

T-18 PROPULSION System and auxiliary Electrics

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P/MIS

SALIENT FEATURES

- Train-18 is 16 car train with 4 basic unit i.e. Two number of end basic unit (DTC-MC-TC-MC) and two number of middle basic unit (NDTC-MC-TC-MC)
- Semi-high speed (160 kmph) multiple unit train-set.
- Train-18 is provided with **IGBT** based energy efficient 3 phase propulsion system and regenerative braking
- Stainless steel car body with continuous window glasses
- All propulsion equipments are shifted from onboard to underslung. All power components such as line & traction converters, auxiliary converter, air compressor, battery box, battery charger, brake chopper resister are mounted under the frame
- Zero discharge vacuum-based bio-toilets
- Modern bolster-less design bogies with fully suspended traction motors,
- Train-18 has 50% powering i.e. Every alternate coach is powered
- Ethernet backbone



END BASIC UNIT



MIDDLE BASIC UNIT

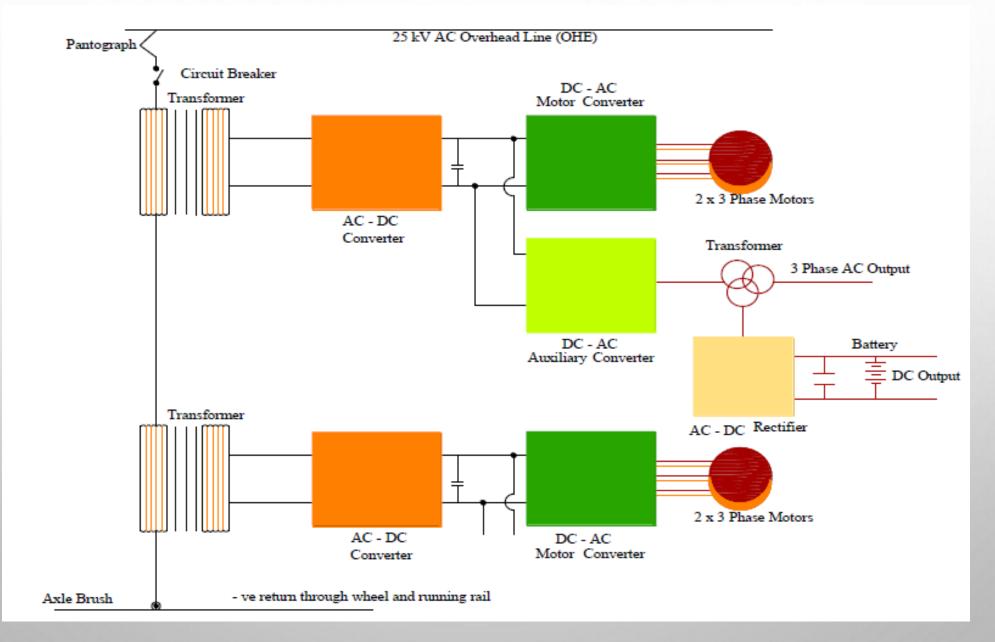
DTC – Driving trailer coach MC – Motor Coach TC – Trailer Coach NDTC – Non- Driving trailer coach

DTC	MC	тс	MC
1. Battery 2. Battery charger	1. Traction Converter 2. Brake Chopper Resistor 3. Traction Motors	1. Transformer 2. Auxiliary Converter 3. Pantograph	1. Traction Converter 2. Brake Chopper Resistor 3. Traction Motors

Formation of Rake (16 coaches): 4 X 4 Basic Units - Each Basic Unit with Four Cars



POWER SCHEMATIC





The 25kV OHE voltage is connected to the transformer primary winding through the pantograph and Vacuum Circuit Breaker (VCB).

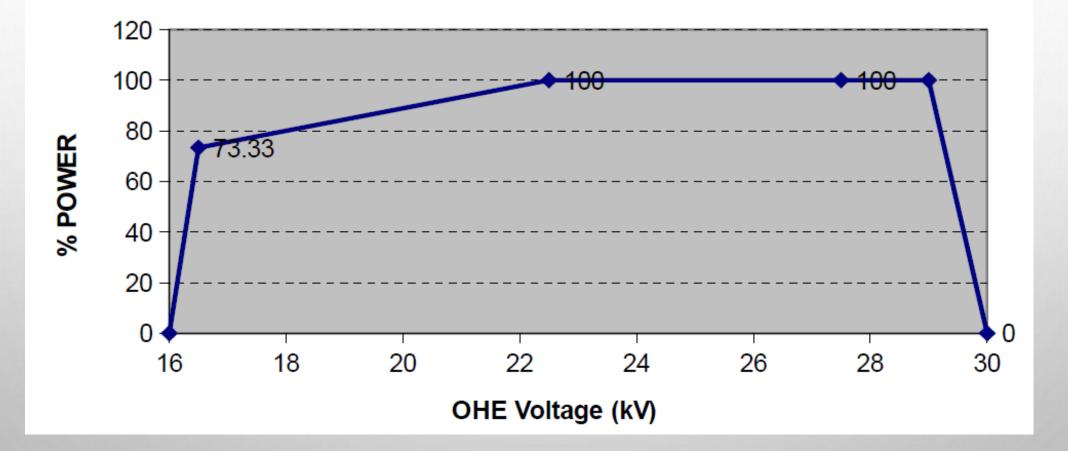
During maintenance, when transformer primary winding is not connected to the OHE line, an earthing switch (connected in parallel to VCB) is used to ground the transformer primary winding and pantograph for safety

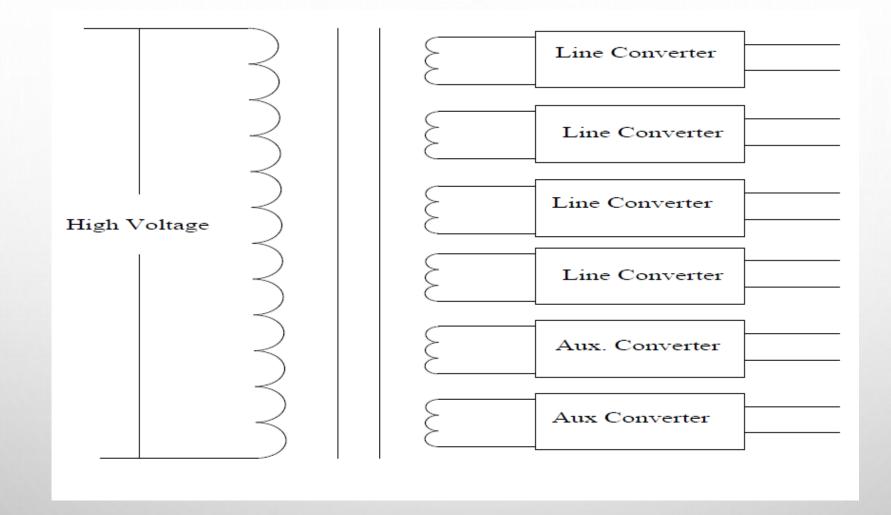


TRACTION TRANSFORMER

- Traction transformer is mounted under slung of trailer coach (TC).
- There are 1 primary winding, 4 traction windings and 2 auxiliary windings in traction transformer.
- Continuous voltage: 19 27.5 kv
- Total transformer continuous rating is 2880 kva under 22.5 kv OHE voltage.
- Each traction winding continuous rating is 603 kva
- Each auxiliary winding continuous rating is 234 kva
- Total approximate weight of transformer is 4900+\-3% kgs.
- One transformer feeds to two motor coaches.
- Traction transformer is oil cooled with help of oil pump and blowers which cool the radiator through which oil is circulated using the oil pump.

% POWER vs. OHE Voltage

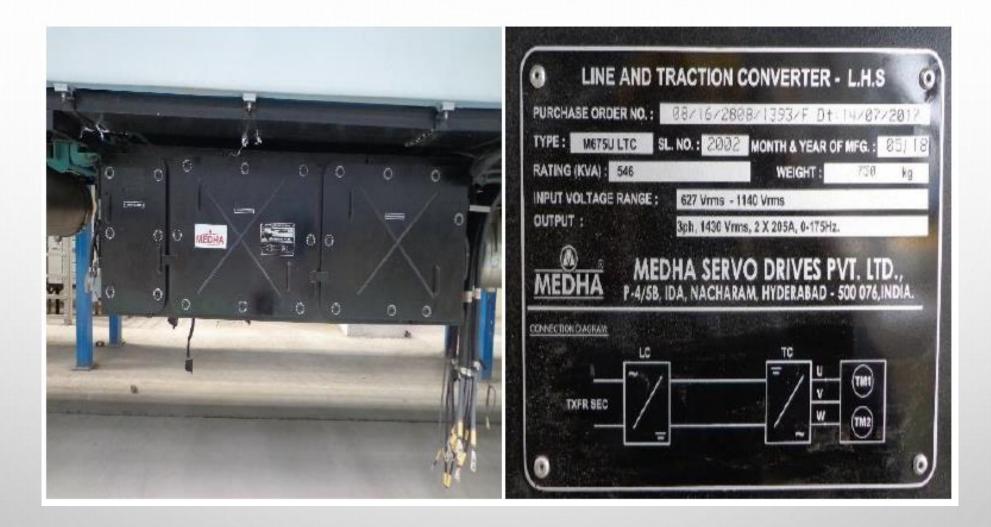




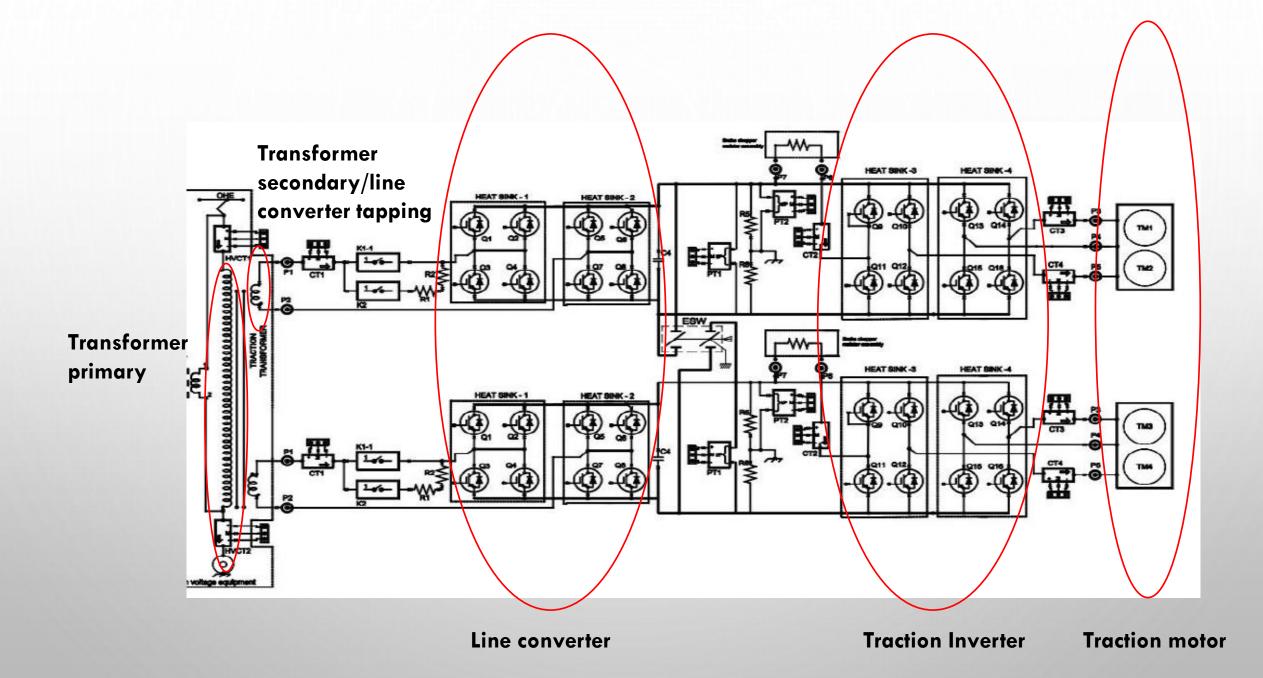
BLOCK DIAGRAM OF TRACTION TRANSFORMER

LINE AND TRACTION CONVERTER

- Each basic unit has 2 motor coaches and each motor coach has 4 traction motors.
- Each motor coach has 2 nos. of line and traction converter (LTC) mounted under slung and each control two traction motors of a bogie.
- Input power to line converter comes from transformer kept in adjacent trailer coach.
- Line and traction converters are forced air cooled.



LINE AND TRACTION CONVERTER



- Line and traction converter cubicle consists of
- -Line converter
- -DC link
- -Brake chopper (BCH) circuit
- -Traction inverter (TI)
- -Line and traction control unit

LINE CONVERTER

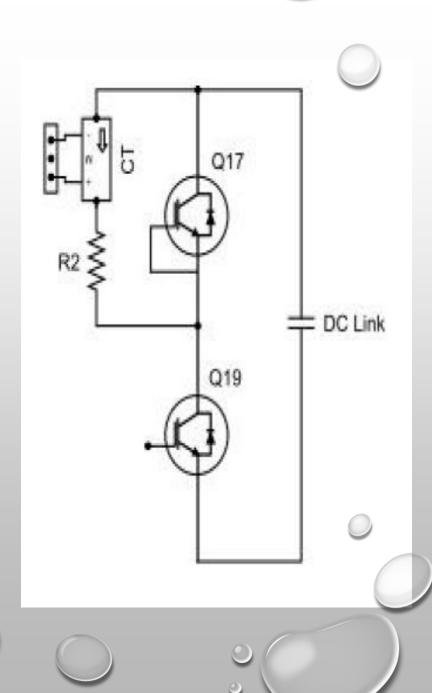
- The line converter interfaces with transformer secondary traction winding AC voltage on one side and DC link on the other side.
- Main function of line converter is to maintain stable dc link voltage at 1800 V irrespective of line and load variations at unity power factor
- The line converter consists of single phase full bridge rectifier with IGBT as active switching devices

DC LINK CAPACITOR

- LTC unit consists of 2 DC link capacitors.
- Dc link capacitor is used to buffer the energy differences between line-side and motor-side of the converter
- DC link capacitor absorbs the harmonic currents produced by line side and motor-side of the converter, thus reducing the ripple voltage
- DC link capacitor is used to limit the switching over voltages of IGBTs.

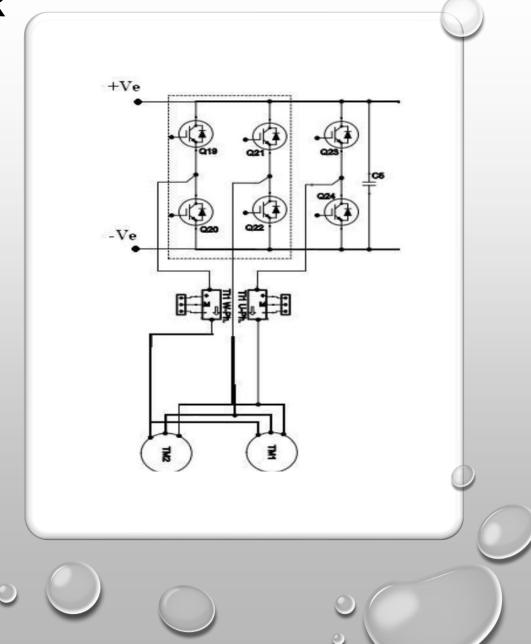
BRAKE CHOPPER CIRCUIT

- Brake chopper circuit comprises of BCH IGBT module and BCH resistor.
- The brake chopper circuit is used to limit the over-voltages in dc link capacitors during abnormal conditions or during transients.
- Over voltages in the dc link capacitors may occur due to:
 -non receptive OHE during regeneration
 - transient load conditions.
- Brake chopper resistor is used to limit the DC link voltage during the dynamic conditions
- It is also used to discharge the high voltage DC link capacitors after panto down.



TRACTION INVERTER

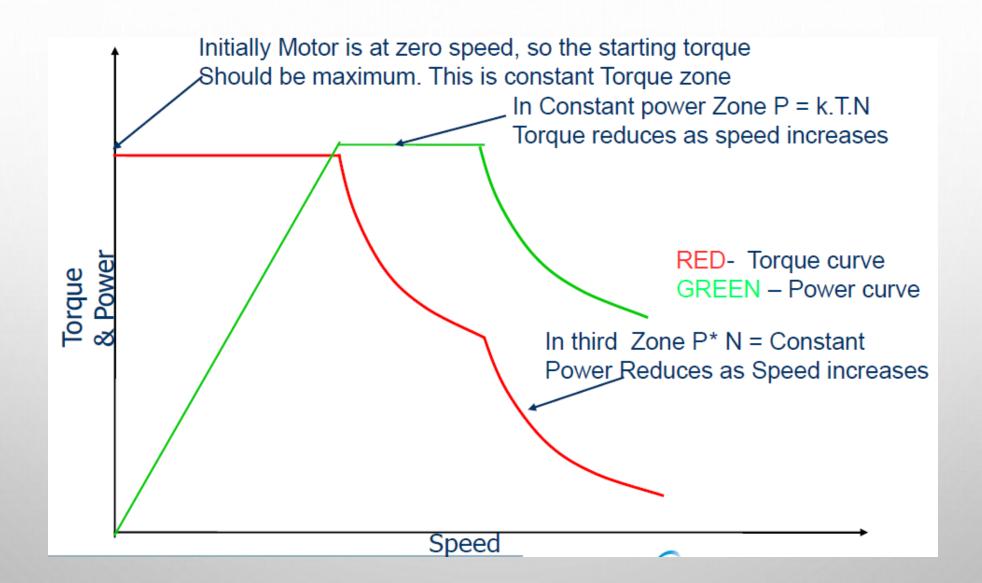
- Main function of TIC :
- oconverts the DC input voltage to 3-phase variable voltage variable Frequency output
- Traction motor torque will be controlled both in motoring mode and Braking mode
- © Controls wheel slip/slide
- Performs various fault diagnostics.



LINE & TRACTION CONTROL UNIT (LTCU)

• Line & traction control unit (LTCU) controls both the line converter and traction inverter and communicates with the main control unit (MCU) through CAN interface. All the LTCU's are similar in construction





AUXILIARY POWER SYSTEM

- Converter unit is required to generate 2 different types of voltages to serve these loads. Those are
- - 415VAC, 3phase, 50hz
- - 110vdc.

415VAC, 3phase, 50hz loads:

- Rmpu
- Cab ac
- Main compressor
- Traction converter cooling blowers
- Transformer radiator fan
- Transformer oil pump
- Water pump for toilet tank
- Aux converter cooling blower.

110 V DC :

- Battery charging
- Coach, vestibules and driver cabin normal lights
- Coach and driver cabin emergency lights
- Twin beam/auxiliary head light, marker light, tail light, flasher light, cluster light, spot lights, passenger alarm indication light, electronic signal bell
- Control electronics loads :PIS, CCTV, relays, contactors, driver desk,brake systems and all other control units
- Auxiliary compressor for pantograph
- Emergency ventilation blowers
- 110vdc toilet loads, seat lights & doors.



- Auxiliary converter is a PWM based IGBT converter, which
- Converts 285VAC-450VAC in to two outputs
- output-1: 415vac (L-L), 3-Φ, 50hz
- output-2: DC output is isolated from input by using DC -DC
- Transformer. DC output is connected to BN bus.

Auxiliary power supply consists of two cubicles.

- Auxiliary converter unit (acu)
- ACU consists of below modules
- 1) AC1 module
- 2) AC2 module
- 3) DC converter module
- Battery charging system (BCS).

○ AC-1 & AC-2 modules consist of below sections:

- i. Line converter section
- ii. Inverter section
- iii. Master & module control section (both control & communication)
- The **line converter section** takes the input (variable single phase AC input) from secondary winding of main transformer and converts to fixed dc-link by controlling pulses of the IGBT's by using DSP controller. Full bridge architecture is used for the line converter.
- The **inverter section** takes the input from common DC link. The IGBT based inverter section is provided after DC link capacitor. A three phase full bridge architecture is used for the inverter.

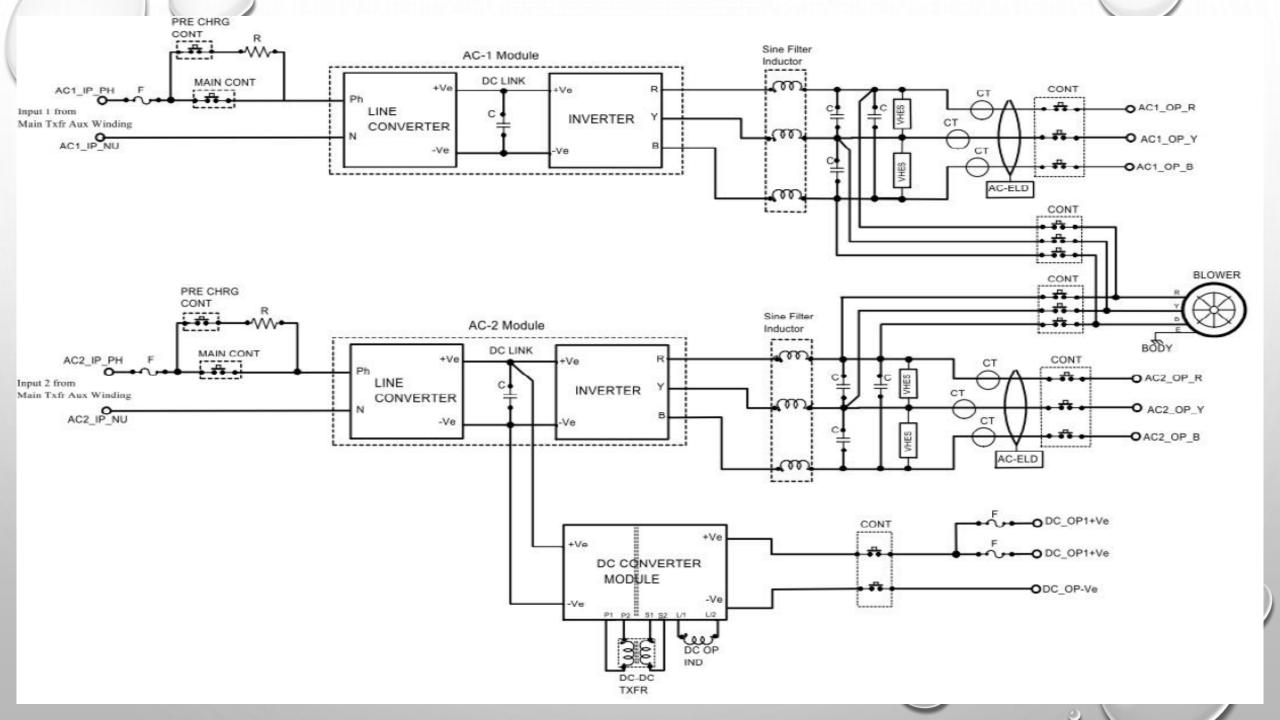
- There is a **master controller section** which controls the line converter &inverter. It is also responsible for monitoring and protecting the complete auxiliary converter unit and records the faults in the memory.
- It also interfaces to TCMS to get commands and to send status to display at driver cabin through ethernet communication.
- **415 V AC output section** It consists of sine filter inductor, capacitor, current transformers, ELD sensor & output contactor.
- 3 Phase 415 V AC, which is passing through sine filter capacitors for filtering PWM sine waveform to pure sine waveform. After filtering, the output is connecting to output terminal through output contactor.

• ACU DC CONVERTER MODULE

- DC converter takes supply form common dc-link of AC2 and converts DC link voltage to isolated and regulated 110vdc output by controlling pulses of IGBTs by using DSP controller.
- The output of DC converter is fed to BN (battery normal) loads, BD (battery direct) loads as well as battery charger.

• BATTERY CHARGING SYSTEM

- Battery charging system (BCS) is a PWM based IGBT converter, which is getting supply from BN bus and charge the battery with constant voltage & constant current limit topology.
- Used to provide the 110vdc supply for battery charging by taking supply from BN bus (115vdc-130vdc).



PROTECTIONS

Line Converter Protections:

- Transformer Primary over voltage and under voltage
- Traction Transformer Secondary over current
- IGBT Heat Sink over Temperature
- Failure of Pre-charging contactor / resistor
- Failure of Main contactor.

DC Link Protections:

- DC Link Over Voltage
- DC Link Short Circuit
- Earth leakage.

Traction Inverter protections:

- Output Over Current
- Output short circuit
- IGBT Heat sink Over temperature
- Traction Motor Over temperature
- Traction Motor Over Speed
- Phase Imbalance.

PASSENGER INFORMATION SYSTEM(PIS)

- The passenger information system for train set (train-18) provides required information to the passengers in a train throughout the journey in both visual and audio information.
- System has provision for public announcement where driver/guard can address all the passengers in the train, inter communication (ic) between driver and guard communication.
- The main aim of this system is to provide convenience to the passengers by providing the station information and other required information.
- The mmi (man machine interface) and ccs (coach controller) in entire train are interfaced with can network.
- The mmi in the trailing coach will behave as master based on direction of the journey and other mmi becomes slave.
- The cc acts as local master for each coach and interface with all the display boards.
- The leading and trailing coaches consist of man machine interface (mmi) with gps.
- Public address system is provided to enable communication between guard and passengers.
- Intercom is provided to enable communication between driver and guard.

MAN MACHINE INTERFACE (MMI)

• Man machine interface is a user friendly module which has 20x4 matrix LCD and 21 keys keypad for displaying the menu screens and accepting the user inputs through keyboard.

- This module is mainly used for configuration and displaying the menu options, system status and route information to user (driver/guard).
- This module is mounted on the driver desk. User can also know the status of each sub system from MMI.
- Complete PIS system can be configured using MMI only.
- MMI has GPS interface to have real time GPS co-ordinates.
- MMI takes care of all operations such as train route simulation using GPS, fault diagnostic of the complete PIS system.
- Train route database of the PIS system is stored in MMI

CAR CONTROLLER

- Car controller is the main system to control and command all sub systems in that particular coach, it acts as local master for that coach.
- Upon receipt of train route selection from MMI, CC transfers the required information to all displays, and then on receipt of station triggers from the MMI, CC will transfer the required display data to display and audio data to the speakers.
- All sub systems in a coach like head code display, single side display, side destination display board and anm are connected to car controller unit.
- It also monitors the health of all the sub systems which are under its control and exchanges the data with MMI for central data storage.
- Speakers are routed from CC in each coach by 50% audio sharing from next coach.

- HEAD COACH DISPLAY
 - IN COACH DISPLAY UNIT
 - SIDE DESTINATION BOARD DISPLAY UNIT
 - PASSENGER EMERGENCY COMMUNICATION UNIT







PASSENGER EMERGENCY COMMUNICATION UNIT

TCMS (TRAIN CONTROL AND MANAGEMENT SYSTEM)

1.Interface to drive command

2. Pantograph control - panto 1 & 4 or panto 2 & 3 work at a time

3. VCB control

4. Traction control

5. Regenerative brake control and total brake calculation

6. Brake blending

7. Interface to RMPU control

8. Interface to door control

9. Interface to brake control

10. Compressor control - 4 compressor per rake 11. Parking Brake control - from both

driver and Guard cab

12. Light Control

13. Roll back Detection

14. Vigilance control (VCD)

15. Cruise Control (Speed Control)

16. Neutral Section Control

17. Test modes - to test input and

output interface

18. Settings through DDU - Various

indication on Driver Display

19. Event Recording

