Low Side drive Card MLSD16

The Low Side Drive Output Card (MLSD16) drives an output device (Contactor, Relay) when switched ON through the MEP system, by connecting the device to negative supply. The positive supply is directly connected to the device.
In both the cards, each output channels are individually reverse polarity, surge and short circuit protected.

A list of digital outputs connected to each card, is given in [Annexure-5](#).

Maintenance:

There are no adjustable / user serviceable components on this card. The card does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre- Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screws. Do not drop down the card into the base unit. Check the tightness of the card fixing screws on the control unit. Conduct manual digital output test on loco as per the procedure. Kindly refer the 'Manual Test for outputs explained in 'System Manual' document No. IM 08.
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

Testing and Trouble shooting: The functionality of these cards can be tested on the locomotive through Display Module even with engine not running. Kindly refer the 'Manual Test for outputs' and 'Auto Test for Relays' explained in 'System Manual' document No. IM 08 and Trouble shooting Manual document No. IM51 for Microprocessor Based loco control system MEP-660. The test procedure of individual digital outputs is given as **Annexure-6**. These cards can be tested on loco to their functionality from M24 schedule onwards.

3.6. Analog Input Cards

The MEP-660 system continuously monitors various parameters like voltages, currents, pressures, and temperatures of various equipments in the locomotive through different sensors. These sensors generate a low current signal, which is proportional to the real value. These low current signals are connected to these analog cards via analog distribution boxes (ADB)

The analog input card process these low current signals into proportionate low voltage signals suitable to micro controller and communicates to the concerned micro controller cards. These Cards provides electrical isolation, between locomotive circuits and micro controller circuits. Each card can process 8 analog inputs.

There are 4 cards used for processing the total Analog Signals that are monitored by the MEP-660 system. The individual card is factory calibrated for accepting the relevant output from the relevant sensor. A list of Analog inputs connected to each card is given in **Annexure – 7**.

3.6.1. Medha Analog Input card MAIP8_AU

This card MAIP8_AU card is connected between MAUCC card and ADB1 Parameters pertaining to Auxiliary generator and Battery charging is mainly connected to this card.

3.6.2. **Medha Analog Input Card MAIP8_WS**

This card MAIP8_WS card is connected between MWS_CC card and ADB2 Individual traction motor current signals are mainly connected to this card.

3.6.3. **Medha Analog Input card MAIP8_EP**

This card MAIP8_EP card is connected between MEP_CC card and ADB3 All the excitation related parameters are mainly connected to this card.

3.6.4. **Medha Improved Analog Input card MAIP16 / MIAI**

This Card MAIP16 / MIAI (Modified analog input card) is connected between MAU_CC control card and ADB4. This card process the signals received from BPP, BCP, FOP, BAP, and LOP sensors. It also provides low current output signals proportional to LOP, FOP and BAP pressure signals measured by the MEP 660 system

Maintenance:

All these cards are factory calibrated and does not require any intermediate calibration in shed. These cards do not require any preventive maintenance schedule unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Get the card calibrated at factory if necessary. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screws. Do not drop down the card into the base unit. Check the tightness of the card fixing screws on the control unit. If any of the displayed parameters is deviated from the standard value, get the cards calibrated at the factory
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.7. **Medha Frequency Input Card (MFIP16)**

This card consists of the hardware required for converting the signals generated by speed sensors of Traction motors and diesel engine to isolated low voltage signals required for the micro controller control system. This card provides electrical isolation, between sensor circuits and micro controller circuits. All the inputs are surge protected. This card can process 16 input signals.

Maintenance:

There are no user serviceable components in this card, and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screws. Do not drop down the card into the base unit. Check the tightness of the card fixing screw on the control unit.
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.8. Medha Pulse Width Modulator Card (MPWM2)

The PWM card converts the low voltage pulse width modulated signals generated by the micro controller system to a high power 72V output for controlling the exciter field current and auxiliary generator field current. This card has two independent channels. An IGBT based PWM driving circuit with built in protection circuits is used for both PWM controls.

Maintenance:

There are no user serviceable components in this card, and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screw. Do not drop down the card into the base unit. Check the tightness of the card fixing screw on the control unit
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.9. Medha Excitation and Propulsion - Power Supply Card (MEPPS)

This module supplies various regulated power supplies of $\pm 9V$, $\pm 12V$ and $\pm 15V$ required for the operation of all the cards in the control unit. These regulated power supplies are generated from nominal 72V DC These are basically switch mode power supplies, which can accept wide variation of input voltage. It provides electrical isolation between input supply from locomotive and various regulated power supply outputs. The input supply is reverse polarity protected, and surge protected. LED's provided on this unit indicate availability of a particular supply voltage.

**Maintenance:**

There are no user serviceable components in this card. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure proper fitment of card and tightness of card holding screws on the base when ever the card is replaced or once in M12 (12 months) schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the card fixing screws on the control unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the card fixing screws on the control unit.
5.	M12	Remove the card from the base and clean the external dust with dry cloth. Gently slide in the card into the ear marked slot and press gently into the socket. And tighten the card fixing screws. Do not drop down the card into the base unit. Check the tightness of the card fixing screws on the control unit
6.	M24	Same as M12
7.	M48	Same as M24
8.	M96	Same as M48

3.10. Medha Display Unit - MDS 733

This sub assembly consists of a 40 character X 4 line alphanumeric vacuum fluorescent display (VFD). It also consists of a keyboard for data entry by the operator, and an acknowledge switch to silence the built in Buzzer (Hooter) and Alarm Gong (ALG) during fault message display. It has an RS485 Serial communication interface for communication with Control Unit. It has its own Power Supply module working on 72V DC for generating regulated power supplies required for display circuits.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of power supply connector and communication cable connector available at the back side of the display unit once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the backside of the display unit.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check the tightness of the MS connectors available at the backside of the display unit.
5.	M12	Same as M4, M8 + Test the Display unit as per the procedure mentioned in Testing and Trouble shooting.
6.	M24	Same as M12
7.	M48	Same as M24 + If necessary replace the following items by sending to factory. <ul style="list-style-type: none"> • Membrane key board,

S.No.	Schedule	Nature of attention
		<ul style="list-style-type: none"> • Acknowledge button, • Hooter and Glass.
8.	M96	Same as M48 + Replace the following items by sending to factory. <ul style="list-style-type: none"> • Membrane key board, • Acknowledge button, • Hooter and Glass.

Testing and Troubleshooting: ---

- Connect 72 Volts DC power supply to the display unit in the test LAB with suitable female connector and cable. The display should initially indicate:

'Excitation And Propulsion Control
 Power ON Self-Check'

- After few seconds, the display show:

'Communication Fail'

- Press Menu key. The display shows main menu options:

1. Faults
2. Display Mode
3. Test Mode
4. Exit

Ensure that no other characters are displayed during the above sequence of check. If any other characters are displayed, the display unit has to be serviced.

3.11. Analog Distribution Box (ADB) - MDB 701

The Analog Distribution Box provides regulated DC power to various sensors that are connected to the ADB. It also collects output signals from these sensors and transmits them to the main control unit. Each analog distribution unit can serve eight sensors and provide one analog output for driving load ammeter. The unit consists of regulated power supplies required for the sensors. These regulated power supplies work on 72V DC.

The unit consists of eight plug-in type MS connectors (circular connectors) for connecting eight individual sensors through independent cables and one connector for connecting one analog output. It also has one MS connector for transmitting all the signals collected from the sensors to the main control unit.

There are 4 ADBs per loco. All are identical and can be interchanged. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of all connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the front side of the ADB.
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check for any physical damages to the pins and threading on each and every connector of the ADB. If necessary replace the connector of it type No. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED1001 for connector details. Check the tightness of the MS connectors available at the front side of the ADB.
5.	M12	Same as M4, M8 + Test the ADB as per the procedure given in 'Testing and Trouble shooting.' Connect all the connectors in the loco and check the tightness of the MS connectors.
6.	M24	Same as M12
7.	M48	Same as M24 + ➤ Replace the interconnecting cable between ADB and sensor on condition basis.
8.	M96	Same as M48 + ➤ Replace interconnecting cable between ADB and sensor. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

Testing and Troubleshooting: ---

Connect 72 Volts DC power supply to the display unit in the test LAB with suitable female connector. Measure Voltage between pins A & B and C & B With B as common point the voltage should be +24V between A&B and –24V between C&B. Check these voltages in all the 1 to 8 connectors. If the voltages are deviated from +24V and –24V then the ADB has to be sent for servicing.

3.12. RPM Distribution Box (RDB) - MDB 702

The RPM Distribution Box (RDB) supplies power to all the speed sensors connected to the RDB. It also collects speed signals from these sensors and transmits these signals to the main control unit. It has eight plug-in type MS Connectors for connecting to individual speed sensors through independent cables.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of all connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the front side of the RDB.

S.No.	Schedule	Nature of attention
2.	T1, T2	-
3.	M2	-
4.	M4, M8	Check for any physical damages to the pins and threading on each and every connector of the RDB. If necessary replace the connector of it type No. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED1001 for connector details. Check the tightness of the MS connectors available at the front side of the RDB.
5.	M12	Same as M4, M8 + Test the RDB as per the procedure given in 'Testing and Trouble shooting.' Connect all the connectors in the loco and check the tightness of the MS connectors.
6.	M24	Same as M12
7.	M48	Same as M24 + ➤ Replace the interconnecting cable between RDB and sensor on condition basis.
8.	M96	Same as M48 + ➤ Replace interconnecting cable between RDB and sensor. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

Testing and Troubleshooting: ---

Connect 72 Volts DC power supply to the display unit in the test LAB with suitable female connector. Measure Voltage between pins and C & B With B as common point the voltage should be +12V between C&B Check these voltages in all the connectors. If the voltages are deviated from +12V then the RDB has to be sent for servicing.

4. Current Sensors

The current sensors are non-contact type and works on Hall effect principle. These sensors measure DC current flowing through the conductor, which is passing through them in a non-contact way. The current carrying cable generates a magnetic field around the sensor, which is proportional to the magnitude of the current flowing through the conductor. By measuring the magnetic flux generated by the cable, the sensor can accurately measure the actual DC current flowing in the cable.

The sensor and its electronic circuits are contained in a dust and water proof enclosure. It has an MS connector for connecting it with Analog Distribution Unit.

There are various range of current sensors used in the MEP-660 control system

4.1. Medha Current Sensor MCS 850

The MCS 850 current sensor is used to measure the Traction alternator current. It can measure from 0 to 5000Amps.
Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

4.2. Medha Current Sensor MCS 820

The MCS 820 current sensors are used to measure the individual Traction motor armature current. It can measure from 0 to 2000Amps.

Please refer 'System Manual' of Microprocessor based loco control system MEP660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

4.3. Medha Current Sensor MCS 803

The MCS 803 current sensors are used to measure the Auxiliary Generator Armature current, battery charging current and Exciter Armature current. It can measure from 0 to 300Amps.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

4.4. Medha Current Sensor MCS 10A

The MCS 10A current sensors are used to measure the Auxiliary Generator Field current, Exciter field current, Control circuit leakage current and Power circuit leakage current. It can measure from 0 to 10Amps.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the sensor end.
2.	T1, T2	-
3.	M2	Clean the dust accumulated on the sensor body and heat sink.
4.	M4, M8	M2 + <ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. ➤ Ensure proper anchoring of the cable with out any hanging.
5.	M12	Same as M4, M8
6.	M24	<ul style="list-style-type: none"> ➤ Remove the sensor from the locomotive and check for any physical damages to the pins or threading on connector. ➤ If necessary, send the sensor for calibration at factory. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details. ➤ Ensure proper anchoring of the cable with out any hanging.
7.	M48	Same as M24 + <ul style="list-style-type: none"> ➤ Replace the interconnecting cable between sensor and ADB on condition basis.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace interconnecting cable between sensor and ADB. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

5. Voltage Sensors

The voltage sensors also work on Hall effect principle. The sensor can measure DC voltage accurately consuming very low current (as low as few mA). The sensor and its electronic circuits are contained in a dust proof and water proof enclosure. It is equipped with a plug in type of MS Connector for electrical connection with Analog Distribution Unit.

5.1. Medha Voltage Sensor - MVS 815

The MVS 815 voltage sensor is used to measure Traction Alternator Voltage. It can measure from 0 to 1500Volts.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for the Dimensional Drawing and mounting details of the control Unit.

5.2. Medha Voltage Sensor - MVS 801

The MVS 801 voltage sensor is used to measure Battery voltage, Aux. Gen. Voltage, BKCP Voltage, LCP voltage. It can measure from 0 to 100Volts.

Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the sensor end.
2.	T1, T2	-
3.	M2	Clean the dust accumulated on the sensor body and heat sink.
4.	M4, M8	M2 + <ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. ➤ Ensure proper anchoring of the cable with out any hanging.
5.	M12	Same as M4, M8
6.	M24	<ul style="list-style-type: none"> ➤ Remove the sensor from the locomotive and check for any physical damages to the pins or threading on connector. ➤ If necessary, send the sensor for calibration at factory. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details. ➤ Ensure proper anchoring of the cable with out any hanging.
7.	M48	Same as M24 + <ul style="list-style-type: none"> ➤ Replace the interconnecting cable between sensor and ADB on condition basis.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace interconnecting cable between sensor and ADB. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

6. Temperature Sensors

This is a semi conductor temperature sensor built in a rugged outer enclosure, which measures the temperature of the outer enclosure body. Different shapes of outer enclosures are used depending upon the application such as water temperature, lube oil temperature, air temperature etc. The sensor is equipped with a plug in type of MS connector for electrical connection with Analog Distribution Unit. It can measure the temperature from -50°C to + 150°C. Different mounting arrangements are provided depending upon the application.

6.1. Medha Temperature Sensor MTS 815A

The model MTS 815A is used to measure the ambient air temperature mounted at the backside of the CP. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

6.2. Medha Temperature Sensor MTS 815L

The model MTS 815L is used to measure the Lube oil temperature mounted on the lube oil pipeline in the expresser room. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for the Dimensional Drawing and mounting details of the control Unit.

6.3. Medha Temperature Sensor MTS815W

The model MTS 815W is used to measure the cooling temperature mounted on the water manifold pipeline near temperature gauge in the expresser room. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for the Dimensional Drawing and mounting details of the control Unit.

Maintenance:

There are no user serviceable components in this module. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the sensor end.
2.	T1, T2	-
3.	M2	Clean the dust accumulated on the sensor body and heat sink.
4.	M4, M8	M2 + <ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. ➤ Ensure proper anchoring of the cable with out any hanging.
5.	M12	Same as M4, M8.
6.	M24	<ul style="list-style-type: none"> ➤ Remove the sensor from the locomotive and check for any physical damages to the pins or threading on connector. ➤ If necessary, send the sensor for calibration at factory. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details. ➤ Ensure proper anchoring of the cable with out any hanging.
7.	M48	Same as M24 + <ul style="list-style-type: none"> ➤ Replace the interconnecting cable between sensor and ADB on condition basis.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace interconnecting cable between sensor and ADB. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

7. Pressure Sensors:

These are basically piezo-electric type sensors generating 4 to 20 mA out put. The body is made up of stainless steel construction and has a threaded mounting arrangement. The sensor is provided with a plug in type MS connector for electrical connection with Analog Distribution Unit.

7.1. Medha Pressure Sensor MPS - 841

The pressure sensor of type No. MPS 841 is used to measure MR pressure in the locomotive to provide cut in and cut out limits for the electro pneumatic governor (EPG). It can measure from 0 to 21Kg/cm². Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

7.2. Medha Pressure Sensor MPS - 842

The pressure sensor of type No. MPS 842 is used to measure Brake Pipe Pressure (BPP) and Brake Cylinder Pressure (BCP) in the locomotive. It can measure from 0 to 14Kg/cm² Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

7.3. Medha Pressure Sensor MPS - 844

The pressure sensor of type No. MPS 844 is used to measure Lube Oil Pressure (LOP) in the locomotive. It can measure from 0 to 10Kg/cm². Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

7.4. Medha Pressure Sensor MPS- 845

The pressure sensor of type No. MPS 845 is used to measure Booster Air Pressure (BAP) in the locomotive. It can measure from 0 to 3.5Kg/cm². Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

7.5. Medha Pressure Sensor MPS- 846

The pressure sensor of type No. MPS 846 is used to measure Fuel Oil Pressure (FOP) in the locomotive. It can measure from 0 to 7kg/ cm². Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

7.6. Altitude Sensor MPS - 843

The Altitude sensor of type No. MPS 843 is used to dynamically measure altitude of the site where the locomotive is working. It can measure from 0 to 3000 meters from sea level. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08 for mounting details and dimensional details of the Pressure sensor.

Maintenance:

There are no user serviceable components in this module. and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Maintenance on locomotive: Ensure tightness of connector once in M4 schedule.

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors available at the sensor end.
2.	T1, T2	-
3.	M2	Clean the dust accumulated on the sensor body and heat sink.
4.	M4, M8	M2 +

S.No.	Schedule	Nature of attention
		<ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. ➤ Ensure proper anchoring of the cable with out any hanging.
5.	M12	Same as M4, M8.
6.	M24	<ul style="list-style-type: none"> ➤ Remove the sensor from the locomotive and check for any physical damages to the pins or threading on connector. ➤ If necessary, send the sensor for calibration at factory. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details. ➤ Ensure proper anchoring of the cable with out any hanging.
7.	M48	Same as M24 + <ul style="list-style-type: none"> ➤ Replace the interconnecting cable between sensor and ADB on condition basis.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace interconnecting cable between sensor and ADB. Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

8. Speed Sensors

The speed sensors are used to measure Tr. Motor speed and engine speeds. These sensors are Hall effect magnetic type sensors. These sensors are mounted over a rotating gear. The sensor generates one electric pulse for every teeth of the wheel and hence the signal frequency is proportional to the RPM of the gear over which the sensor is mounted.

8.1. Tr. Motor Speed Sensor - T815

T815 is a Hall effect magnetic sensors are used to measure the individual traction motor armature speed and from which the wheel RPM is calculated. The sensor is mounted on the Traction Motor end shield to measure the RPM of Traction Motor shaft with the help of a toothed wheel (like any gear wheel). The toothed wheel has been on to the armature shaft at the end of the CE bearing. The sensor is built in a rugged enclosure with a cable. The cable is coupled to the sensor cable coming from ADB available in the CP. The frequency output is 60 Hz if the Tr. Motor Armature rotates at 60RPM.

Maintenance:

There are no user serviceable components in the sensor module and does not require any preventive maintenance schedule unless otherwise mishandled.

Cleaning:

- Blow out the dust accumulated on the sensor element and cable.
- Remove the Tr. Motor speed sensor from the Tr. Motor.
- Clean the sensor element and cable with a light cleaning solution to remove oil and dirt.
- Clean the connectors and pins with a light cleaning solvent.

Inspection:

- Check for any physical damages on the sensor tip.
- Check for any physical damages to the cable coming out of the sensor.
- Check the connector for proper locking with female socket. If the connector is slack replace both Male and female connectors of the sensor cable.

- Please refer **Annexure – 8** for type of connector and crimping tool required for replacement.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	➤ Check the tightness of the Bayonet connector available at the sensor top.
2.	T1, T2	-
3.	M2	<ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. Ensure proper anchoring of the cable with out any hanging. ➤ Check the tightness of intermediate cable connectors at the anchoring bracket for the Traction motor speed sensor cables.
4.	M4, M8	Same as M2 + <ul style="list-style-type: none"> ➤ Ensure tightness of Traction Motor speed sensor mounting screws on the Tr. Motor commutator end bearing end cup.
5	M12	<ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors. Ensure proper anchoring of the cable with out any hanging. ➤ Check the tightness of intermediate cable connectors at the anchoring bracket for the Traction motor speed sensor cables. ➤ Ensure the sensor cable in intact with out any damage. Replace cable if damaged. ➤ Ensure tightness of Traction Motor speed sensor mounting screws on the Tr. Motor commutator end bearing end cup.
6.	M24	Same as M12
7.	M48	<ul style="list-style-type: none"> ➤ While the Tr. Motor is taken for over haul, remove the sensor element from the Tr. Motor. ➤ Send the sensor for calibration at factory. ➤ Assemble the sensor on the overhauled traction motor. ➤ Replace the interconnecting cables from the sensors and RDB on condition basis.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace the interconnecting cables from the sensors and RDB. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

8.2. Engine Speed Sensor - T817

The Engine speed sensor T817 is also a hall effect magnetic sensor used for measuring the engine RPM. The sensor is mounting on the cam gear cover to measure the engine RPM. It generates one pulse for each teeth of the cam gear. As the cam gear is directly driven by the engine crankshaft, the pulses per second or frequency generated by the sensor is proportional to the engine RPM.

Maintenance:

There are no user serviceable components in the sensor module and does not require any preventive maintenance schedule and calibration unless otherwise mishandled.

Cleaning:

- Blow out the dust accumulated on the sensor element.
- Remove the Engine speed sensor from cam gear cover while the cover is on the engine block itself, as per the MAINTANANCE INSTRUCTIONS FOR ENGINE SPEED SENSOR T-817, document No. IM 47.

- **Do not remove the cover from the engine block with Engine speed sensor available on the cover. Slippage of the cover over the gear can damage the sensor.**
- Remove the cam gear cover for inspection and secure in a safe place.
- Provide proper protecting cover for the sensor fixing nut on the cam gear cover to avoid damage to threads.
- Clean and remove iron particles accumulated on the sensor tip.
- Clean the sensor element with a light cleaning solution to remove oil and dirt accumulated on the sensor.
- Clean the connectors and pins with a cleaning light solvent. Provide protecting cap to safe guard the pins in the connector.

Inspection:

- Check for any physical damages on the sensor and its accessories.

Testing: --

After cam gear cover is fitted on the engine block, mount the engine speed sensor as per the MAINTANANCE INSTRUCTIONS FOR ENGINE SPEED SENSOR T-817, document No. IM 47.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	➤ Check the tightness of the MS connector available at the sensor end.
2.	T1, T2	-
3.	M2	➤ Check for any oil leakage from the sensor weld nut and the sensor is in tact on the cam gear cover.
4.	M4, M8	➤ Check the tightness of the MS connectors. Ensure proper anchoring of the cable with out any hanging. ➤ Check for any oil leakage from the sensor weld nut and the sensor is in tact on the cam gear cover.
5.	M12	Same as M4, M8.
6.	M24	➤ Remove and re-assemble the engine speed sensor as per the above maintenance schedule.
7.	M48	Same as M24 + ➤ Calibrate the sensor at factory. ➤ Re-assemble the engine speed sensor as per the above maintenance schedule. ➤ Replace the interconnecting cable between sensor and RDB on condition basis.
8.	M96	Same as M48 + ➤ Replace the interconnecting cables from the sensors and RDB. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

9. Resistor Unit - MRP 703

This Unit consists of various filter resistors used for protection of micro controller from surges and electrical noise on train lines (MU wires) and other connections from switches and feedback contacts from relays etc. The unit has got 3 MS connectors for electrical connection. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for the Dimensional Drawing and mounting details of the resistor unit.

Maintenance:**Cleaning:**

- Blow out the dust accumulated on the resistor elements with a dry compressed air.
- Clean the elements and the body with a dry cloth.
- Clean the connectors and pins with a cleaning solvent after blowing.

Inspection:

- Check for any physical damages to the resistor elements.
- Check for any disconnected wires at the resistor element and connectors.
- Replace the damaged resistor elements. The resistor element is 1.0K Ohms / 25watts.

Testing:

- Check the value of each resistor element between connector pins as given below. The value of resistor element should be 1.0 K Ohms $\pm 10\%$.

S.No.	Load 1		Load 2		Load 3	
	Pin	Pin	Pin	Pin	Pin	Pin
1.	U	A	U	A	U	A
2.		B		B		
3.		C		C		
4.		D		D		
5.		E		E		
6.		F		F		
7.		G		G		
8.		H		H		
9.	V	J	V	J	V	J
10.		K		K		
11.		L		L		
12.		M		M		
13.		N		N		
14.		P		P		
15.		R		R		
16.		S		S		

If any resistance is open circuited, replace the resistor element.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check the tightness of the MS connectors.
2.	T1, T2	-
3.	M2	Check for any damaged / over heated resistor elements.
4.	M4, M8	<ul style="list-style-type: none"> ➤ Check for any damaged / over heated resistor elements ➤ Check the tightness of the MS connectors. ➤ Ensure proper anchoring of the cable with out any hanging.
5.	M12	Same as M4, M8.
6.	M24	Unload and service it as per the above maintenance schedule. <ul style="list-style-type: none"> ➤ Check the tightness of the MS connectors.
7.	M48	Same as M24

S.No.	Schedule	Nature of attention
8.	M96	Same as M48 + ➤ Replace the interconnecting cable from the resistor unit and TB. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.

10. ANCILARY UNITS:

10.1. CGR / PGR Resistor unit – MRP 706

CGR and PGR are two separate resistor panels mounted on a single bracket. The resistors are used to limit the ground leakage current when ever any control circuit or power circuit are grounded in service. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for the Dimensional Drawing and mounting details of the CGR / PGR resistor units.

CGR Panel: This is a single resistor element panel. The value of the resistor element is 50 ohms / 300watts.

PGR Panel: The PGR panel has got two resistor elements of 50 Ohms / 300Watts. The effective resistance between the terminals should read as 100 Ohms / 300Watts / $\pm 10\%$.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the resistor elements with a dry compressed air.
- Clean the elements and the body with a dry cloth.

Inspection:

- Check for any physical damages to the resistor elements like cracked / broken insulators / tubes.
- Check for any disconnected / over heated wires/shoes at the resistor element connections.
- Replace the damaged resistor elements. The resistor element is 50 Ohms / 300 watts.

Testing:

- Check the value of each resistor element between terminals. The resistance should be with in $\pm 10\%$. of the specified value in the following table.

Panel name	Resistance value.
CGR	50 Ohms / 300Watts
PGR	100 Ohms / 300 Watts

If any resistance is open circuited, replace the resistor element.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	➤ Blow out the dust accumulated on the resistor panel. ➤ Check the tightness of the connections at the panel. ➤ Check for any over heated / burnt wires at the terminal connections.

S.No.	Schedule	Nature of attention
2.	T1, T2	-
3.	M2	Check for any damaged / over heated resistor elements.
4.	M4, M8	Same as M2
5.	M12	Same as M4, M8.
6.	M24	Unload the panel from loco and service it as per the above maintenance procedure.
7.	M48	Same as M24
8.	M96	Same as M48

10.2. Memory Freeze cum VCD Disable Unit - MMF 705

This is a simple module consisting two toggle switches and one LED. One of the toggle switch is used to freeze the memory from recording the events. The LED will glow if this switch is kept in ON position after breaking the glass. The second toggle switch is used to disable the VCD. Normally these switches are sealed with different glass. Please refer 'System Manual' of Microprocessor based loco control system MEP-660, document No. IM 08, for the Dimensional Drawing and mounting details of the Memory freeze unit. In regular schedule it is essential to ensure that the sealing glass is in tact and not broken.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Dismantle the unit.
- Inspect for any dis-connected wires. From the PCB and the connector.
- Inspect for any damaged threads / pins on the connector.
- Test the module as per the given testing procedure.
- Assemble the unit.

Testing:

Alerter Disable switch:

- Connect a multi-meter in the very low resistance range between pin Number A&B.
- Switch ON the ALTS DSBL SW.
- The meter should indicate 0 resistance. Otherwise replace the switch.

Memory Freeze switch:

- Connect a multi-meter in the very low resistance range between pin Number A&C.
- Switch ON the MMF SW.
- The meter should indicate 0 resistance. Otherwise replace the switch.

MMF LED

- Connect 72Volts DC variable source between pin numbers E&D.
- The LED should glow. If not replace the LED circuit.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Clean the module with dry cloth. Ensure sealing glass is in tact. If glass is broken replace the MMF box after providing the glass.
2.	T1, T2	-
3.	M2	Check the connector tightness of MMF cum VCD disable module.
4.	M4, M8	Same as M2.
5.	M12	Same as M4, M8.
6.	M24	Remove the MMF box from the loco and service it as per the above maintenance procedure.
7.	M48	Same as M24
8.	M96	Same as M48

10.3. XD23-XC13 Assembly unit

These are basically a protection components connected in the exciter field circuit to quench the inductive surges generated in the exciter field during switching operation of the PWM.

Maintenance:**Cleaning:**

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Base: Inspect the base for any cracks / broken pieces. The base should not have any cracks.
- Heat sink: Check the heat sink for any flash over / burning marks. The heat sink should be clean and there should not be any flash over / burning marks.
- Terminals and leads: Inspect the terminals and the leads for loose connections. There should not be any burning / over heated symptoms.
- Tightness of the connections: The terminal stud should be tight on the base. The Diode connections should be tight on the terminal studs.
- Shorting links: Shorting link plates should be available between diode connecting terminals and loco connection studs.
- Check the capacitor connections are intact and the capacitor is in good condition.

Testing:**Diode:**

- Measure forward resistance with a multi-meter. The forward resistance should be between **infinity** (13.7MΩ)
- Measure the reverse resistance with a multi-meter. The reverse resistance should be between **low** (10.3KΩ)
- If the Resistance values are deviated, replace the diode of same capacity.

Capacitor

- Measure the capacitor value with an LCR meter.
- The value of the capacitor is **1μ fd.**

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	<ul style="list-style-type: none"> ➤ Clean the dust accumulated on the module with a dry cloth ➤ Check for any over heated / flash over marks on the terminals. ➤ If any overheating symptoms are found attend and check for any loose connections.
2.	T1, T2	-
3.	M2	<ul style="list-style-type: none"> ➤ Check for any over heated / flash over marks on the terminals. ➤ Check the tightness of connecting terminals on Panel.
4.	M4, M8	Same as M2
5.	M12	Same as M4, M8.
6.	M24	<ul style="list-style-type: none"> ➤ Remove the unit from loco and service it as per the above maintenance schedule. ➤ While reconnecting ensure the connections are given correctly as per drawing. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.
7.	M48	Same as M24
8.	M96	Same as M48

10.4. Motor Cut Out Switch Box - MSP 707

This module is a traction motor isolation box used to isolate any defective traction motor in service. Six toggle switches are provided on the box with an ear marking of MCOS1 to MCOS6. Operating this switch on the locomotive will isolate the concerned traction motor.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Base: Inspect the box for any physical damages.
- Toggle switches: Check the physical condition of the switches. There should not be any broken / damaged switches.
- Terminals and leads: Inspect the switch terminals and the leads for loose connections. All the connections should be tight. If the connections are soldered inspect for any dry solder. There should not be any burning / over heated symptoms.
- Connector connections: The wires coming from the switches should have good soldering at the connector. Inspect for the interconnecting leads. Replace any damaged leads.
- Connector: Check for any damaged pins or damaged threads on the connector.

Testing:

- Measure contact resistance of each toggle switch between the pins of the connector as below. There should not be any resistance.

Between pins of the connector		Resistance between pins
G	A	
	B	
	C	
	D	
	E	
	F	

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre- Commissio.	<ul style="list-style-type: none"> ➤ Clean the dust accumulated on the module with a dry cloth ➤ Ensure the switches are in normal position. ➤ Check the tightness of MS connector.
2.	T1, T2	-
3.	M2	<ul style="list-style-type: none"> ➤ Ensure the switches are in normal position. ➤ Check the tightness of MS connector.
4.	M4, M8	Same as M2
5.	M12	Same as M4, M8.
6.	M24	<ul style="list-style-type: none"> ➤ Remove the unit from loco and service it as per the above maintenance schedule. ➤ While reconnecting ensure the connections are given correctly as per drawing. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.
7.	M48	Same as M24
8.	M96	Same as M48

10.5. Speed Sensor Interface Unit - MSI 761

This module is an interface unit to split the engine speed signal into two isolated speed signals. One set of speed signals derived from ESS1 / ESS2 are connected to MEP-660. The second set of speed signals are connected to MCBG. In this unit one toggle switch is provided to select MEG601 or Other governor mode. The switch should be always on 'MEG601' side if Medha make MCBG is connected other wise the switch should be kept in 'Others' position.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Base: Inspect the box for any physical damages.
- Toggle switch: Check the physical condition of the switch. There should not be any broken / damaged switch.
- Terminals and leads: Inspect the switch terminals and the wiring for any dry solder / disconnected wires. All the connections should be tight. There should not be any burning / over heated symptoms.

- Connectors: Check for any damaged pins or damaged threads on the connectors. Check the soldering condition of the wires for any dry solder / broken strands of the wire. If any damages are found, re-solder the wires.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	<ul style="list-style-type: none"> ➤ Clean the dust accumulated on the module with a dry cloth. ➤ Check the tightness of connectors.
2.	T1, T2	-
3.	M2	Check the tightness of connectors.
4.	M4, M8	Same as M2
5.	M12	Same as M4, M8.
6.	M24	<ul style="list-style-type: none"> ➤ Remove the unit from loco and service it as per the above maintenance schedule. ➤ While reconnecting ensure the connections are given correctly as per drawing. ➤ Please refer 'Electrical Schematics' for Microprocessor based Loco control system MEP-660, document No. ED1000 / ED 1001 for cable details.
7.	M48	Same as M24
8.	M96	Same as M48

10.6. FCP Panel – Type SFCP - 25

Field Control Panel (FCP) is a resistor panel. These resistors are used in the Exciter field circuit to drop the voltage from 72V to the required level. This panel consists of four adjustable resistors.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the resistor elements with a dry compressed air.
- Clean the elements and the body with a dry cloth.
- Clean the terminals from dust.

Inspection:

- Check for any physical damages to the resistor elements. Replace the damaged resistor elements if any with same value.
- Check for any over heated lugs at the resistor elements. If found replace the lugs.
- Check for any disconnected wires at the resistor element and connectors.
- Check the tightness of adjustable clamps on the resistor element.

Testing:

Check the values of each resistor between the terminals specified in brackets. The values of each resistor are as under. If the resistance values are deviated, adjust the values with in the range. If any resistance is open circuited, replace the resistor element.

EFR1 ---69.5 to 70.5 ohms (B-C) EFR2 ---1.38 to 1.42 ohms (C-D)
 EFR3 ---14.5 to 14.7 ohms (E-F) EFR4 ---2.65 to 2.75 ohms (D-E)

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Check for any damaged / over heated resistor elements. Check for any over heated lugs on the terminals or at resistor elements. If so replace the FCP.
2.	T1, T2	-
3.	M2	<ul style="list-style-type: none"> ➤ Check for any damaged / over heated resistor elements ➤ Ensure proper anchoring of the connecting wires with out any loose hanging.
4.	M4, M8	Same as M2
5.	M12	Same as M4, M8.
6.	M24	Unload and service it as per the above maintenance schedule.
7.	M48	Same as M24.
8.	M96	Same as M48 + <ul style="list-style-type: none"> ➤ Replace the interconnecting wires between the resistor element and TB. ➤ Harness the wires properly.

10.7. HLD Relay Module - MRA 710

This is a simple relay module incorporated in the head light circuit. With introduction of DC-DC converter instead of HLPR for headlight, the output voltage signal is 24 volts. Any digital input signals are recognized as high when the voltage is more than 30V. So simple relay logic has been used to convert this 24VDC signal into 72VDC signal. The status of the headlight is sensed through this relay box and is communicated to MEP-660 and recorded in the event recorder.

Maintenance:**Cleaning:**

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Dismantle the unit.
- Inspect for any disconnected wires.
- Check the tightness of connecting wires on TB
- Test the module as per the given testing procedure.
- Assemble the unit.

Testing:

- Connect 72 Volts DC power supply to the HLD relay module across 50A & 52HL terminals.
- Check the voltage across HLB - 52HL and HLD-52HL. The voltage should be zero. If voltage is available at HLB and HLD terminals, replace the 24V relays on the PCB.
- Apply 24 volts between HLBR and 52HL.
- Measure the voltage between HLB and 52H terminals. The Voltage should be same as applied across 50A and 52HL.
- If voltage is zero or less than the 72V, replace the 24V relay on the PCB.
- Remove 24 volts and connect between HLDR and 52HL.
- Measure the voltage across HLD and 52HL. The voltage should be same as applied across 50A and 52HL.

- If voltage is zero or less than the 72V, replace the 24V relay on the PCB.
- Disconnect all the supply wires.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	➤ Clean the dust accumulated on the module with a dry cloth
2.	T1, T2	-
3.	M2	Check the tightness of connecting terminals.
4.	M4, M8	Same as M2.
5.	M12	Same as M4, M8.
6.	M24	Remove the HLD Relay module from the loco and service it as per the above testing procedure.
7.	M48	Same as M24
8.	M96	Same as M48

10.8. VCD Magnet Valve – Type: 3332-10-4G

VCD magnet valve is direct operated electro Pneumatic valve used to apply penalty brakes whenever any safety devices like VCD / AEB / Fire Alert are operated in the locomotive. It is normally closed valve and the valve open when ever 72V is applied to coil. When this valve is energized the valve vents out the pilot air connected to inlet causing automatic brake application. The Valve model No. 3332-10-4g and is manufactured by M/s. Rotex.

Maintenance:

Cleaning:

- Blow out the dust accumulated on the module with a dry compressed air.
- Clean the module with a dry cloth.

Inspection:

- Dismantle the unit and check the condition of valve as per the maintenance procedure given by M/s. Rotex.
- Replace the rubber components if required as specified by the principle manufacturer.
- Test the module as per the given testing procedure.

Testing:

- Check the operating coil resistance. The resistance should be with in the specified limits of the maintenance data as per the principle supplier.
- Connect the air supply with a pressure 5Kg/cm² to port no.1 and ensure there is no leakage of air from port 2 of the valve.
- Apply variable DC voltage slowly from 0 to 72Volts to the operating coil of the Magnet Valve.
- Slowly rise the voltage until the valve is fully opened. The valve should open fully between 25 to 48VDC.
- Slowly decrease the voltage until the valve is fully closed. The valve should close between 9 to 21 V.
- Remove all the electrical and pneumatic connections to the valve.

Maintenance on locomotive:

S.No.	Schedule	Nature of attention
1.	Pre-Commissio.	Clean the dust accumulated on the valve with a dry cloth.
2.	T1, T2	-
3.	M2	The cut out cock provided in front of VCD magnet valve should always be in open position.
4.	M4, M8	Same as M2.
5.	M12	Same as M4, M8.
6.	M24	Remove the VCD Magnet valve from the loco and service it as per the above testing procedure.
7.	M48	Same as M24
8.	M96	Same as M48.

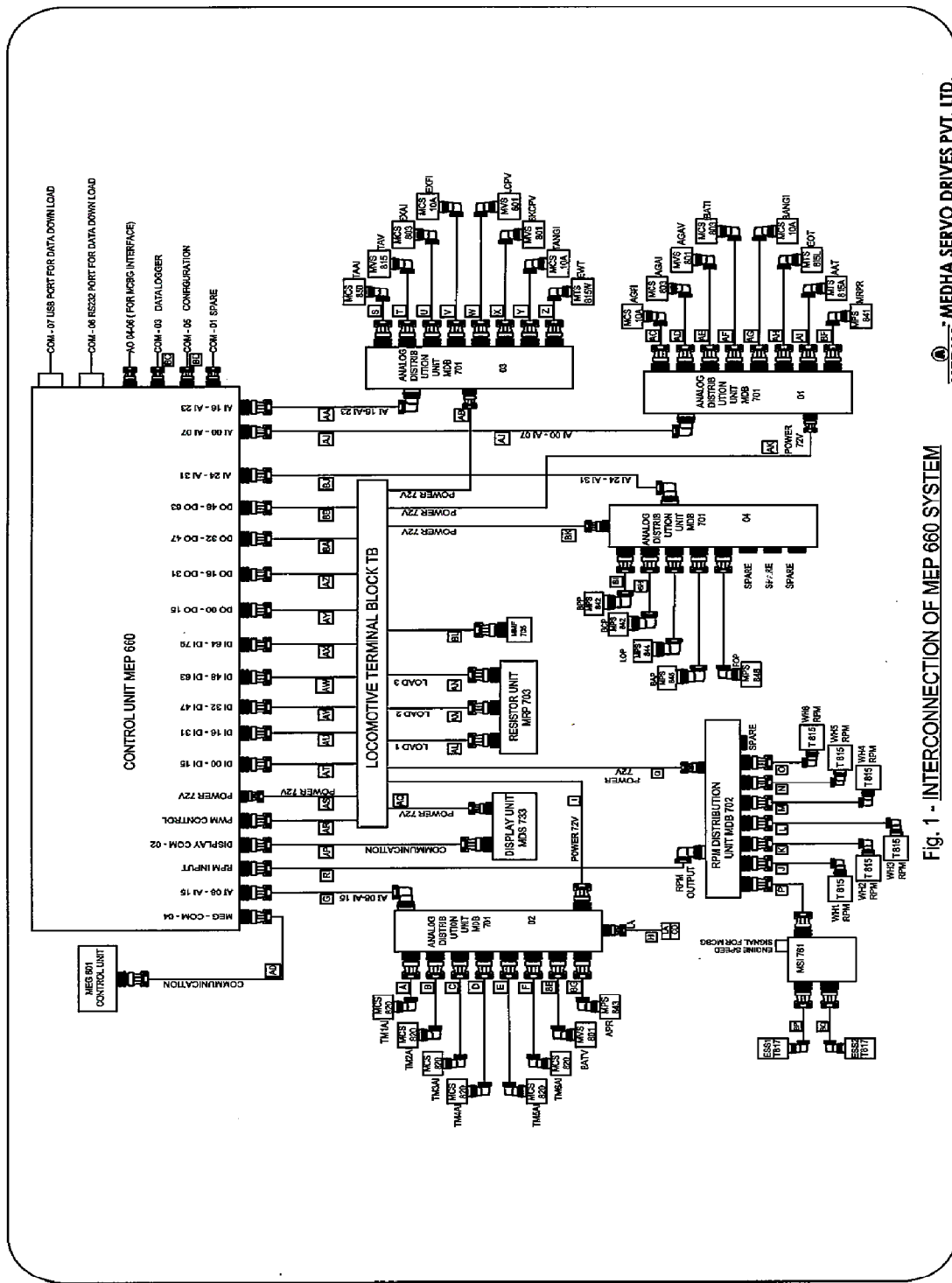
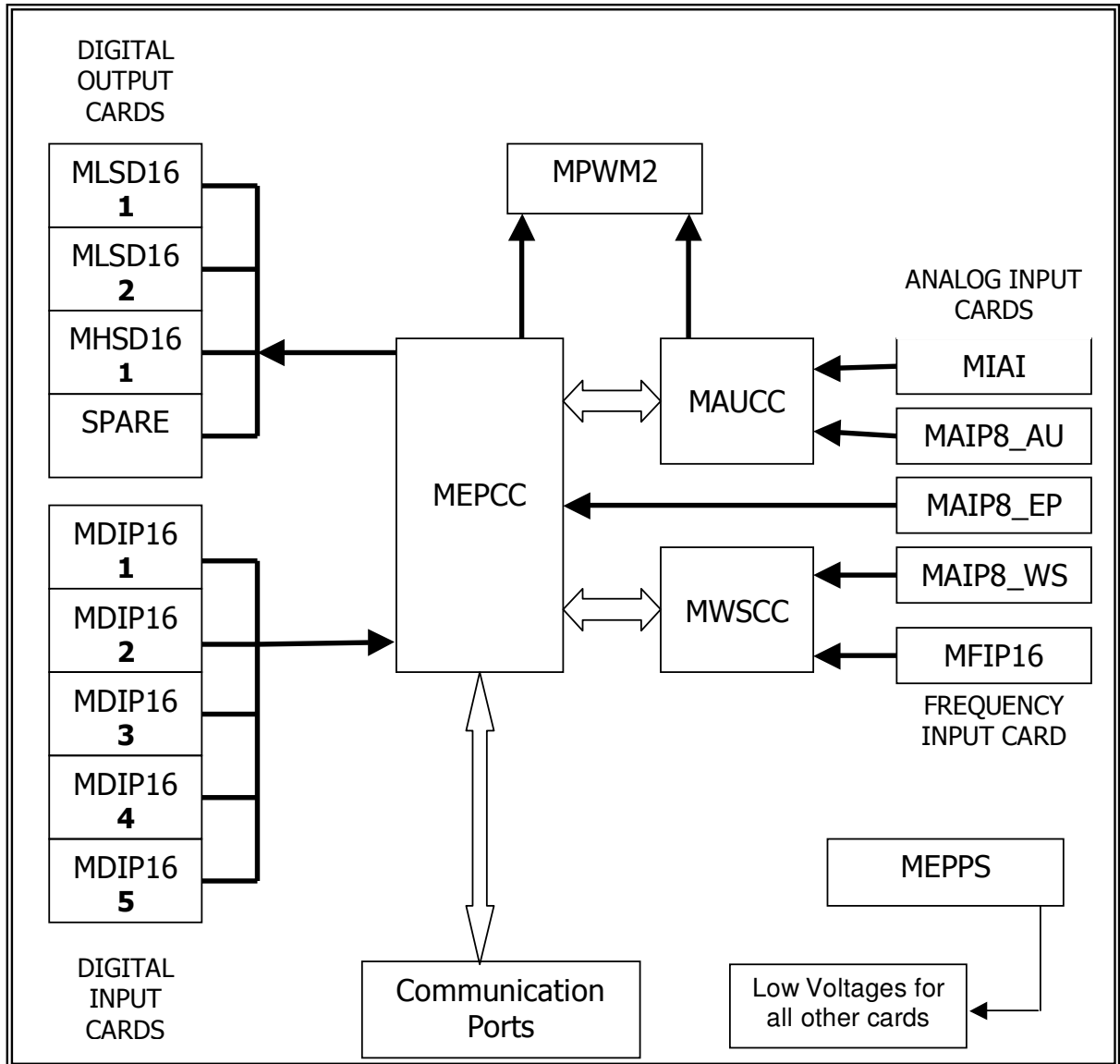


Fig. 1 - INTERCONNECTION OF MEP 660 SYSTEM

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Annexure - 2

Inter connections of Cards in MEP-660 Control unit



Annexure 3

List of Digital Input cards - channel wise

Signal Name	Signal Description	Digital Input No.	DIP Card No./Channel
TL8	REVERSER in forward (SH)	DI00	1/0
TL0	REVERSER in reverse (LH)	DI01	1/1
TL15	MCH 2,4,6,8 (AV)	DI02	1/2
TL12	MCH 5,6,7,8 (BV)	DI03	1/3
TL7	MCH 3,4,5,6,7,8 (CV)	DI04	1/4
TL3	MCH 5,6 (DV)	DI05	1/5
TL16	Throttle	DI06	1/6
TL6	Motoring	DI07	1/7
TL13	MFPB Contactor on FPC	DI08	1/8
TL17	Brake Setup	DI09	1/9
TL23	Braking	DI10	1/10
TL2	ALG- Alarm Gong	DI11	1/11
TL10	Wheel Slip Buzzer	DI12	1/12
TL64	Sanding	DI13	1/13
TL25	EP Compressor ON/OFF	DI14	1/14
REV-OFF / 16D	Both Rev in OFF / MCB 1&2 OFF	DI15	1/15
CK1FB	CK1 FB contact	DI16	2/0
CK2FB	CK2 FB contact	DI17	2/1
CK3FB	CK3 FB contact	DI18	2/2
P1FB	P1 FB contact	DI19	2/3
P21FB	P21 FB contact	DI20	2/4
P31FB	P31 FB contact	DI21	2/5
P2FB	P2 FB contact	DI22	2/6
P22FB	P22 FB contact	DI23	2/7
P32FB	P32 FB contact	DI24	2/8
S1FB	S1 FB contact	DI25	2/9
S21FB	S21 FB contact	DI26	2/10
S31FB	S31 FB contact	DI27	2/11
BKT-B FB	BKT in B FB contact	DI28	2/12
BKT-M FB	BKT in Mot FB contact	DI29	2/13

Signal Name	Signal Description	Digital Input No.	DIP Card No./Channel
REV-F FB	REV in Forward FB contact	DI30	2/14
REV-R FB	REV in Reverse FB contact	DI31	2/15
GF FB1	GF FB contact	DI32	3/0
RFC FB (72)	RFC Supply contact	DI33	3/1
EXPR FB	EXPR FB contact	DI34	3/2
AGPR FB	AGPR FB contact	DI35	3/3
LWS FB	LWS I/P	DI36	3/4
OPS FB (1B)	OPS in Governor	DI37	3/5
ALARM FB (37)	Alarm FB	DI38	3/6
STOP	Engine Stop FB	DI39	3/7
START (43E)	Engine Start FB	DI40	3/8
ECS FB	ECS in Run Switch	DI41	3/9
MCOS1	TM 1 Cut Out	DI42	3/10
MCOS2	TM 2 Cut Out	DI43	3/11
MCOS3	TM 3 Cut Out	DI44	3/12
MCOS4	TM 4 Cut Out	DI45	3/13
MCOS5	TM 5 Cut Out	DI46	3/14
MCOS6	TM 6 Cut Out	DI47	3/15
FP FB (71)	FP Contactor	DI48	4/0
GF FB2	GF Contactor FB	DI49	4/1
PCS FB	PCS FB	DI50	4/2
AG FB (49B)	AG FB	DI51	4/3
PSH DB3	Power Supply Health DB3	DI52	4/4
PSH DB2	Power Supply Health DB2	DI53	4/5
PSH DB1	Power Supply Health DB1	DI54	4/6
PSH DB4	Power Supply Health DB4	DI55	4/7
Rect. Hot	Rectifier Diode Hot (presently by passed)	DI56	4/8
RBBFB	Rectifier Blower Fail (presently by passed)	DI57	4/9
FSFB	Field Shunting Contactor FB	DI58	4/10
VCDR FB	VCD Relay FB	DI59	4/11
AFLR FB	Flasher Relay FB	DI60	4/12
AFL P1	AFL Pressure Switch P1 FB	DI61	4/13
AFL P2	AFL Pressure Switch P2 FB	DI62	4/14

Signal Name	Signal Description	Digital Input No.	DIP Card No./Channel
AFL RST	AFL Reset PB	DI63	4/15
VCD RST	VCD Reset PB	DI64	5/0
AEB Disable	Auto Emergency Brake Enable / Disable switch	DI65	5/1
HORN	Horn PB FB	DI66	5/2
W171	W171 AFL Enable FB	DI67	5/3
PCS1	PCS1 FB	DI68	5/4
DEB ENG FB *	Dust Exhauster Breaker Engine Feed back	DI69 *	5/5
DEB CB-FB **	Dust Exhauster Breaker Car body Feed back	DI70 **	5/6
CEBFB	Crankcase Exhauster Breaker Feed back	DI71	5/7
ALTR DSBL FB	VCD disable switch	DI71	5/8
MMF FB Applicable to locos with event recorder	Memory Freeze switch	DI73	5/9
FL FB Applicable to locos with event recorder	Flasher feed back	DI74	5/10
HLD FB Applicable to locos with event recorder	Headlight Dim Feed back	DI75	5/11
HLB FB Applicable to locos with event recorder	Headlight Bright feed back	DI76	5/12
SLBC FB Applicable to Locomotives with Self Load Box feature only.	Self load box contactor Feed back	DI77	5/13
TE_LIMIT_SW Applicable for TE_limit featured locos only	Tractive effort limitation feature.	DI78	5/14
AEB RESET	AEB Reset Feed back	DI79	5/15

* D169 is changed to MU penalty brake feedback signal.

** D170 is changed to Fire Alarm feed back signal.

Annexure – 4

MANUAL DIGITAL INPUTS CHECK PROCEDURE THROUGH DISPLAY UNIT

- 1 Ensure that all Digital Input Connectors are connected to Control Unit of MEP 660 System.
- 2 Switch ON MPCB available on the control panel. After displaying initial power ON check message, the display shows Default screen parameters.
- 3 The digital input status LED's on the digital input cards in Slots 9, 10,11,12 and 13 will glow as per the annexure-4A
- 4 Switch ON MCB1 and MCB2 on both control stands.
- 5 Ensure control air pressure is more than 4.8Kg/Sq.cm.
- 6 Ensure that BP is more than 4.2Kgs/Sq.cm or PCS is in pick up condition or DMR is in ON position.
- 7 Press "MENU" key on display unit keyboard. The display shows main menu options. Select "Test Mode" from available options. The display prompts for a password. After entering a valid password (5 Digit), a sub menu options under 'Test Mode' are displayed. Select the option "Manual Tests for Inputs".
- 8 The display prompts for the conditions to be fulfilled before conducting manual test. Ensure that the required conditions are fulfilled and then press 'Enter' button to proceed for manual testing.
- 9 Press down "arrow" key to proceed with the testing of all inputs one after the other.
- 10 The Display shows the name of the input and its status. If the status is "ON", it corresponds to 72V and if the status is OFF, it corresponds to 0 V for that particular digital input.
- 11 If the status of digital input is shown as ON, the corresponding green and yellow LEDs on the card should also glow.
- 12 Change the status of the input from ON to OFF and vice versa by operating corresponding handles, switches, interlocks etc., and verify that the digital input signal status is correctly recognized by the system as indicated by the corresponding LED on the Digital input cards "MDIP16" and displayed status of the digital input on the display unit. Glowing GREEN LED on the Card means input is detected as "ON" and GREEN LED OFF means input is detected as "OFF". Also verify that the Green and Yellow LED's on the same "MDIP16" card are showing the same status. If this condition is not satisfied, the card could be faulty.
- 13 Repeat 9 to 12 till all the Digital Inputs as listed below are checked.
- 14 Ensure that status shown by the display and the status shown by the LED's are matching correctly.

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
1	TL8	Reverser Handle in forward (Short Hood) direction	DI00	9	0	<ul style="list-style-type: none"> ➤ Move RH to Forward ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. 	DI status toggles with GF switch ON/OFF.
2	TL0	Reverser Handle in forward (Short Hood) direction	DI01	9	1	<ul style="list-style-type: none"> ➤ Move RH to Reverse ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. 	DI status toggles with GF switch ON/OFF.

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
3	TL15	MHW 2,4,6,8 (AV)	DI02	9	2	Move Master Handle to 2,4,6,8 Notch positions.	DI status ON in prescribed notch positions. DI status OFF in other notch positions.
4	TL12	MHW 5,6,7,8 (BV)	DI03	9	3	Move Master Handle to 5,6,7,8 Notch positions.	DI status ON in prescribed notch positions. DI status OFF in other notch positions.
5	TL7	MHW 3,4,5,6,7,8 (CV)	DI04	9	4	Move Master Handle to 3,4,5,6,7,8 Notch positions.	DI status ON in prescribed notch positions. DI status OFF in other notch positions.
6	TL3	MHW 5,6 (DV)	DI05	9	5	Move Master Handle to 5,6 Notch positions.	DI status ON in prescribed notch positions. DI status OFF in other notch positions.
7	TL16	Throttle (Engine Speed) Control	DI06	9	6	Move throttle to IDLE. Ensure MCB1 & MCB2 are in ON position.	DI status toggles with switching ON/OFF of MCB1 or MCB2.
8	TL6	Motoring Control	DI07	9	7	<ul style="list-style-type: none"> ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. 	DI status toggles with GF switch ON/OFF.
9	TL13	FPC Contactor	DI08	9	8	Ensure MFPB1 and MFPB2 are switched ON.	DI status toggles with switching ON/OFF of MFPB1 or MFPB2.
10	TL17	Dy. Brake Setup	DI09	9	9	<ul style="list-style-type: none"> ➤ Move RH to either Forward or Reverse. ➤ Move Master Handle to "OFF" position. 	DI status toggles with Master Handle position OFF to Idle position.
11	TL23	Dy. Brake Control	DI10	9	10	<ul style="list-style-type: none"> ➤ Move RH to either Forward or Reverse. ➤ Move Master Handle to "B" position. 	DI status toggles with Master Handle position OFF to "B" positions.

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
12	TL2	Alarm signal	DI11	9	11	Operate SR relay manually.	DI status ON if SR relay operated manually.
13	TL10	Wheel Slip Buzzer	DI12	9	12	Operate SANDR relay manually.	DI status ON if SANDR relay operated manually
14	TL64	Sanding signal	DI13	9	13	Press SAND push button	DI status ON if SAND push button is pressed.
15	TL25	EP Compressor ON/OFF	DI14	9	14	Version 1.0 locos ➤ Switch on LPS10 switch (EPG switch)	DI status toggles with EPG switch operation.
						Version 2.0 and above ➤ Switch on LPS10 switch (EPG switch) ➤ Operate CMR relay manually.	DI status ON if CMR relay operated manually.
16	REV-OFF	Both RH in neutral	DI15	9	15	Version 1.0 Locos Both RH in neutral position.	DI status toggles with RH operation.
	16D	MCB1 & MCB2 OFF				Version 2.0 and above Switch ON both MCB1 & MCB2 breakers.	DI status toggles with MCB1 operation.
17	CK1FB	CK1 FB signal	DI16	10	0	Manually open and close the Feed Back contact.	DI status toggles with feed back contact close/open.
18	CK2FB	CK2 FB signal	DI17	10	1		
19	CK3FB	CK3 FB signal	DI18	10	2		
20	P1FB	P1 FB signal	DI19	10	3	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
21	P21FB	P21 FB signal	DI20	10	4	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
22	P31FB	P31 FB signal	DI21	10	5	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
23	P2FB	P2 FB signal	DI22	10	6	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
24	P22FB	P22 FB signal	DI23	10	7	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
25	P32FB	P32 FB signal	DI24	10	8	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
26	S1FB	S1 FB signal	DI25	10	9	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
27	S21FB	S21 FB signal	DI26	10	10	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
28	S31FB	S31 FB signal	DI27	10	11	Manually operate power contactor by operating magnet valve. Feedback contact should open or close.	DI status toggles with feed back contact operation
29	BKT-B FB	BKT in B FB signal	DI28	10	12	Manually operate BKT to braking side. Manually open or close the BKT B Feed back interlock.	DI status ON if BKT B feedback interlock closes.
30	BKT-M FB	BKT in Mot FB signal	DI29	10	13	Manually operate BKT to motoring side. Manually open or close the BKT M feedback interlock.	DI status ON if BKT M feed back interlock closes.
31	REV-F FB	REV in Forward FB signal	DI30	10	14	Manually operate Reverser by pressing magnet valve to forward position. Manually open or close the REV F feedback interlock.	DI status ON if REV F feedback interlock closes.
32	REV-R FB	REV in Reverse FB signal	DI31	10	15	Manually operate Reverser by pressing magnet valve to reverse position. Manually open or close the REV R feedback interlock.	DI status ON if REV R feedback interlock closes.

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
33	GF FB1	GF FB signal	DI32	11	0	Close and Open the auxiliary contact of GF Contactor.	DI status toggles with GF auxiliary contact operation
34	RFC FB (72)	RFC Supply	DI33	11	1	<ul style="list-style-type: none"> ➤ Switch ON FPB Breaker ➤ Switch ON RFCB Breaker 	DI status toggles with RFCB breaker operation
35	EXPR FB	EXPR FB signal	DI34	11	2	Operate EXPR relay manually.	DI status toggles with EXPR operation.
36	AGPR FB	AGPR FB signal	DI35	11	3	Operate AGPR relay manually.	DI status toggles with AGPR operation.
37	LWS FB	LWS FB signal	DI36	11	4	Verify by opening and closing the LWS cutout cock and ensure LWS is operating.	DI status toggles with LWS operation
38	OPS FB (1B)	OPS signal from WW Governor	DI37	11	5	Pull out Low lube oil button in WW Governor. And reset the button.	DI status toggles with LLOB button operation.
39	ALARM FB (37)	Alarm PB	DI38	11	6	Press ALARM push button	DI status toggles with ALARM push button operation.
40	STOP	Engine Stop PB	DI39	11	7	Press Engine Stop push button	DI status toggles with Engine Stop Push button operation.
41	START (43E)	Engine Start PB	DI40	11	8	Pack CK1, CK2 and CK3 main contacts with insulation sheet. Press Engine Start push button	DI status toggles with Engine Start push button operation.
42	ECS RUN FB	ECS status	DI41	11	9	Move ECS to RUN position and back to IDLE	DI status toggles with ECS operation.
43	MCOS1	TM 1 Cut Out	DI42	11	10	Operate the switch OFF and ON	DI status toggles with MCOS1 operation.
44	MCOS2	TM 2 Cut Out	DI43	11	11	Operate the switch OFF and ON	DI status toggles with MCOS2 operation.
45	MCOS3	TM 3 Cut Out	DI44	11	12	Operate the switch OFF and ON	DI status toggles with MCOS3 operation.

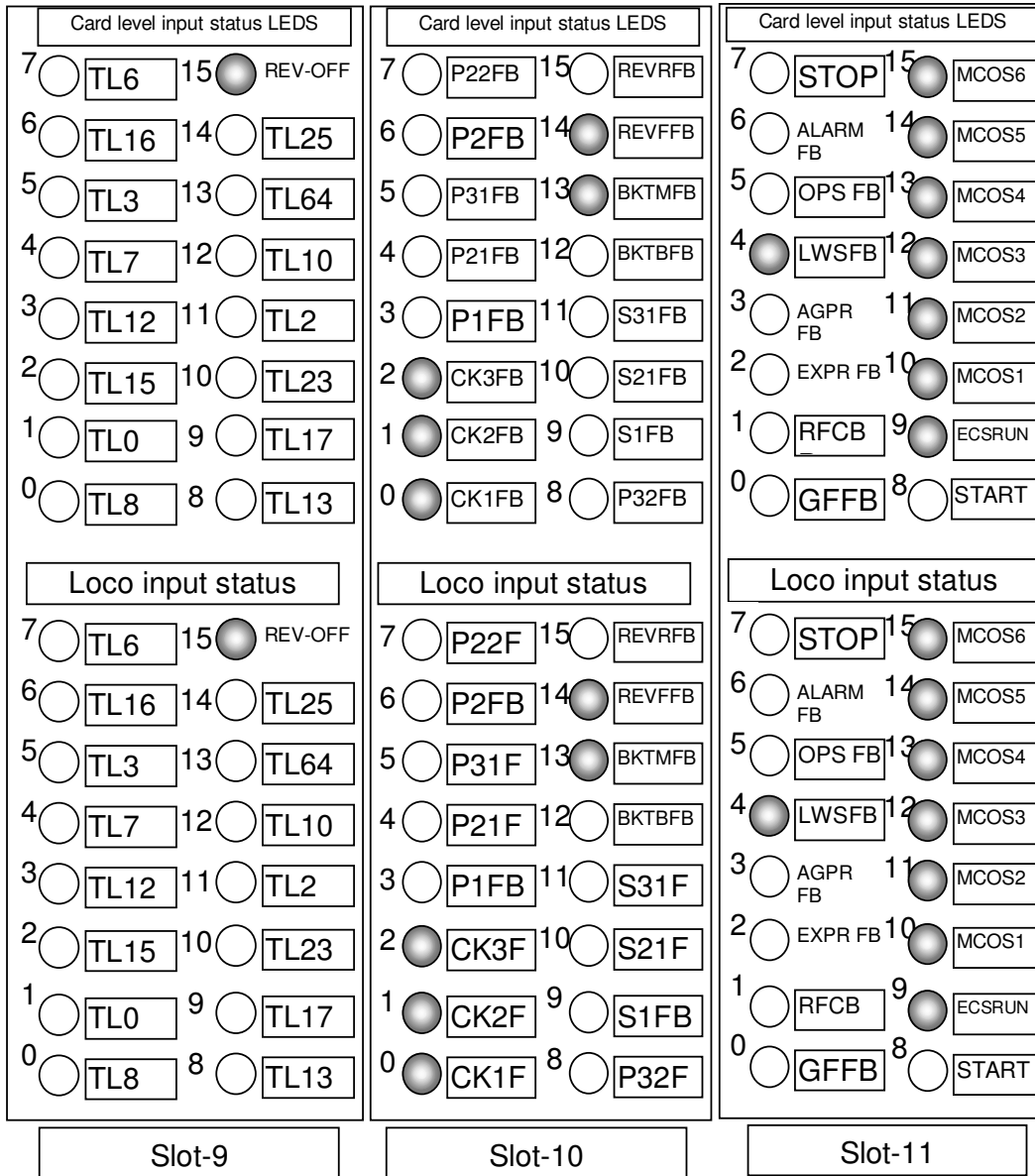
S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
46	MCOS4	TM 4 Cut Out	DI45	11	13	Operate the switch OFF and ON	DI status toggles with MCOS4 operation.
47	MCOS5	TM 5 Cut Out	DI46	11	14	Operate the switch OFF and ON	DI status toggles with MCOS5 operation.
48	MCOS6	TM 6 Cut Out	DI47	11	15	Operate the switch OFF and ON	DI status toggles with MCOS6 operation.
49	FPC FB (71)	FP Contactor	DI48	12	0	Switch ON FPB and switch OFF	DI status toggles with FPB breaker operation.
50	GF FB2	GF Contactor Feed Back	DI49	12	1	Close and Open the auxiliary contact of GF Contactor.	DI status toggles with GF auxiliary contact operation
51	PCS FB	PCS Feed Back	DI50	12	2	<ul style="list-style-type: none"> ➤ Apply emergency through A9 and drop the BP pressure below 2.8 Kg/cm². ➤ Release A9 to normal position. ➤ PCS closes at 4.2Kg/cm². 	DI status toggles with the BP pressure operation.
52	AGFB FB (49B)	AGFB feedback	DI51	12	3	Switch ON AGFB Breaker	DI status toggles with AGFB breaker operation.
53	PSH3	Power Supply Health DB3	DI52	12	4	<ul style="list-style-type: none"> ➤ Disconnect and connect the PSH3 wire on the TB. ➤ Reconnect the PSH3 wire to the same TB. ➤ Ensure tightness of the wire. 	DI status toggles with PSH3 wire disconnection and connection.
54	PSH2	Power Supply Health DB2	DI53	12	5	<ul style="list-style-type: none"> ➤ Disconnect and connect the PSH2 wire on the TB. ➤ Reconnect the PSH2 wire to the same TB. ➤ Ensure tightness of the wire 	DI status toggles with PSH2 wire disconnection and connection
55	PSH1	Power Supply Health DB1	DI54	12	6	<ul style="list-style-type: none"> ➤ Disconnect and connect the PSH1 wire on the TB. ➤ Reconnect the PSH1 wire to the same TB. ➤ Ensure tightness of the wire 	DI status toggles with PSH1 wire disconnection and connection

S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
56	PSH4	Power Supply Health DB4	DI55	12	7	<ul style="list-style-type: none"> ➤ Disconnect and connect the PSH4 wire on the TB. ➤ Reconnect the PSH4 wire to the same TB. ➤ Ensure tightness of the wire 	DI status toggles with PSH4 wire disconnection and connection
57	Rect. Hot	Rectifier Diode Hot	DI56	12	8	Disconnect and connect the DLK1 wire on the TB.	DI status toggles with DLK1 wire connection / disconnection.
58	Rect. Blower Fail	Rectifier Blower Breaker status	DI57	12	9	Switch ON and OFF circuit breaker RBB.	DI status toggles with RBB Breaker operation.
59	FS FB	Field Shunting Contactor Feed Back	DI58	12	10	Short the auxiliary contact wires of any field shunting contactor.	DI status toggles with FS feed back operation.
60	VCDR FB	VCD Relay Feed Back. Note: In Ver.1 the name is ALRTRB relay.	DI59	12	11	Operate VCDR relay manually.	DI status toggles with VCDR relay operation.
61	AFLR FB	Auto Flasher Relay FB	DI60	12	12	Operate AFLR relay manually.	DI status toggles with AFLR relay operation.
62	AFL P1	Auto Flasher Pressure switch P1FB	DI61	12	13	Move A9 handle to full service zone and release.	DI status toggles with P1 pressure switch operation.
63	AFL P2	Auto Flasher Pressure switch P2FB	DI62	12	14	Move A9 handle to full service zone and release.	DI status toggles with P2 pressure switch operation.
64	AFL RST	Auto Flasher Reset Push Button	DI63	12	15	Press AFL Reset push button.	DI status toggles with AFL reset button operation.
65	VCD RST	VCD reset Push Button	DI64	13	0	Press VCD reset push button	DI status toggles with VCD reset button operation.
66	AEB IP	AEB Enable/Disable status.	DI65	13	1	Operate the AEB input key if AEB is provided.	DI status toggles with AEB input key operation.
67	HORN	Horn Push Button FB	DI66	13	2	Press any HORN push button	DI status toggles with HORN push button operation.
68	W171	Wire 171 Auto Flasher enable FB	DI67	13	3	Move RH to either Forward or Reverse direction.	DI status toggles with RH direction operation.

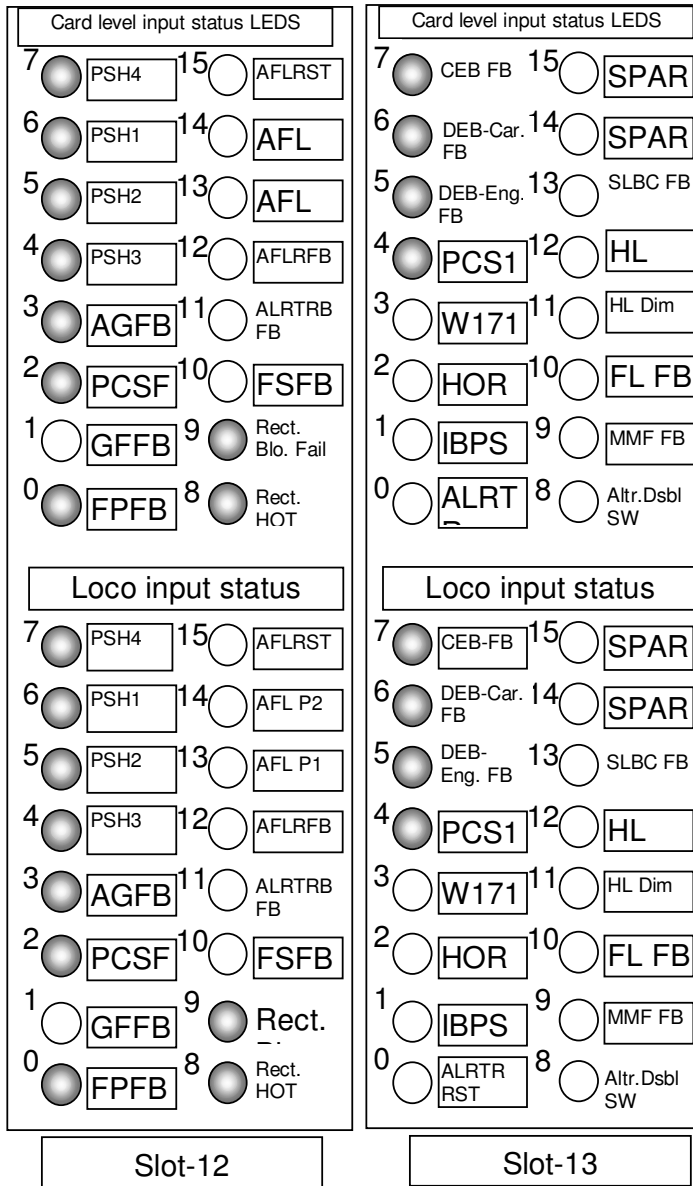
S. No.	Signal Name	Signal Description	Digital Input No.	Corresp. LED Location		Test Condition	Observation
				Slot No.	LED No.		
69	PCS1 FB	PCS 1 FB (for dual brake Loco only)	DI68	13	4	<ul style="list-style-type: none"> ➤ Open the PCS connecting wire 162 (ID: AX) at TB. ➤ Reconnect the wire back to same TB. ➤ Ensure tightness of the wire. 	DI status toggles with PCS switch operation.
70	VCD/AEB MU FB	Penalty Brake MU signal	DI69	13	5	<ul style="list-style-type: none"> ➤ Short the wire TL20 with 51. ➤ Remove the short link. 	DI status toggles with energisation of wire TL20 (MU).
71	FAS FB	Fire Alarm System Feed Back	DI70	13	6	<ul style="list-style-type: none"> ➤ Short the wire TL11 with 51. ➤ Remove the short link. 	DI status toggles with energisation of wire TL11 (MU).
72	CEB FB	CEB Breaker feed back	DI71	13	7	Switch ON / OFF CEB Breaker.	DI status toggles with CEB Breaker operation.
73	VCD Dsbl SW	VCD Disable Switch	DI72	13	8	Operate Alerter disable switch.	DI status toggles with Alerter disable switch operation.
74	MMF FB	Memory freeze switch for event recorder	DI73	13	9	Operate Memory freeze switch.	DI status toggles with Memory freeze switch operation.
75	FL FB	Flasher Light feed back for event recorder	DI74	13	10	Operate flasher light switch	DI status toggles with Flasher light switch operation.
76	HLD	Head light Dim for event recorder	DI75	13	11	<ul style="list-style-type: none"> ➤ Switch ON HLPB Breaker ➤ Kept head light switch in Dim position. 	DI status toggles with Head light switch position.
77	HLB	Head light Bright for event recorder	DI76	13	12	<ul style="list-style-type: none"> ➤ Switch ON HLPB Breaker ➤ Kept head light switch in Bright position. 	DI status toggles with Head light switch position..
78	SLBC FB	Self load box Contactor feed back for locos fitted with Self Load Box feature only	DI77	13	13	Close the auxiliary contact of self-load box contactors if available.	DI status toggles with SLBC auxiliary contact operation.
79	TELS FB	TE limit switch FB	DI78	13	14	Operate the TE limit switch	DI status toggles with TE limit switch operation.
80	AEB Reset	AEB Reset input	DI79	13	15	Operate the AEB reset switch if provided	DI status toggles with AEB reset button operation.

Annexure – 4A (1/2)

Digital input status shown with all breakers ON and master handles in IDLE, BKT in motoring and Reverser in Forward and air brake system working normal. – PCS and PCS1 Status depend on Air brake. Rect. Blo Fail & Rect. Hot status depends on type of rectifier.



Annexure – 4A (2/2)



Annexure 5
List of Digital Output cards - channel wise

Signal Name	Signal Description	Digital Output No.	DOP Card No./Channel
Low Side Drive			
P1 CL	P1 Coil	DO00	1/0
P21 CL	P21 Coil	DO01	1/1
P31 CL	P31 Coil	DO02	1/2
P2 CL	P2 Coil	DO03	1/3
P22 CL	P22 Coil	DO04	1/4
P32 CL	P32 Coil	DO05	1/5
S1 CL	S1 Coil	DO06	1/6
S21 CL	S21 Coil	DO07	1/7
S31 CL	S31 Coil	DO08	1/8
BKT-M CL	BKT - Mot Coil	DO09	1/9
BKT-B CL	BKT-Brake Coil	DO10	1/10
REV-F CL	REV Forward Coil	DO11	1/11
REV-R CL	REV Reverse Coil	DO12	1/12
GF CL 1	GF Contact Coil 1	DO13	1/13
CKC CL	CKC Coil	DO14	1/14
EXPR CL	EXPR Coil	DO15	1/15
R1 CL	R1 Coil	DO16	2/0
R2 CL	R2 Coil	DO17	2/1
GF CL 2	GF Contact Coil 2	DO18	2/2
AGPR CL	AGPR Coil	DO19	2/3
SANDR CL	Sanding Relay Coil	DO20	2/4
BKIV CL	BKIV Coil	DO21	2/5
SR CL	Signal Relay Coil	DO22	2/6
DMR CL	DMR Relay Coil	DO23	2/7
FSR CL	Field Shunting Relay Coil	DO24	2/8
VCDR CL	VCD Relay Coil	DO25	2/9
AFLR CL	Flasher Relay Coil	DO26	2/10
CMR CL	CMR Relay Coil	DO27	2/11
SLBR CL Applicable to Locos	Self Load Box Relay Coil	DO28	2/12

Signal Name	Signal Description	Digital Output No.	DOP Card No./Channel
with Self Load Box feature only.			
PLPC CL Applicable for locos fitted with pre-lubrication feature	Pre lubrication Pump Contactor	DO29	2/13
SPARE		DO30	2/14
SPARE		DO31	2/15
High Side Drive			
AV CL (15A)	AV Coil	DO32	3/0
BV CL (12A)	BV Coil	DO33	3/1
CV CL (7C)	CV Coil	DO34	3/2
DV CL (3A)	DV Coil	DO35	3/3
HOT_ENG_LED (16L)	Hot Engine LED	DO36	3/4
CK_TIP_W 73)	CK Tip Weld LED	DO37	3/5
GND_LED (35)	Ground Indication LED	DO38	3/6
OVR_LD_LED (RL-2)	Over Load Indication LED	DO39	3/7
AFL LED	Flasher LED	DO40	3/8
VCD LED	VCD LED	DO41	3/9
MMF LED	Memory Freeze indication LED	DO42	3/10
Pre/post LED	Pre and post lubrication LED	DO43	3/11
SPARE		DO44	3/12
SPARE		DO45	3/13
SPARE		DO46	3/14
SPARE		DO47	3/15

Annexure – 6

MANUAL DIGITAL OUTPUTS CHECK PROCEDURE THROUGH DISPLAY UNIT

- 1 Ensure that all Digital Output Connectors are connected to Control Unit of MEP 660 System.
- 2 Ensure control air pressure is more than 4.8Kg/Sq.cm.
- 3 Ensure that BP is more than 4.2Kgs/Sq.cm or PCS is in pick up condition or DMR is in ON position.
- 4 Press “MENU” key on display unit keyboard. Main Menu options are displayed on the screen. Select “Test Mode” from available options. The display prompts for a password. After entering the valid password (5 digits), sub-menu options under ‘Test Mode’ are displayed. Select “Manual Tests for Outputs”. The display prompts for the conditions to be fulfilled before conducting the manual output tests.
- 5 After fulfilling the required conditions, Press “ENTER” key to proceed for testing.
- 6 Press down “arrow” key to proceed with testing of all outputs one after the other starting from the output channel 1.
- 7 The Display shows the name of the output and its status.
- 8 Change the status of output from ON to OFF and vice versa by pressing 1 for ON and 0 for OFF and verify that it is correctly recognized by the system as seen by the corresponding Feed Back LED on the “MDIP16” card and also Feedback status shown on display. Also ensure output device is toggled ON/OFF correctly as per the (1/0) key pressed.
- 9 Repeat 6 to 8 till all the Digital Outputs as listed in the “Digital Outputs list” are checked and found to be working as desired and also recognized correctly by the system and shown correctly on the Display Unit.

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
1	P1 CL	P1 Coil	DO00	10	3	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI19 should glow when Output is made ON
2	P21 CL	P21 Coil	DO01	10	4	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI20 should glow when Output is made ON
3	P31 CL	P31 Coil	DO02	10	5	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI21 should glow when Output is made ON
4	P2 CL	P2 Coil	DO03	10	6	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI22 should glow when Output is made ON
5	P22 CL	P22 Coil	DO04	10	7	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI23 should glow when Output is made ON
6	P32 CL	P32 Coil	DO05	10	8	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI24 should glow when Output is made ON
7	S1 CL	S1 Coil	DO06	10	9	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI25 should glow when Output is made ON

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
8	S21 CL	S21 Coil	DO07	10	10	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI26 should glow when Output is made ON
9	S31 CL	S31 Coil	DO08	10	11	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI27 should glow when Output is made ON
10	BKT-M CL	BKT - Mot Coil	DO09	10	13	<ul style="list-style-type: none"> ➤ Set BKT to Braking side ➤ Move RH to For/Rev ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. ➤ Press 1 to switch ON & press 0 to switch OFF. 	BKT should through to Motoring position.
11	BKT-B CL	BKT- Brake Coil	DO10	10	12	<ul style="list-style-type: none"> ➤ Set BKT to Motoring side ➤ Move RH to For/Rev ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. ➤ Press 1 to switch ON & press 0 to switch OFF. 	BKT should through to Braking position.
12	REV-F CL	REV For Coil	DO11	10	14	<ul style="list-style-type: none"> ➤ Set REV to reverse position. ➤ Move RH to FOR side in CS1 ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. ➤ Press 1 to switch ON & press 0 to switch OFF. 	Reverser should through to forward position.
13	REV-R CL	REV Rev Coil	DO12	10	15	<ul style="list-style-type: none"> ➤ Set REV to Forward position. ➤ Move RH to REV side on CS1 ➤ Switch ON both GF switches ➤ Move Master Handle to 1st notch. ➤ Press 1 to switch ON & press 0 to switch OFF. 	Reverser should through to reverse position
14	GF CL 1	GF Contactor Coil 1	DO13	11	0	Press 1 to switch ON & press 0 to switch OFF.	Digital Inputs DI32 & DI 49 should glow when Output is made ON
				12	1		
15	CKC CL	CKC Coil	DO14			Cannot be tested.	No feedback

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
16	EXPR CL	EXPR Coil	DO15	11	2	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI34 should glow when Output is made ON
17	R1 CL	R1 Coil	DO16	11	1	<ul style="list-style-type: none"> ➤ Ensure MFPB1 and MFPB2 are in ON position. ➤ Switch ON FPB Breaker ➤ Press 1 to switch ON & press 0 to switch OFF. 	Digital Input DI33 should glow when Output is made ON
18	R2 CL	R2 Coil	DO17	11	1	<ul style="list-style-type: none"> ➤ Ensure MFPB1 and MFPB2 are in ON position. ➤ Switch ON FPB Breaker ➤ Press 1 to switch ON & press 0 to switch OFF. 	Digital Input DI33 should glow when Output is made ON
19	GF CL2	GF Contactor Coil 2	DO18	11	0	Press 1 to switch ON & press 0 to switch OFF.	Digital Inputs DI32 & DI49 should glow when Output is made ON
				12	1		
20	AGPR CL	AGPR Coil	DO19	11	3	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI35 should glow when Output is made ON
21	SANDR CL	Sanding Relay Coil	DO20	9	13	Press 1 to switch ON & press 0 to switch OFF.	Both Digital Inputs DI12 and DI13 should glow when Output is made ON
22	BKIV CL	BKIV Coil	DO21	--	--	Press 1 to switch ON & press 0 to switch OFF.	Ensure BKIV valve is energised when Output is made ON. Display shows 'No Feed back'. Ensure magnetization of the valve through an iron plate.
23	SR CL	Signal Relay Coil	DO22	9	11	Press 1 to switch ON & press 0 to switch OFF.	DI11 LED & Alarm should ON when output is made ON

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
24	DMR CL	DMR Relay Coil	DO23	--	--	Press 1 to switch ON & press 0 to switch OFF.	DMR Should pick up when output is made ON. Display shows 'No Feed Back'
25	FSR CL	Field Shunting Relay Coil	DO24	12	10	Press 1 to switch ON & press 0 to switch OFF.	FSR relay and FS contactors should pick up when out put is made ON. Digital input DI 58 should glow when out put is made ON
26	VCDR CL	VCD Relay Coil	DO25	12	11	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI59 should glow when Output is made ON
27	AFLR CL	Flasher Relay Coil	DO26	12	12	Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI60 should glow when Output is made ON
28	CMR CL	CMR Relay Coil	DO27	9	14	Ensure LPS10 is switched ON. Press 1 to switch ON & press 0 to switch OFF.	Digital Input DI14 should be ON when output is made OFF and should be OFF when output is made ON. Display shows 'No Feed back' when the output is made ON
29	SLBR CL	SLBR relay coil	DO28	13	13	Press 1 to switch ON & press 0 to switch OFF.	SLBR relay and SLBC contactors should pick up when output is made ON. Digital Input DI 77 should glow when output is made ON. <u>Applicable for locos fitted with self load box features only.</u>
30	PLPC CL	PLPC contactor coil	DO29			Press 1 to switch ON & press 0 to switch OFF.	PLPC should pickup when output is made ON. <u>Applicable for locos fitted with Pre lubrication feature only</u>
31	Spare		DO30				
32	Spare		DO31				

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
33	AV CL (15A)	AV Coil	DO32			Press 1 to switch ON & press 0 to switch OFF.	Check voltage between 15A and 4 wires. It should be more than 65VDC when Output is made ON.
34	BV CL (12A)	BV Coil	DO33			Press 1 to switch ON & press 0 to switch OFF.	Check voltage between 12A and 4 wires. It should be more than 65VDC when Output is made ON.
35	CV CL (7C)	CV Coil	DO34			Press 1 to switch ON & press 0 to switch OFF.	Check voltage between 7C and 4 wires. It should be more than 65VDC when Output is made ON.
36	DV CL (3A)	DV Coil	DO35			Press 1 to switch ON & press 0 to switch OFF.	Check voltage between 3A and 4 wires. It should be more than 65VDC when Output is made ON.
37	HOT_ENG_LED (16L)	Hot Engine LED	DO36			Press 1 to switch ON & press 0 to switch OFF.	Hot Engine LED Indication should glow when Output is made ON
38	CK_TIP_W (73)	CK Tip Weld LED	DO37			Press 1 to switch ON & press 0 to switch OFF.	CK Tip Weld LED indication should glow when Output is made ON
39	GND_LED (35)	Ground Indication LED	DO38			Press 1 to switch ON & press 0 to switch OFF.	Ground LED Indication should glow when Output is made ON
40	OVR_LD_LED (RL-2)	Over Load Indication LED	DO39			Press 1 to switch ON & press 0 to switch OFF.	Over Load LED indication should glow when Output is made ON
41	AFL LED	Flasher LED	DO40			Press 1 to switch ON & press 0 to switch OFF.	Auto Flasher LED indication should glow when Output is made ON

S.No.	Signal Name	Signal Description	Digital Output No.	Corresponding LED on Digital input card		Test condition	Observation
				Slot No.	LED No.		
42	VCD LED	VCD LED	DO41			Press 1 to switch ON & press 0 to switch OFF.	VCD LED indication should glow when Output is made ON
43	MMF LED	Memory freeze LED	DO42			Press 1 to switch ON & press 0 to switch OFF.	Memory freeze LED indication should glow when output is made ON. Applicable only to locos fitted with event recorder.
44	PPL LED	Pre/Post Lubrication LED	DO 43			Press 1 to switch ON & press 0 to switch OFF.	Pre / Post Lubrication LED indication should glow when output is made ON. Applicable for locos fitted with pre lubrication feature only.
45	Spare		DO 44				
46	Spare		DO 45				
47	Spare		DO 46				
48	Spare		DO 47				

Annexure 7

LIST OF ANALOG INPUTS IN MEP660

Signal Name	Sensor Type	Signal Description	Measuring Range
TAV	MVS 815	Rectifier Output Voltage	1500 V
LCPV	MVS 801	Governor Load Control Rheostat Output	100 V
BKCPV	MVS 801	Master Controller Braking Potentiometer	100 V
BATV	MVS 801	Battery Voltage	100 V
AGAV	MVS 801	Auxiliary Generator Armature Voltage	100 V
TAAI	MCS 850	Rectifier Output Current	5000 A
TM1AI	MCS 820	TM1 Armature Current	+/- 2000 A
TM2AI	MCS 820	TM2 Armature Current	+/- 2000 A
TM3AI	MCS 820	TM3 Armature Current	+/- 2000 A
TM4AI	MCS 820	TM4 Armature Current	+/- 2000 A
TM5AI	MCS 820	TM5 Armature Current	+/- 2000 A
TM6AI	MCS 820	TM6 Armature Current	+/- 2000 A
EXAI	MCS 803	Exciter Armature Current	+/- 300 A
AGAI	MCS 803	Auxiliary Generator Armature Current	+/- 300 A
BATI	MCS 803	Battery Charging/ Discharging Current	+/- 300 A
AGFI	MCS 10A	Auxiliary Generator Field Current	+/- 10 A
EXFI	MCS 10A	Exciter Field Current	+/- 10 A
BANGI	MCS 10A	Battery Earth Fault Current	+/- 10 A
TANGI	MCS 10A	Power Ground Fault Current	+/- 10 A
MRPR	MPS 841	MR Pressure	0 to 20 kg/cm ²
BPP	MPS 842	Brake Pipe Pressure	0 to 14Kg/ cm ²
BCP	MPS 842	Brake Cylinder Pressure	0 to 14Kg/ cm ²
APR	MPS 843	Altitude Sensor	0 to 3000 Mtrs
LOP	MPS844	Lube oil pressure	0 to 14 Kg./ cm ²
BAP	MPS845	Booster air pressure	0 to 3.5 Kg./ cm ²
FOP	MPS846	Fuel Oil pressure	0 to 7 Kg./ cm ²
EWT	MTS 815	Engine Water Temperature	-50 to +150 deg C
EOT	MTS 815	Lube Oil Temperature	-50 to +150 deg C
AAT	MTS 815	Ambient Air Temperature	-50 to +150 deg C

Annexure – 8

CRIMPING TOOL & CONNECTOR PIN DETAILS

Crimping tool model No : M22520 / 1-01
 Make of the tool : Astro Tool Corporation,
 21625 S.W. T-V Hwy. Beaverton,
 Oregon 97006 USA.
 Web Site: .
 Approximate price : Rs. 20,000/-.

Crimp type pin details are given below:

S. No.	Connector Model	Pin Part No.	Where used.	Cost
1	MS 3108F 16-9S, C30	AEC # 12SKT C30	EWT / EOT cable	Rs. 510/-
2	MG 00F 18-10S GP C30	AEC # 12SKT C30	TM speed sensor cable	Rs. 540/-
3	MS 3108F-12SP-10S GP C30	AEC # 16SSC C30	ESS cable	Rs. 342/-