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विद्युत सिगनल प्रयोगशाला
प्रयोग नं: ई एस एल 39

IRISET
ELECTRICAL SIGNALLING LABORATORY
EXPERIMENT NO.: ESL – 39

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प्राप्त अंक
Marks Awarded :

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Instructor Initial :

MEDHA ELECTRONIC INTERLOCKING SYSTEM (MEI 633)

(RDSO/ SPN/192/2005)

SYSTEM DESCRIPTION: -

MEI633 is a microprocessor based system with interface to the Points, Signals, Track Circuits, Axle Counters, Level Crossing Gates, Ground Frames, and Block Instruments for Block working with adjacent stations, and crank handles for manual operation of Points. It has the provision to interface with an External Data Logger, Centralised Traffic control (CTC) or Automatic train protection (ATP) through Serial Link.

It is a self-contained independent system, which can be used standalone to control the train movement in the Yard. In case of big yards, where the System capacity is not sufficient to address the needs of interlocking, two systems can be cascaded using a Serial link to achieve the required functionality.

MEI633 System implements Two-out-of-Two Hardware architecture with identical Hardware and identical Software for Vital modules with Hot standby configuration. An upgraded version of MOTOROLA 68K family CPU, with RISC architecture is used in the system.

BASIC HARDWARE/SOFTWARE ELEMENTS:

The MEI633 comprises of the following sub-systems:

(a) Central Interlocking Unit (CIU)
(b) Object Controllers (OC)
(c) Panel Processor Unit (PP)
(d) Power Supply Module
(e) Control Cum Indication Panel (CCIP)
(f) Counter Box Module
(g) Data Logger (DL)
(h) Video Display Unit Control Terminal (VDU CT)
(i) Maintenance Terminal (MT)
(j) Front Panel Display Unit (FPD)

The major building blocks of MEI633 are Central Interlocking Unit (CIU), Object Controller Modules (OCM) and Panel Processor (PP). CIU collects the Yard information from OCMs and operator commands from PP/VDU CT. CIU validates and executes

interlocking equations based on the available information. The outcome of the equation execution will be transmitted to OCM for driving out put relays and also to give indications in the PP/VDU. Driving an output relay generally clears a signal or operates a point.

Central Interlocking Unit (CIU)

Central Interlocking Unit (CIU) Central Interlocking Unit consists of Vital Interlocking Card (VIC), Communication processer (COMP) Card, Communication Interface (CIF) Card and Voltage Health Monitoring (VHM) Card, which are enclosed in a single rack. Input data from PP/VDU Modules, OCMs is received by CIU. The received input data is processed as per the interlocking application logic by CIU and output data is generated based on the input data .The respective output data is sent to PP/VDU Modules, Counter Box, MT and OCMs.

PSB (Power supply Board-B type) - CIU has two numbers of power supply modules (B type) to provide the required voltages to all the cards in the CIU to provide power to the VIC, COMP cards and are rated at 4.5V@3A.

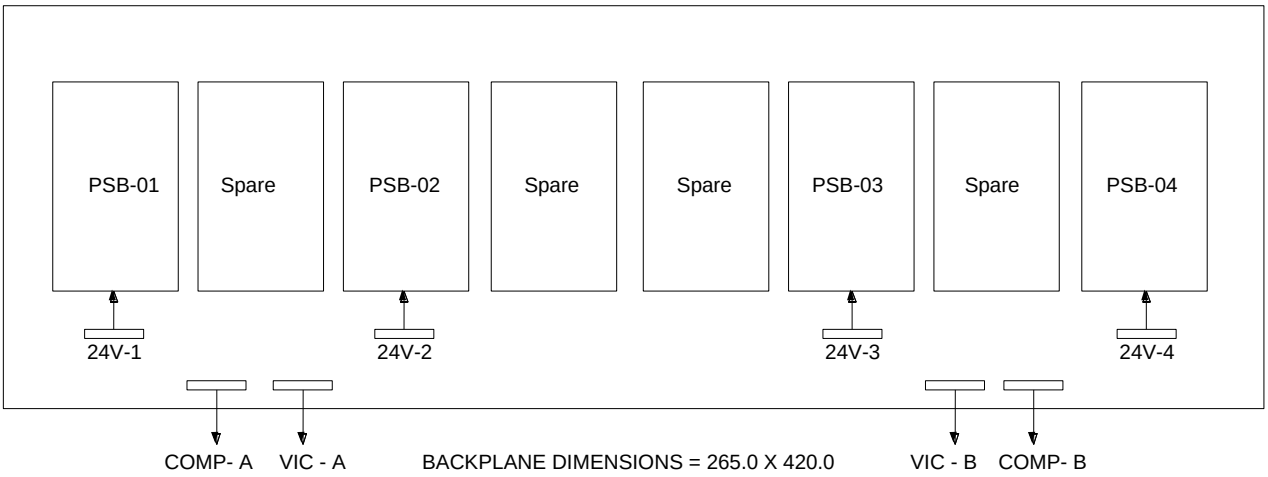
VHM cards - VHM-A monitors the voltage and health of VIC-A & COMP-A.VHM-B monitors the voltage and health of VIC-B & COMP-B.

VIC card – VIC card receives the wayside function input data from the field and the commands issued from CCIP/VDU through COMP card. It processes the received inputs and generates output data, which is in turn sent to wayside functions (OC) as well as to CCIP/VDU through COMP card.

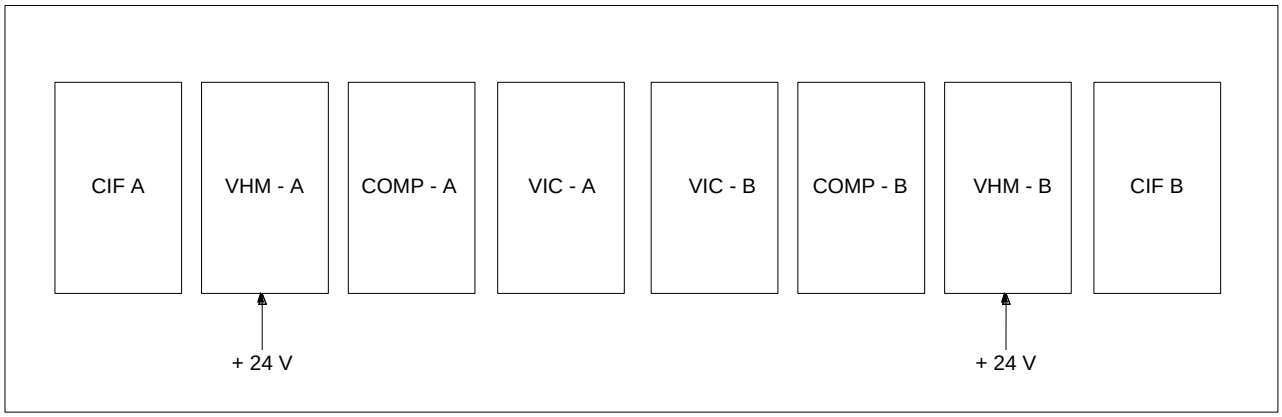
COMP card - COMP card is connected to PP/VDU Modules, Counter Box, CTC, Other EIS and OCMs through OFC interface. COMP requests wayside function input data from OCMs and sends the wayside function output data to OCMs. Each COMP can be connected to other Electronic Interlocking Systems (EI), if more than one EI is installed in the yard.

CIF card – CIF card acts as interface between COMP card and OCMs and it converts the serial data stream generated by UARTs (from COMP) to RS-485 signals and vice-versa.

Serial communication ports - CIU has 12 serial communication ports, out of which 8 ports are used for 32 OCMs (on each port, a maximum of 4 OCMs can be connected), one port is used for PPs and VDUs (a maximum of 4 PPs and/or 4 VDUs can be connected), one port is reserved for other EIS, one port is reserved for CTC and the remaining port is reserved for future use, as shown in the block diagram. CIU is also connected to Counter Box, MT, Data Logger (DL) and Display units (identified as DISPLAY-A and DISPLAY-B). Besides the above CIU also consists of EMI filters for input 24v DC supply and **Ring Modems (RM)** for communication with Object Controllers(OCs),PP/VDU.



CIU - TOP BACK PLANE(CIU Top BIN)



CIU - BOTTOM BACK PLANE (CIU Bottom BIN)

RING MODEMS (RM) - OFC to RS 485 Converter

1. These Ring Modems are used for communication between CIU to OCM, OCM to OCM, CIU to PP & VDU.
2. The Ring Modem is capable to convert OFC signals to RS 485 level signals & vice versa. Hence they can function in bidirectional mode.
3. Each Ring Modem has 2 sections primary &secondary.
4. In the Communication Network between CIU & peripherals the CIU is connected as Master & others are connected as Slave modes.
5. Connection between CIU & peripherals i.e connection from Master to Slave shall be primary to primary, secondary to secondary.
6. Connection between peripherals shall be primary to secondary, secondary to primary.
7. Each OFC is connected to 2 number of Ring Modems and is connected to CIU in two different channels Ch.A & Ch.B.
8. Four OC's are connected in one ring circuit to CIU through 2 channels.
9. Total 8 channels are provided in CIU for connection of 32 no.of OC's
10. VDU & PP along with counter box are connected in one network to CIU through one channel in CIU-A and one channel in CIU-B

Object Controllers (OC):

Object Controller Modules are meant for acquiring the Vital Field Input Data and for driving the Vital Field Outputs. It consists of 5 I/P cards 3 O/P cards. It can handle up to 40 Inputs & 24 Outputs (i.e. 8x5 = 40 I/P's, 8x3 =24 O/P's). A maximum of 32 OCMs can be connected in a system.

Input Way side Function Module (WFM) - Input WFM gets the status of the wayside functions in the yard through Input relay contacts and sends the same to Input output Communication Modules, IOCOM-A and IOCOM-B. Each Input WFM can read at most eight wayside function inputs. A WFM consists of two Way side function processors (WFP)–Master WFP & Slave WFP.

Output WFM - Output WFM receives the wayside function output data from IOCOMs and drives the wayside functions through output relay drive (ORLD) card connected to it. Each Output WFM can drive at most 8 wayside function outputs. A WFM consists of two WFPs – Master WFP and Slave WFP.

IOCOMs - Object Controller Module consists of two IOCOM cards namely IOCOM-A, IOCOM-B. Input and out put WFMs are connected to IOCOM-A and IOCOM-B through RS485 interface. IOCOM-A and IOCOM-B are connected to COMP-A and COMP-B of CIU respectively, through OFC interface.

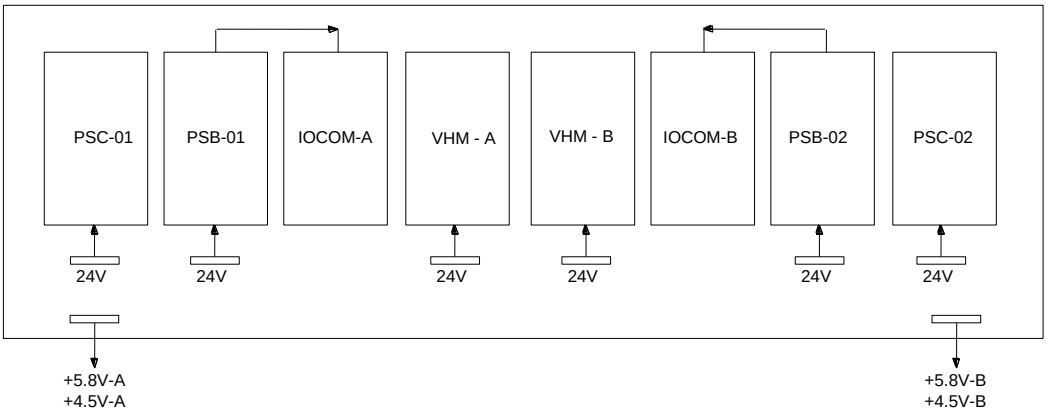
IOCOMs transfer the wayside function input data received from Input WFMs to respective COMPs. IOCOM-A and IOCOM-B receive the wayside function output data from respective COMPs and sends the same to Output WFMs.

VHMs (Voltage Health monitoring cards) - Each OCM consists of two VHMs namely OVH-A and OVH-B for monitoring the voltage and health of IOCOM-A and IOCOM-B respectively.

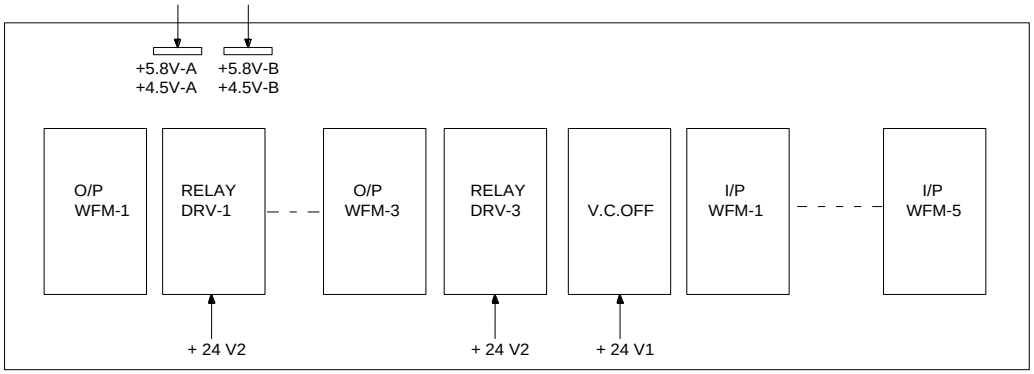
Power supply boards - OCM consists of power supply modules, which provides the required voltages to the cards in the OCM. Power supply board "B type" – 2Nos and Power supply board "C type"-2 Nos are provided in each OCM.

OVC cards - All Output WFMs in OCM are monitored by Vital Cut-off (OVC) card. OVC card drives the VCOR, based on the voltage and health status of connected Output WFMs in the OCM.

ORLD card -To drive out put relays, one output relay drive (ORLD) card is provided for each Output WFM.



OCM -TOP BACK PLANE (OCM Top BIN)



OCM - BOTTOM BACK PLANE (OCM Bottom BIN)

VCOR Relay

The Vital Cut-Off Relay (VCOR) is a fail-safe QN Signaling Relay that is driven by the Vital Cut-Off card. The front contacts of VCOR are used to provide power for driving the external output relays. The output relays can be driven only when the VCOR is in picked-up state. Each Object controller module is provided with one VCOR. The vital cut-off card is responsible for picking up the VCOR. The vital cut-off card monitors the voltages of all the output WFP CPU cards. It also monitors the health status of all the output WFP CPUs. The vital cut-off card energizes the VCOR only when the voltage inputs and health of all the output WFP CPUs are OK. For any failure detected in the status of voltage or health of the output CPUs, the VCOR is commanded to drop. Also, for any critical fault or any kind of wrong side failure that is detected by the output WFP CPU, the VCOR is dropped by which all the output relays connected to that particular Object controller are de-energized thereby ensuring the safety of the system. Whereas, during VCOR is in dropped condition, all the input relay contacts are still read by the system as VCOR will not cause to drop input relays.

Panel Processor Unit (PP)

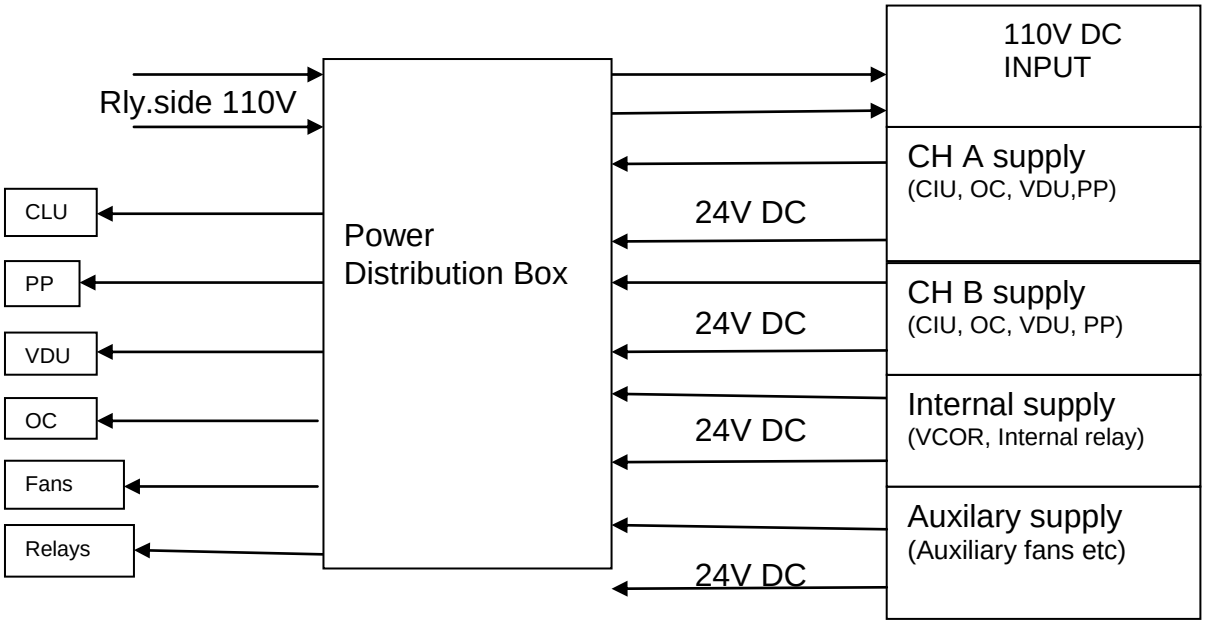
Panel Processor module consists of two Panel Processors (PP A & PP B) and each is connected to a common set of Input and Output cards through parallel interface. On the other hand, each Panel Processor is connected to COMP through Optical Fiber Interface.
Each Panel Processor scans the state of the inputs on CCIP through Input cards, and sends the same to VICs via the respective COMP. Each of them receives Indication Information from active VIC and drives the same to CCIP through output cards, providing visual indication to operator. Indication Information represents the current Yard status. The Panel Processor CPU cards and the Input/output cards are housed in separate enclosures. The data transfer between the CPU cards in one enclosure and the Input/output cards in the other enclosure is achieved by the use of PP Extender Driver card on the CPU enclosure and PP Extender Receiver card on the I/O Enclosure.

Power Supply Module

MEI633 uses three types of Power Supply modules viz, Type A, Type B and Type C Power supplies. These power supplies are designed specifically to meet the requirements of various cards in the CIU, OC and PP modules. All the three types take +24V as input. Power supply Type A (M633PSA-01) is used to power the Input and Output cards of the PP module and is rated at 4.5V@8A. Type B Power supplies (M633PSB-01) are used to provide power to the VIC, COMP, PP CPU and IOCOM CPU cards and are rated at 4.5V@3A. Type C Power supplies (M633PSC-01) are dual output type and are used to provide power to the Input and Output WFM CPU cards and are rated at 4.5V@6A,5.8V@2A.

Mini IPS for MEI 633:

- MEI633 System comes with its own power supply system.
- Railway has to extend 110V DC power from its IPS system.
- MEI 633 has got its own mini IPS system with several 5A, 110V/24V DC-DC converter modules.
- The input 110V DC & the outputs 24V DC are taken through a power distribution box which has fuses & MCB’s & SPD’s for each supply line.
- The power distribution box consists following connections.
- Input DC 110V from Rly IPS is connected to IPS of MEI 633 through a 63A MCB & a 20A fuses.
- Channel A 24V DC supply line protected with SPD and 10A Fuse.
- Channel B 24V DC supply line protected with SPD and 10A Fuse.
- Internal 24V DC supply line protected with SPD and 10A Fuse.
- FMC supply 24V DC protected with SPD and 10A Fuse.
- Panel indication 24V DC supply protected with SPD and 10A fuse.



MEI 100 – IPS

Counter Box Module

Counter Box consists of CPU card and Driver card. Counters & Buzzers Driver card is used to drive the counters and buzzers. CPU card is connected to Driver card and on the other hand it is connected to COMP-A and COMP-B, through Optical Fiber Interface. CPU card receives messages from both COMPs. Ultimately it takes data to drive counters and buzzers from the active COMP channel. Counter Box module also indicates VIC-A and VIC-B status (Active, Standby and Not Available) by the corresponding LEDs.

Data Logger (DL)

External Data Logger (DL) is a device connected to CIU through RS232-OFC interface. DL is used to log the yard and system status in every cycle. Proprietary serial communication protocol is used for Communication between CIU and Data Logger.

Video Display Unit Control terminal (VDU CT)

VDU CT is a PC with Software based controlling Terminal. It is connected to CIU through OFC Interface. Operator can issue commands using the simulated buttons on the VDU screen. It sends the command and receives the yard status from COMP and displays the same on the VDU screen.

Front Panel Display (FPD)

A front panel LED Display is connected to CIU through RS232 interface. The system consists of two LED display units, namely Display-A and Display-B for the main and standby units separately. This LED Display is used to display the system faults/recovery messages.

Maintenance Terminal (MT)

Maintenance Terminal is a PC based indication and monitoring unit. MT is connected to CIU through RS232- OFC Interface. MT screen shows the status of the system logs, the events/faults received from CIU and generates alarm signal if any critical fault is received from the CIU. Proprietary serial communication protocol is used for communication between CIU and MT.

- MT is a password-protected application, where unauthorized access is not allowed.
- The Event log/Fault analysis can be performed over a required time frame, chosen by the maintenance staff. Print facility is also available.
- The Playback feature of MT provides the Operator/Maintainer to visualize the Yard status over a required time frame and thus making the analysis easier.
- Fault messages are in simple English and greatly help to pinpoint the error location within the shortest time frame.

System Operation

- Cycle time of MEI633 is 333 ms.
- The actual state of the yard is displayed on CCIP/VDU CT.
- CIU receives commands from CCIP/VDU CT.
- CIU performs interlocking equation execution based on the received commands from CCIP/VDU CT and field inputs.
- CIU generated field outputs, which are transmitted to field modules, and indication output which is transmitted to PP/VDU CT.

Software

The system is configurable for any change of Yard Functions or Yard Function Arrangement. To achieve this, the Software has two layers:

- *Executive or System Software:* which defines what the system can do and how the various parts operate together. This Software remains constant for the system for any Yard.
- *Application Data:* It contains the logic that defines how the inputs and outputs of a particular station are related, and the Input and Output connectivity details of the System. This data is Yard specific and will change whenever the Yard configuration changes.
- The System Software and Application Data are stored in different Read Only Memories.
- The System has the facility for modification of Application Data as and when it is required.

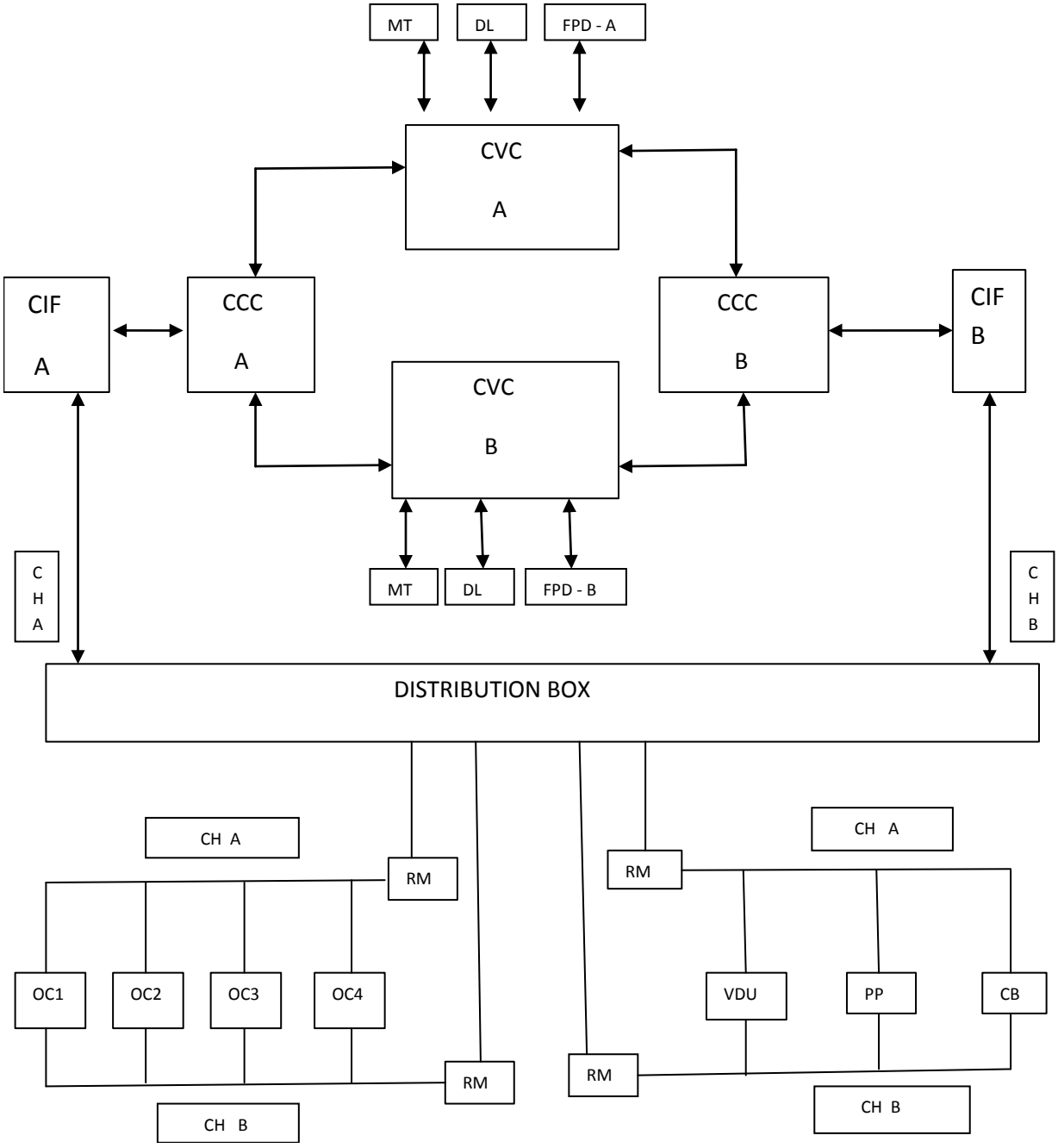
- The System Software is designed with a provision for modular expansion. Subset of C language is used to develop the software, with pre-defined coding standards and guidelines.
- CENELEC EN 50128 guidelines for SIL4 systems are followed for System Software development.

Maintenance

- CIU logs the generated events and fault codes in external flash memory in every cycle. It transmits event log to Data logger, fault information to FPD, and both event, fault information to Maintenance Terminal.
- CIU based Maintenance Terminal is developed as a user-friendly application providing hassle-free Interface, thus making the life easy for the Maintainer to pinpoint the problems during troubleshooting.
- Earthling for the installation will be checked once in every six months and regular maintenance activities.

Example

A) If the communication messages from IOCOM_0 to COMP are corrupted - Fault code displayed on MT is "Channel Noisy – IOCOM0"
B) If the communication messages from IOCOM_0 to COMP are not available – Fault code displayed on MT is "Link Fail- IOCOM0"
C) If the position of the Point18 in the field is undetermined - Fault code displayed on MT is "Point Detection Failed - PT18"
D) If HR Relay of Signal is picked up unintentionally, a wrong side failure is indicated along with safety action - Fault code displayed on MT is "HR Wrong Side Fail- SIGI.



CIU Architecture of the MEI 633

ARCHITECTURE OF OBJECT CONTROLLER MODULE

REVIEW QUESTIONS

1) What are the functions of the VCOR relay?

2) What is the procedure to initiate VDU panel operations?

3) Draw the block Diagram of MEI 633 complete architecture?

Date:

Signature of the trainee