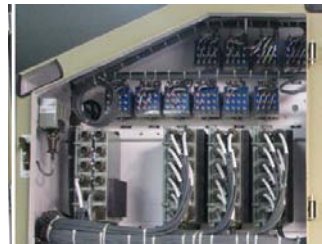




(Govt. of India)
(Ministry of Railways)

HAND BOOK
ON
MICROPROCESSOR BASED CONTROL SYSTEM
(Version 3.0)
FITTED ON DIESEL LOCOMOTIVES



For official use only)
CAMTECH/2012/M/MPCS version 3.0/1.0
June 2013

*Centre
for
Advanced
Maintenance
TECHnology*



Excellence in Maintenance

MAHARAJPUR, GWALIOR – 474005
महाराजपुर, ग्वालियर – 474005

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FOREWORD

The failure of Micro Processor Based Control System has a great impact on the reliability of the diesel locomotive. Due to various modifications Micro Processor Based Control System is upgraded with version 3.0 hence proper knowledge of this upgraded control system is necessary to staff involve operation of these locomotives. This handbook with version 3.0 has been prepared for staff who are involved in the maintenance and operation of Diesel locomotives.

This hand book not only describes general description of MPCS but care has been taken to explain basic things about Micro Processor Based Control System version 3.0 including its description, function details, display details and setting of various parameters with various upgraded features.. With these important features, I am sure that the handbook be highly useful to the concerned staff, to ensure trouble free service of the Micro Processor Based Control System.

12.06.2013
CAMTECH, GWALIOR

A R Tupe
Executive Director

PREFACE

Control System is the vital part of diesel electric locomotive. Micro Processor based Control System version 2.0 has been recently updated as version 3.0. Proper knowledge and up keeping of MEP Control System version 3.0 is necessary to ensure reliability and availability of locomotives. This handbook on micro Processor based Control System version 3.0 of Diesel locomotives has been prepared by CAMTECH with the objective that those involved in operation and maintenance of diesel electric locomotives, must be aware of sufficient knowledge of complete updated MPCS and must know how to work with this system properly.

Technological Up gradation and learning is a continuous process. Hence feel free to write to us for any addition / modifications or in case you have any suggestion to improve the handbook. Your contribution in this direction shall be highly appreciated.

12th June 2013
CAMTECH GWALIOR

(K.P.Yadav)
Director/Mech

CORRECTION SLIPS

The correction slips to be issued in future for this handbook will be numbered as follows:

CAMTECH/M/2012/MPBCS/1.0/C.S. # XX date -----

Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

CORRECTION SLIPS ISSUED

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MICROPROCESSOR BASED CONTROL SYSTEM (VER3)

1.0 NEEDS OF MBCS VERSION 3.0

In initial during year 2001 when MEP-660 prototype was developed, 16-bit 87C196 micro controller was selected to suit the existing MEP specifications. At that time the number of I/O s has been provided in the MEP-660 were 192 (Digital Input–80, Digital Outputs–64, Analog inputs –32, Frequency inputs –16). After a time a stage has come that all the Digital I/Os has been exhausted but the requirements by customer was increasing. In addition to the new Safety logic requirements, data management was also increased. Therefore the existing hardware is enhanced to scatter the new increased I/Os with new philosophy of control.

1.1 SUB-ASSEMBLIES REMOVED FROM VER 2.0:

Unit Name	Model No	Qty
MCOS Unit	MSP 707	01

1.2 REDESIGNED SUB-ASSEMBLIES IN MEP VER 3.0

UNIT NAME	MODEL NO.	QTY.
CONTROL UNIT	MEP660 (Ver-3)	01
Control Cards	MEPMCC,MEPDMC	01+01
Digital input cards	MIDIP24	05+01
Digital output cards	MILS16, MIHS16	02+01
Analog input cards	MAIP10-x	03+01
Frequency input cards	MIFIP16	01
Power supply cards	MEPHPS	02
PWM card	MEPPWM2	01

Memory Card	MMC-16.It is the external memory card(CFM)	01
DISPLAY UNIT	MDS739	01
ADB	MDB719	03+01
RDB	MDB720	01
SPEED SENSOR (TM)	T-818,T817	06

1.3 SUB-ASSEMBLIES ADDED IN MEP VER 3.0

UNIT NAME	MODEL NO.	QTY.
Intelligent Data logger	MEPIDL	01
LRMS card (Optional)	MEPRM	01
End On Train Telemetry (Optional)	MEPEOT	01
Analog output card	MAOP8	01
PRESSURE SENSOR – EWP	MPS847	01
PIEZO BUZZER, 12V	-	01
GRCO1 -- 2-POLE ASSEMBLY	-	01
Fuel Oil level sensor (Optional)	Type MFL	01
Digital Air Flow Sensor (Optional)	Type MAF	01
Grid Blower Sensor (Optional) Radiator	834	
Fan Speed Sensor (Optional)		

1.4 MODIFIED LOGICS FROM VER.2

INTELLIGENT LOW IDLE FEATURE

- ♦ Low IDLE feature is provided in Ver.2 to reduce the engine RPM to 350.
 - If the engine runs in IDLE for more than 05 minutes, & in MEP LOW IDLE Flag is enabled, MEP energizes AV and DV digital outputs.
- ♦ If the Governor supports this combination, the Governor brings the engine RPM to 350.
- ♦ However lube oil pressure **is proportional to engine RPM** and in some locos, diesel engine is getting shut down due to low lube oil pressure.
- ♦ To avoid unnecessary line failures, the end user fear to use this feature.
- ♦ To overcome this unwanted engine shut down and still get fuel economy Intelligent Low Idle Feature has been introduced.
- ♦ In this feature
 - When Engine is running in IDLE for more than 5 minutes, Low IDLE flag is enabled and LOP is more than 1.7Kg/cm^2 (User settable Parameter), then only MEP goes into Low IDLE mode.
 - MEP energizes AV and DV digital outputs and MCBG brings the engine rpm to 350 rpm.
 - During Low IDLE mode operation, if LOP is less than 1.2 Kg/cm^2 (User settable), MEP automatically revert back to IDLE mode.
 - MEP de-energizes AV and DV digital output and MCBG brings back engine RPM to 400 and the lube oil pressure increases.
 - LOW IDLE mode is linked to LOP value, engine does not shut down due to low lube oil pressure. So End user need not fear for unnecessary shutdown while working in low IDLE mode. There is sure of fuel savings with this feature.

FIRE ALERTER SYSTEM

- ♦ In MEP-Ver.2 also this fire alerter system is available. Due to lack of digital inputs, single input has been connected to MEP. No identification whether the fire is in lead loco or trail loco.
- ♦ In Ver. 3, for Fire Alert system two digital inputs are allotted to identify whether it is trail or lead loco.
- ♦ The fire alerter provides two potential free contacts which energizes digital inputs FAS FB and TL 11 (MU wire).
- ♦ If both FAS FB and TL 11 are high, system display a message “1073 - Fire occurred in loco. Check for fire and extinguish fire. Restrictions: Engine Shutdown”.
- ♦ Along with message, power is cut off, engine is shut down and VCDR relay is switched OFF to apply brakes.
- ♦ If TL 11 alone is high display shows the message “2031 - Fire alarm occurred. Check loco thoroughly and reset fault. Restrictions: Cranking prohibited”.
- ♦ Along with message, power is cut off, engine is shut down. Brake valve gets supply through TL20 wire.

PRE / POST LUBRICATION FEATURE

Pre Lubrication:

- Both the features are implemented in MEP-660 Ver.2 itself. With field experience, slight logics are changed in Ver.3
- Pre Lubrication is avoided if the engine is re-cranked within 30 minutes from the last shut down time. This is because, sufficient lubrication film will be available within 30 minutes. If 30 minutes is lapsed, engine cranks after pre lubrication.
- In case of any cranking restrictions, the same is displayed before starting pre-lubrication.

- A countdown timer is shown on the display unit, to indicate the time left for cranking.
- After completion of pre lubrication, display shows “Pre lubrication completed and engine is ready for cranking”.
- Engine cranks normally.

Post Lubrication

- In Ver.2 the Post lubrication is carried out only when the engine shut down through **STOP** push button.
- Where as in MEP Ver.3, post lubrication is carried out for any type of engine shutdown.
- Post lubrication is for 5 minutes (user settable).
- During Post lubrication, display will shows a message “Post lubrication ON. Keep breakers ON”.

IMPROVED LOGIC FOR FSC FAULT DECLARATION:

- ♦ In Ver 2.0, to know Field shunt contactors status, only one digital input is allotted. Aux. Contacts of all FS contactors are connected parallel.
- ♦ During wheel slip at higher speeds, sometimes FSC stuck open faults are declared even though contacts are in good conditions.
 - In Ver 2.0, these FSC faults frequently we will find in WDM3D locos based on current differences.
 - To avoid the FSC faults frequent logging, loco speed has been increased to **90 KMPH**.
- So in Ver 3.0, 6 individual digital inputs are allotted for individual field shunt contactors.
 - FS contactor stuck open / stuck closed faults are now declared based on the individual contactor feedback signals and not based on TM currents.

1.5 ADDITIONAL FEATURES IN VERSION 3.0

POWER SETTER

- ♦ When locos work in Multiple Unit operation, sometimes while hauling empty racks, all the locos work in 4th or 5th notch on level and down gradients.
- ♦ When the locomotives work below 7th notch, they are not fuel efficient.
- ♦ If one of the loco is made working at 7th / 8th notch and other locos to run at IDLE, this combination may result in overall fuel efficiency.
- ♦ This can be done either removing the MU cable or keep ECS in IDLE position in rear locos. But this can be done manually by driver which is inconvenient to him & he may not bother to do.
- ♦ Power setter is a feature to bring the rear locos to IDLE without going to rear locos and removing the MU cables.
- ♦ Power Setter Enable Switch is provided like TE Limit Switch. Normally this switch is in 'Disable' position.
- ♦ When the driver wants single loco power, he will simply keeps this switch in 'Enable' position.
- ♦ Keeping this switch in 'Enable' position, Train Line Wire TL1 is energized in all the locos.
- ♦ With MU wire TL 1 status high and wire 16D is OFF, the locomotive will work in IDLE mode only even though throttle signals (TL15, TL12, TL7 and TL3) are available.
- ♦ So all the Rear locos work in IDLE, where as lead loco work as per notch position. The driver can work in higher notches and get fuel efficiency.
- ♦ While this switch is in 'Enable' position, 'Power Setter Enabled' message is displayed once in every 5 minutes.
- ♦ However Dynamic brake works normally in all locos and gets full control.

- ♦ When driver wants both the locos power, he simply keeps this switch in 'Disable' Position. All the locos work normally.

EXTENDED DYNAMIC BRAKING FEATURE

- ♦ The maximum Dynamic Braking effort in Alco locomotives is in between **30 to 60 Kmph only**.
- ♦ Below 30 KMPH, the braking effort reduces since the grid current reduces due to TM armatures speed drops down.
- ♦ In some steep gradient sections, the maximum speed is only 30KMPH. So these locos does not provide effective dynamic brake and pneumatic brakes have to be used to control the loco speed.
- ♦ To achieve higher braking effort in lower speeds this feature is implemented in ALCO locomotives.
- ♦ To increase grid current below 30 KMPH, either the TM armature voltage has to be increased which is not possible due to design characteristics of TM or reduce the grid resistance by shorting certain elements in the resistor elements.
- ♦ At 21.5 Kmph (User settable) MEP energize Extended Dynamic Brake Relay (EDBR) to provide supply to 6 EDBC contactors.
- ♦ These pneumatic contactors are connected across certain portion of the grid resistors.
- ♦ Energizing these 6 contactors, the effective grid resistance is reduced to 0.1875Ω from 0.5Ω .
- ♦ As the resistance is smaller, the grid current increases and results in higher braking effort at low speeds.
- ♦ To achieve single stage braking effort, 6 PCs has to be provided in the locomotive.
- ♦ It is possible to have two stage reduction of grid resistance to provide effective dynamic brake even below 25 KMPH.

RECTIFIER FUSE BLOWN PROTECTION

- ♦ In power rectifiers, fuses are provided in series with each diode.
- ♦ In case of any diode short circuited, this fuse will blowout and the diode is isolated from the circuit.
- ♦ This fuse is a special type of fuse, having a micro switch.
- ♦ The micro switch is operated through a lever whenever the fuse is blown out.
- ♦ In Ver.2, the fuse blown status is not monitored by MEP. Only LED indication is given to driver.
- ♦ In Ver 3.0, one digital input is allotted for rectifier fuse blown protection and is connected to wire No. 111 in rectifier panel.
- ♦ When this input is HIGH, the system declares a fault message “1066 – Rectifier fuse blown, Restrictions: power limited to 4th notch”.
- ♦ Along with the message engine rpm and power both will be restricted to 4th notch.
- ♦ Whenever wire no. 111 is low, system will declare “1661- Rectifier fuse OK now”.
- ♦ After fault recovery, engine rpm and power will raise as per notch position.

POWER DE-RATION DURING POWER GROUND

- ♦ In Ver.2 when the TANGI value is more than 0.4 Amps, MEP declares fault message ‘Power Circuit Ground fault’
- ♦ In Ver. 3 the notch power is de-rated if TANGI current is more than 0.4 Amps and still permit the loco to work with de-rated power.
- ♦ This feature is very useful to avoid online failures and to protect power circuit from further damages.
- ♦ For every 0.1 Amp increment above 0.4 Amps of TANGI current, 20% of that notch power is de-rated.

- ♦ The display shows a message “2021 – Power reduce due to power circuit ground”.
- ♦ The de-ration continues up to TANGI value reaches 0.9 Amps (user settable) and thereafter system declares a message “1007 - Power circuit ground fault” along with engine Idling and Power cut off.

INTEGRATED SPEEDOMETER

- ♦ In Ver 3.0 system, no need of external stand alone speed recorder.
- ♦ MEP 660 systems will generate an analog output signal based on the calculated speed from TM RPMs.
- ♦ The same signal will be fed to external analog meter to indicate the locomotive speed.
- ♦ Even **3 TM speed sensors** are declared faulty; the speedometer indicates the loco speed without any trouble.

TM SPEED SENSOR FAULTS IN STAND STILL CONDITION:

- In Ver 2.0 ‘Speed sensor x faulty’ can be declared while the loco is running only. Type of fault cannot be identified.
- To be more clear in fault declaration, the TM speed sensors are re-designed in MEP-660 Ver.3.
- With new design of TM speed sensor, it is possible to detect TM speed sensor faults due to cable open / short even loco is in standstill position.
 - Normally the sensor output current at Loco stand still is between 4 to 16 mA.
 - If the output current is out of range, the system declares ‘Speed sensor X Faulty.’
- Any TM speed sensor faults related to air gap is declared while the loco is moving only.

- If current output signal is within range and rpm is erratic / not showing, then it will declare 'Speed Sensor x air gap fault.'

PROTECTION AGAINST WATER PUMP FAILURES

- ♦ In case of water pump failed, at present in Ver.2, there is no direct detection. Even though indirectly can be identified, there is no protection except power reduction.
- ♦ In Ver.03, water pressure sensor is provided to measure the outlet pressure of water pump.
- ♦ MEP-660 continuously monitors this water pump pressure along with LWS input and accordingly to Table given below

(Ref- .Final Modification sheet No. MP. MOD .EC. 08.58.10 (Rev.- 01) Date : 18.02.11)

S.no	WP Pr. (kg/cm ²) at idle	EWT Sensor and check for rate of rise of EWT>90°C for 3 minutes	EOT Sensor and Check for Rate of rise of EOT >100°C for 3 minutes	Action	Display and Fault Logging
1.	≥0.4	Healthy	Healthy	Normal Run	-
2.	≥0.4	Faulty	Healthy	Normal Run	EWT sensor faulty
3.	≥0.4	Healthy	Faulty	Normal Run	EOT sensor faulty
4.	≥0.4	Faulty	Faulty	Normal Run. Turn on R1 and R2	EVVT & EOT sensor faulty*
5.	<0.4#	Healthy	Healthy	Normal Run	Low water pressure
6.	<0.4#	Faulty	Healthy and temp. ≥3 °C	Engine Shut down	Low Water Level or water pump faulty & EWT sensor faulty

7.	<0.4#	Faulty	Healthy and temp. <3 °C &LWS is low	Engine Shut down	Low Water Level or water pump faulty & EWT sensor faulty
8.	<0.4#	Faulty	Healthy and temp. <3 °C &LWS is high	Normal Run	EWT sensor faulty
9.	<0.4#	Healthy and temp. $\geq 2^{\circ}\text{C}$	Healthy	Engine Shut down	Low Water Level or water pump faulty
10.	<0.4#	Healthy and temp. <2°C	Healthy & LWS is low	Engine Shut down	Low Water Level or water pump faulty
11.	<0.4#	Healthy and temp. <2°C	Healthy & LWS is high	Normal Run	-
12.	<0.4#	Healthy	Faulty	Engine Shut down	Low Water Level or water pump faulty & EOT sensor faulty
13.	<0.4#	Faulty	Faulty	Engine Shut down	Low Water Level or water pump faulty & EOT sensor faulty
14.	<0.4#	EWT $\geq 95^{\circ}\text{C}$	Healthy	Engine Shut down	Low Water Level/ water pump faulty
15.	<0.4#	Faulty/ Healthy	EOT > 111 °C	Engine Shut down	Low Water Level/ water pump faulty

Water pump pr. <0.4 kg/cm² at idle for 20 sec.

* 'Hot engine' situation will not be declared, although water & lube oil temp. may be high.

However, eventually engine will be shut down due to LLOP.

DATA DOWN LOADING TO PEN DRIVE

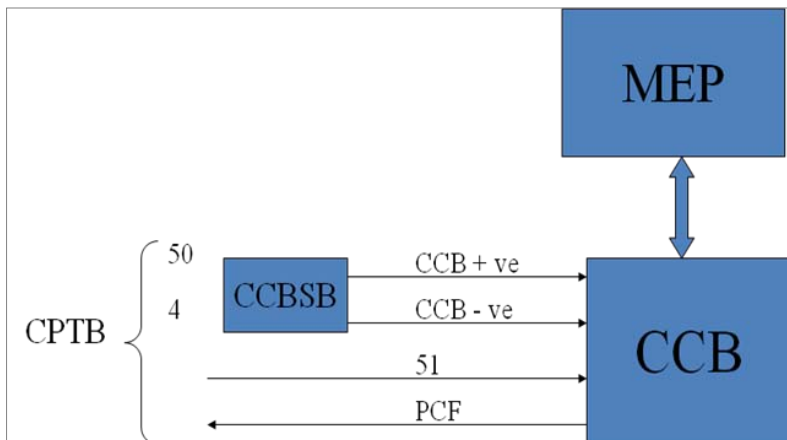
- ♦ In Ver.2, data can be down loaded to PC/LAPTOP only. It is not possible to down load the data to a pen drive. It is difficult to down load data by an officer who is foot plating.
- ♦ In Ver.3, provision has been provided to down load the data from the memory.
- ♦ As soon as the pen drive is installed, the following options are prompted to user for selection.
 - Event recorder Data
 - Long Term
 - Short Term
 - Operators configuration
 - Faults only
 - Faults with FDP

INTERFACE WITH COMPUTER CONTROL BRAKING

- ♦ Alco locomotives are so far equipped with IRAB brake system which is analog type pneumatic control.
- ♦ Computerized Control Brake system is a new brake system supplied by M/S Knorr Bremes in GM locos.
- ♦ Lot of failsafe features are available with CCB and Railway wants to adopt the same brake system in Alco locomotives.
- ♦ With adoption of CCB in Alco locomotives, the following brake related equipments are removed.
 - Complete Brake panel is replaced with CCB.
 - AFL P1 | Equalizing pressure signal from CCB
 - AFL P2 | BP pressure signal from CCB
 - Whenever Emergency Brake signal is received from CCB or based on EP & BP pressures, Auto flasher lights are switched ON.
 - BP, BCP pressure sensors. Signals are taken from CCB.

- BKIV valve
- Foot pedal Switch.
- VCD Valve – Penalty brake signal is communicated to CCB
- ♦ CCB is connected to the MEP system via RS 485 communication.
- ♦ If any fault in CCB, the same will be indicated in MEP 660 Display unit and it will apply brakes.
- ♦ In MEP system, only fault message will appear but there is no controlling in CCB related issues.
- ♦ CCB provides potential free contacts PCR which is equivalent to PCS. Whenever CCB requires power cut off, these contacts are operated.
- ♦ Whenever MEP wants brake application, the brake signal is communicated to CCB and the brakes are applied by CCB through Display unit Air brake self test can be conducted.
- ♦ There are 4 wires going to CCB and one RS485 communication cable.

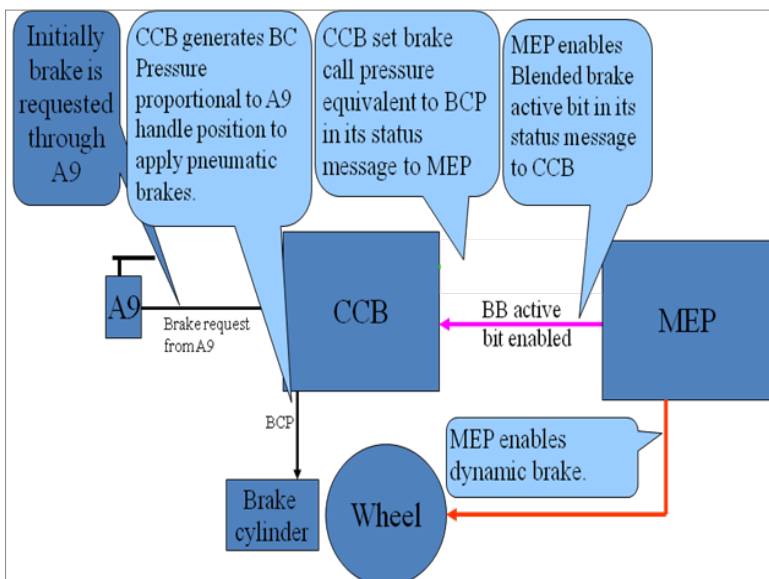
CCB CONNECTIONS

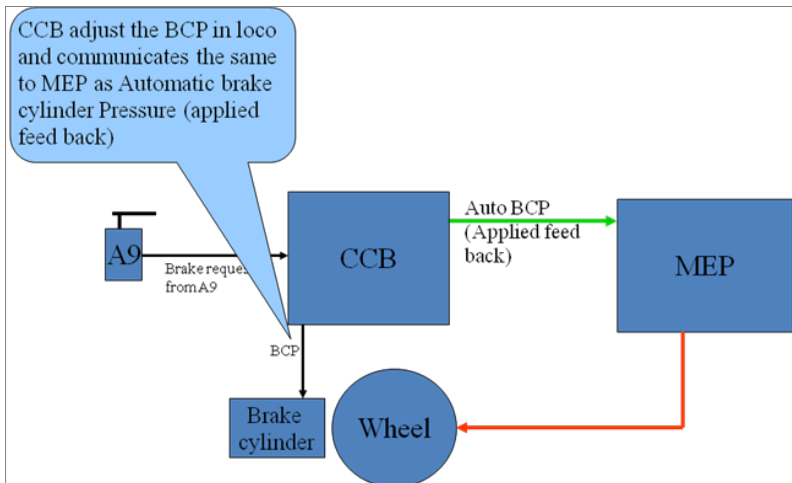
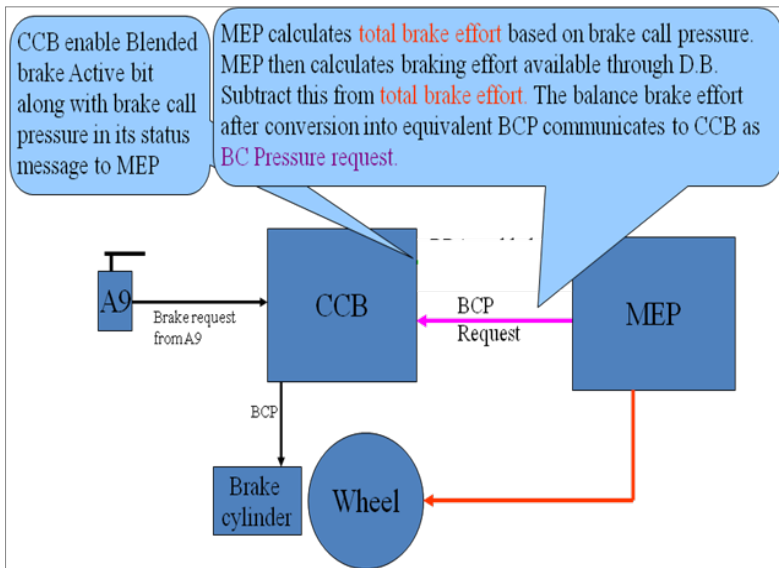


BLENDED BRAKING SYSTEM

- ♦ So far with IRAB brake system on Alco locomotives there is no provision to use both dynamic brake and pneumatic brakes simultaneously.
- ♦ With computerized brake system it is possible to use combination of pneumatic brake and dyn brake.
- ♦ Pneumatic brakes are substituted to the extent possible by dynamic brake to reduce wheel wear and cool running of wheels.
- ♦ In CCB fitted locomotives, Blended Brake switch is proved to enable / disable this feature by driver.
- ♦ Blended brake is possible only on lead locomotives. CCB does not permit Blended brake on Trail locos.
- ♦ When the BB switch is ON, loco is in coasting and the driver applies brakes through A9,
 - Initially all the brake effort is set by CCB through pneumatic brake only.
 - CCB set the brake call pressure information equivalent to BCP pressure which is proportional to A9 handle position.
 - MEP enables dynamic braking and then enables blended brake active bit. In turn CCB enables blended brake active bit. Now both the systems are ready to use blended brake.
 - Once the blended brake active bit is enabled by CCB in its communication, MEP dynamically calculates braking effort provided by dynamic brake and pneumatic brake.
 - MEP subtracts the braking effort available from dynamic brake from the total braking effort derived from requested brake call pressure to arrive at brake cylinder pressure.
 - MEP communicates this pressure to CCB as Brake cylinder pressure request.
 - CCB adjusts the loco brake cylinder pressure accordingly as long as blended brake active bit is exchanged mutually.

- The above cycle repeats once the driver changes A9 handle position.
- CCB communicates automatic brake pressure (Applied feedback).
- Over a period of time dynamic brake effort will substitute for most or all of the locomotive's pneumatic brake effort. CCB will maintain minimum brake cylinder pressure.
- As the dynamic brake effort reduces at lower speeds, MEP continuously calculates the braking effort available through dynamic brake, and accordingly adjust the brake cylinder pressure request.
- CCB disable the blended brake active bit under the following:
 - CCB is set as trail loco.
 - Emergency brake is initiated.
 - Dynamic brake is activated by driver.
- Bail-Off request by driver.





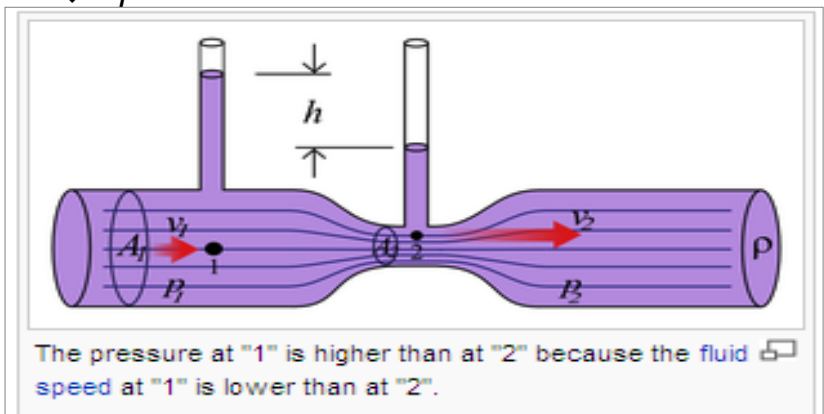
1.6 ADD-ON FEATURES TO VERSION.3

Loco Remote Monitoring System (LRMS):(Optional)

- ♦ In Ver. 2, There is one standalone unit which is having GSM / CDMA chip sets, it will collect the data for every 1 minute from locomotive and will be placed in server which is placed at **our Head Quarters**.
- ♦ In Ver. 3, the standalone unit has become into an add on card with all the necessary hardware.
- ♦ By using this feature, locomotive position, health condition, fault data pack, event recording etc., can be monitored remotely.
- ♦ Whenever we want to track the locomotive, we have to connect thru web site (www.loconet.in). Thru internet, data can be monitored remotely and same can be downloaded.

Fuel Oil measurement: (Optional)

- ♦ A fuel oil level measuring sensor is added to the fuel tank.
- ♦ Along with this sensor, ADB4 is also included.
- ♦ T



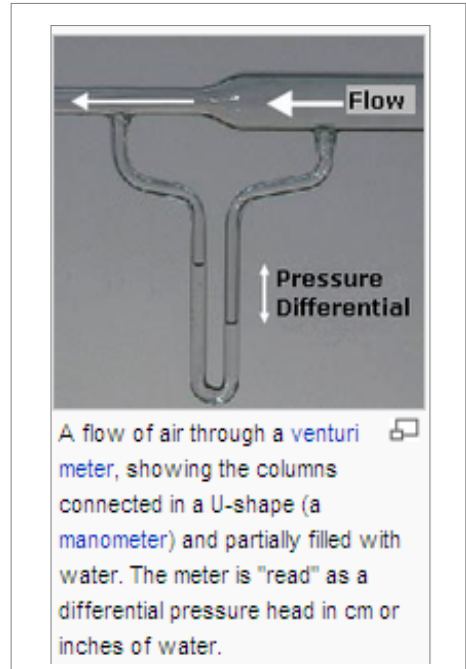
rovides an analog current signal 4 to 20 milliamps proportional to fuel oil level available in the tank.

- ♦ The sensor requires to be calibrated after installation because the fuel tank capacity and size changes from loco to loco.

Fuel level will be indicated in IDLE screen.

Digital Air Flow measurement: (Optional)

- ♦ This sensor is same as air flow measuring valve in the existing IRAB system.
- ♦ The sensor is a venturi meter type connected in the BP circuit between MR and C2 Relay valve.
- ♦ The venturi effect causes pressure difference between input and output of the meter. The pressure difference is proportional to rate of air flow.
- ♦ It measures the rate of air flow from MR to maintain required BP pressure.
- ♦ The rate is converted into LPMs and is indicated to the driver.



TFT Display in both the control stands

- ♦ TFT (Thin Film Transistor) LCD display unit is a customer requirement.
- ♦ All the existing analog gauges will be replaced with single TFT display.

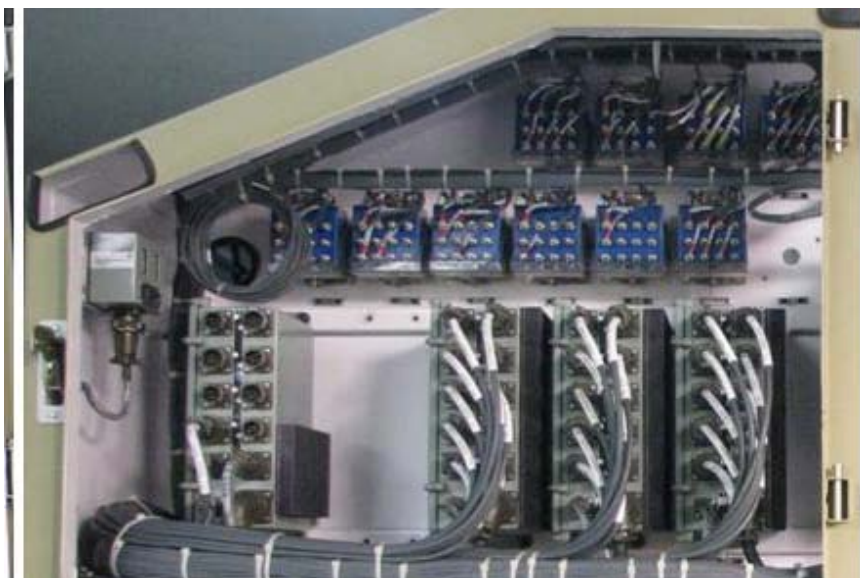
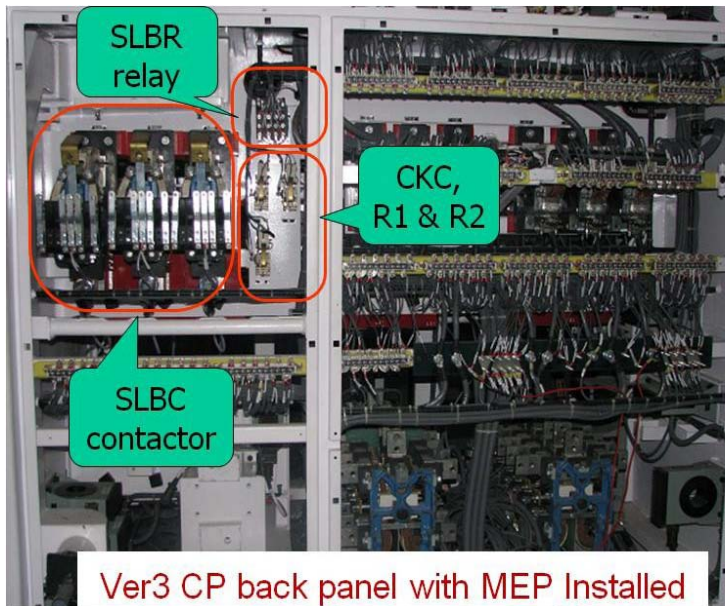
- ♦ Two Such displays will be provided one in each control stand.
- ♦ In MEP 660 Ver. 3, required information is communicated via RS 485 communication to both the TFT screens. Dedicated communication provision is made in the Ver 3.0

End of Train Telemetry (EOTT): (Optional)

- ♦ This is an add on feature which is Under development.
- ♦ There will be a signaling unit fitted at the last coach/wagon which communicates with main unit provided in driver cab.
- ♦ This EOT communicates its existence and BP pressure at the last vehicle.
- ♦ This unit helps faster reorganization during train parting because communication will be lost.
- ♦ If the driver wants fast brake application, he can do so through a switch. The EOT unit vents the BP from the last coach also in proportionate to BP pressure available in the locomotive.
- Later on we can remove the Guard coach, wherever this feature is installed in locomotive.

2.0 MEP-660 VER. 3 INSTALLATION





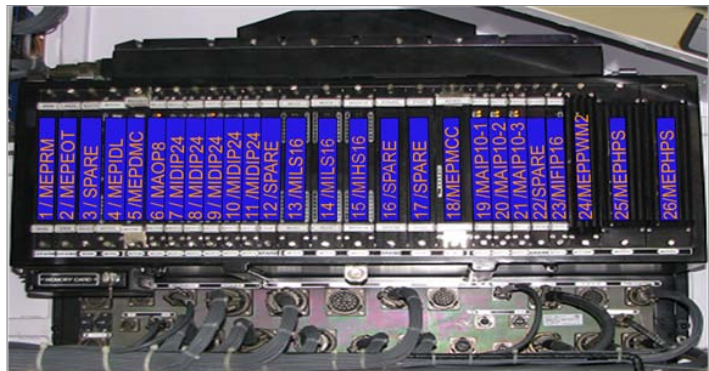
Ver3 Analog
Distribution Boxes

3.0MEP-660 VERSION 3.0 SPECIFICATIONS

Hardware	Version 2.0	Version 3.0	Expandable
Digital Inputs	80 (16/card –5 cards)	120 (24/Card-5 Cards)	Up to 144
Digital Outputs	48 (16/card-3 Cards)	48 (16/card-3 Cards)	Up to 64
Analog inputs	32 (8/card-4 Cards)	30 (10/card-3 Cards)	Up to 40
Analog outputs	4 (LM,LOP, BAP, FOP)	8 (LM, SPM, FOP, LOP, BAP, ACPC)	02 spare channels
PWM outputs	2	2	6
External Memory	8MB	16MB	
Internal Memory	8MB	32MB	
Communication ports	RS485-MCBG, Display RS232- Config., Data log. USB – Data down load	RS485 – Display (Dual),MCBG, CCB,RS232 – ODL, Print USB–Pen Drive, Config. IDL Config., Pen drive (IDL)	

4.0 MAIN ASSEMBLIES OF VERSION 3.0 CONTROL UNIT-V3

- ◆ This is the main control equipment in the Microprocessor control system.
- ◆ Locomotive is interfaced through connectors and they are unique.
- ◆ These are bayonet type as against circular threaded type in V2.
- ◆ Internal wiring of these connectors to the back plane is eliminated as compared to Version 2 Control unit.
- ◆ The control unit is totally no wire system.
- ◆ The total control system is functionally divided into different modules.
- ◆ These modules are dust proof and plug in type cards for easy replacement.



- **Control cards** 3
- **Digital Input cards** 5+1Spare

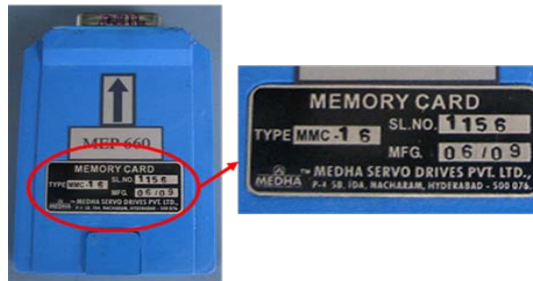
- **Digital Output cards** 3+1 Spare
- **Analog input cards** 3+1 Spare
- Analog output card 1
- Frequency input card 1
- PWM control card 1
- Power supply card 2
- Spare (MEPRM) 1
- Spare (EOTT) 1
- Spare 2
- ♦ Within the control unit, air turbulence is created through fans for efficient heat dissipation.
- ♦ These fans are mounted in the fan assembly and are fitted on top of the Control unit.
- ♦ Supply to these fans is connected from RDB unit through a connector.
- ♦ Failure of these fans will cause a fault log.
- ♦ Loco works normally without any restrictions.

External Memory Box

The memory card module is shifted to left hand corner from right corner.



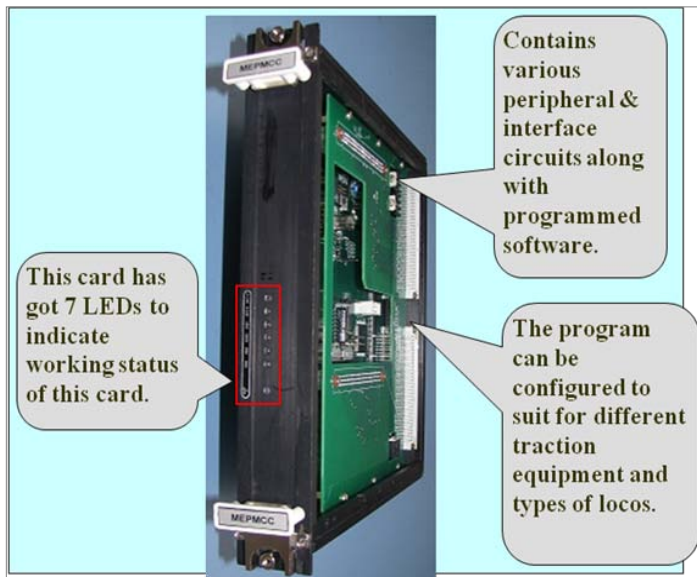
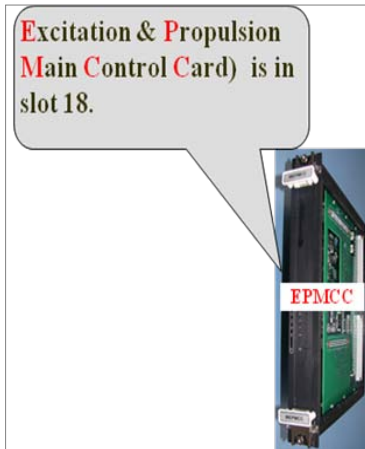
The memory card capacity is increased to 16 MB as against 8MB.

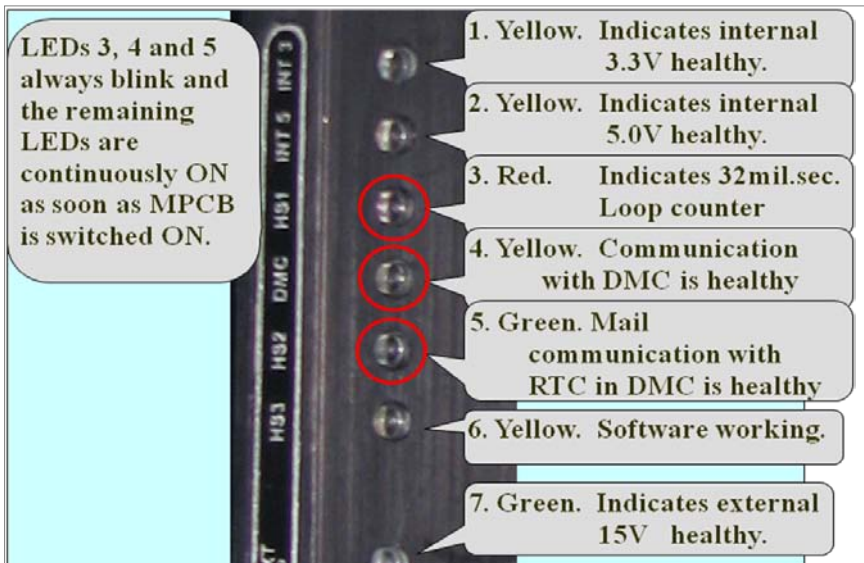


- Additional connectors are accommodated for present and future up gradations like LRMS, DPC, TFT display etc.
- ♦ Card slots have been increased to 26 as against 19 to accommodate additional present and future requirements.
- ♦ Pen drive slots have been provided for data down loading.

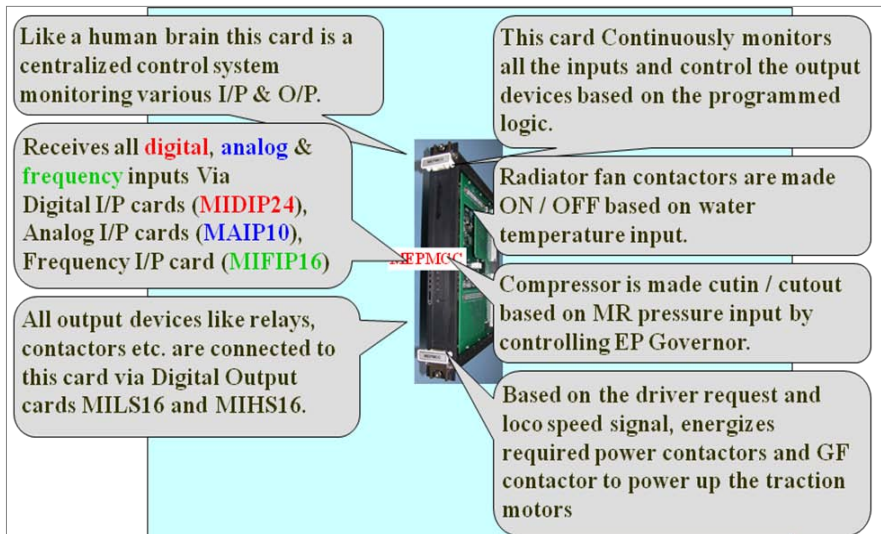
4.1 Description of Control Unit Cards (Block Diagram)

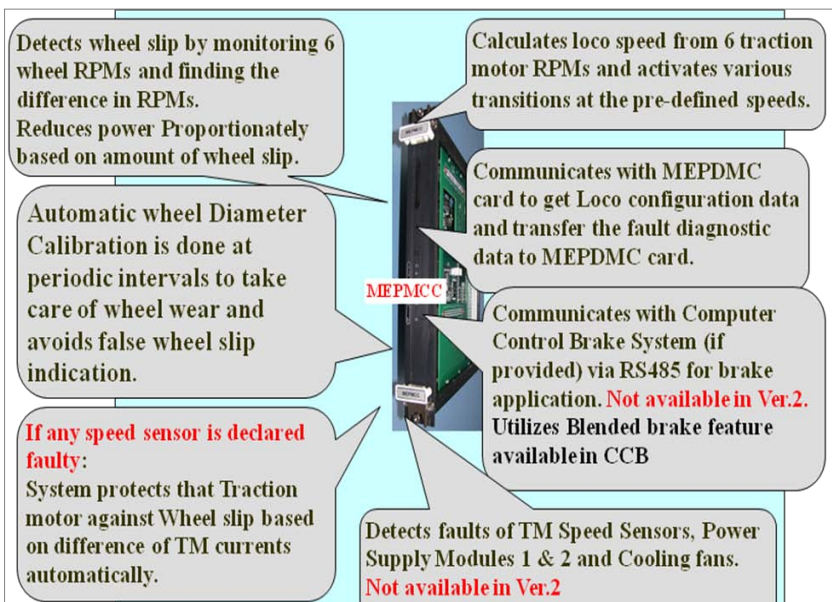
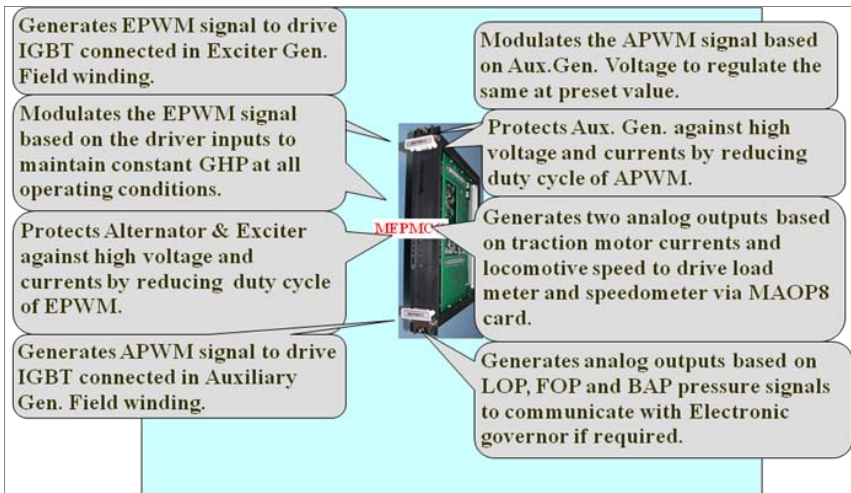
Control Card





MEPMCC Card





MIDIP24-Digital Input Card

- **MIDIP24** (Medha Improved Digital Input card) is a digital input card.
- Each card contains 24 input channels as against 16 in V2 card.
- This card contains necessary hardware to convert high voltage signals (72V) into isolated low voltage signals of 5V required for micro controller.
- It provides electrical isolation between locomotive circuits and micro controller circuits.
- All these channel inputs are reverse polarity protected.

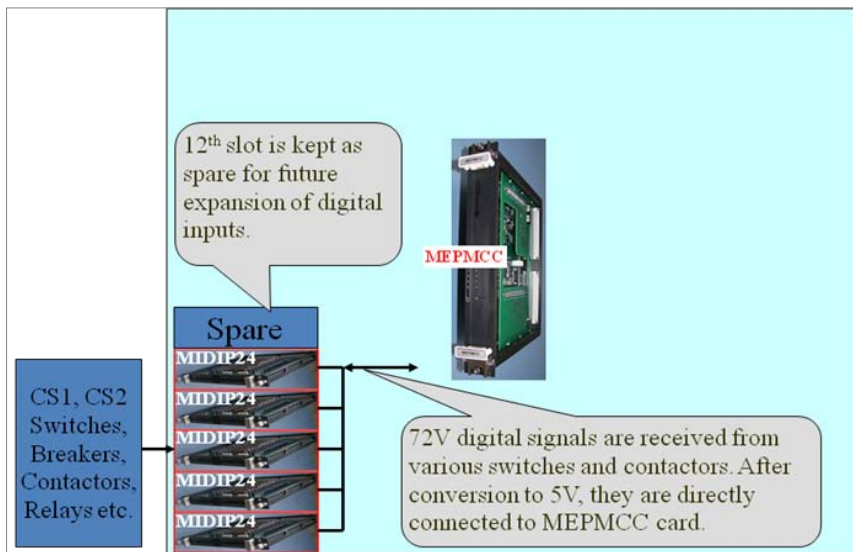
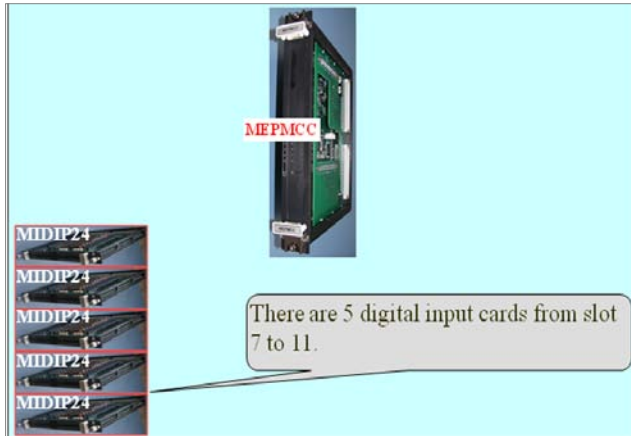


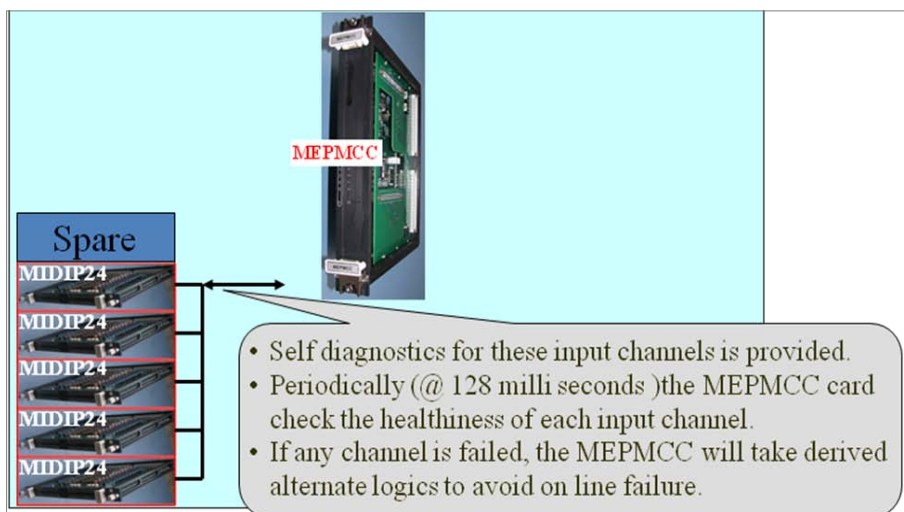
- 24 Green LEDs are available at bottom portion of the front fascia.
- These LEDs are numbered from 0 to 23.
- These Green LEDs indicate the status of 72V input signal from loco.

- 24 Yellow LEDs are available on top portion of the front fascia.
- These LEDs are also numbered from 0 to 23.
- Corresponding Yellow LED indicates that the input 72V signal is converted to 5V by the card.
- The 5V output signal is communicated to MEPMCC card.

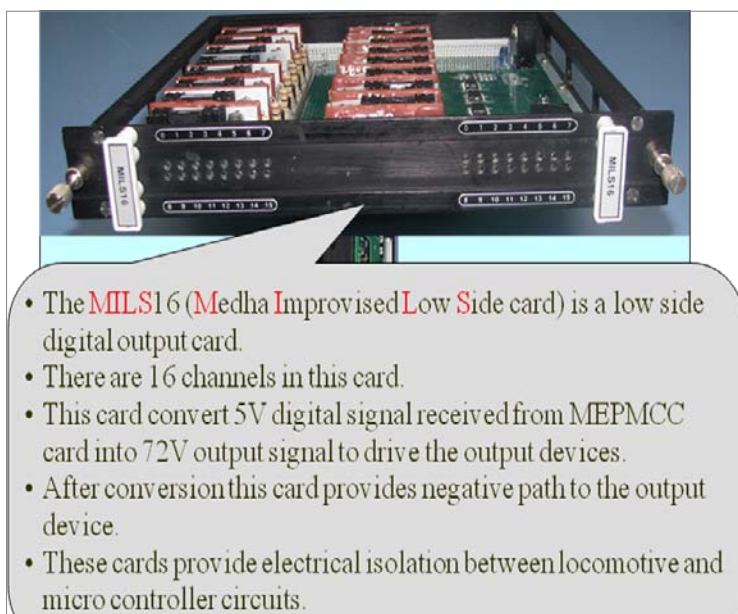


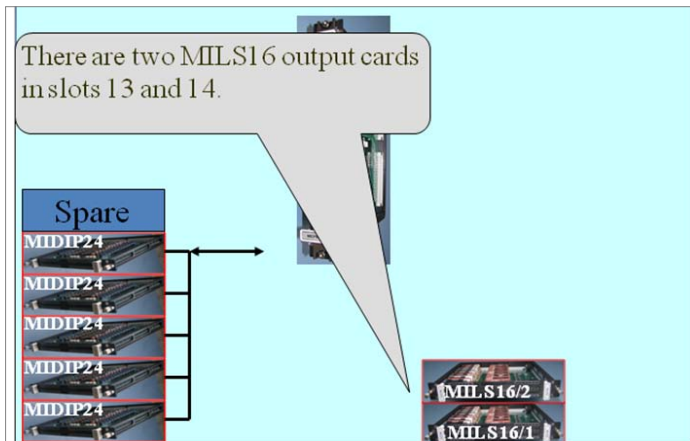
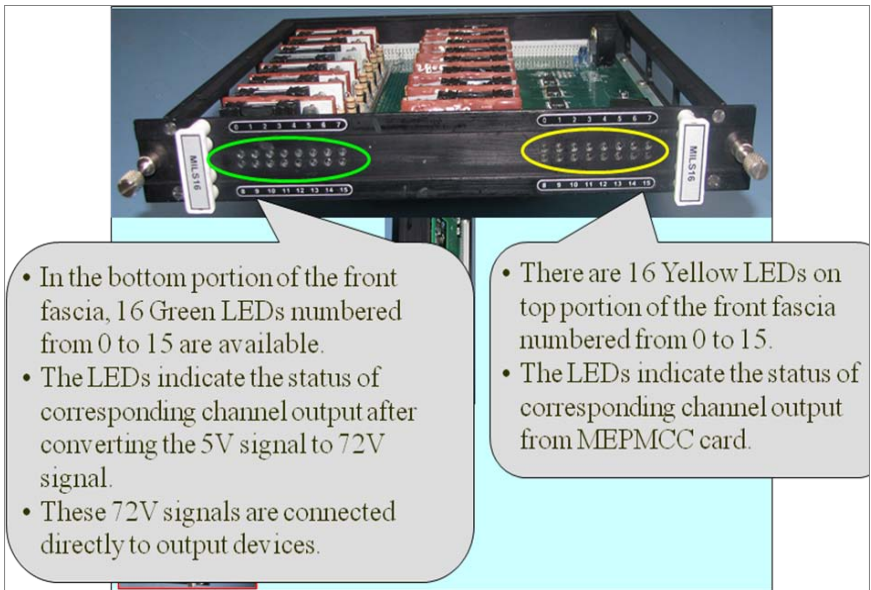
MIDIP24-Digital Input Card





MILS16 - Digital output Card





MIHS16 - Digital output Card



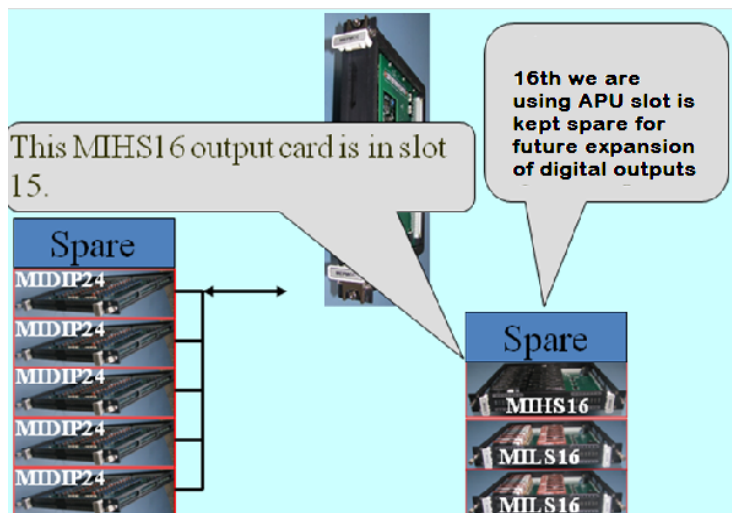
- The **MIHS16** (Medha Improved High Side card) is a High side digital output card.
- There are 16 channels in this card.
- This card convert 5V digital signal received from MEPMCC card into 72V output signal to drive the output devices.
- After conversion this card provides positive path to the output device.
- These cards provide electrical isolation between locomotive and micro controller circuits.



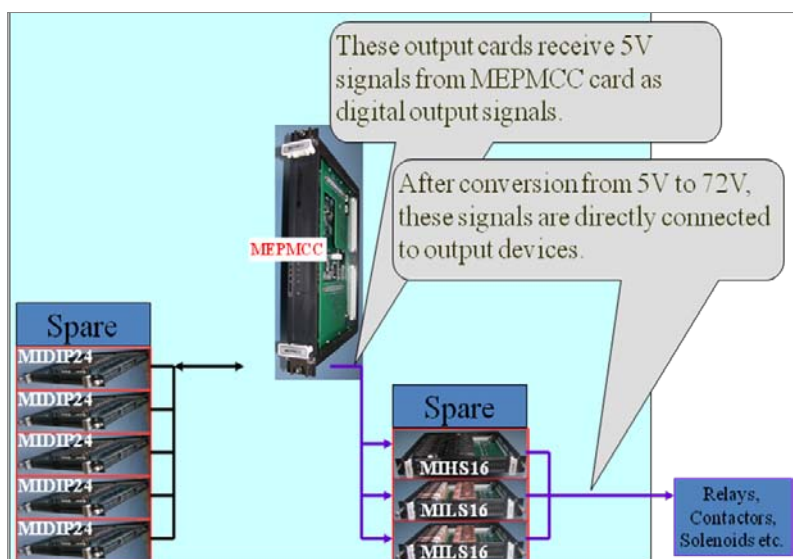
- In the bottom portion of the front fascia, 16 Green LEDs numbered from 0 to 15 are available.
- The LEDs indicate the status of corresponding channel output after converting the 5V signal to 72V signal.
- These 72V signals are connected directly to output devices.

- There are 16 Yellow LEDs on top portion of the front fascia numbered from 0 to 15.
- The LEDs indicate the status of corresponding channel output from MEPMCC card.





Digital output Card



MAIP10-# Analog input card



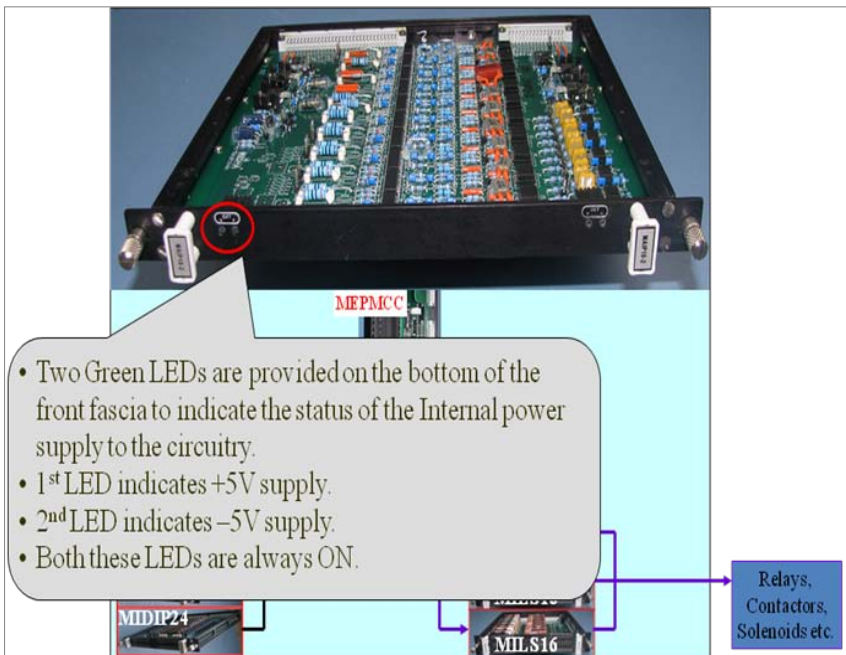
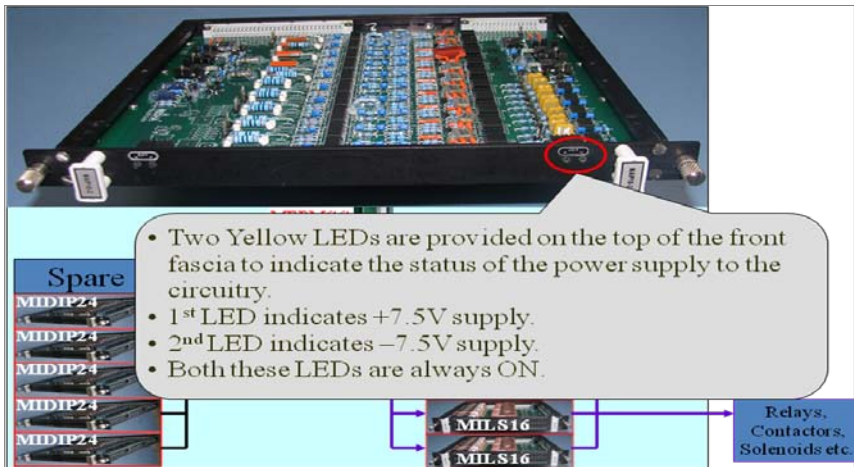
- MAIP10 Medha Analog InPut card is an analog signal processing card.
- These cards receive analog signals (milli amps) from various sensors through respective ADBs.
- These cards contain necessary hardware to convert these current signals into low voltage signals (0 to 5V) with electrical isolation.
- The converted signals are communicated to MEPMCC control card for further process.

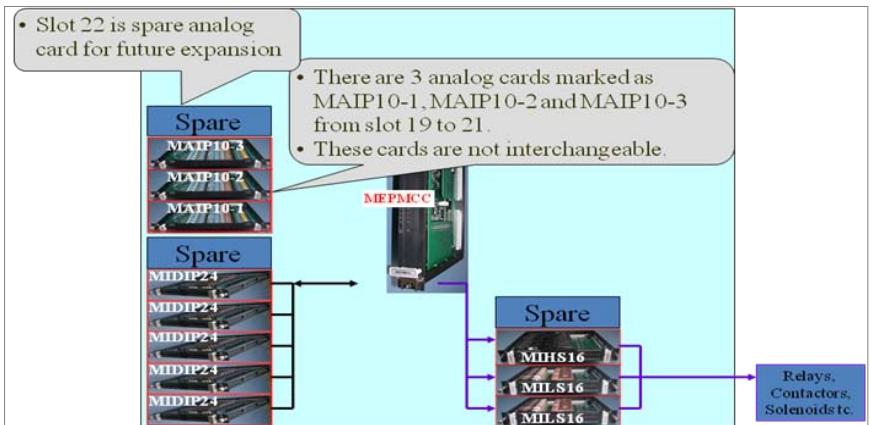
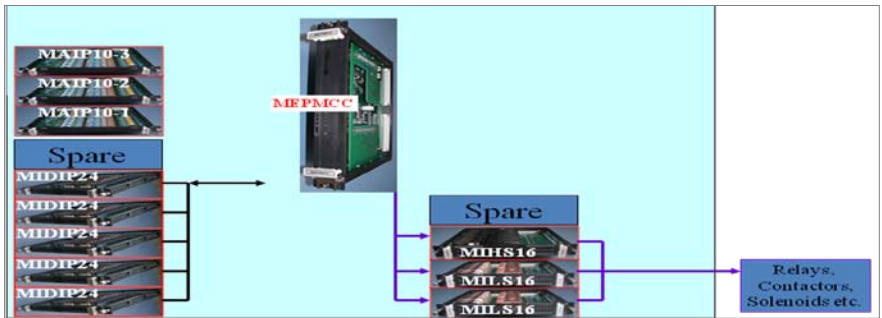
Relays,
Contactors,
Solenoids etc.

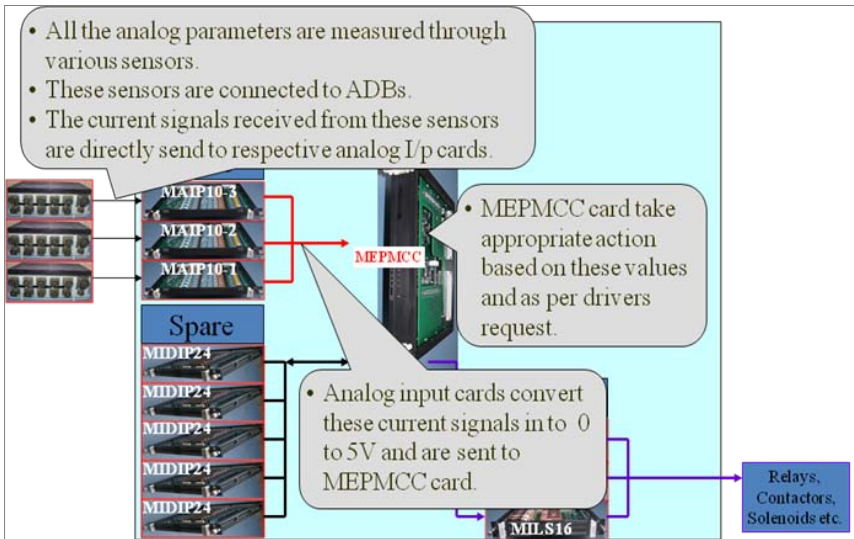


- Each card can handle 10 analog inputs (different sensors).
- Each channel is calibrated to earmarked sensor output.

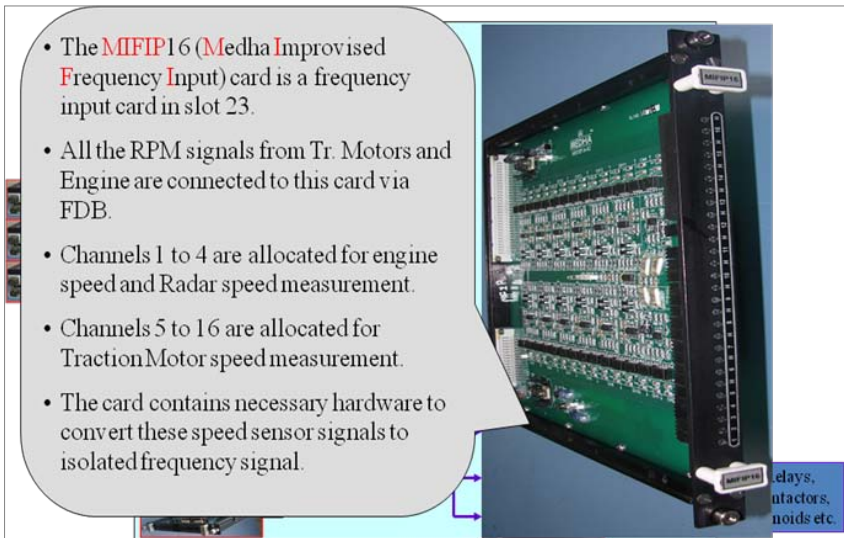


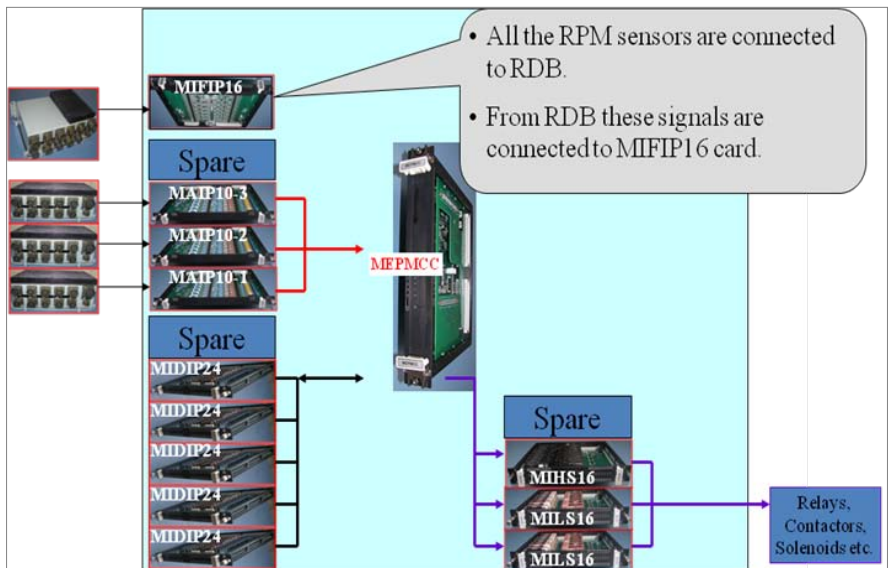
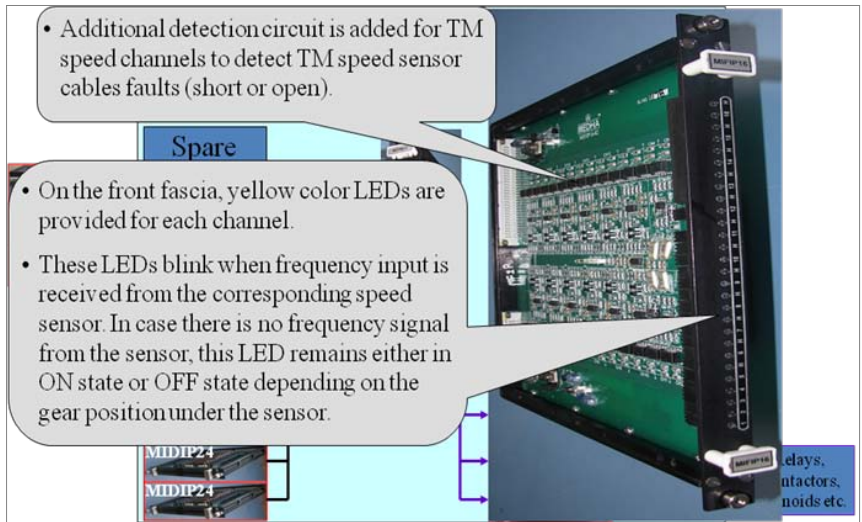


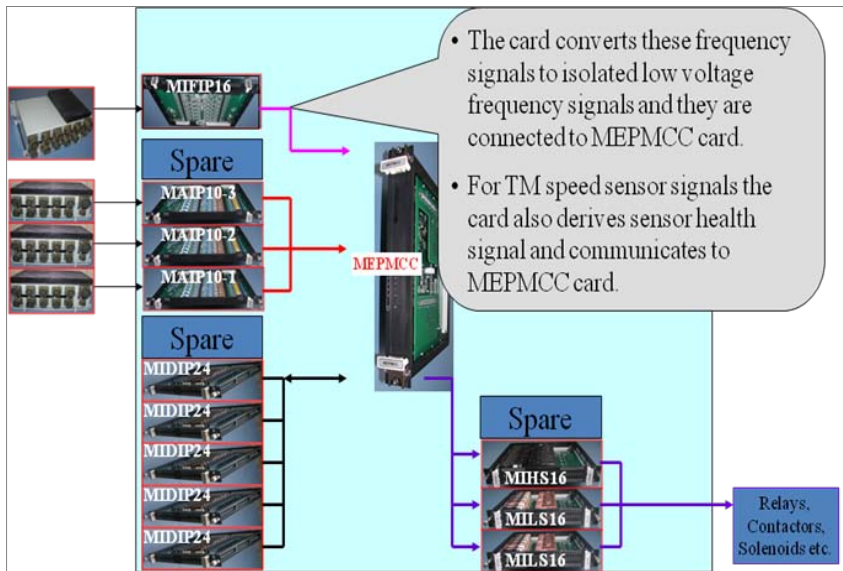




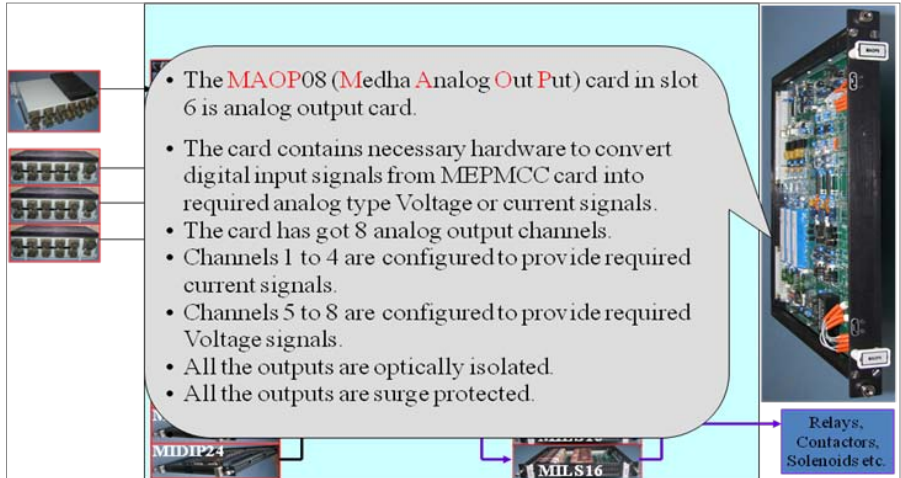
MIFIP16 Frequency input card

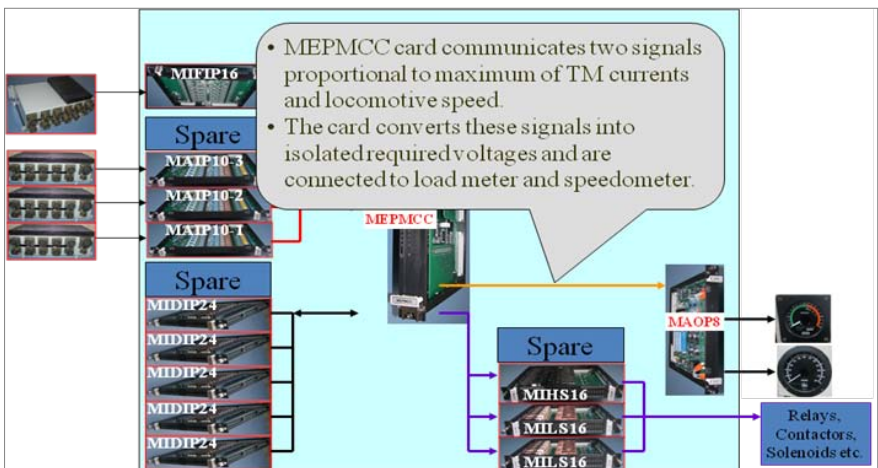
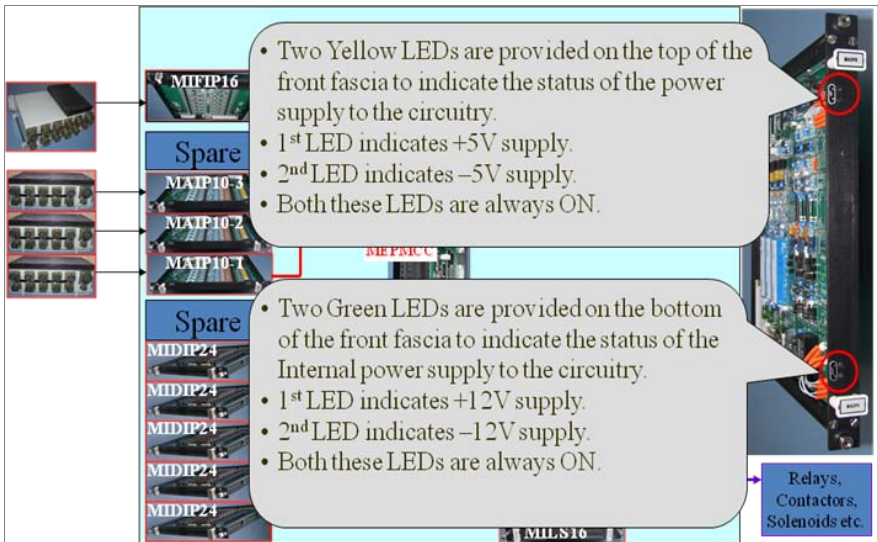


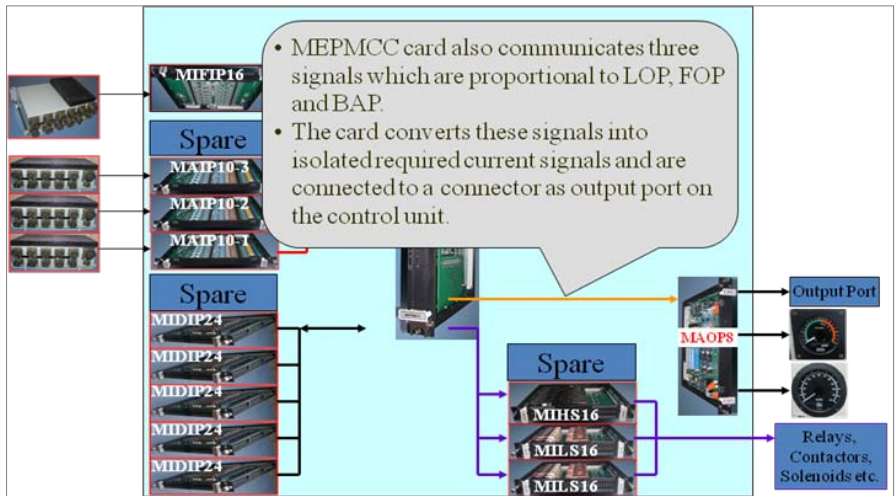




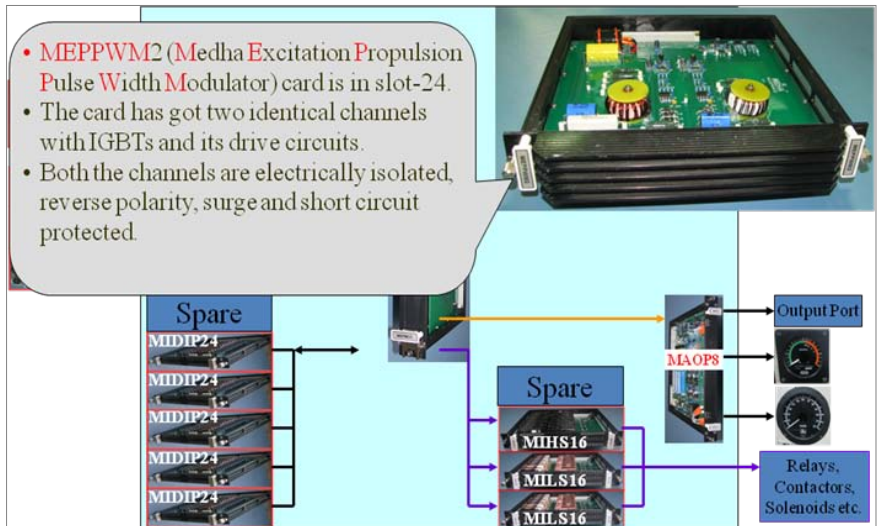
MAOP8 Analog Output card

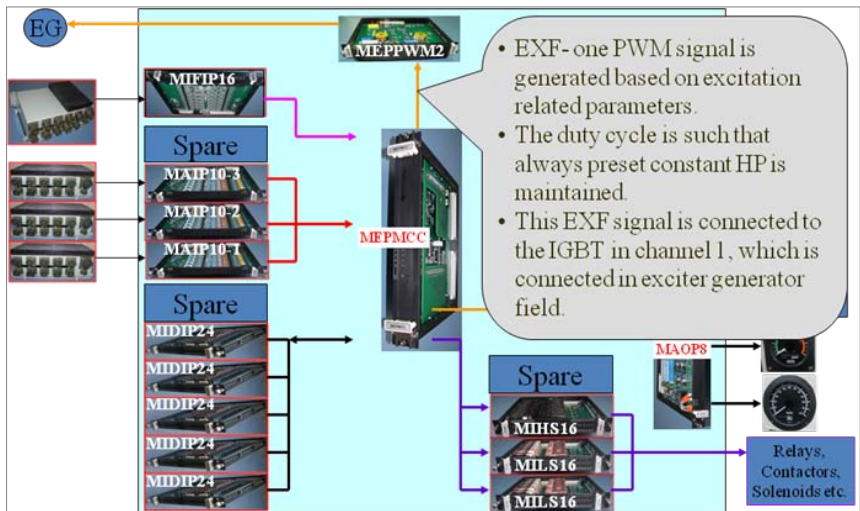
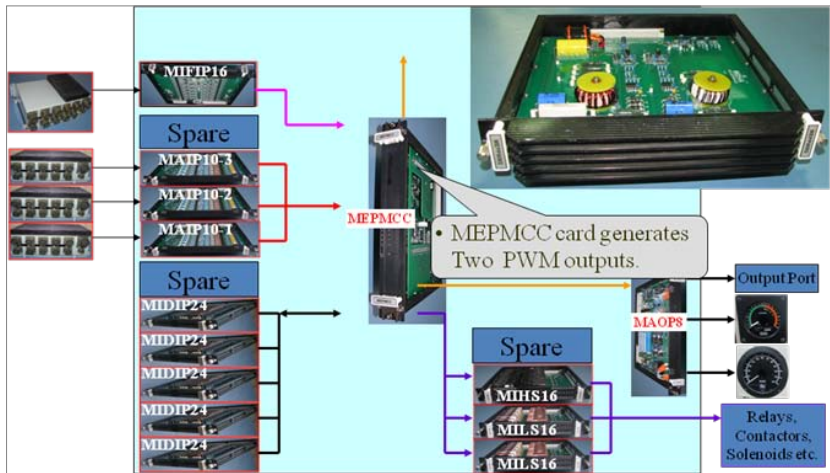


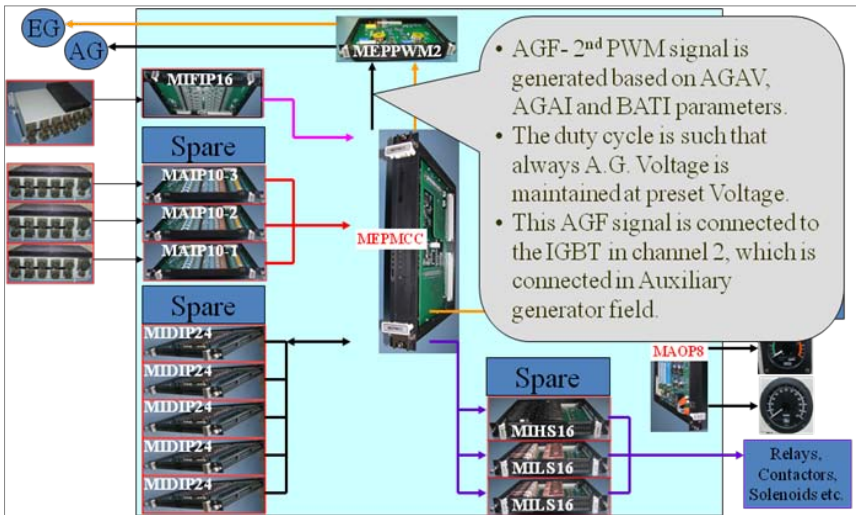




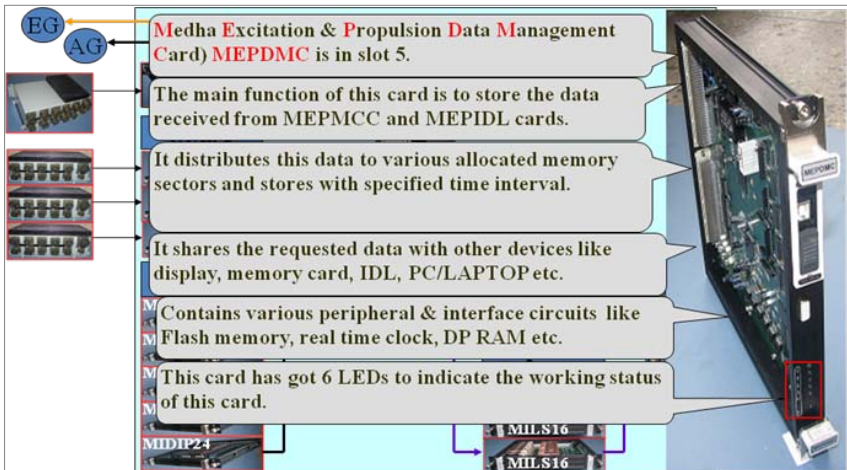
MEPPWM2 card

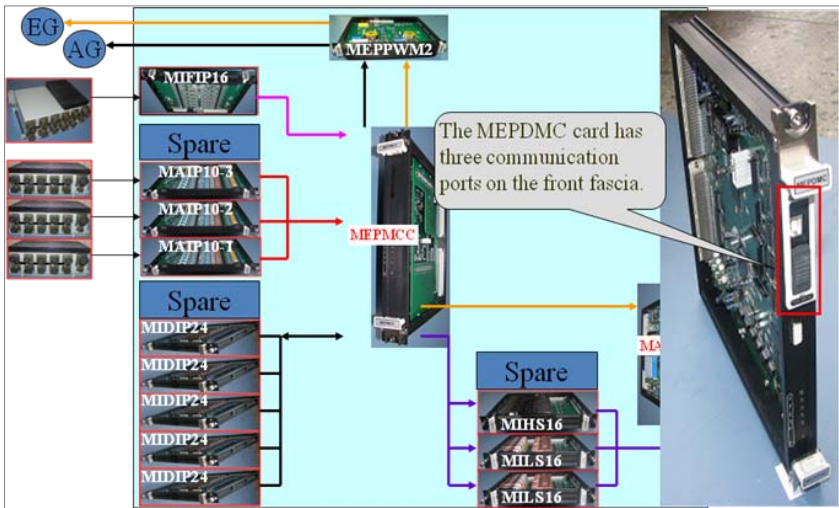
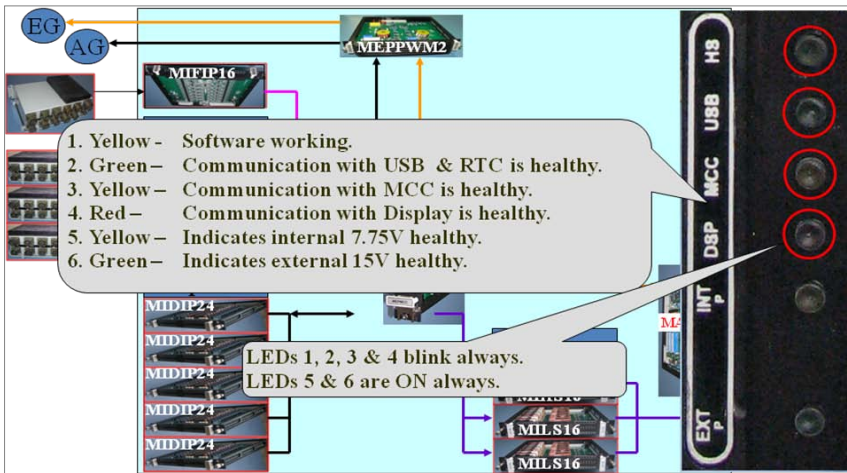


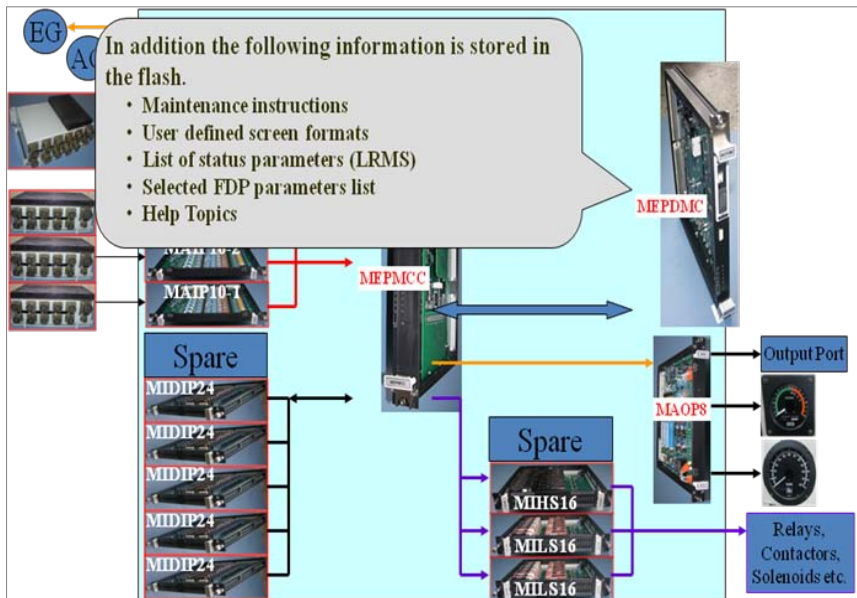
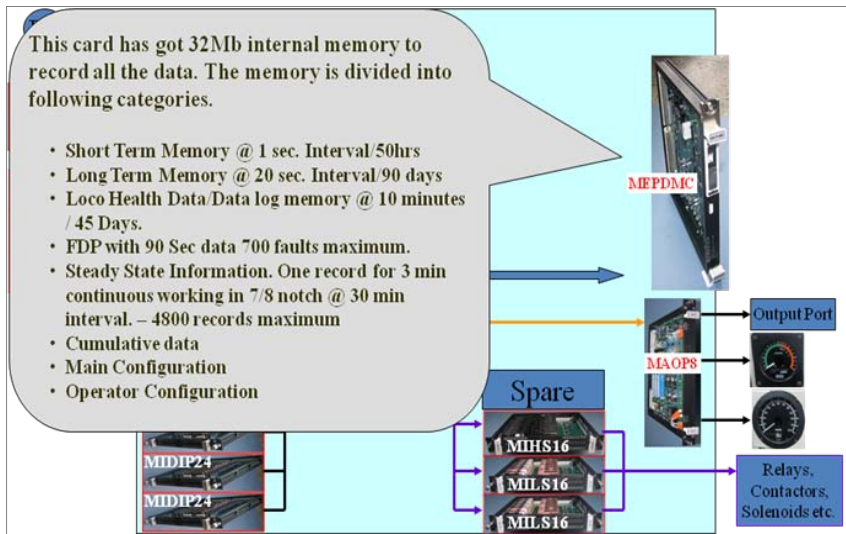


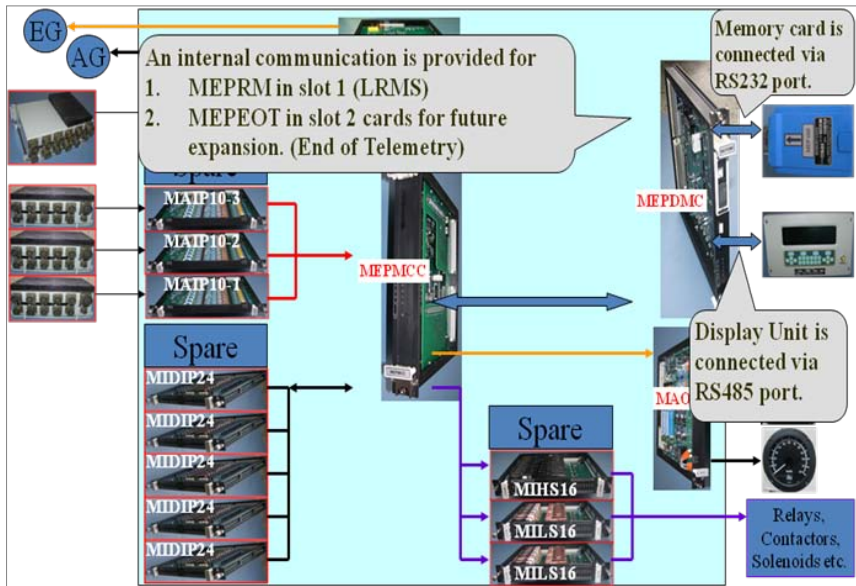


MEPDMC

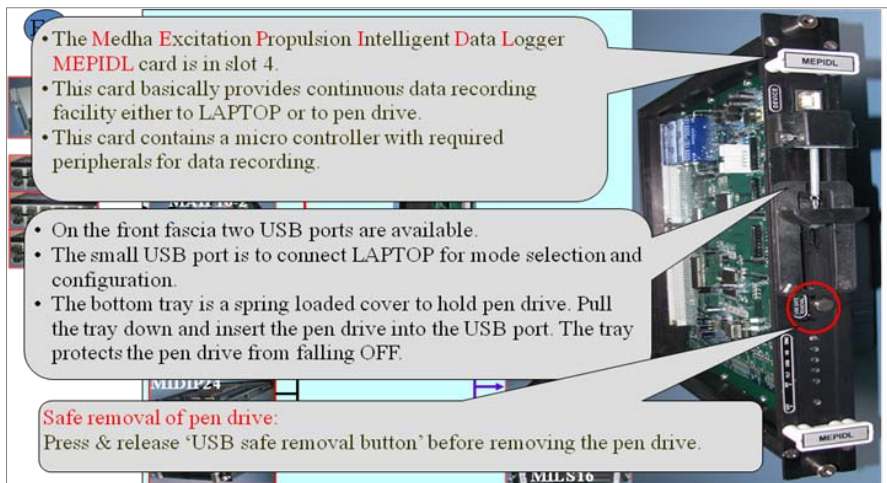


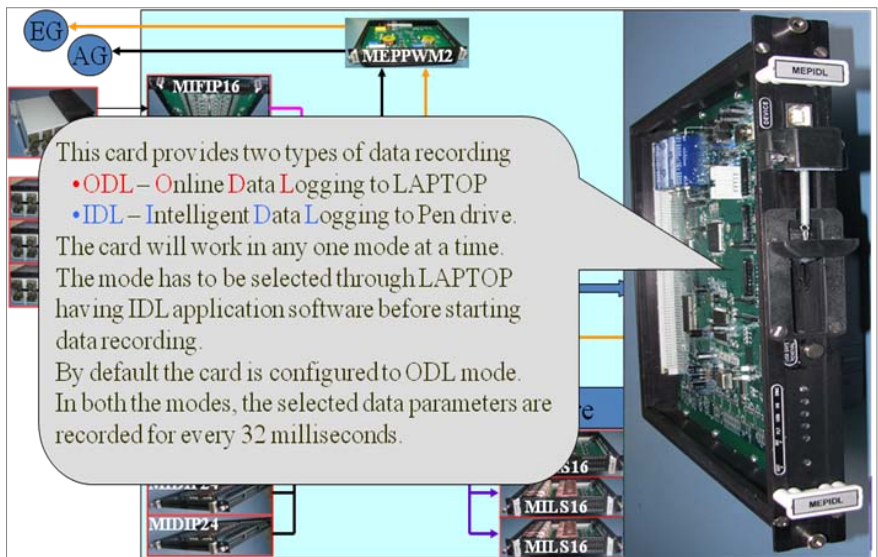
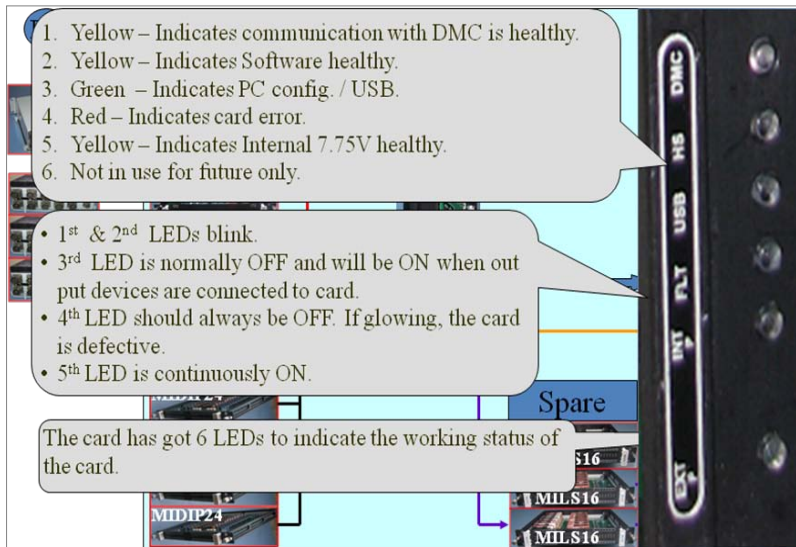




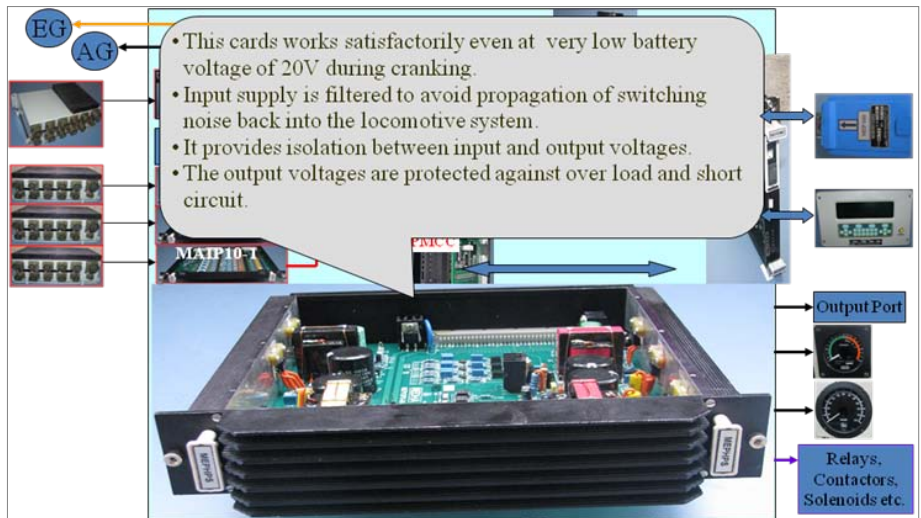


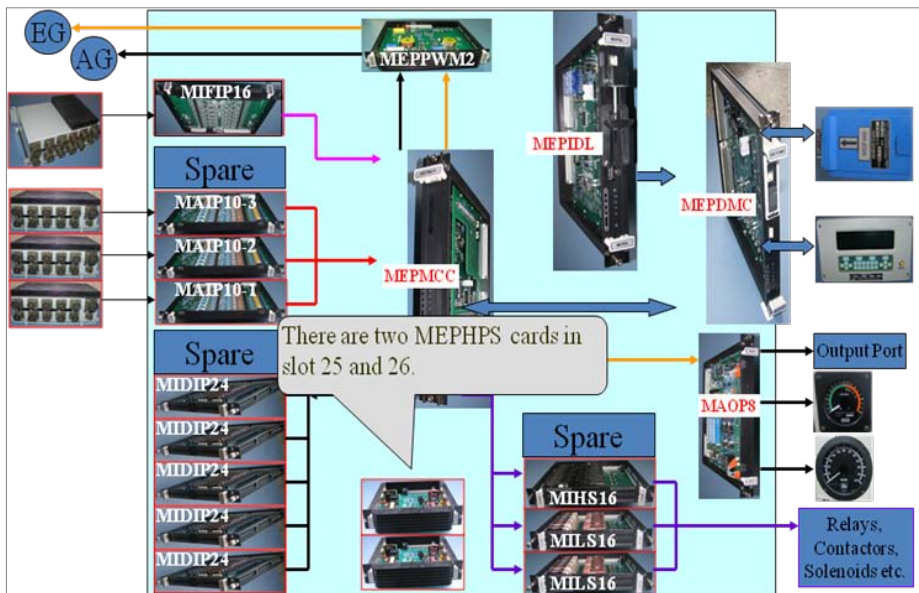
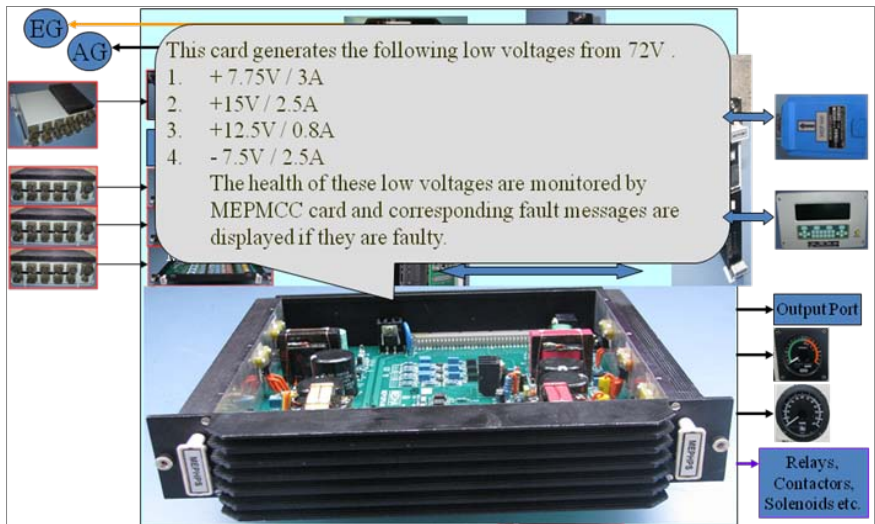
MEPIDL

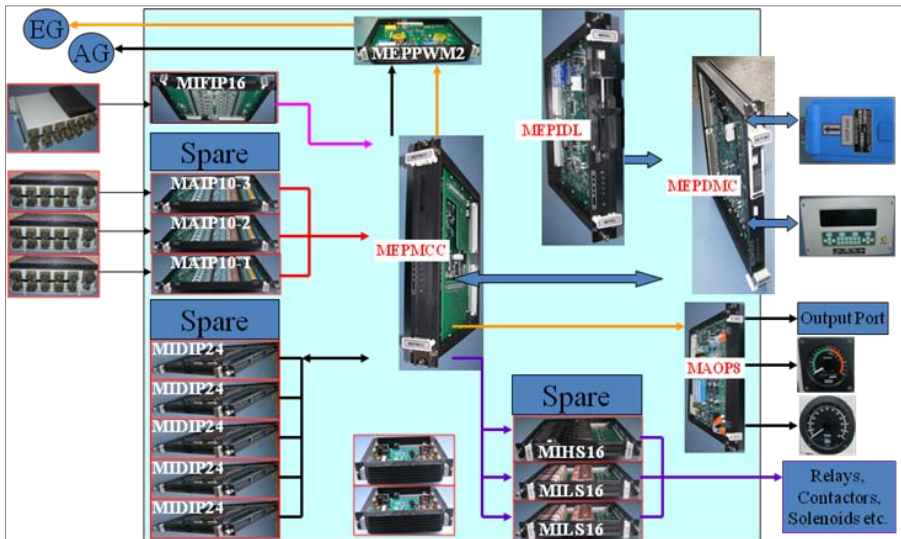




MEPHPS card







4.2 Description of DISPLAY UNIT TYPE – MDS 739 (Block Diagram)

- Display unit is the main interface between the user and the equipment.
- The display has been changed to 256 X 64 pixel graphical VFD as against Alphanumeric VFD in V2.



- All the external connectors are changed to bayonet type for easy and quick connections.
- The buzzer has been brought out side the display unit

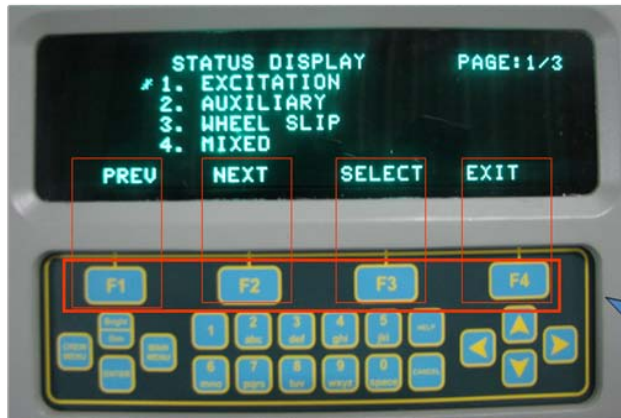


- Being a graphical display, the maximum number of lines are 6 and maximum characters per line is 36.
- Top five lines are used for data display and the bottom most line is used to indicate the commands for function keys.



In addition to the number and navigation keys, four function keys F1, F2, F3 and F4 are available on top portion of the key pad.

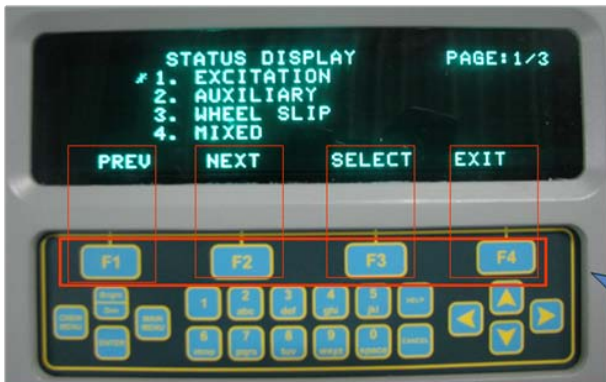
Action for these keys changes from screen to screen and is indicated against each key on the display screen.



The key board is different from V2

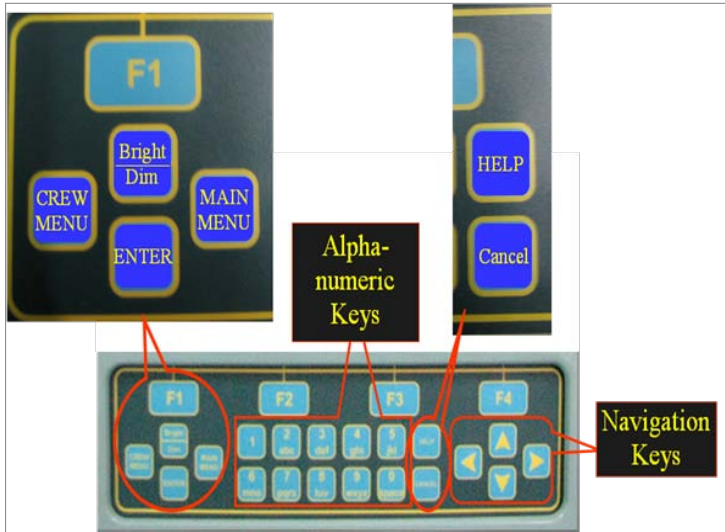
In addition to the number and navigation keys, four function keys F1, F2, F3 and F4 are available on top portion of the key pad.

Action for these keys changes from screen to screen and is indicated against each key on the display screen.



The key board is different from V2

DISPLAY UNIT TYPE – MDS 739



Display unit

Display unit is the main interface between the user and the equipment. The display has been changed to 256 X 64 pixel graphical VFD as against Alphanumeric VFD in Ver 2. All the external connectors are changed to bayonet type for easy and quick connections. The buzzer has been brought outside the display unit. The graphical display is configured for 6linesx40 characters. Top five lines are used for data display and the bottom most line is used to indicate the commands for function keys. In addition to the number and navigation keys, 4 function keys F1, F2, F3 and F4 are available on top portion of the keypad. Action for these keys changes from screen to screen and is indicated against each key on the display screen.

4.3 ADDITIONAL FEATURES IN DISPLAY UNIT

New Test Modes :In addition to Ver.2 test facilities, in Ver.3 few more test facilities are added for easy maintenance. They are:

- Meters Test
 - Load Meter
 - Speed Meter
- PWM Test
 - EPWM
 - APWM
- Radiator Fan Test
- Transition Test
- AEB Test
- Air Brake Test
- Fuel Oil Level calibration test (Optional)
- Blended Brake Test
- Load test and self load test
- Auto test for relays
- Manual test for input and output test.

TM cut out / cut in through Display

- In Ver. 2, MCOS switches are available to isolate a defective traction motor.
- In Ver. 3, MCOS switches are not available, the same function can execute through Display unit.
- Main Menu
 - 4 TM cut out
 - ♦ TM status screen is displayed.
 - ♦ Change / F3 TM1 is highlighted. Use arrow keys to select TM
 - ♦ Cut out / F3 to change the status.

Configuration through Display Unit

As per user requirement, some of the parameters are given access to configure through Display.

- Date & Time
- Loco Information

- Loco No.
- Loco Type
- Home shed
- T.A. Type
- T.M.Type
- Wheel Diameters
- 8Th notch Limits
 - T.A. Voltage limit
 - T.A. Current limit
 - GHP limit
- AG Voltage limit
- ETS Settings:
 - TS1
 - TS2
 - ETS1
 - ETS2
- Load Meter calibration
- Speed Meter calibration
- Loco speed limit

Fault Data Pack through Display Unit

- In Ver.3 the fault data pack can be viewed through Display. There is no need to down load the data to LAPTOP/PC.

This can be selected through menu / submenu:

- View Active Faults
 - Faults History
 - ♦ Faults repetition
 - ♦ History / F4
 - ♦ Data pack / F4

User defined Display screens

- In Ver. 2 Display unit, all the parameters are grouped into a pre-defined screen formats, which cannot be changed.

- In Ver. 3 Display unit, user can define a screen format with his selected parameters like in GM locomotives.
- Either using Display configuration software or through display one can select the required parameters and define the screen.
- Up to 8 such user screens can be defined.

Maintenance mode with password

- In Ver. 2, faults which are generated during loco testing and schedule attention are also logged in the fault data pack.
- Actually these faults are not necessary to log in memory
- During fault analysis, it is very difficult to understand whether these faults are real or logged during testing by maintenance staff.
- Unnecessarily logging of these faults creating confusion and occupying memory also.
- In Ver. 3, to avoid such confusion and unnecessary memory occupation, 'Maintenance mode' option has been provided.
- During schedule attention, the staff has to select this 'Maintenance Mode' and perform regular testing.
- During this maintenance mode any faults generated does not log in to memory but will be displayed on display for information to operator.
- Operator should come out of this mode manually after testing.
- Otherwise also the system automatically comes out if loco speed is > 3 kmph.

Loco operation soft keys

- Some digital input channel failure is causing a line failure of the locomotive.

- There is no fault tolerance for these digital input channel failures in Ver.2.
- In order to avoid On-line failures due to some digital input channel failure and clearly identify that the problem is with hardware, self check routine for digital input channels is provided in MEP-660 Ver.3.
- MEPMCC card checks the health status of these channels at regular intervals of 128 m.sec.
- If any channel is found defective:
 - System logs a fault that particular digital input is defective.
 - If alternate logic is available, the system allows normal operation of loco.
 - Where alternate logic is not available, system permits loco with some restrictions.
 - Where user selection is essential for that input, soft keys are provided through display to toggle the status of that input in the software.
- The following are the digital input channels where soft keys are provided:
START, STOP, ECS, VCD Reset., AFL Reset, TE Limit SW.
- Display shows the soft key screen automatically.

Fault History

- In Ver. 3, through display unit we can analyze the fault data pack.
- Under 'Faults' option,
 - 'Faults History' sub menu.
 - ♦ Faults Repetition:
 - ♦ How many times each fault is repeated is indicated. Data pack can also be seen for that fault.
 - ♦ Faults Since date:

- ♦ Faults within period can be selected.
- ♦ All Faults:
 - ♦ All the faults in the memory can be viewed.

Monthly mileage data

- So far in Ver. 2, cumulative parameters are recorded and can be seen notch wise cumulative figures through display.
 - EKMS, Distance, Time, GHP.
- But in Ver. 3, these parameters can be viewed month wise & notch wise.
- This feature is very helpful in calculating the fuel economy.
- Under 'Collective Data' option
 - 'Monthly data' submenu given.
 - ♦ 'Monthly mileage data' option is available.
 - ♦ In that screen, Month wise distance in kilometers will displayed.
 - ♦ In the bottom right, PRINT option is available to take a snap shot print to PC / Laptop.

DATA RECORDING

Steady State Information Pack:

- ♦ When locomotive is working in 7th / 8th notch continuously for 3 minutes, the system log a record in steady state pack, to know loco performance in higher notches.
 - The following Parameters are recorded in this pack--Date, Time, Eng.RPM, LOP, BAP, FOP, EWT, EOT, TAV, TAAI, GHP, loco No., Notch, BATI.
- After 30 minutes again it will log a pack, when working in 7th/8th notch continuously for 3 minutes.

- This steady state information pack will be logged only in internal memory.
- Latest 4800 records will be available in internal memory.

90 sec fault data pack for selected critical faults:

- In Ver. 2, only 8 sec data pack is available for all faults.
 - 5 sec. Data Prior to fault declaration, fault declaration sec. and 2 sec. Data after fault declaration.
- It is very difficult to know the actual status at the time of fault occurrence.
- In Ver. 3, for clarity and better analysis, 90 sec data pack is available for selected faults. For all other faults 10 seconds data pack is available.
 - 60 sec. Data prior to Fault declaration, Fault declaration second, fault instantaneous data and 30 sec. Data after fault declaration.
 - 5 sec. Data prior to fault declaration, Fault sec. Data, fault instantaneous data and 3 sec. Data after fault declaration is available for other faults.
- Any fault can be added or deleted from 90 sec. Data pack.
- Latest 700 records will be available with 90 sec data pack.
 - In the fault analysis software while viewing fault data pack, optional buttons 90sec / 10sec appear for selected faults only to view 90 sec. Data pack.

5.0 MAIN SUB ASSEMBLES

VOLTAGE SENSOR Type – MVS 8XX

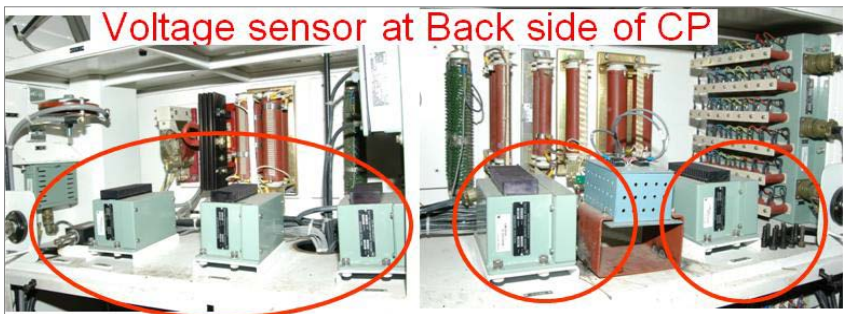
- ◆ These are Hall effect sensors
- ◆ It generates a proportional current signal to the DC voltage applied.
- ◆ These are more accurate and can measure from 1.5 V to 1500V.
- ◆ The output signals are connected to ADB through round MS connector and cable.
- ◆ There are two ranges of Voltage sensors used.
- ◆ MVS 815 – 0 to 1500V – 1 No.
- ◆ MVS 801 – 0 to 100V - 4 Nos



DLW Locos



DMW Locos



CURRENT SENSOR Type MCS 8XX, 10A

- ◆ These are non-contact type Hall effect sensors. It measures the current flowing through the cable/bus bar through the sensor.
- ◆ The current carrying cable produces magnetic field around the sensor proportional to the current.
- ◆ The hall effect sensor which is placed in the magnetic field, measures the strength of magnetic flux produced by the cable.



- ◆ The sensor generates a current signal proportional to the magnetic field strength.
- ◆ This signal is connected to the analog distribution unit through plug in type MS connector and a cable.
- ◆ There are four ranges of current sensors used in MEP-660.
- ◆ MCS10A – 0 to 10 Amps.– 4 Nos.
- ◆ MCS803 – 0 to 300 Amps–3 Nos.
- ◆ MCS820 – 0 to 2000 Amps–6Nos.
- ◆ MCS850 – 0 to 5000 Amps– 1 No.



PRESSURE SENSOR Type MPS 8XX



Pressure Sensor

There are different pressure sensors used:

- ◆ MPS841 – 0 to 21 Kg/Sq.Cm. MRPR
- ◆ MPS842–0 to 14 Kg/Sq.Cm. BPP, BCP
- ◆ MPS844 – 0 to 10 Kg/Sq.Cm. LOP
- ◆ MPS845 – 0 to 3.5 Kg./Sq.Cm BAP
- ◆ MPS846 – 0 to 7 Kg/Sq.Cm. FOP
- ◆ MPS847-0 to 7Kg/Sq.cm.



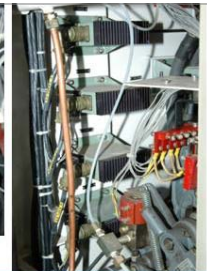
EWP



0 to 2000 Amps Tr.
Motor Current sensors



0 to 300 Amps
Current sensors



0 to 10Amps
Current sensors

Current sensor at various locations

Temperature Sensors



Water Temperature
sensor in Exp Room



Lube oil Temp
sensor in Exp Room

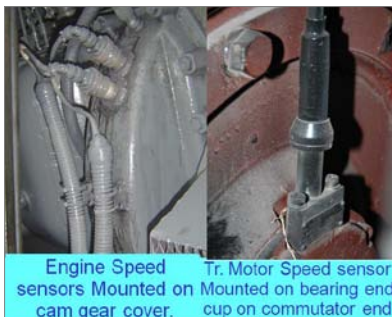


Ambient Air Temp
sensor in back
side CP



Altitude sensor (MPS843 –0 to 3000 meters of altitude)

Speed Sensor

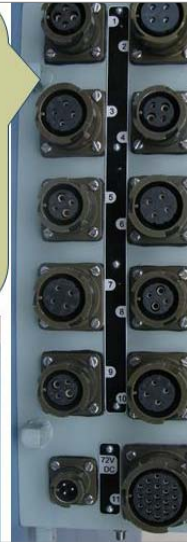


Engine Speed
sensors Mounted on
cam gear cover. Tr. Motor Speed sensor
Mounted on bearing end
cup on commutator end

ANALOG DISTRIBUTION UNIT (ADB) TYPE – MDB 719

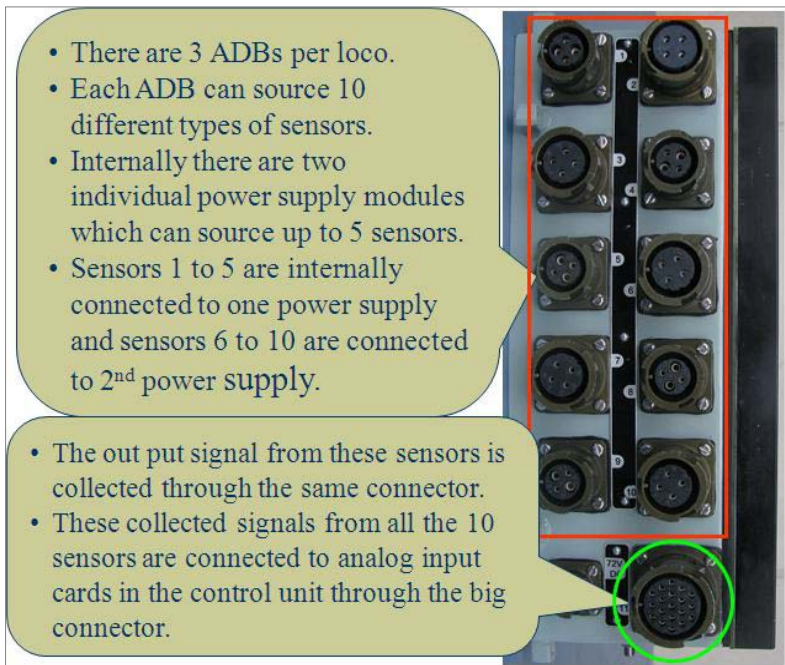
- Analog Distribution Boxes are like junction boxes to provide low voltage sources for all the analog sensors.
- There are 12 bayonet connectors. 1 to 10 for connecting 10 different sensors. 11th connector is for interconnecting to control unit. The 12th connector is for power supply.
- From 1 to 10, each connector is earmarked for a particular sensor and they are polarized to avoid wrong connection of the sensors.

ANALOG DISTRIBUTION UNIT (ADB) TYPE – MDB 719

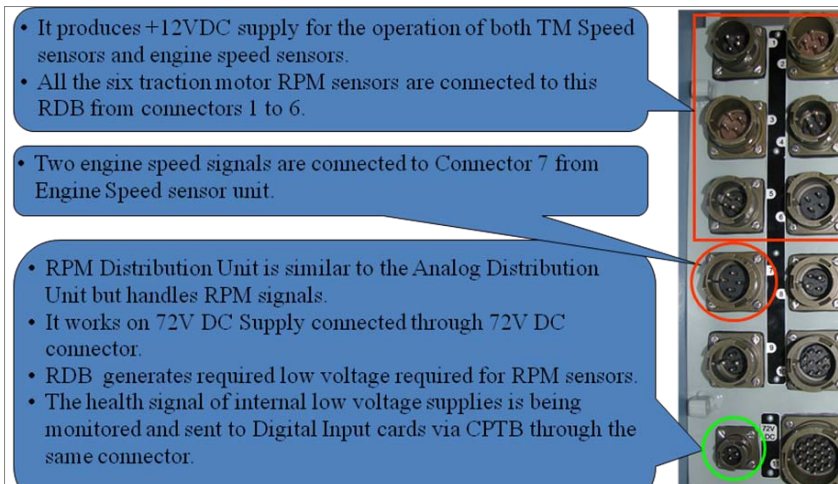


- 72V DC power supply is connected through the small connector marked as 72V DC.
- The ADB generates +24 and –24 Volts DC power supply for all voltage, current and temperature sensors.
- Only +24 Volts is used for pressure sensors.
- Health of the internal low voltage supplies are monitored and the status is sent to the Digital input cards via CPTB through the same connector.





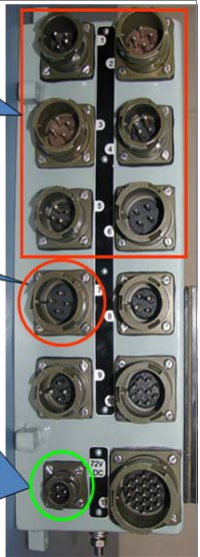
RPM DISTRIBUTION UNIT (RDB)TYPE – MDB 720



- It produces +12VDC supply for the operation of both TM Speed sensors and engine speed sensors.
- All the six traction motor RPM sensors are connected to this RDB from connectors 1 to 6.

- Two engine speed signals are connected to Connector 7 from Engine Speed sensor unit.

- RPM Distribution Unit is similar to the Analog Distribution Unit but handles RPM signals.
- It works on 72V DC Supply connected through 72V DC connector.
- RDB generates required low voltage required for RPM sensors.
- The health signal of internal low voltage supplies is being monitored and sent to Digital Input cards via CPTB through the same connector.



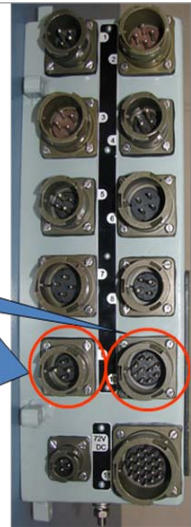
- In the RDB, 24V fan health signals are converted into 72V signals.
- Two common health signals for internal fans (ICFH) and external (EXCFH) are connected to Digital input cards via CP/TB.

- All the output RPM signals are transmitted to MIFIP16 card through connector 11.



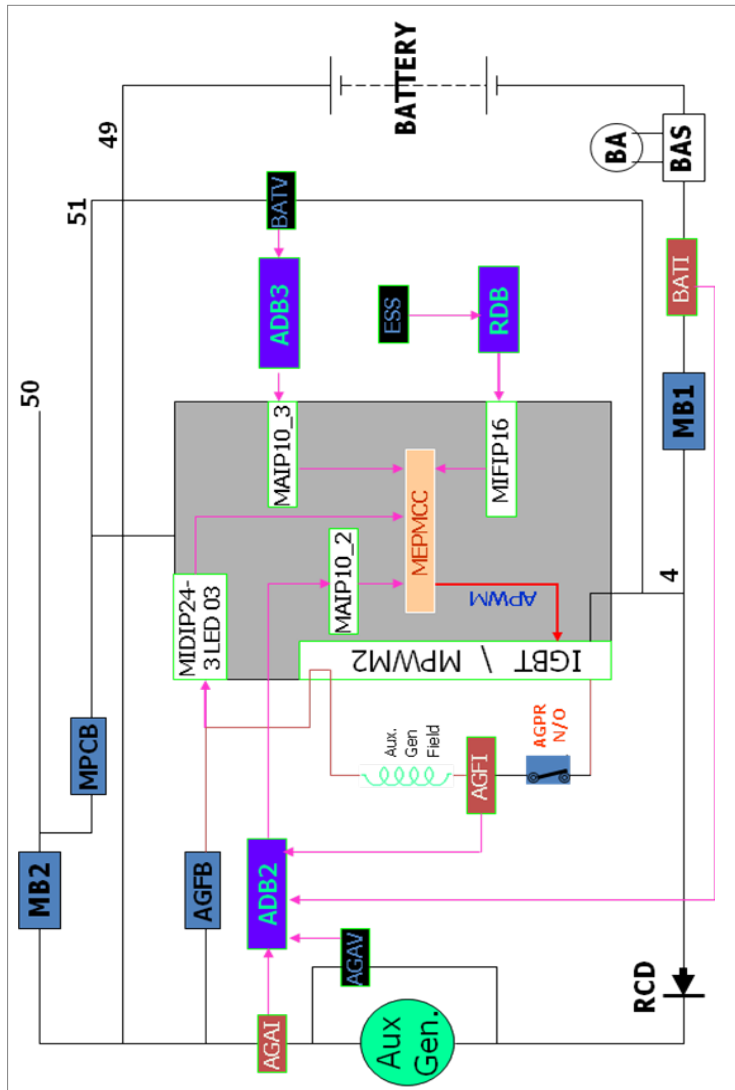
- RDB generates 24V DC for the cooling fans provided in control unit.
- 5 fans (3 internal + 2 External) are connected through connector 10.
- Health status (24V) of these fans is also connected through this connector.

- In the RDB, 24V fan health signals are converted into 72V signals.
- Two common health signals for internal fans (ICFH) and external (EXCFH) are connected to Digital input cards via CP/TB.



Auxiliary control

This card continuously monitors Auxiliary Generator parameters received from MAIP8_AU card and MIAI card. It generates PWM signal based on AGFI, AGAV, AGAI, BATI. Imposes limits on AGAV, AGAI, AGFI & BATI. This card also contains RTC to generate time stamp. It communicates with MEPCC and Display unit to communicate faults and parameters. It generates output port signals (FOP, LOP and BAP) for MCBG and it also generates faults related to Aux. Gen.



Auxiliary Power Unit Type – MAP756

Auto Engine Shutdown and Start(AESS)with APU Concept

- ♦ *While main engine is working in idle, it is delivering power of around 250 HP. This power is consumed by..*
 - *TM blowers*
 - *Radiator fan*
 - *Exciter Generator*
 - *Auxiliary generator*
 - *Compressor*
- ♦ *Only compressor & Aux generator are performing useful job Remaining are simply consuming power.*
- ♦ *If a smaller engine having low SFC can perform the required functions of idling locomotive, lot of diesel oil can be saved on Indian Railways and to nation.*
- ♦ *With this concept AESS with APU is designed.*

AESS with APU

- *AESS: This system continuously monitors the following parameters:*
 - *Idling state of the locomotive.*
 - *Health status of the battery & compressor.*
 - *Safety parameters of the engine.*
- *Automatically shuts down the diesel engine if all the above parameters are within limits.*
- *Automatically starts the diesel engine whenever the driver requires starting the train.*

APU: Auxiliary Power Unit

- *A small engine coupled to a baby compressor and an alternator is called APU. This Smaller engine having low SFC produces required limited HP.*
 - *Required fuel is only consumed.*
- *Baby compressor maintains MR pressure.*
 - *No reduction of BP pressure and the train can be started as and when required.*

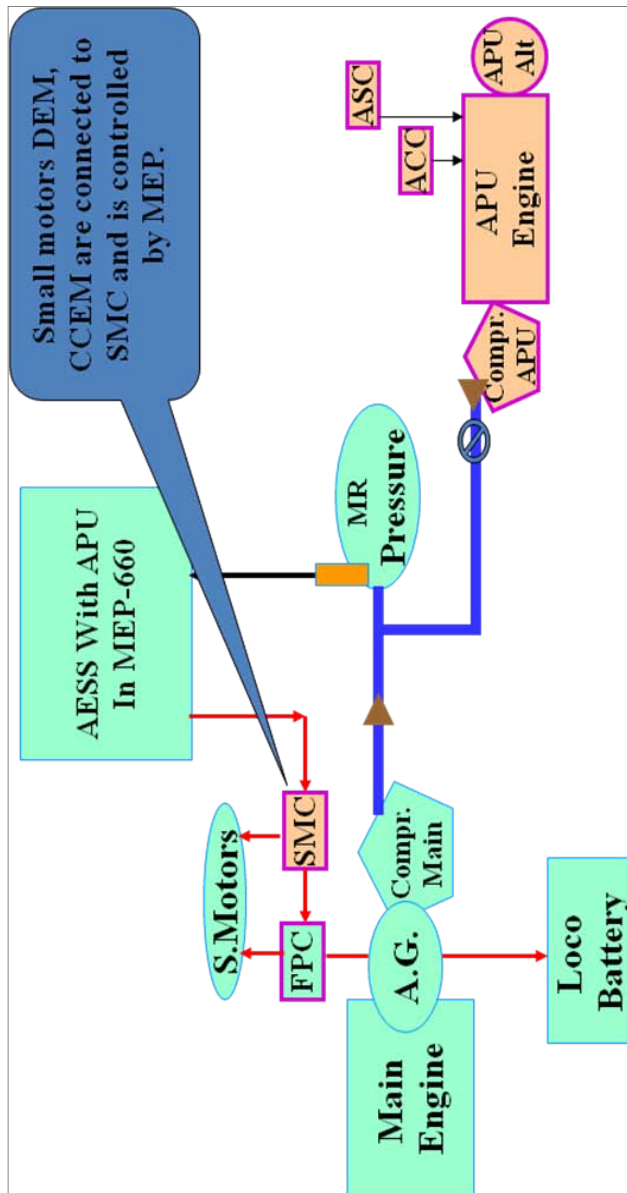
- *Alternator along with rectifier generates 72V DC and charge locomotive batteries while the main engine is shut down.*
- *Ensures engine cranking without failure.*
- *Control circuitry*
 - *Provides automatic change over.*

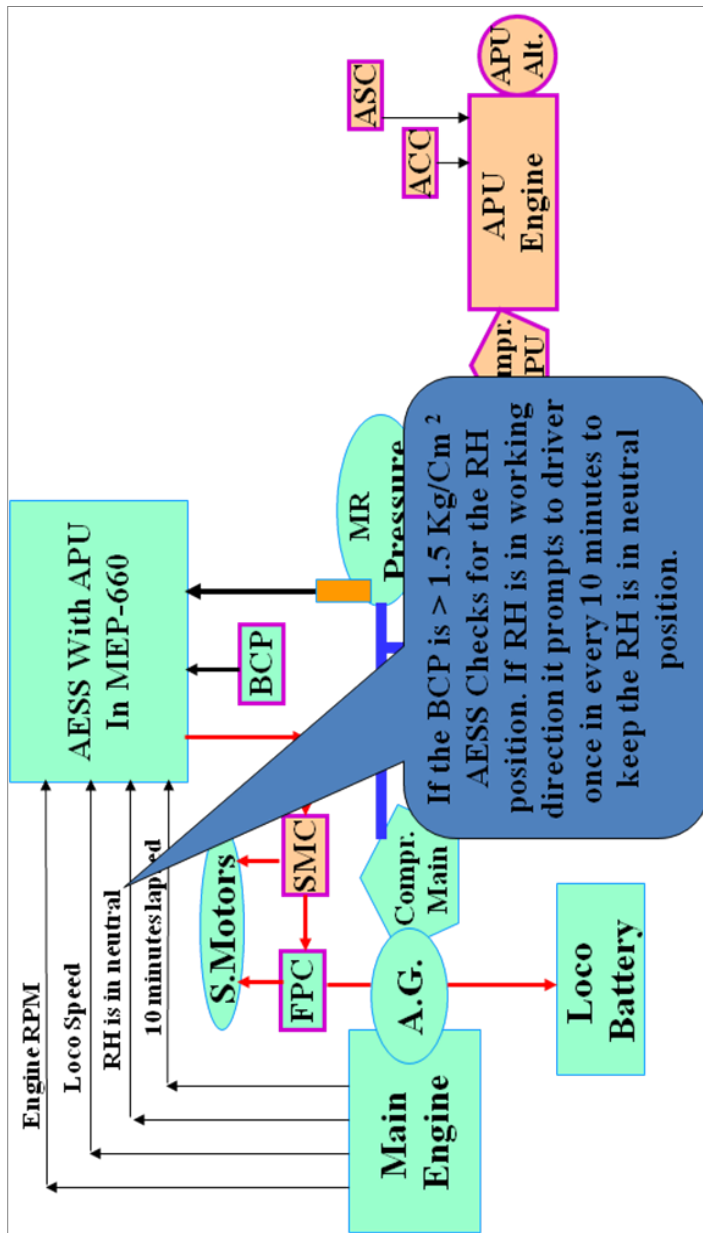
AESS with APU Added advantages

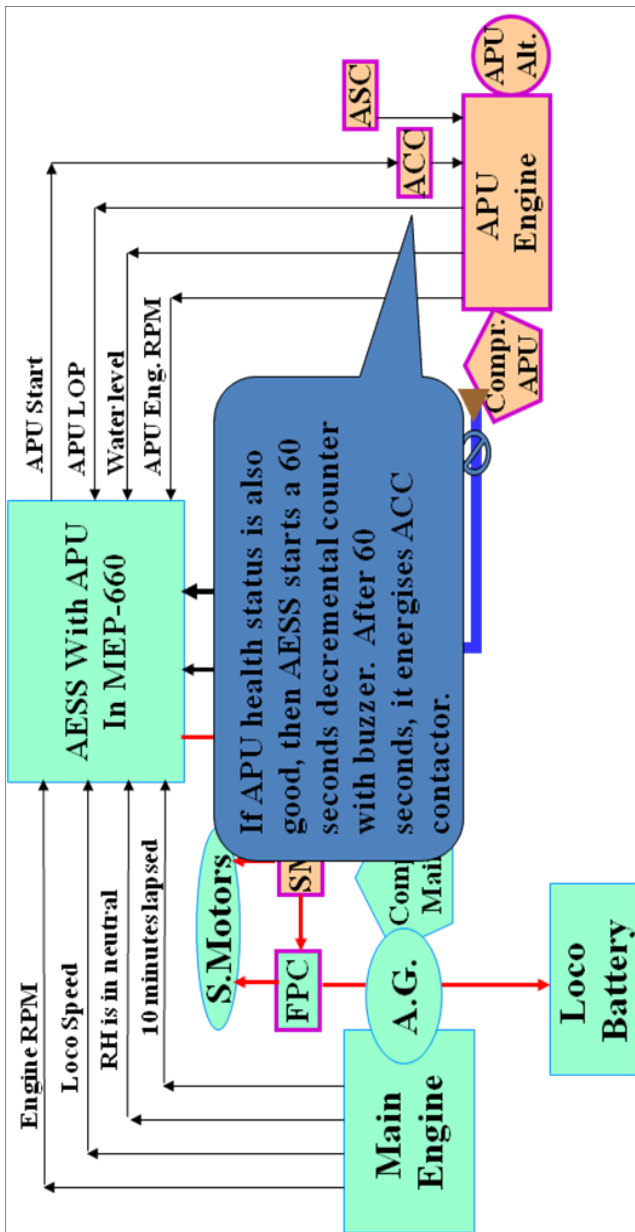
- ♦ Reduction in fuel oil and lube oil consumption.
- ♦ Reduction in emissions.
- ♦ Extended engine life.
- ♦ Active 365 days a year, 24 hours a day.
- ♦ Continuous monitoring of parameters before and after shutdown.
- ♦ Provides documentation and verification of fuel savings.
- ♦ More fuel saved through load shredding.
 - ♦ Dust exhaust motors, CCEM, RBM, and FPM are not required when engine is shutdown. Unnecessarily they consume power. These motors are switched OFF and save fuel further.

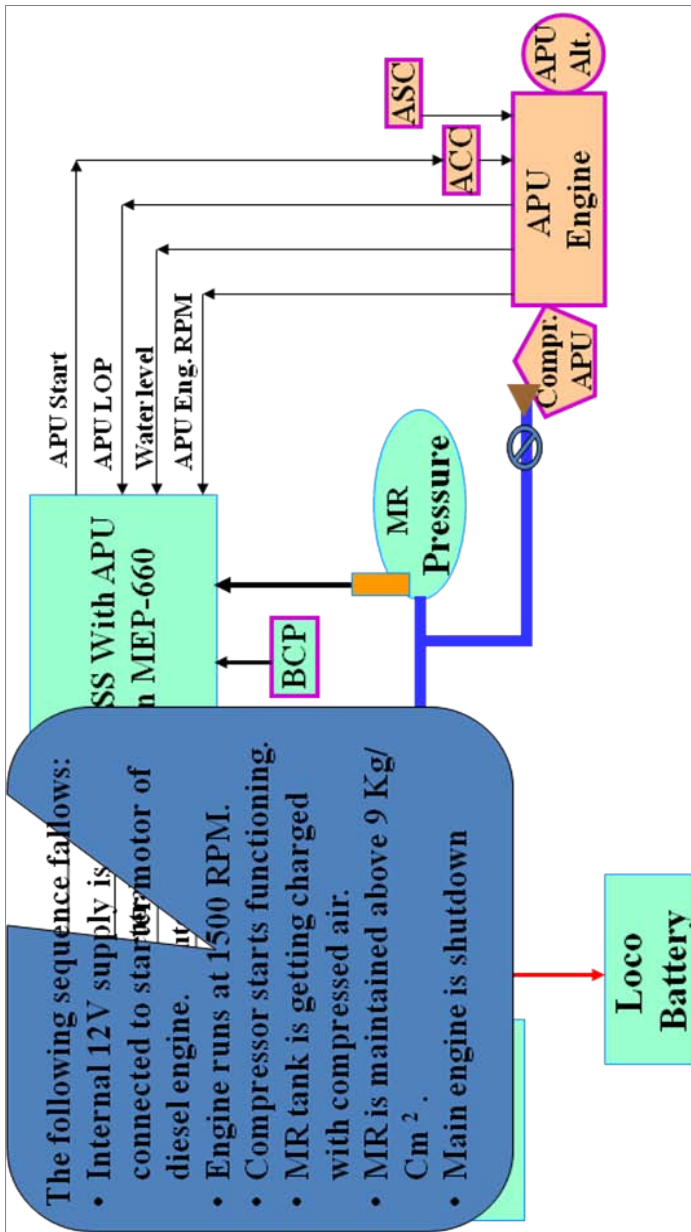
Norms to go into Fuel Save mode

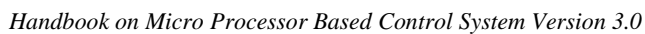
- ♦ Loco should be idling for more than 10 minutes.
- ♦ AESS with APU checks the following conditions before going into fuel save mode.
 - Driver acceptance – AES switch is in ON.
 - Loco is not set for load / self load test
 - Loco is set to lead position
 - APU status is healthy– Water level, fuel oil level etc.
 - *Main Engine EWT and EOT sensors are healthy and the temperature is $> 30^{\circ}\text{C}$.*
 - *Battery charging current is below 10 Amps.*
 - *MRPR is $> 7.5 \text{ Kg/Cm}^2$*
- ♦ *Then AESS with APU goes into FUEL SAVE Mode.*

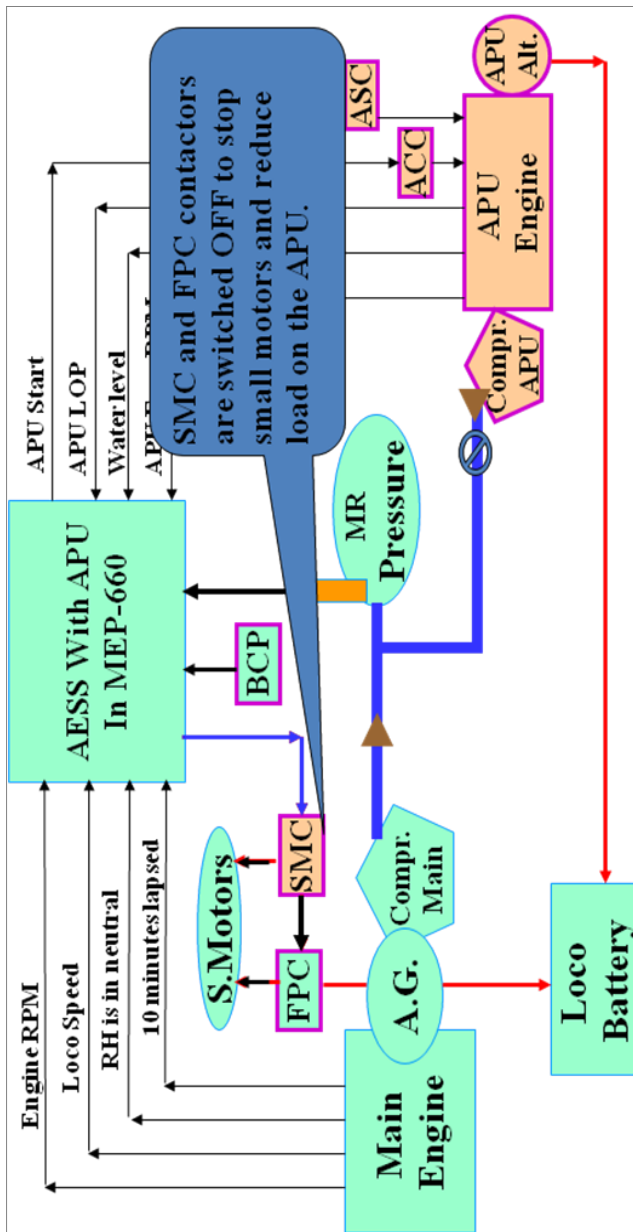


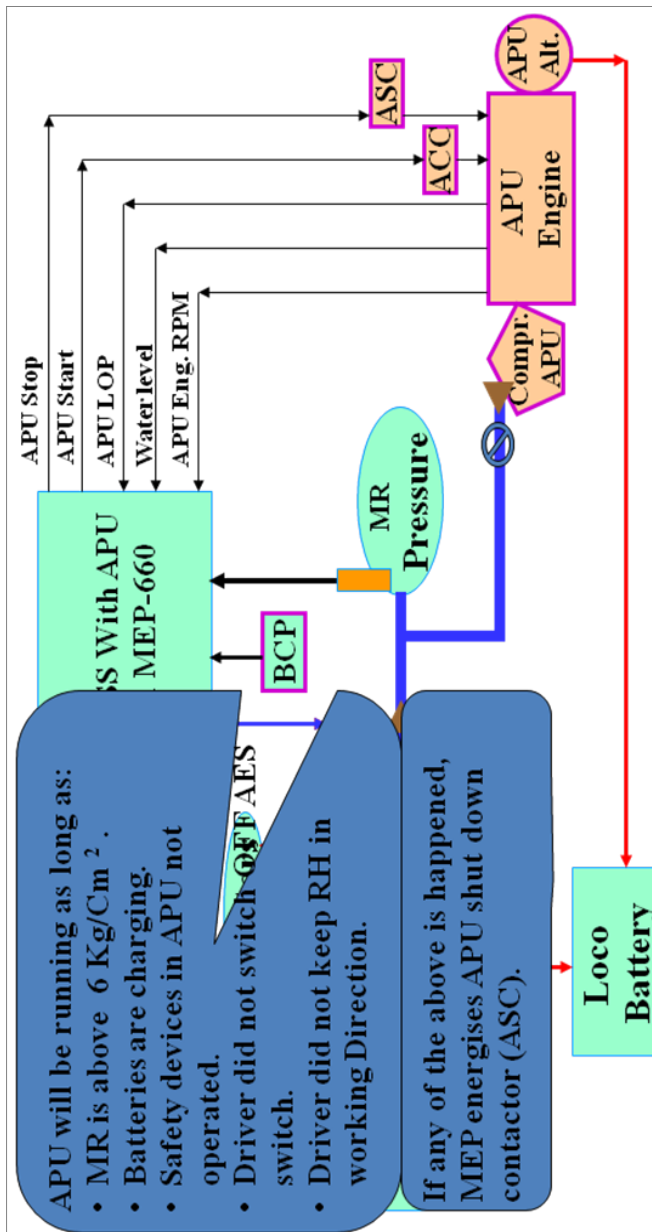


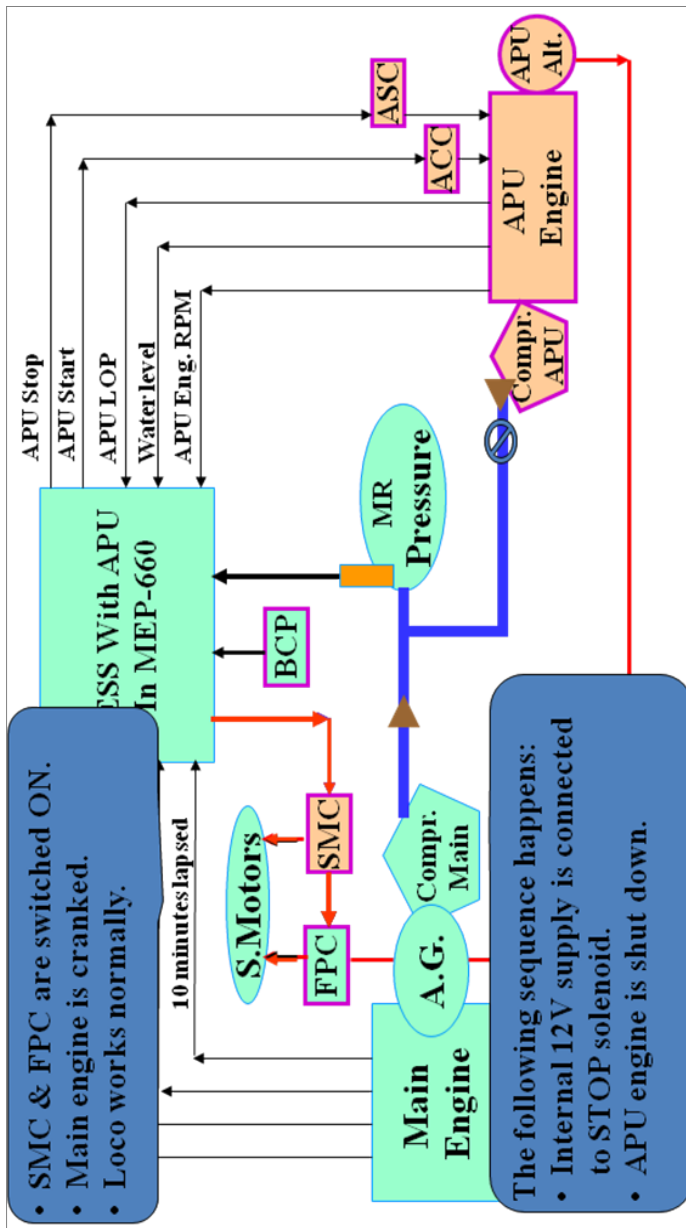












6.0 DISPLAY FUNCTIONS & NAVIGATION

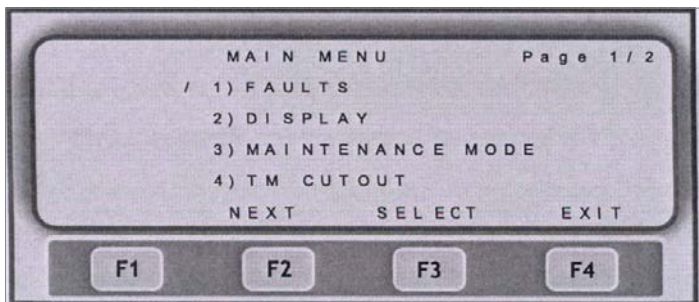
MAIN MENU

The main menu is accessed by pressing Main Menu Key on the key board. All the display options pertaining to loco maintenance are listed under this main menu. There are 8 sub options defined under main menu. These 8 options are divided into 02 screens as shown below.

The first PAGE 1/2 of Main Menu has the 4 options:

1.Faults, 2.Display, 3.Maintenance Mode 4. TM Cutout

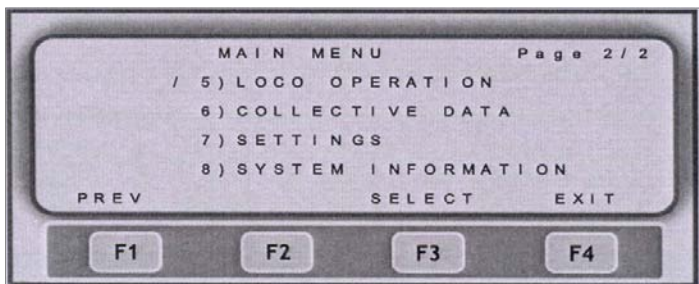
SCREEN 1



The user can press F2 key to go to the Next screen, F3 key to select a particular choice of menu and F4 key to Exit from the screen.

SCREEN 2

To go to PAGE 2/2 of main menu, press 'F2" key on screen 1/2 of main menu.



The screen has next 4 sub options: 5. Loco Operation, 6.Collective Data, 7.Settings, 8. System Information

On this screen "F1" key changes to screen 1/2. Pressing "F4" key the screen goes to default screen.

To select any sub option on these two screens, place the cursor against the required option using up/down arrow keys and then press "Enter" key or "F3" key. Immediately the menu screen changes to the sub menu of the option selected.

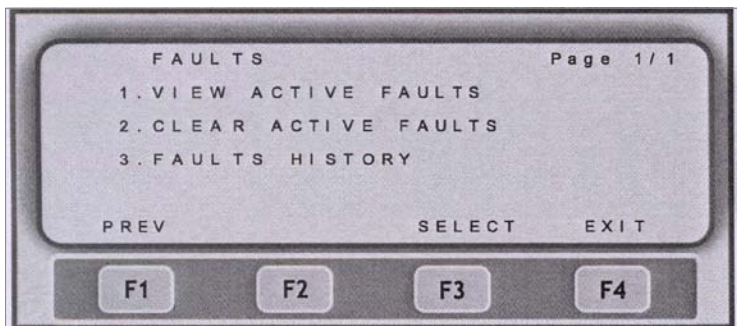
FAULTS

This Fault menu option provides the user the facility to view active faults,



Faults Sub Menu

clear active faults, and also list the logged faults in required sorted order. User can go to 'FAULTS' sub menu simply by pressing 'Main Menu' key on the key board. The display shows screen 1/2 of main menu options. On this screen press "1" key or "F3" key or "Enter" key to select 'FAULTS' menu. The Faults screen is displayed on pressing the soft key 1, as shown in Fig. The User can select the option of his choice by pressing F3 Key.



VIEW ACTIVE FAULTS

The screen for 'View Active Faults' is shown



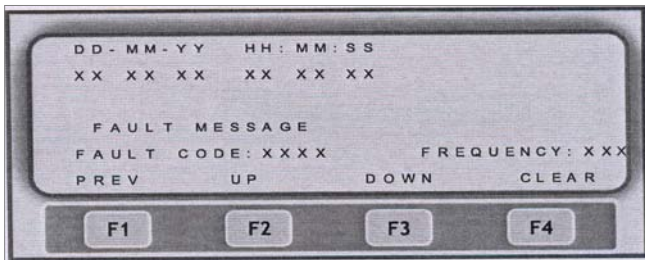
in Fig. The details regarding the Active Faults is seen in this screen.



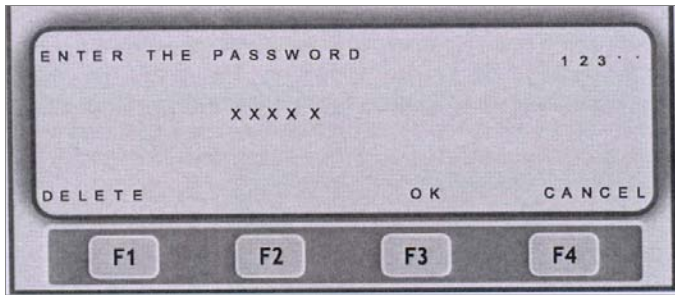
Registered fault, if any are displayed. User can navigate through the faults using down arrow key until 'No more faults logged' message is displayed. Press 'MENU' key to select 'Exit' option.

CLEAR ACTIVE FAULTS

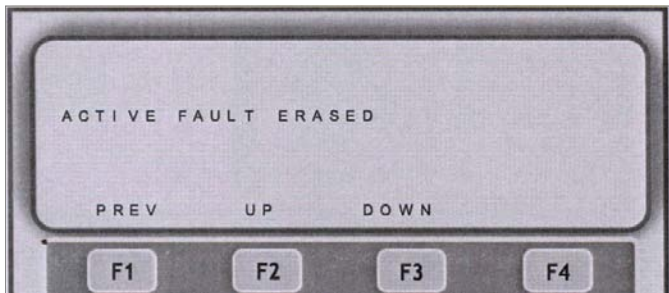
The screen for 'Clear Active Faults' is in Fig.



Message is displayed with "CLEAR" option against F4. After noting down the faults, to clear fault Press 'F4' key and down arrow key to see next fault. Based on the severity of the fault, if pass code is prompted, enter the pass code to clear the fault, otherwise the fault gets cleared and next logged fault is displayed. Continue the above till all faults are cleared. Press 'MENU' key to select exit option. The user can go to the Previous screen by pressing F1 Key. After pressing the F4 Key, the password for clearing the High Level Faults has to be entered as shown in the Fig. given below

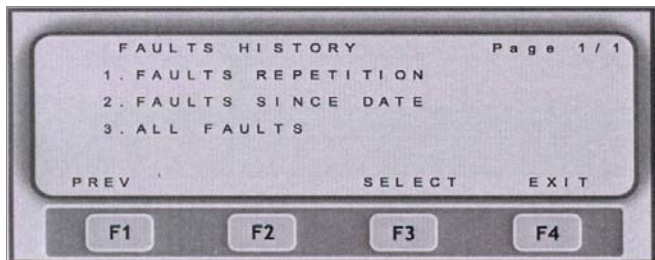


The Active Faults are cleared after entering the password. After pressing F3 Key, the screen with cleared Active Faults is displayed as given below.



FAULTS HISTORY

The screen for 'Faults History' is as given below.



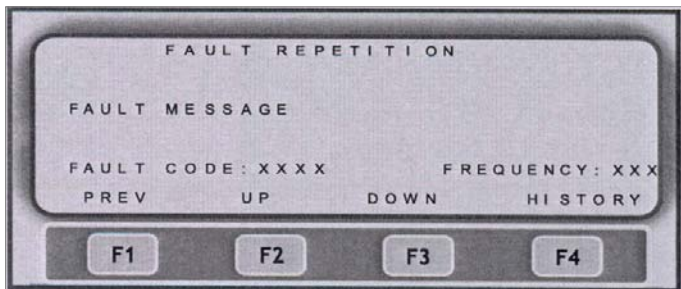
The screen for Faults History displays information on Faults Repetition, Faults since Date and All Faults. The user can select F1 Key to go to the previous screen, F3 Key to select the option of his choice and F4 Key to exit .

FAULTS REPETITION

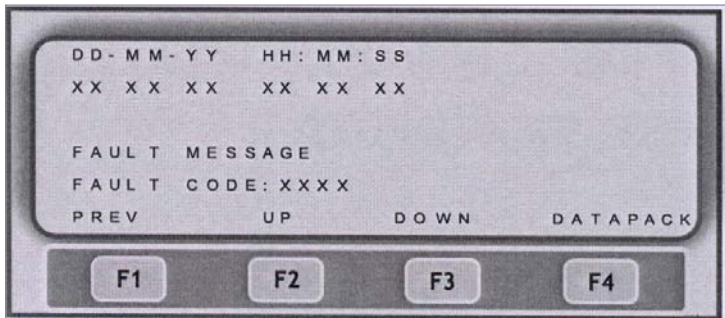


The

screen for 'Faults Repetition' is as given below. Fault is indicated with the frequency with 'History' option against F4. By selecting 'History' through 'Data pack' option we can see the individual sec. Data packs by using scroll key.



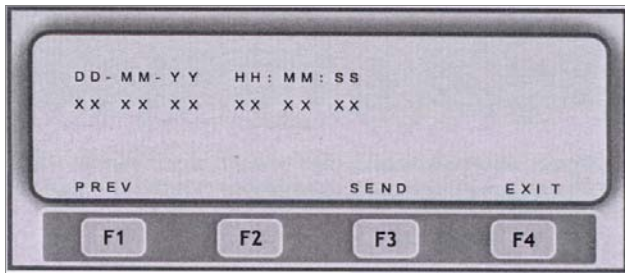
On pressing F4 Key, the screen appears as in Fig



FAULTS SINCE DATE

The screen for 'Faults Since Date' is in Fig. .

By entering particular date and time, the specified range of faults only can see through this option.

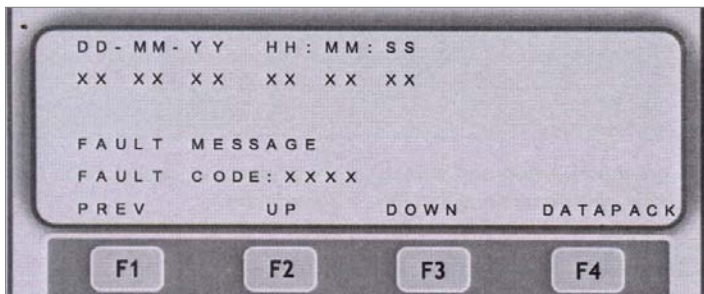


The user can go to the previous screen by pressing F1 Key and Exit from this screen by pressing 'F4'.

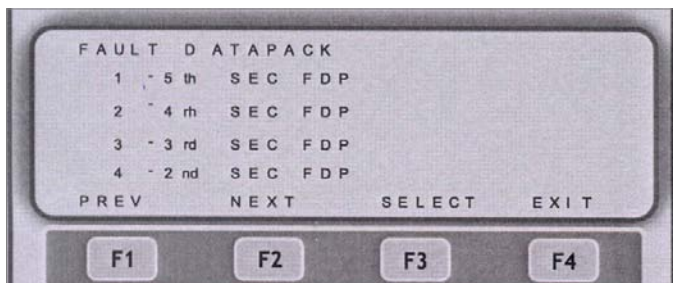
ALL FAULTS SCREEN



The 'All Faults Screen' is shown in Fig..
All faults data packs can see through this option.



On pressing F4 Key, the screen displaying the Fault Data pack appears as shown in Fig



More screens on the same level are displayed on pressing F2 Key. These screens are shown in Figs.



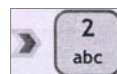
If the user presses F3 Key and selects any of the above shown Fault Data Packs, then the screen as shown in Fig. appears.



The Previous and Next screens can be viewed by pressing F2 and F3 Key.

DISPLAY SCREENS

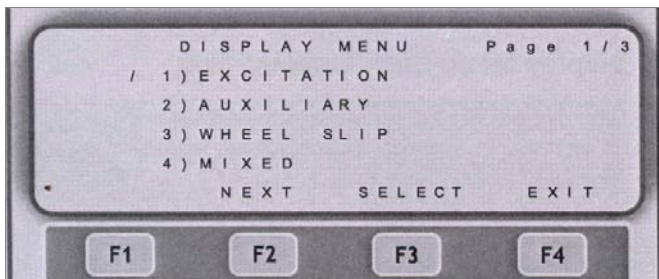
The next option under the "MAIN MENU" is "DISPLAY". The



display screens are shown in Figures given below.

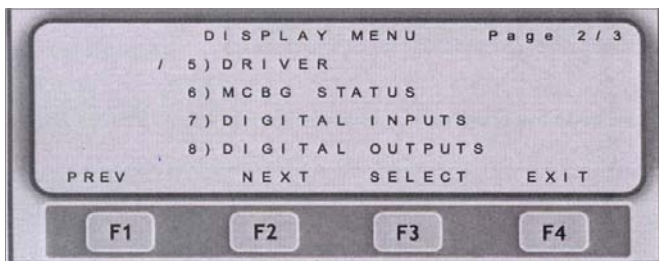
The "DISPLAY" sub menu can be selected from the screen 1/2 of Main Menu. Press "2" key or down arrow key once followed by "F3" key or "Enter" key. This screen displays the screens such as Excitation, Auxiliary, Wheel Slip, Mixed, Driver, MCBG Status, Digital Inputs and Digital Outputs. The User can select the option of his choice by pressing F3 Key.

SCREEN 1



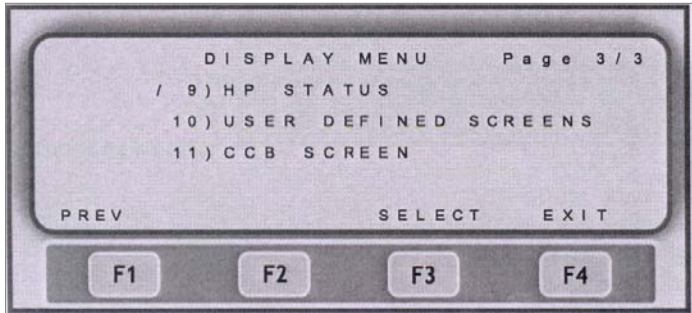
For going to the next screen, F2 has to be pressed. User can press F4 Key to exit from the screen.

SCREEN 2



The User can select the option of his choice by pressing F3 Key. For going to the next screen, F2 has to be pressed. Similarly, F1 should be pressed for going to the previous screen. User can press F4 Key to exit from the screen.

SCREEN 3

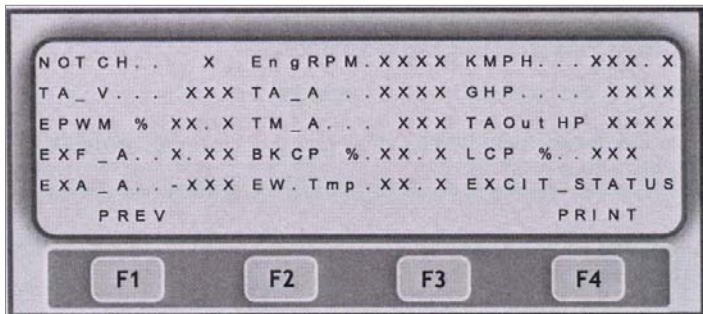


The User can select the option by pressing F3 Key. F1 should be pressed for going to the previous screen. User can press F4 Key to exit from the screen.

DISPLAY MENU SUB SCREENS EXCITATION SCREEN



The 'Excitation Screen' is shown in Fig given below.

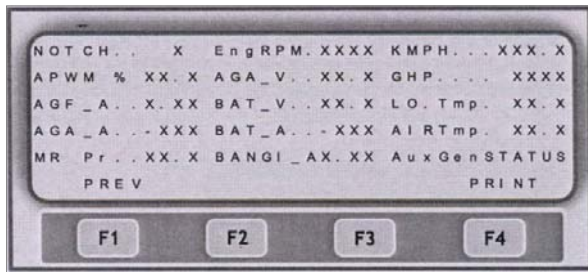


The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

AUXILIARY SCREEN



The 'Auxiliary Screen' is displayed below.

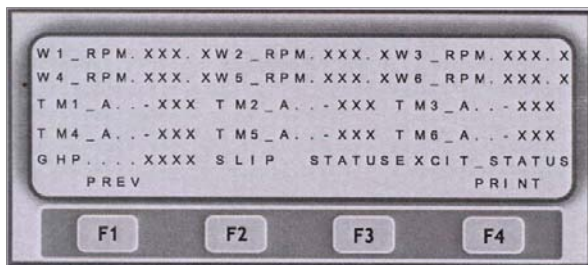


The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

WHEEL SLIP SCREEN



The 'Wheel Slip Screen' is displayed below.



The user can go to the previous screen by using F1 Key or Print the Screen, by using F4 Key.

MIXED SCREEN



The 'Mixed Screen' is shown in Fig.



The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

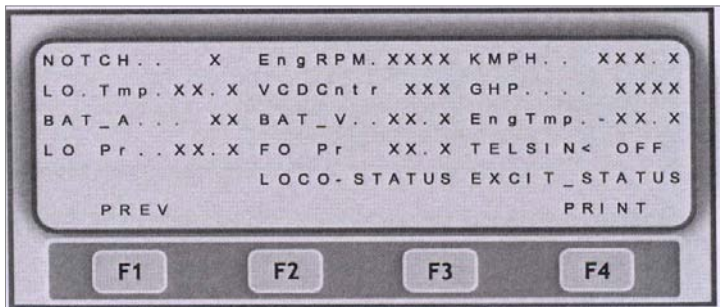
DRIVER SCREEN



The 'Driver Screen' is displayed by three different screens which are shown in Figures as given below.

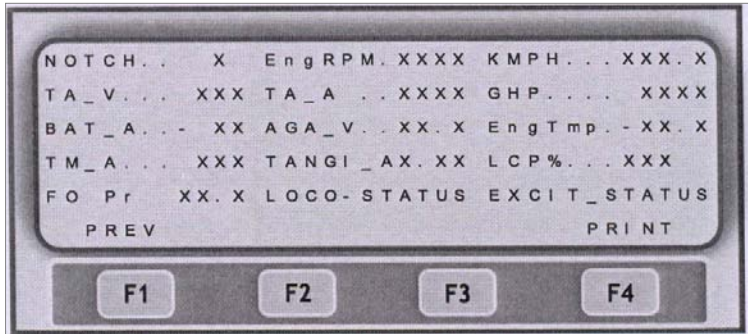
The driver's display mode is same as the default display. Various parameters that are displayed in this option **_re Notch**, Engine RPM, KMPH, TA Amps, TA Volts, Gross HP, BA Amps, AG Volts, Engine Temp, TM Amps, TM field Amps, Brake KW, TM Armature Amps, BKCP Lube Oil Temp, Gross HP, BA Amps, BA Volts, LOP. These parameters are distributed into three display modes. 1. IDLE 2. Motoring 3. Braking
The MEP-660 automatically changes the display to the corresponding mode based on the master handle position.

Idle Screen



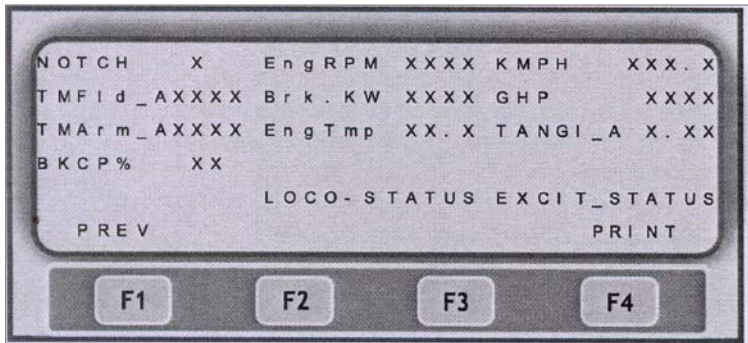
The user can go to the previous screen by using F1. Key or Print the Screen by using F4 Key.

Motoring Screen



The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

Dynamic Brake Screen

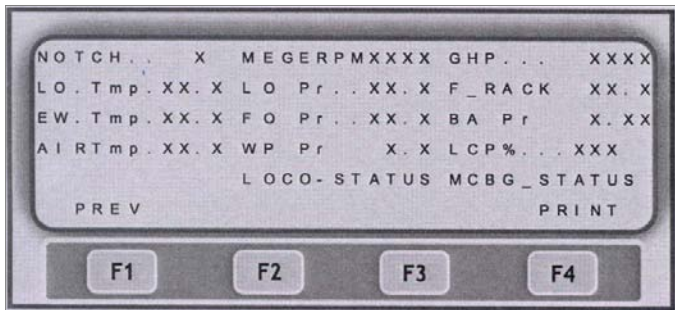


The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

MCBG STATUS SCREEN



The 'MCBG Status Screen' is as in Fig. given below



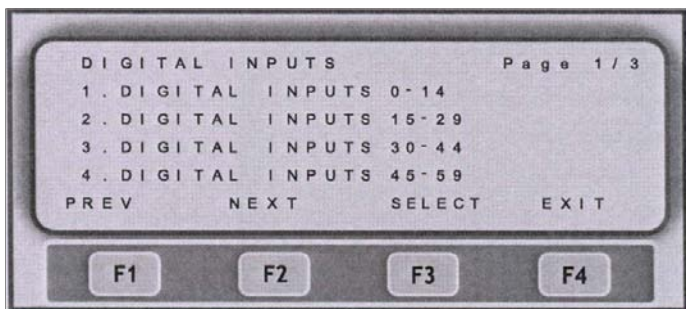
The user can go to the previous screen by using F1 Key or Print the Screen by using F4 Key.

DIGITAL INPUTS



The 03 'Digital Inputs Screen' are as Fig. given below. These screens display the Digital Inputs 00 to 143. This option is very useful to find out the status of any digital input in the locomotive. This display helps in finding out the wiring mistakes / the device mistakes. There are 144 digital input channels provided in MEP-660 Ver. 3. The status of these channels is distributed to 10 screens accommodating 15 channels in each screen. For easy navigation a sub menu is displayed indicating the digital input channel groups.

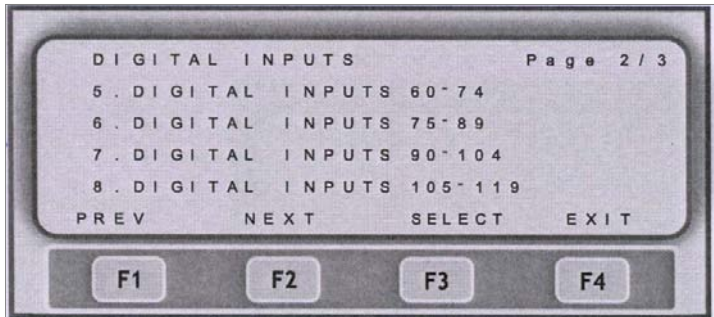
Screen 1



This screen displays Digital Inputs DIOO to DI59. The user can select F1 Key to go to the previous screen

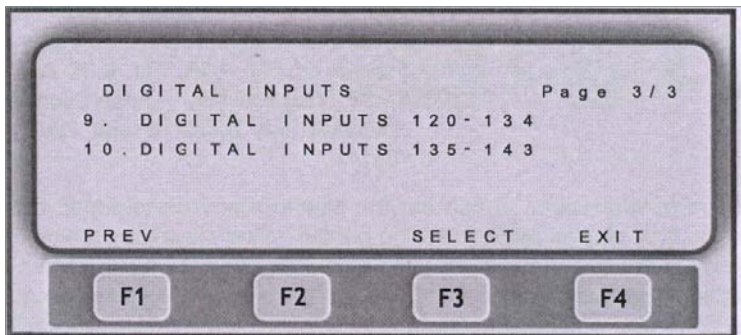
and F2 Key to go to the next screen. To select the choice of Digital Inputs, the user has to press F3 Key. F4 Key has to be pressed to exit from this screen.

Screen 2



This screen displays Digital Inputs DI60 to DI119. The user can select F1 Key to go to the previous screen and F2 Key to go to the next screen. To select the choice of Digital Inputs, the user has to press F3 Key. F4 Key has to be pressed to exit from this screen.

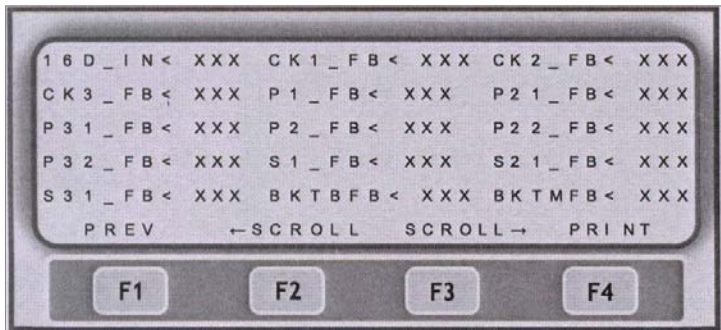
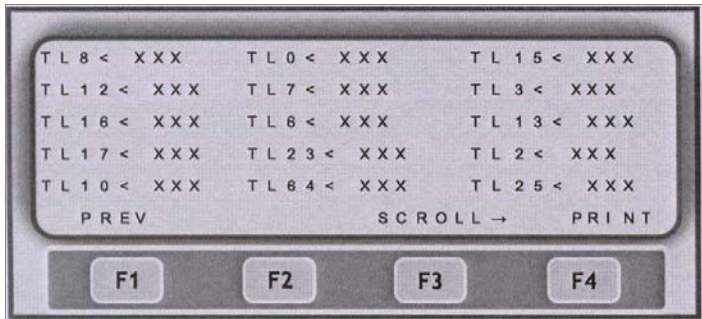
Screen 3



This screen displays Digital Inputs DI120 to DI143. The user can select F1 Key to go to the previous screen. To select the choice of Digital Inputs, the user has to press F3 Key. F4 Key has to be pressed to exit.

If user selects any of the Digital Inputs, then the parameter screen appears and on selecting the first option the following screen appears and in that if F3 is

pressed, then the screen appearing is same as selecting Option 2, that is, the screens are inter related. So by selecting F3, all the Digital Inputs screens can be seen as shown in Figures as below.



If F3 is pressed again, then the screen' for option 3 is displayed. This way all the Digital Input screens can be seen by pressing F3 key.

DIGITAL OUTPUTS

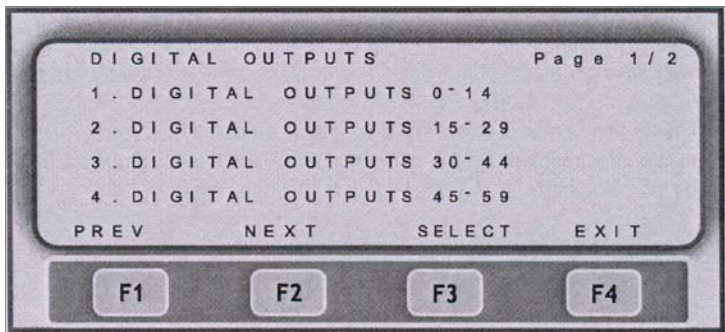


The 02 'Digital Outputs Screen' are as below. These screens display the Digital Outputs **DO00 to DO63**.

This option is very useful to find out the status of any digital output channel. There are 64 digital output channels provided in Ver.3. All the digital output channels are divided into groups and each group

contains 15 channels. For easy navigation a sub menu is displayed indicating the digital output channel groups.

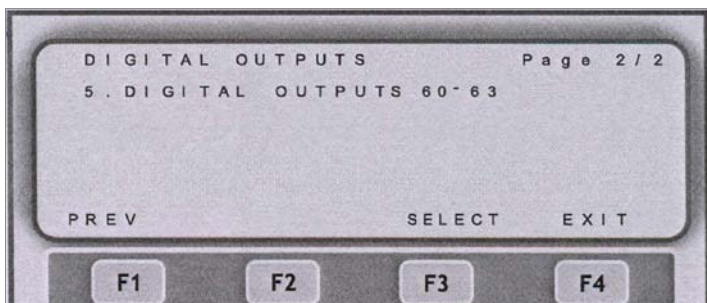
Screen 1



This screen displays Digital Outputs **D000 to D059**. The user can select F1 Key to go to the previous screen and F2 Key to go to the next screen. To select the choice of Digital Outputs, the user has to press F3 Key. F4 Key has to be pressed to exit from this screen.

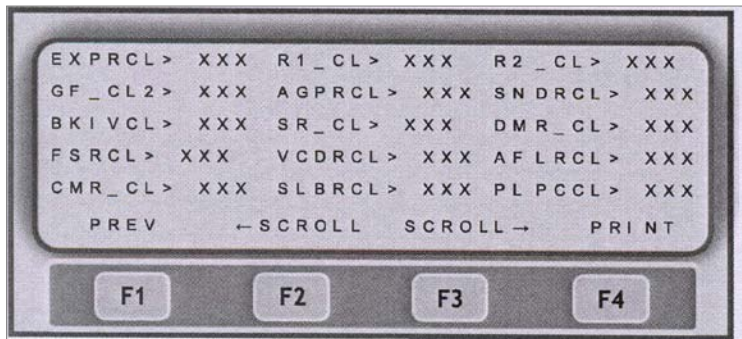
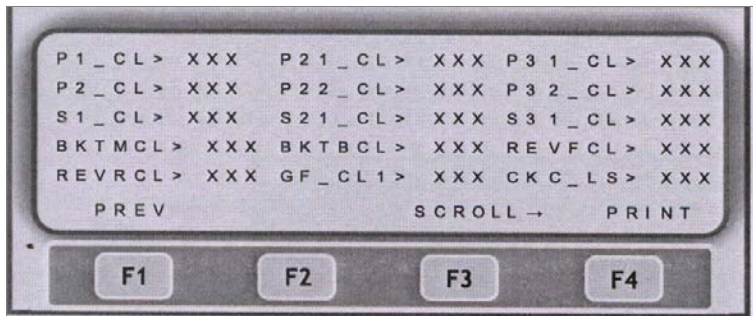
Screen 2

This screen displays Digital Outputs **D000 to D063**. The user can select F1 Key to go to the previous screen. To select the choice of Digital Outputs, the user has to press F3 Key. F4 Key has to be pressed to exit from this screen.



If user selects any of the Digital Outputs, then the parameter screen appears and on selecting the first option the following screen appears and in that if F3 is

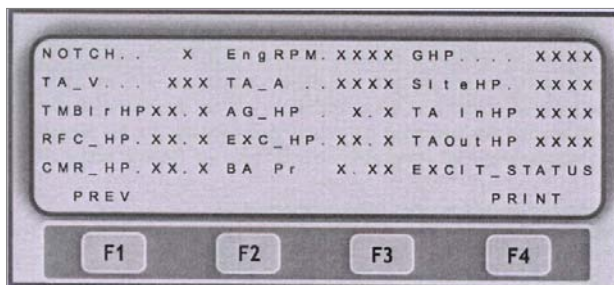
pressed, then the screen appearing is same as selecting Option 2, that is, the screens are inter related. So by selecting F3, all the Digital Outputs screens can be seen, as shown in Figs given below.



HP STATUS



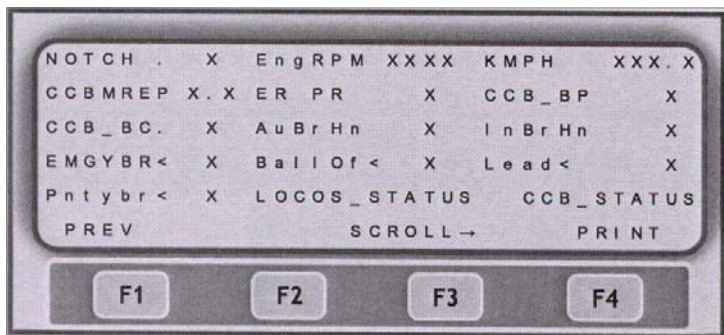
The 'HP Status Screen' is shown as given below.



CCB SCREEN



When the loco is equipped with computerized controlled brake system, the parameters related to CCB are collected and displayed in MEP display for user interface. There are two screens which can be selected to monitor. The 'CCB Screens' are as below.



7.0 FAULT DIAGNOSTICS

The Microprocessor Control System is built with an online fault diagnostic system. The system continuously monitors operating levels of parameters of various equipment on loco like currents, voltages, temperatures, pressures, RPMs etc. and identifies any abnormal conditions of working of any equipment, indicating a fault in that equipment

At present about 320 numbers of various faults are identified. On identification of any fault, an appropriate control action is taken instantly by the system to avoid damage to traction equipment.

A fault message, along with any restriction applied due to the fault, is displayed on the display unit for the convenience of the driver.

The faults are classified into three levels such as high, medium and low priority, based on the severity of the effect of the fault on locomotive operation.

The faults, which lead to engine shut down, prohibition of motoring and dynamic braking etc. are high priority faults. The faults leading to reducing power of locomotive, the faults resulting in cutting out of traction motor are also in high priority. All these faults are treated as, high priority faults. The alarm gong (ALG) and the display buzzer are energized either continuously or for 30 second in case of these faults. The driver can silence ALG and buzzer by pressing the acknowledge switch provided on the display unit. Even otherwise, in case of most of these faults, the ALG and buzzer gets switch OFF automatically after 30 secs.

The faults resulting in reduction of power, prohibition of dynamic braking, prohibition of battery charging etc. are treated as medium priority faults. In these cases, the ALG is energized for 5 seconds and the display of fault message and buzzer continues for 15 seconds.

The faults for which fault tolerance is built in the system and other faults are treated as low priority faults. In these cases, ALG do not energize but the fault message is displayed and the buzzer to the display unit is energized for 15 seconds.

For any fault, it is possible to manually clear the fault through the display unit, after attending to it. By pressing the "MENU" key one should select "Faults" menu. After selecting the 'Faults' menu, the sub-menu option "Clear Active Faults" should be selected from the sub-menu options. Now the operating / maintenance staff can navigate through the active faults at that point of time, which are displayed one by one based on their priority,

Three levels of access are defined to clear these faults.

Access level-1: By pressing the 'CLEAR' (F4 function key), the fault displayed on the display unit can be cleared after noting down and attention to the fault. If the displayed fault is an access level-1 fault, the system clears the fault immediately and informs the same on the display unit. Simultaneously the system removes any restrictions imposed on loco operations due to that fault and the next fault message as per the priority is displayed. The operator has to press once again 'CLEAR' (F4 function key) to clear the fault displayed on the display. Likewise the driver or operator can clear all the access level-1 faults.

Access Level-2: Level-2 faults are meant for clearing only by maintenance staff of the locomotive shed. After the pass code is validated, the system prompts for confirmation asking the user to Press 'OK' (F4 function) key against each such fault before clearing the fault.

Access Level-3: Very few faults are identified as very critical which require through inspection / attention on the control system and as well as on loco. Access to clear these faults is given to those people who have

deep knowledge of the locomotive and as well as microprocessor control system..

In MEP Version 3 user can download internal memory and external memory from USB. At any time, any of these files thus down loaded, can be viewed by the user by the Open File Option from file menu. User can select a file and its path and then click Open to open that file. Select the data file and click Open. Only one file can be opened at any given point of time. Once the file is selected all the faults logged are displayed in tabular form along with date and time of occurrence of fault, error code, and full description of fault. There could be data files relating to many Loco numbers. For opening a data file of a particular loco from the list of all locos, user can enter the desired loco number in the text box. The data files related to that particular loco number then gets sorted out. User can choose the desired file and then click Open to open that particular file. To view the Fault Data Pack of a particular error, double click on that particular error or click on Fault Data Pack button all the 10/90 seconds data packs are displayed in a table.

8.0 USER PROGRAMMABLE PARAMETE RS

The Microprocessor Control System MEP 660 is designed as a very flexible control system. It can be configured for various types of traction equipment on the loco and various types of locomotives also. The user himself can do these configuration settings. For this purpose, a special software is developed, which can be loaded on any PC/LAPTOP/NOTE BOOK/Display Unit. A connector is provided on the MEP 660 system for USB communication with PC for this purpose. The other end of the cable should be connected to the USB port of any PC. The configuration software is very user friendly, being

WINDOWS based and menu driven. Even a new user can also learn to use this software very quickly and with ease.

All the parameters that can be programmed by user are divided into number of functional groups, which can be selected from the menu. For example, if the HP limit group is selected HP limits for each notch is displayed. For each parameter the present set value, unit, minimum and maximum permitted, values, and default values are displayed. Hence the user need not refer to any other literature to use the system. After setting the parameters to the required level, by a mouse click on the "Send" button on the screen or pressing AL T +'S" key, the new values are transmitted to the MEP 660 system. By a mouse click on the "Read config" button on the screen or pressing AL T+'R" key user can verify that system has accepted the correct values. These parameter changes can be done online when the engine is running or even when the loco is moving. The system automatically takes care of proper implementation. Some of the parameter groups available are listed below:

- HP limit for each notch
- Alternator current limit for each notch
- Alternator voltage limit for each notch
- Traction alternator current Vs. efficiency table for 8th notch in steps of 250 Amps
- Traction alternator current Vs. efficiency table for 5th notch in steps of 250 Amps
- Dynamic braking parameters
- Excitation limits of various traction equipment
- Notch wise engine speeds
- Engine temperature levels for different controls
- Transition speeds
- Power ratings of auxiliary equipment

- Auxiliary generator control
- Wheel diameters
- HP Factors
- Transition Settings through flag selection
- Excitation propulsion through flag selection
- Miscellaneous settings like Engine Speed limit, Loco Speed limit, TDR OFF delay time, TA Field Resistance, Total TMS etc.

DATA LOGGING

The MEP 660 system provides continuous data logging of the following parameters at the rate of once in every 10 minutes. The parameters are:

- Notch Position
- Battery Voltage
- Lube Oil pressure
- Booster Air Pressure
- Fuel Oil Pressure
- Loco speed
- Engine Water Temperature
- Engine Oil Temperature
- Battery Charging/Discharging Current.
- Engine Temperature
- Main Reservoir Pressure
- Brake Pipe Pressure
- Traction Alternator Voltage
- Traction Alternator Armature Current .
- Power Ground Leakage Current
- Gross Horse power
- VCD status

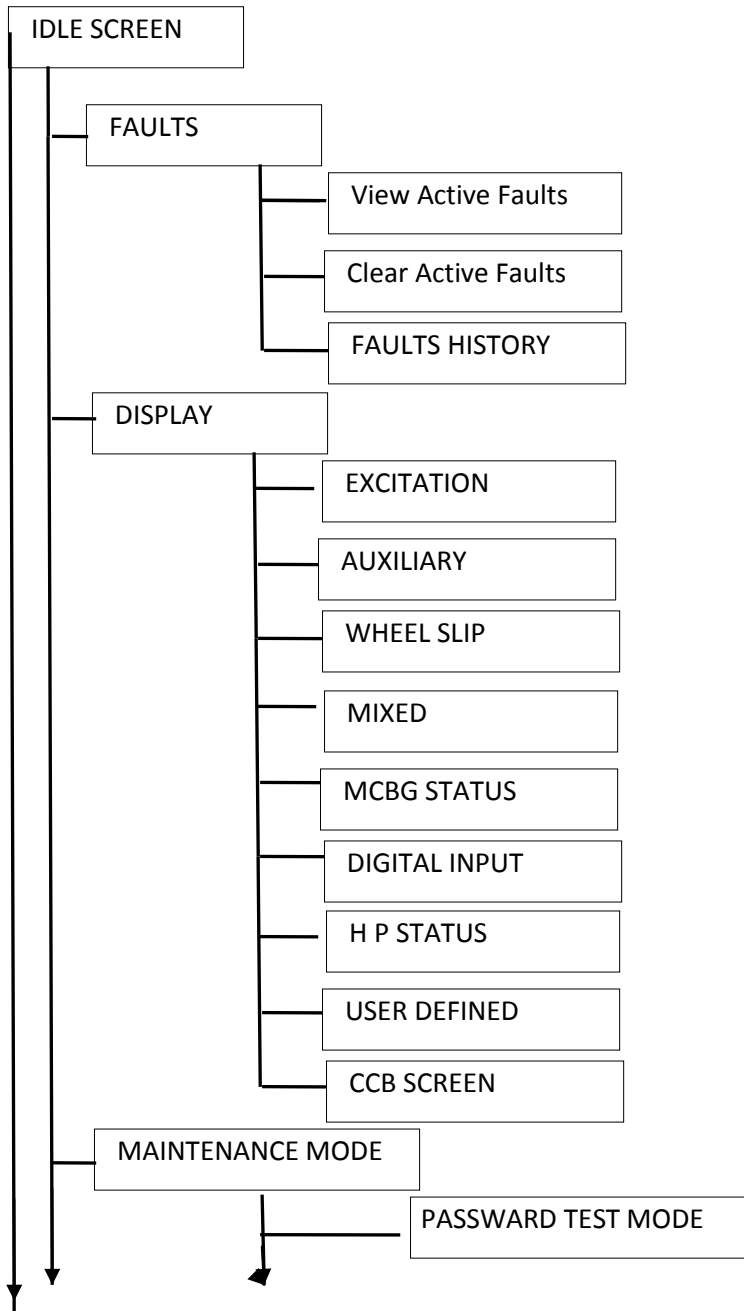
This data can be down loaded in to a Note Book PC by connecting the serial port of the same, through a cable, to the connector provided on MEP 660 system for this purpose. The menu driven software loaded on the note book PC does the job by selecting RDL. The data

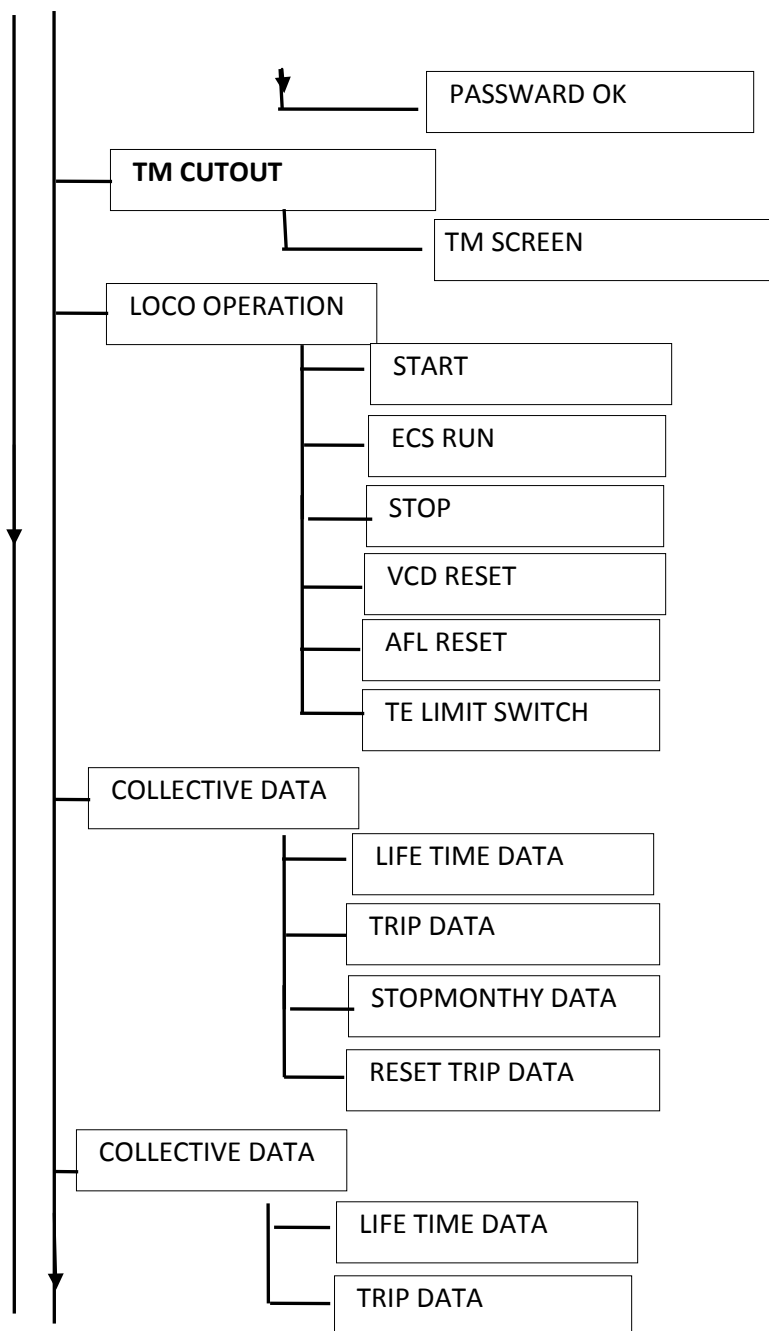
downloaded is automatically saved in a file, with the file name allotted by the system. At any time, any of these files thus downloaded, can be viewed by the user, by selecting the "Data Log" option in "View Data" pull down menu, and selecting the required file from a list of available files, which are displayed by their name along with the date and time stamp, of downloading.

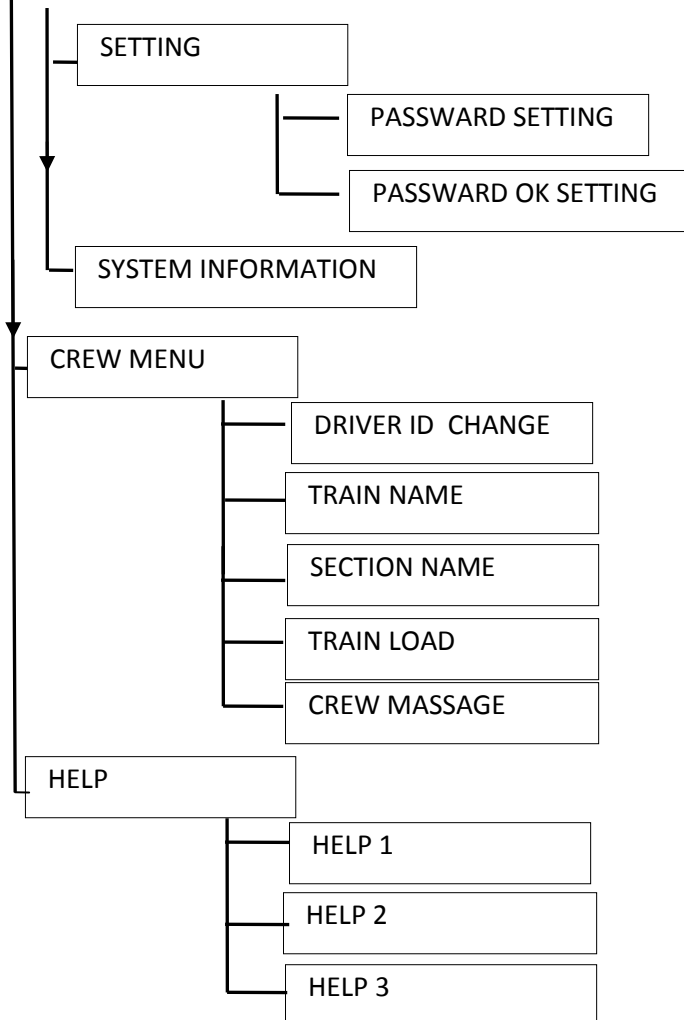
The MEP 660 system also provides cumulative information of locomotive duty cycle, total KW generated, Kilo Meters traveled and number of operating hours etc. This data can be viewed on Trip/Monthly schedules or Cumulative basis.

Real time Data monitoring is possible on a PC while the loco is running. The selected parameters can be viewed either in graphical or in a tabular form. This type of monitoring helps in identifying the faults online.

9.0 STEP WISE TROUBLE SHOOTING CHART

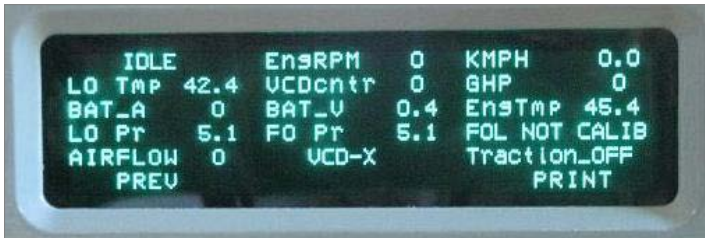






SCREEN PHOTOGRAPH FOR TROUBLE SHOOTING

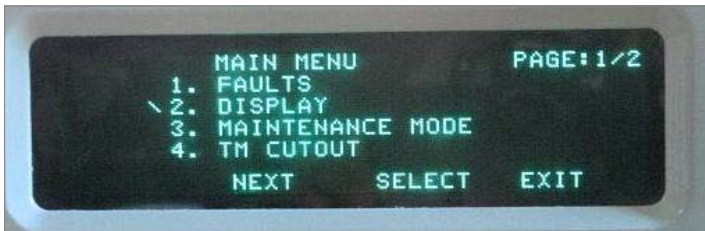
IDLE SCREEN



FAULTS SCREEN



Display screen



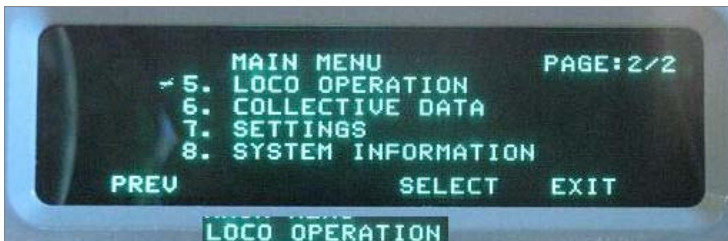
Maintenance Mode screen



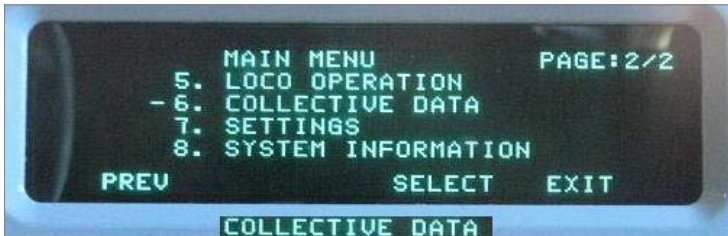
TM Cut out Screen



Loco operation



Collective data



Settings



System Informations



CREW MENU SCREEN



HELP SCREEN



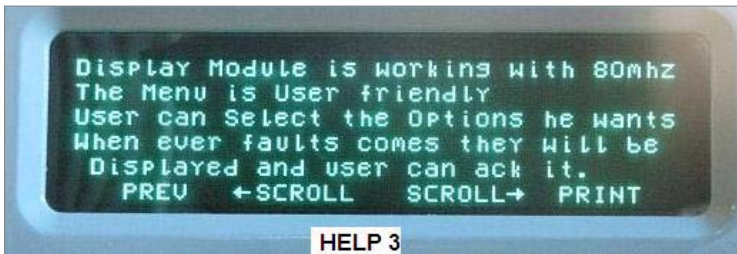
Help 1



Help 2



Help3



OUR OBJECTIVE

To upgrade maintenance technologies and methodologies and achieve improvement in productivity and performance of all Railway assets and man power which inter-alia would cover reliability, availability, utilization and efficiency.

If you have any suggestions and any specific comments, please write to us.

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