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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

WESTRACE Mark II
ELECTRONIC INTERLOCKING



CAMTECH/S/PROJ/2019-20/SP5
October 2019
Target group:
SSEs/JEs(Signal) & Signal Maintainers

अआमा सं RDS
रेल अग्रदूत Transforming Railways

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Centre for Advanced Maintenance Technology

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Disclaimer

The information given in this pamphlet does not supersede any existing provisions laid down in Signal Engineering Manual, Railway Board and RDSO publications. This document is not statutory and instructions given in it are for the purpose of guidance only. If at any point contradiction is observed, then S.E.M., Rly. Board/RDSO guidelines or Zonal Rly. instructions may be followed.

Introduction

WESTRACE MK2 is a processor based vital signalling system, designed, manufactured and supplied by M/s Siemens. Some of the salient features are:

- The Processor Module, PM manages all vital and non-vital processing diagnostics and communication
- Hot swappable – All Modules can be removed and replaced while the WESTRACE MK2 interlocking is running—no configuration of new modules required
- Application data is stored on the PM backplane. Application Data does not have to be loaded and checked when the module is replaced.

Hardware

WESTRACE Mark II comprises of following components:

- Equipment housing
- Processor Modules (PM)
- Parallel Input Modules (PIM)
- Relay output modules (ROM)

WESTRACE MK2 Communications

WESTRACE MK2 systems use two types of communication:

Serial Module Bus

The Serial Module Bus (SMB) is used for local communication between a PM and IO modules. The SMB is part of the backplane within the housing. It can be connected to other housings, both local and remote via Ethernet.

Ethernet

PMs use Ethernet to communicate with:

- Control Centre
- MoviolaW
- Remote WESTRACE sub-systems
- Object controllers
- Other interlocking and compatible equipment

Power Supplies

WESTRACE operates from one or two 24 V DC, uninterruptable, smooth, supplies. The input voltage range is suitable for operation from a float charged battery. Typically two supplies are used, derived from separate sources to give high availability. Each housing requires its own power connection.

WESTRACE systems also require 50 V DC signalling supply to power ROM50 modules and provide input to PIM50 modules from external relay contacts..

Functions of various components

Module	Function
PM Processor Modules	Manages all interlocking functions (logic processing, IO modules, communication). Every WESTRACE system requires at least one PM. Two PMs may be connected in hot-standby for improved availability.
PIM50 Parallel Input Module 50 V DC	Receive input voltages from external devices. Two PIM50s may be connected in hot-standby for improved availability. They have 12 voltage detection inputs per module (50 V dc).
ROM50 Relay Output Module 50 V DC	Output to dc loads such as relays. Two ROM50 may be connected in hot-standby for improved availability. They have 8 voltage-source relay outputs per module (50 V dc).
Housings	Housings contain the modules. The housing backplane is used to communicate between modules. The PM backplane stores Application Data and provides Ethernet interfaces for PMs.
MovoilaW	MoviolaW is software installed on a PC. It is a suite of diagnostic tools used to monitor, record, and playback interlocking events and faults. It provides information that can help locate problems.

System Architecture

The WESTRACE Mk2 system uses Ethernet for vital and non-vital communications making it adaptable to applications of any size.

The PM contains three microprocessors. Microprocessors A and B perform the system's vital logic processing using diverse redundant channels. Microprocessor D manages communications and diagnostics. The block diagram of WESTRACE Mk2 system is given below:

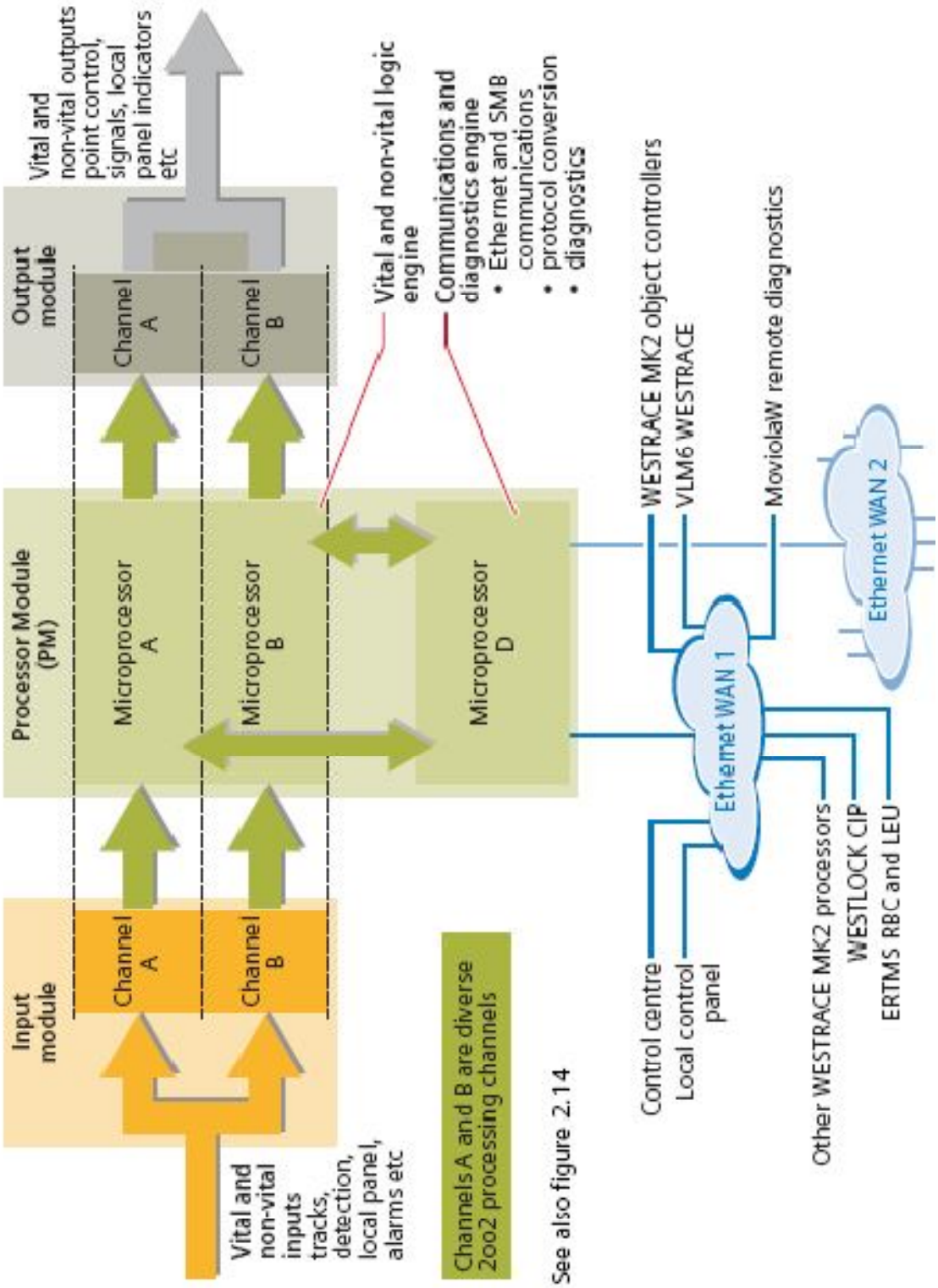


Fig.1: Block diagram of WESTRACE Mk2 System

Brief description of components

Housings

WESTRACE MK2 modules must be fitted into WESTRACE MK2 housings.
Available housings:

- 5-slot — a half 19" width housing that holds 5 modules maximum;
- 10-slot — a full 19" width housing that holds 10 modules maximum;

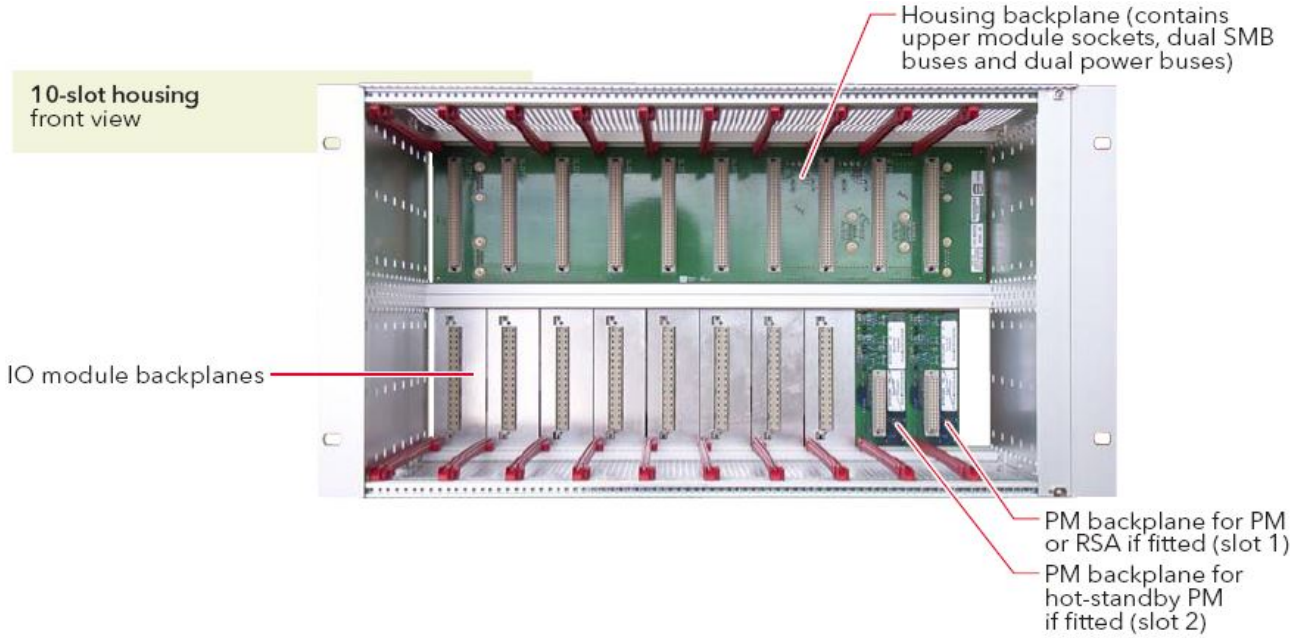


Fig.2(a): WESTRACE MK2 Housing front view

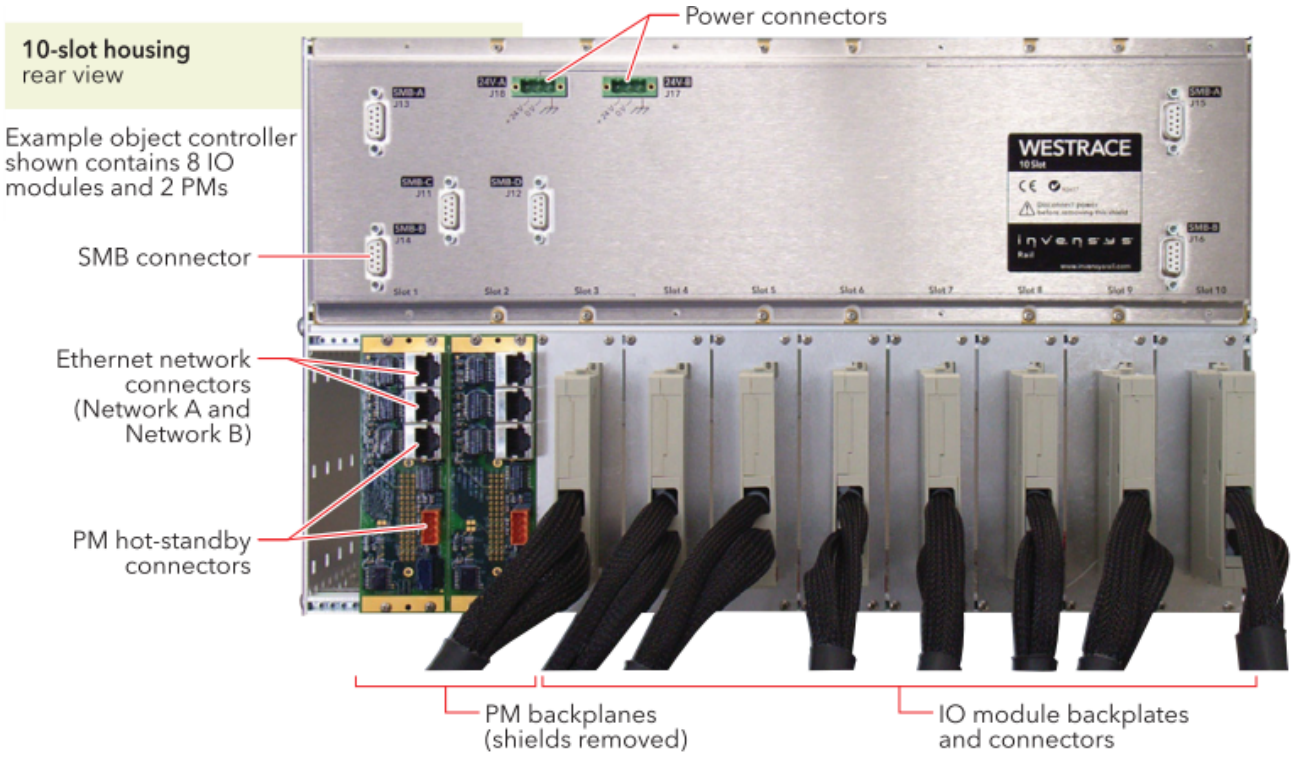


Fig.2(b) : WESTRACE MK2 Housing rear view

Processor Module (PM)

The PM is the heart of WESTRACE Mk2 . It executes the interlocking logic as defined in the Application Data. A PM is normally placed in slot 1 of housing 1. Hot-standby PMs are normally placed in slots 1 and 2 of housing 1 or slot 1 in each of two co-located housings.

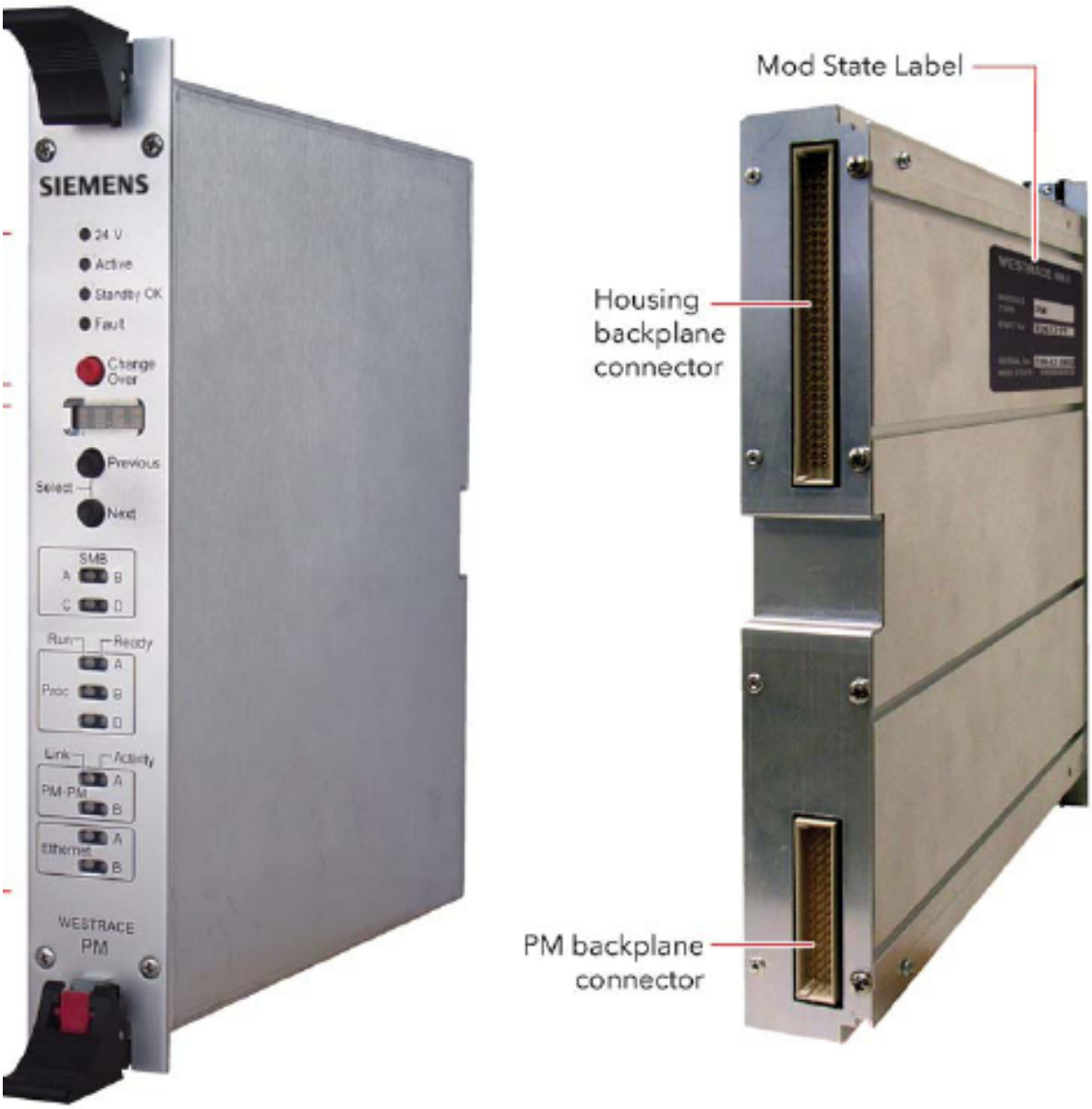


Fig.3: Processor Module (PM) front and rear views

Some of the salient features of PM are:

- Processor module is with 2oo2 architecture
- Additional processor, Processor D is there to take care of Diagnostics and Communications
- 255 vital communication sessions can be established
- 196608 logic states can be defined
- Dual redundant Serial Module Buses are available (A/B & C/D)
- Onboard flash for quick configuration – No need of Programmer and UV eraser

Parallel Input Module - PIM

PIMs receive 50 V DC inputs from the contacts of relays proving the status of outdoor gears such as:

Track Proving Relays (TPRs, VRs), Point Detection Relays (WKRs), Signal Aspect Proving Relays (ECRs), Interlocked Level Crossing Gate Proving Relay (LXPR), Crank Handle Proving (CHPR) etc.

PIMs in turn provide an equivalent logic state to the PM.

PIM50 have 12 inputs. Two PIMs of the same type may be connected in hot-standby for improved availability.

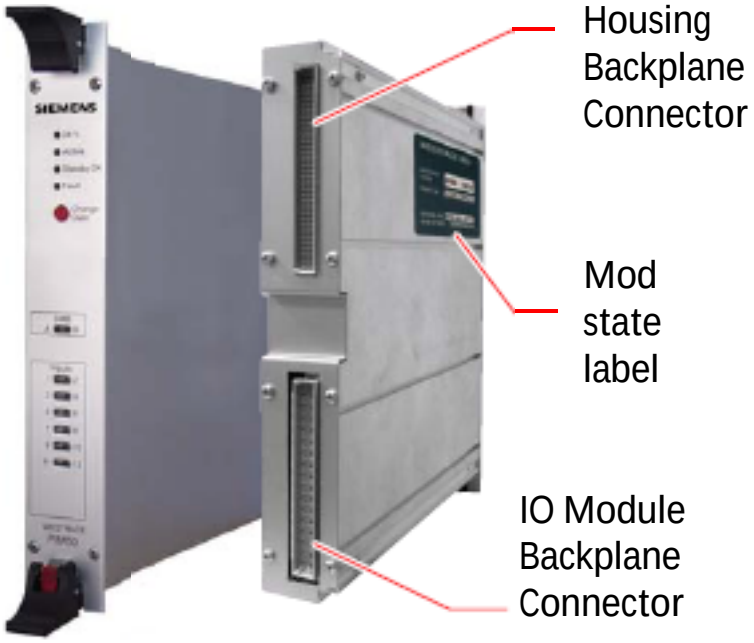
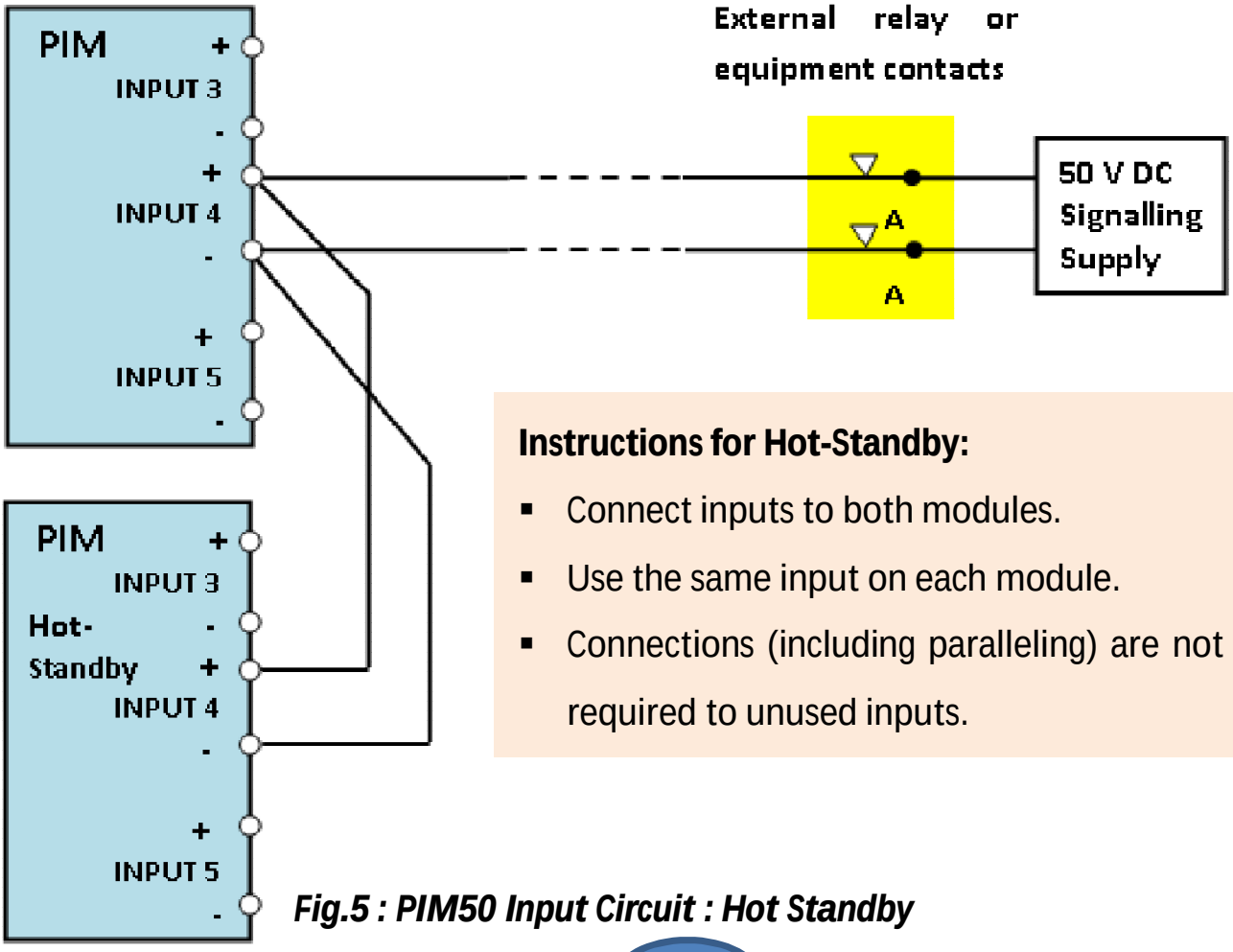


Fig.4 : Parallel Input Module (PIM) front and rear views



Instructions for Hot-Standby:

- Connect inputs to both modules.
- Use the same input on each module.
- Connections (including paralleling) are not required to unused inputs.

Fig.5 : PIM50 Input Circuit : Hot Standby

Relay Output Module - ROM

ROM receive logic states as 50 V DC input from the Processor Module (PM) and applies 50 V DC voltage to its isolated output terminals to pick up controlling relays for outdoor signalling gears such as Signal Control Relays HR, DR & HHR, Point Control Relays WNR & WRR, Crank Handle Lock Relay CHLR etc.

ROM50 have 8 outputs. Outputs of Hot-Standby modules are paralleled as shown in Fig.6.

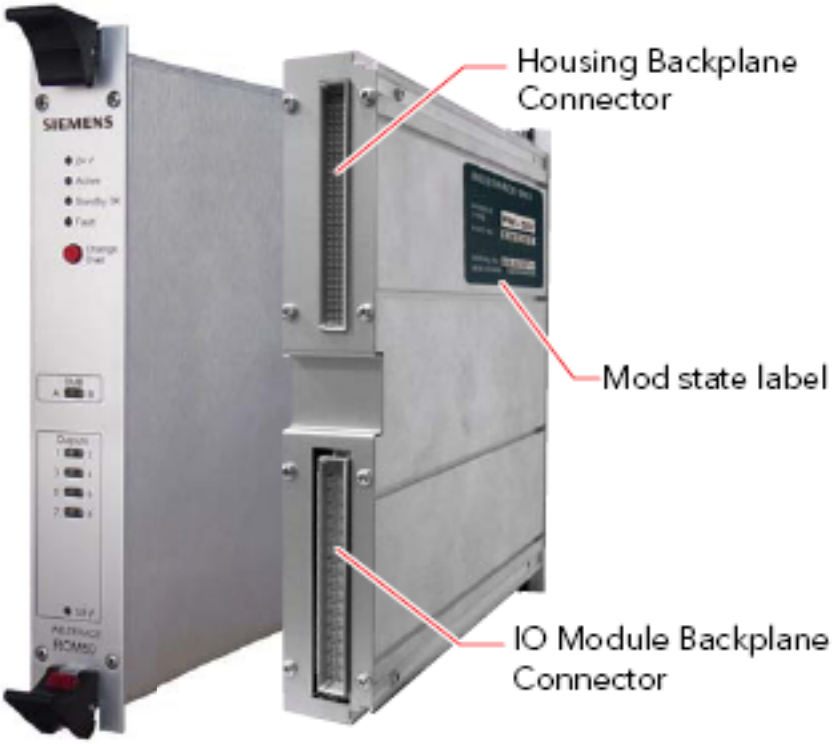
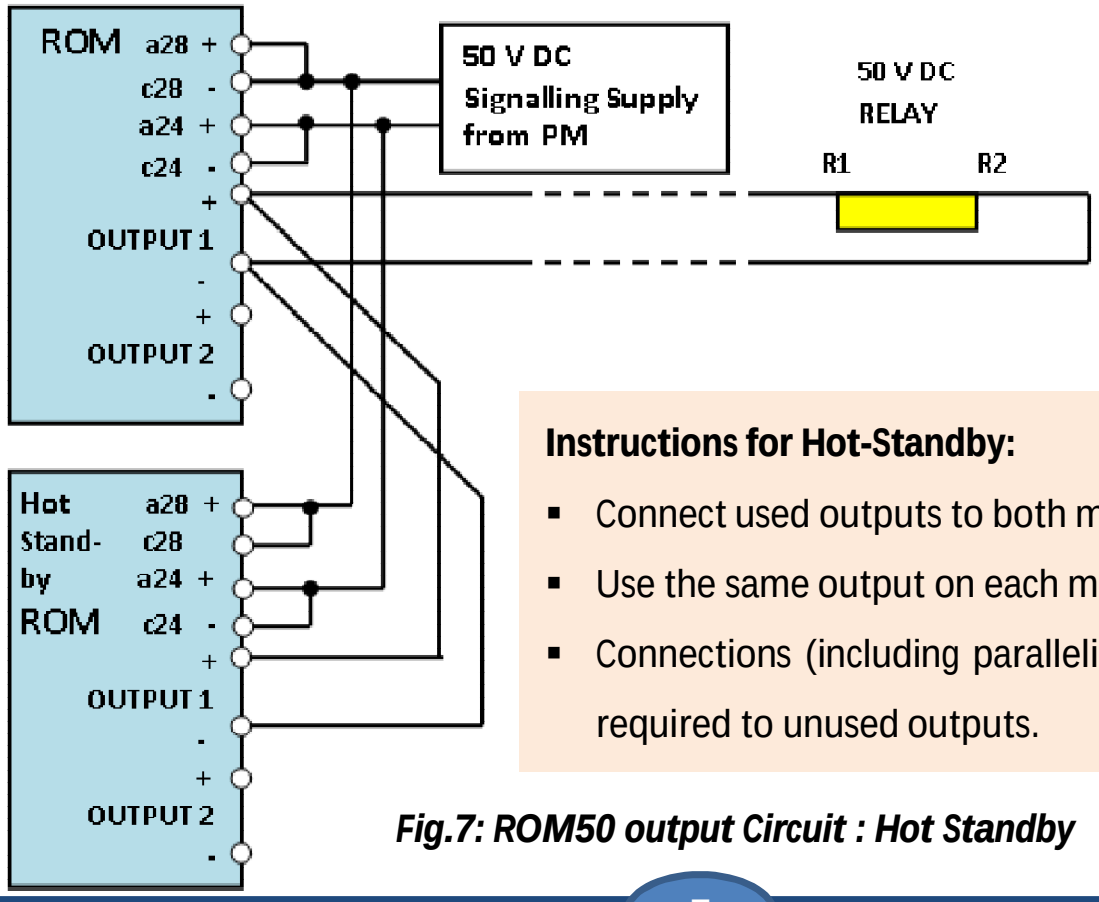


Fig.6: Relay Output Module (ROM) front and rear views



Instructions for Hot-Standby:

- Connect used outputs to both modules.
- Use the same output on each module.
- Connections (including paralleling) are not required to unused outputs.

Fig.7: ROM50 output Circuit : Hot Standby

Common Front panel LED indications

LEDs are useful for quickly identifying most faults. All LEDs are visible without removing any covers. Use MoviolaW fault codes for more detailed information.



24 V supply LED:
- Green = both 24 V supplies OK
- Red= one 24 V supply is OK
- Unlit = no 24 V supply

Active LED:
- Flashing green = module is active (online)
- Unlit = module is inactive

Standby OK LED:
- Green = Redundant pair is synchronized and standby module is ready to enter into active mode.
- Red = Redundant pair is not synchronized or standby module is not ready to enter into active mode.
- Unlit = module is not part of a hot-standby pair

Fault LED:
- Red = module has a fault
- Unlit = no fault

For a hot-standby pair, press active module's **Change Over** button to swap operation to the other module

Serial Module Bus A and B status LEDs:

Active PM, and active or inactive IO module
- Flashing green = SMB activity (transmitting or receiving)
- Unlit = no SMB activity (may be caused by failed link)

Inactive PM

Note.: The indications and their meanings given above are common to all modules.

Fig.8: Module front panel common LEDs and button

PM front panel indicators

PM display shows the PM settings menu, and mode, status and error messages.

PM display buttons:
Use **Previous** or **Next** to navigate display menu.
Press both to **Select** the current menu item.



See Fig.8

Processor **Run** LEDs (Left column) indicate the health of vital processors A and B, and non-vital processor 'D':
- Unlit A and B = boot and initialization phases.
- Flashing RED A & B =APPDEL phase.
- Flashing GREEN A & B = Operational Mode (PM healthy)
- Flashing GREEN D =all phases

Processor **Ready** LEDs (Right column) indicate the status of processor A and B application data transfer:
- RED = Processor loading application data
- GREEN = Processor has received application data Processor D **Ready** LED is reserved for future use

Serial **M**odule **B**us A,B,C & D status LEDs:
- Flashing GREEN = SMB activity (Transm-itting or Receiving)
- Unlit = No SMB activity (may be failed link)

All SMB unlit = inactive PM

Hot –standby **PM-PM Link** status LEDs (Left column):
- GREEN =Hot-standby 100 Mbps link exists between PMs
- YELLOW = Hot-standby 10 Mbps link exists between PMs
- Unlit = No link

Hot-standby **PM-PM Activity** status LEDs (Right column):
- Flashing YELLOW = Frame reception or transmission between Hot-standby PMs
- Unlit = Otherwise

Ethernet Link status LEDs (Left column) for Network A & Network B:
- GREEN = 100 Mbps link exists
- YELLOW = 10 Mbps link exists
- Unlit = No link

Ethernet Activity status LEDs (Right column) for Network A & Network B:
- Flashing YELLOW = Frame reception or transmission
- Unlit = Otherwise

Fig.9: Processor Module front panel indicators

Front panel LED indications of Parallel Input Module and Relay Output Module

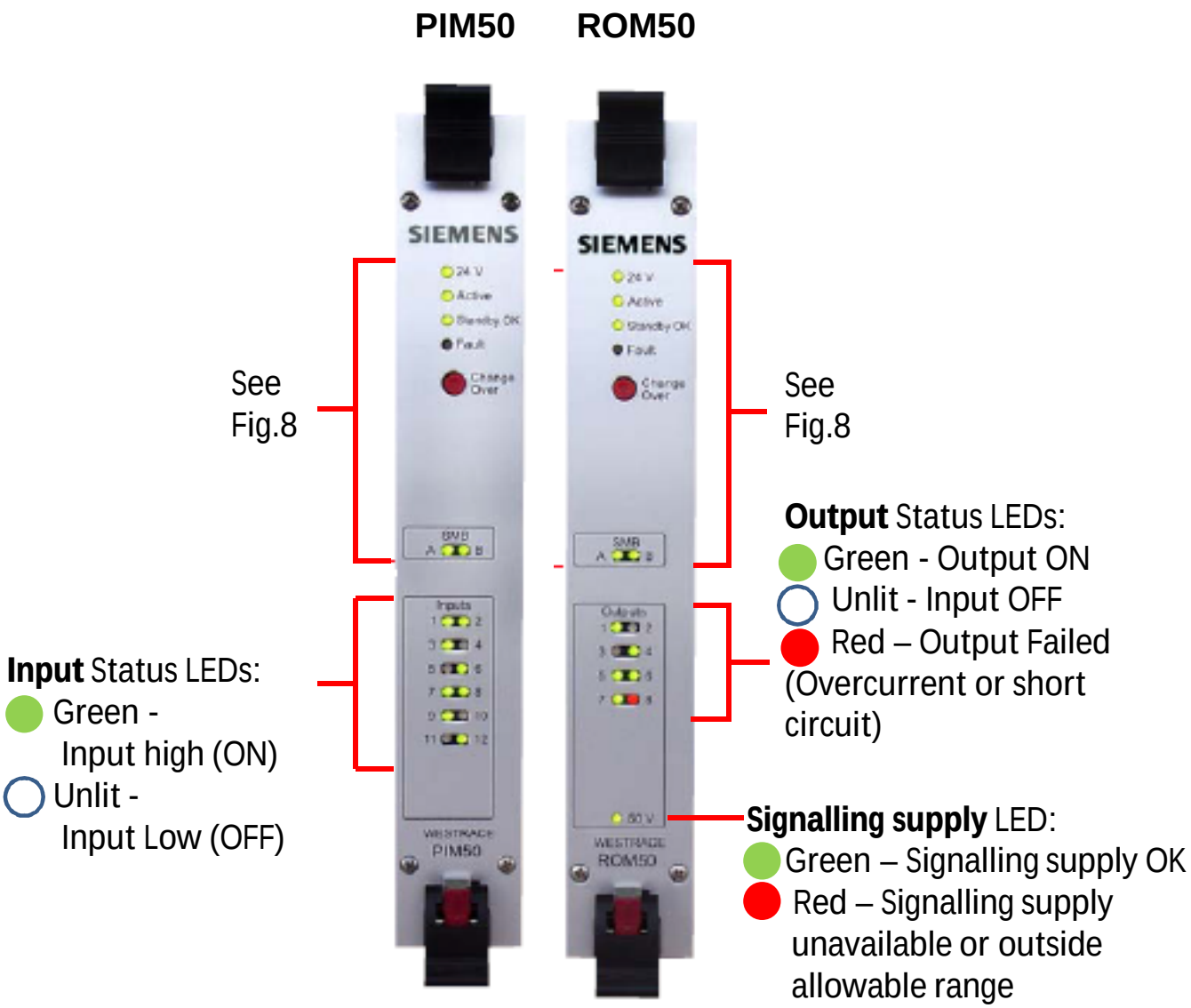


Fig.10 : Front Panel LED indications PIM50

Fig.11 : Front Panel LED indications ROM50

Removing a Module

Use the Faulty Equipment Return Form (Appendix C of of "First Line Maintenance manual –Trackguard WESTRACE MK2") to record the LED display on the faulty module. Follow the prescribed guideliness for disconnection before removing the module and then follow these steps (Refer Fig . 11):

a) Loosen the captive lock screw in each handle (if lock screws are fitted).
NOTE: Module lock screws may not be fitted because they are only required in high-vibration environments.

b) Press the red button in the lower handle.
This releases the lower handle and begins the module shutdown process.

c) Wait one second after depressing the red button to allow the module to shutdown.

d) Swing both handles outwards to release the module.
e) Slide the module out along its guides.
f) The interlocking's configuration requires that the module which is removed should be replaced by similar type of module.



Fig.12: Removing module from its housing

Inserting a Module

Follow these steps in reference to Fig. 13:

a) Check that you have the correct module for the slot. (It is possible to break the polarising pegs off the rear connector by forcing the incorrect module into a slot.). Align the rails on the left top and bottom edge of the module with the tracks at the top and bottom of the slot. Push the module in until the levers start to engage.

b1) Press the red button to allow the lower handle to swing down.

b2) Ensure that both handles are in the outwards position.

c) Slide the module in along its guides and press it into the connector.
NOTE: Do not use excessive force: it's possible to bend terminals and break polarising pegs if the rear connectors and sockets are mis-aligned.

d) Swing the upper and lower handles inwards to seat the module. The handles pull the module home as you swing them inwards.

e) Check that the LEDs indicate the normal working.

f) Tighten the captive lock screw in each handle (if module lock screws are fitted).

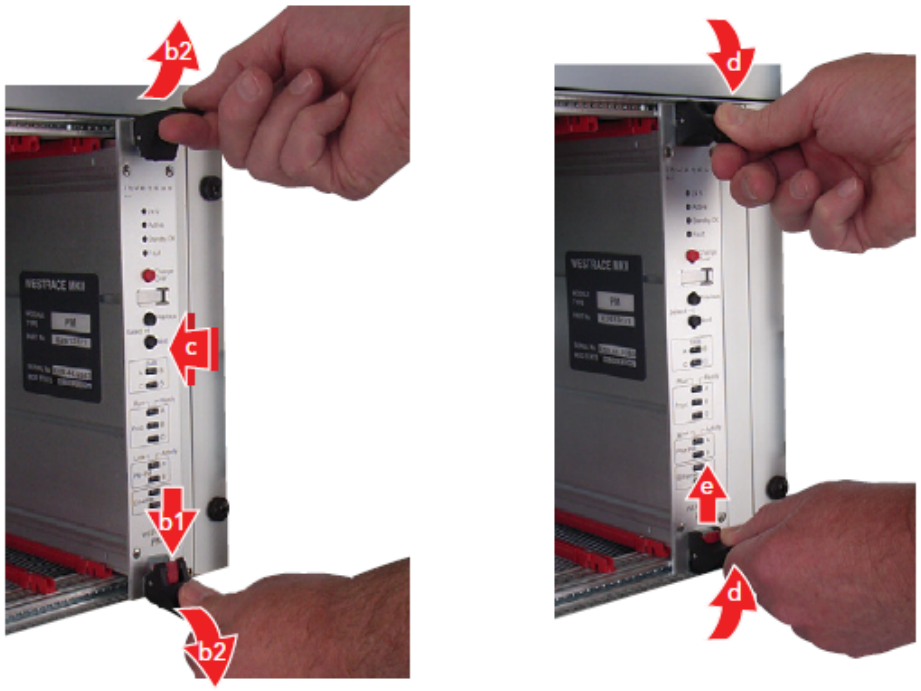


Fig.13: Inserting a Module in the proper slot

Manual Changeover of active module in a hot- standby pair

For a hot-standby pair, press the red Changeover button on the active module to force the inactive module in the pair to become online.

Check that the activated module is error free.

Once the modules are all working correctly after changeover/replacement, fix the screws at the top and bottom of the module, if they are used.

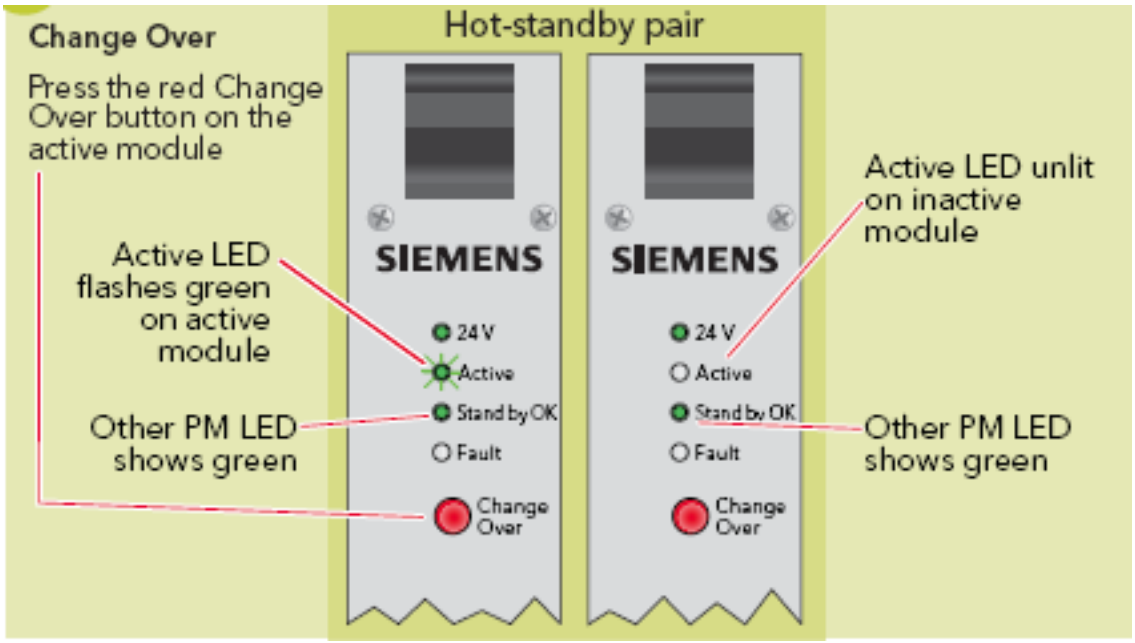


Fig.14: Changing over the active module in a hot-standby pair

Maintenance

Maintenance of WESTRACE MK2 is limited to the replacement of faulty modules, backplanes and cables. All modules can be swapped out while WESTRACE is running. Most faults are indicated by the Fault LED on the front of the module that requires replacement.

Modules require no configuration before replacement because the PM backplane stores all configuration data. The housing backplane contains all housing and installation address links.

WESTRACE may use hot-standby pairs of modules. Any fault on a module that is operating hot-standby will initiate an automatic change over to the standby module without interruption to the system operation. The faulty module can then be replaced (hot-swapped) without interrupting the railway.

Checking of Power Supplies

Verify the nominal value of all power supplies. Check the

(i) Main Power Supply

(ii) Signalling Power Supplies

- 50 V DC for ROM50 smoothed to not exceed
  Minimum 42 V, Maximum 60 V for 800 Ω to 10 k Ω loads.
  Minimum 47.5 V, Maximum 52.5 V for 200 Ω to 800 Ω loads.

- WESTRACE Power Supply (24 V DC). This should be within these limits:
  24 V DC nominal
  20 V DC minimum trough
  30 V DC maximum peak (including ripple & noise)

Check list for Signal Maintainer:

After any maintenance task and before leaving the installation site, the maintainer should check the following items:

- "24 V" LED is lit green in all modules.
- "Fault" LED is OFF in all modules.
- "Active" LED is lit green only on active modules.
- "Standby OK" is lit green in the active and inactive modules of any hot-standby pair of modules.
- "Standby OK" LED is OFF in standalone modules.
- "50 V" LED is lit green in all ROM50 modules.
- "SMB" "A" and "SMB" "B" LEDs are flashing green in all IO modules.
- "SMB" "A" and "SMB" "B" LEDs (and "SMB:" "C" and "SMB" "D", if configured) are flashing green in all PMs.
- "Proc" "Run" "A", "B" and "D" LEDs are flashing green in all PMs.
- "Proc" "Ready" "A" and "B" LEDs are lit green in all PMs.
- "PM-PM" "Link" status LEDs are lit green in all redundant PMs.

- "PM-PM" "Activity" status LEDs are flashing yellow in all redundant PMs.
- "Ethernet" "Link" status LED "A" (and "B", if used) is lit green in all PMs.
- "Ethernet" "Activity" status LED "A" (and "B", if used) is flashing yellow in all PMs.
- PM displays are clear.

Error codes

The PM display panel shows two types of error codes:

- Vital error codes—for errors in vital logic processing microprocessors
- Non-Vital error codes—for errors in the microprocessor that manages communications and diagnostics

Vital Error codes

Vital error codes are displayed as two pairs of hex digits. The first two digits show the error code for the A channel. The second two digits show the error code for the B channel.



Fig.15: Vital error codes display on PM display panel

Table F.1 "PM Display Panel Vital Error Codes for the A and B Channels (When not specified the error code applies to both channels)" on page F-3 of "First Line Maintenance manual –Trackguard WESTRACE MK2" lists the Vital Error codes that can be displayed in the PM display panel.

Non-Vital Error Codes

Non-vital error codes are displayed by both the PM and RSA. The codes are displayed with a "D" as the first character, followed by a blank character, then two hex digits indicating the error value for the non-vital channel



Fig.16: Non-Vital error codes display on PM display panel

Table F.2 "PM Display Panel Non-Vital Error Codes" on page F-10 of "First Line Maintenance manual –Trackguard WESTRACE MK2"lists the Non Vital Error codes that can be displayed in the PM display panel.

Do's & Don'ts for WESTRACE MK2

DO

- ✓ Keep the E.I. Room free from dust & Moisture and keep lesser ambient temperature.
- ✓ Keep the E.I. Room with good air flow circulation and ventilation.
- ✓ Place the removed faulty Modules with an Equipment Fault Report into an anti-static bag.
- ✓ Maintain minimum 24 Volt DC at the WESTRACE Housing Power Supply connectors (24 Volts).
- ✓ Maintain minimum 50 Volt DC at the WESTRACE Input/Output Modules (50 Volts).
- ✓ Take backup of MoviolaW – Maintenance Terminal User Data Event/Fault Log files in every 45 days.
- ✓ Check network cables connectivity between WESTRACE to WESTCAD & MoviolaW.
- ✓ Follow the Hot swap procedure of Restarting, Removing and Inserting of Modules.
- ✓ Ensure that "24 V" LED is lit Green in all Modules & "Fault" LED is OFF in all Modules.
- ✓ Ensure that "50 V" LED is lit Green in all ROM Modules & "SMB-A" , "SMB-B" LEDs are flashing Green in all IO Modules.
- ✓ Read carefully WESTRACE Fault Description on FLM during troubleshooting.
- ✓ Perform WESTRACE MK2 System Changeover on every fortnight.

DO NOT

- X **Attempt WESTRACE MK2 Trouble shooting if you do not have proper WESTRACE MK2 training.**
- X **Remove SMB cables, PM-PM Data cable, PM-PM Status cable, I/O connectors, when the system is ON.**
- X **Force modules into slots during insertion.**
- X **Touch the module components.**
- X **Repair modules on your own.**
- X **Alter WESTRACE MK2 Link setting MoviolaW & WESTCAD PC I.P. settings without Authorization.**
- X **Delete / modify application logic programs without Authorization.**
- X **Use any kind of solvents, detergents or abrasive cleaners on the housing or internal components.**
- X **Use vacuum cleaner /blower INSIDE the Housing.**
- X **Remove Optic Fiber Cable connector when system is ON.**
- X **Installation of Unauthorized software in WESTCAD/MoviolaW PCs.**
- X **Switch "OFF" WESTCAD {Operator VDU} terminal .**
- X **Switch "OFF" MoviolaW Diagnostic terminal.**
- X **Switch "OFF" Network Switch Power Supply and remove Network Communication cable.**