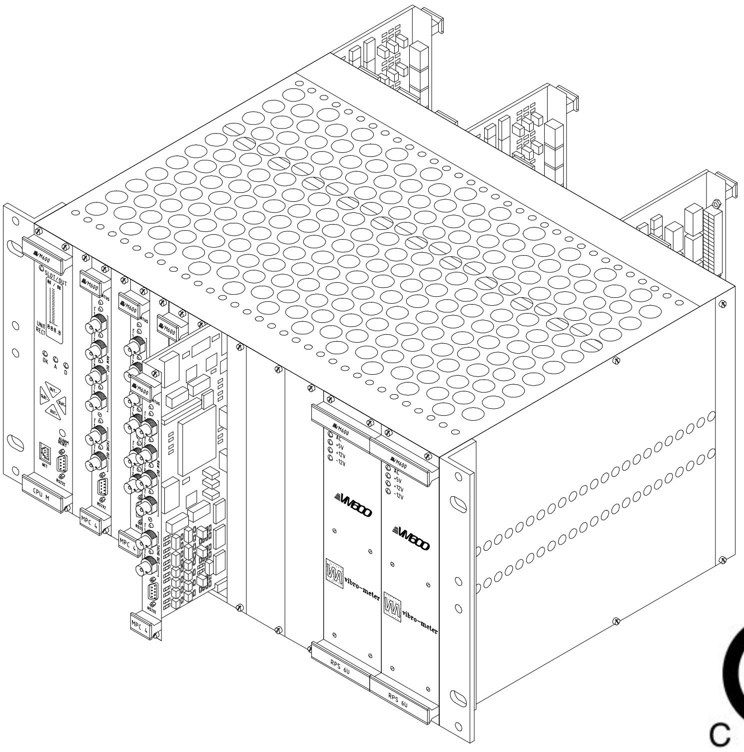
HARDWARE MANUAL

VM600
machinery protection system (MPS)
(CSA version)



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VM600 MPS hardware manual (CSA version) MAMPS-HW/E-CSA
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REVISION RECORD SHEET

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14	30.06.2015	Peter Ward	Added information on VM600 MPS rack (CPUM) security (see 1.3 Communicating with the VM600 MPS and 6 CPUM / IOCN card pair). Clarified the maximum current available for a VM600 rack using two RPS6U rack power supplies (see 2.9.6 Racks with two RPS6U rack power supplies in order to supply power to the cards). Added information on the difference between MPC4 and MPC4SIL cards (4.1 Different versions of the MPC4 card). Corrected the specification of the power supply in 4.4.2 Speed signal inputs to be consistent with 9 Configuration of MPC4 / IOC4T cards. Clarified operation of OK system (that is, sensor OK check in 4.7.1 OK system checking and 5.8.1 OK system checking. Added a table summarising the operation of LEDs on the CPUM panel (see Table 6-1). Added a table summarising the different processing modes supported by the different versions of the MPC4 card (see Table 7-1). Corrected how the VM600 MPS software calculates S_{max} (7.7 Smax measurement) and added information on an alternative way to calculate it (7.17 Dual mathematical function). Added information on narrow-band fixed frequency processing (7.18 Narrow-band fixed frequency). Added information on relay terminology (9.4.1 Relay terminology) and clarified how to configure relays on an IOC4T card in 9.4 Configuring the four local relays on the IOC4T (updated Figure 9-24 and added 9.4.2 Operation of relays). Clarified the use of micro-switches to configure the relays on an IOC8T card as NE/NDE (see 10.3 Configuring the four local relays on the IOC8T). Updated the fuse rating for racks running on an AC supply (see 13.6.1 General checks for racks). Clarified CPUM and IOCN connector terminology (RJxx replaced by xPxC, as appropriate) and their use. Updated to include the new CPU module (PFM-541I or equivalent) fitted to the CPUM card (see 6 CPUM / IOCN card pair, 12 Configuration of CPUM / IOCN cards and Appendix A Environmental specifications) and removed all references to the point-to-point protocol (PPP).	PW

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16	---	Peter Ward	Corrected the LP/HP ratio listed as a principal feature of 7.2 Broad-band absolute bearing vibration as the up to 100 limit applies to double integration only (an error introduced in edition 12 of the manual incorrectly stated "up to 100 with single or double integration"). Updated to include the improved RPS6U rack power supply (see 2.9 RPS6U rack power supply), which also included changes to the front panel, associated rear panels and labelling. Some specification changes were also required (see A.1 Overall and A.2 Operating temperatures for individual VM600 system components).	PW

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17	26.02.2018	Peter Ward	Added a statement that Meggitt SA product certifications and warranties are valid only for products purchased directly from Meggitt SA or an authorised distributor (see IMPORTANT NOTICES). Updated Figure 4-6 and Figure 5-3 to use “Alarm Reset”, rather than “Latch reset or latch delay”. Clarified the parameters that can be used for adaptive monitoring (see 4.6.3 Adaptive monitoring). Updated information on the channel inhibit function to clarify its operation and reflect changes in the latest versions of card firmware (see 4.6.6 Channel inhibit function and 5.7.4 Channel inhibit function). Updated status indicator LED information for the MPC4 card to include the behaviour for latched alarms (see Figure 2-5 and 4.9 Operation of LEDs on MPC4 panel). Updated status indicator LED information for the AMC8 card to include the behaviour for latched alarms (see Figure 2-7 and 5.10 Operation of LEDs on AMC8 panel). Updated the electrical circuit protection information to include the improved RPS6U rack power supply (see 8.3.2 Circuit breaker and 8.3.3 Supply wiring). Added connection diagrams for measurement chains using a GSI127 connected to an IOC4T card (see 9.2.4.1 Voltage-modulated signal with GSI127 galvanic separation unit and 9.3.4.1 Voltage-modulated signal with GSI127 galvanic separation unit). Updated 9.7 DSI control inputs (DB, TM, AR) and 10.5 DSI control inputs (DB, AR) to clarify the type of Alarm Reset (AR) signal required. Added information on the voltage and current limits of the IOC4T card’s common reference/return (RET) signal (see 9.5 Configuring the four DC outputs and 9.7 DSI control inputs (DB, TM, AR)). Clarified that the IOCN card’s group A and group B connectors primarily support RS-485 communication (see 12.6.3 RS, A and B connectors). Added end-of-life product disposal information (see 14 End-of-life product disposal). Updated the Energy product return procedure and form to be consistent with the Meggitt Vibro-Meter® website (see 15 Service and support). Added installation category and pollution degree information in Appendix A Environmental specifications. Updated the Power supply perturbation AC line frequencies to use nominal values (see A.1 Overall).	PW

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PREFACE

About this manual

This manual provides information on the VM600 series machinery protection system (MPS), from the Meggitt Sensing Systems' Vibro-Meter® product line.

It offers information concerning the installation, configuration and general use of the system.

About Meggitt, Meggitt Sensing Systems and Vibro-Meter

Headquartered in the UK, Meggitt PLC is a global engineering group specialising in extreme environment components and smart sub-systems for aerospace, defence and energy markets.

Meggitt Sensing Systems is the operating division of Meggitt specialising in sensing and monitoring systems, which has operated through its antecedents since 1927 under the names of ECET, Endevco, Ferroperm Piezoceramics, Lodge Ignition, Sensorex and Vibro-Meter. Today, these operations are integrated under one strategic business unit called Meggitt Sensing Systems, headquartered in Switzerland and providing complete systems, using these renowned brands, from a single supply base.

The Meggitt Sensing Systems facility in Fribourg, Switzerland operates as the legal entity Meggitt SA (formerly Vibro-Meter SA). This site produces a wide range of vibration, dynamic pressure, proximity, air-gap and other sensors capable of operation in extreme environments, electronic monitoring and protection systems, and innovative software for aerospace and land-based turbomachinery. This includes the VM600 machinery protection system (MPS) produced for the Vibro-Meter® product line.

Who should use this manual?

The manual is written for operators of process monitoring/control systems using a VM600 machinery protection system (MPS).

Operators are assumed to have the necessary technical training in electronics and mechanical engineering (professional certificate/diploma, or equivalent) to enable them to install, program and use the system.

Applicability of the manual

The manual applies to a VM600 machinery protection system (MPS) using the new generation of VM600 MPC4 cards (hardware versions 03x, 11x, 21x and subsequent models). These later cards are easily distinguished from earlier models as they have seven LEDs on their panels, whereas previous versions (01x and 02x) had only one LED (identified as DIAG).

Users of systems having earlier versions of the MPC4 card should refer to edition 4 of this manual.

Structure of the manual

This section gives an overview of the structure of the document and the information contained within it. Some information has been deliberately repeated in different sections of the document to minimise cross-referencing and to facilitate understanding through reiteration.

The chapters are presented in a logical order. You should read those that are most relevant to you and then keep the document at hand for future reference.

The structure of the document is as follows:

Safety Contains important information for your personal safety and the correct use of the equipment.

THIS SECTION SHOULD BE READ BEFORE ATTEMPTING TO INSTALL OR USE THE EQUIPMENT.

Part I: Functional description of VM600 MPS system

Chapter 1 *Introduction* – Familiarises the user with the function and features of the MPS.

Chapter 2 *Overview of VM600 MPS hardware* – Provides information on the physical aspects of the various cards and other components making up the system. Describes the elements on the panels of the cards and system components.

Chapter 3 *General system description* – Describes the MPS from a global, rack-level point of view. Introduces the MPC4 / IOC4T and AMC8 / IOC8T card pairs. Describes the rack backplane and its buses.

Chapter 4 *MPC4 / IOC4T card pair* – Contains a block diagram of this card pair and information on the signal processing performed by it. Provides details on inputs and outputs, rectification techniques, alarm monitoring possibilities (levels, delay time, hysteresis, logical combinations), the OK System and the operation of the LEDs on the panel of the MPC4.

Chapter 5 *AMC8 / IOC8T card pair* – Contains a block diagram of this card pair and information on the signal processing performed by it. Provides details on inputs and outputs, processing functions, alarm monitoring possibilities (levels, delay time, hysteresis, logical combinations), the OK System and the operation of the LEDs on the panel of the AMC8.

Chapter 6 *CPUM / IOCN card pair* – Provides a brief overview of the function of this card pair and contains a block diagram of each card.

Chapter 7 *Processing modes and applications* – Describes the operation of the MPS in all its operating configurations (broad-band vibration, shaft relative vibration, eccentricity, dynamic pressure and so on). Processing steps are shown in block diagrams and additional background information on the measurement type is provided.

Part II: Installing VM600 MPS hardware and using the system

Chapter 8 — *Installation* – Provides information on installing the cards and power supplies in the VM600 MPS rack.

Chapter 9 — *Configuration of MPC4 / IOC4T cards* – Describes the connectors on the IOC4T card. Includes typical connection diagrams for measurement signal sensors (for example, accelerometers, proximity probes) and speed signal sensors. Contains information on attributing specific alarm signals to specific relays on RLC16 cards using the Open Collector Bus and the Raw Bus.

Chapter 10 — *Configuration of AMC8 / IOC8T cards* – Describes the connectors on the IOC8T card. Includes typical connection diagrams for thermocouples, RTD devices as well as other sensors providing a voltage-based or current-based signal. Contains information on attributing specific alarm signals to specific relays on RLC16 cards using the Open Collector Bus and the Raw Bus.

Chapter 11 — *Using the RLC16 card* – Provides information on the screw terminal strips on these relay cards.

Chapter 12 — *Configuration of CPUM / IOCN cards* – Contains details on configuring jumpers on the two cards, as well as information on connectors.

Part III: Maintenance and technical support

Chapter 13 — *Maintenance and troubleshooting* – Contains some basic tips for fault-finding. Also includes information on long-term storage of racks.

Chapter 14 — *End-of-life product disposal* – Provides information and contact details concerning the environmentally friendly disposal of electrical/electronic equipment at the end of its useful life.

Chapter 15 — *Service and support* – Provides contact details for technical queries and information concerning the repair and return of equipment.

Part IV: Appendices

Appendix A — *Environmental specifications* – Contains general environmental specifications for the entire machinery protection system viewed as a whole.

Appendix B — *Data sheets* – Includes data sheet information for all cards and other system components used in the VM600 MPS. The data sheets provide full electrical and mechanical specifications, ordering information and so on.

Appendix C — *Definition of backplane connector pins* – Contains pin definitions for connectors P1, P2, P3 and P4 for each slot in the ABE04x rack.

Appendix D — *Abbreviations and symbols* – Contains a list of abbreviations and measurement unit symbols used in this document.

Product Defect Report — Allows the user to indicate problems observed on a module/system component, thus enabling our customer support department to repair the equipment as quickly as possible.

Documentation Evaluation Form — Allows the user to provide us with valuable feedback on our documentation.

Terminology

MPC4 cards

NOTE: The MPC4 machinery protection card is available in different versions, including a standard version, a separate circuits version and a safety (SIL) version.
See 4 MPC4 / IOC4T card pair for additional information.

In general, MPC4 is used in this manual to refer to all versions of the card. However, where it is necessary to make a distinction, **MPC4** is used to indicate the standard and separate circuits versions of the card and **MPC4SIL** is used to indicate the safety version.

Software

VM600 MPSx is proprietary software from Meggitt Sensing Systems that can configure and manage VM600 racks containing AMC8 and MPC4 cards:

- VM600 MPS1© allows the complete configuration of a VM600 machinery protection system and the display of live data. It is intended to be used for machinery protection applications.
- VM600 MPS2© allows the complete configuration of a VM600 machinery protection system and the display of historical or live data. It is intended to be used for machinery protection and/or basic condition monitoring applications.

  (VM600 MPS2 includes all of the functionality provided by the VM600 MPS1 software with additional features, such as plots for the visualisation and trending of data.)

VibroSight® is proprietary software from Meggitt Sensing Systems that can configure and manage VM600 XMx16 cards such as the XMC16, XMV16 and XMVS16, and/or VibroSmart® distributed monitoring system (DMS) modules such as the VSI010 and VSV300.

Related publications and documentation

For further information on the use of a VM600 machinery protection system (MPS), the operator is referred to one or more of the following Meggitt Sensing Systems (MSS) manuals:

- *MPCC configuration software for VM600 series machinery protection card*
  (MSS document ref. MAMPCC-30/E)
- *VM600 MPS1 configuration software for machinery protection system software manual*
  (MSS document ref. MAMPS1-SW/E)
- *VM600 MPS2 configuration software for machinery protection system software manual*
  (MSS document ref. MAMPS2-SW/E).

Operators of networked VM600 racks should also refer to the following document:

- *VM600 networking manual*
  (MSS document ref. MAVM600-NET/E).

Operators of safety-related systems should also refer to the following document:

- *VM600 safety manual*
  (MSS document ref. MAVM600-FS/E).

For information on the use of a VM600 condition monitoring system (CMS), refer to the following Meggitt Sensing Systems (MSS) documentation:

- *VM600 condition monitoring system (CMS) hardware manual*
  (MSS document ref. MACMS-HW/E).

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SAFETY

Symbols and styles used in this manual

The following symbols are used in this manual where appropriate:

The WARNING safety symbol

THIS INTRODUCES DIRECTIVES, PROCEDURES OR PRECAUTIONARY MEASURES WHICH MUST BE EXECUTED OR FOLLOWED. FAILURE TO OBEY A WARNING CAN RESULT IN INJURY TO THE OPERATOR OR THIRD PARTIES.

The CAUTION safety symbol

This draws the operator's attention to information, directives or procedures which must be executed or followed. Failure to obey a caution can result in damage to equipment.

The ELECTROSTATIC SENSITIVE DEVICE symbol

This indicates that the device or system being handled can be damaged by electrostatic discharges. See Handling precautions for electrostatic sensitive devices on page xvi for further information.

NOTE: The NOTE symbol. This draws the operator's attention to complementary information or advice relating to the subject being treated.

Important remarks on safety

Read this manual carefully and observe the safety instructions before installing and using the equipment described.

By doing this, you will be aware of the potential hazards and be able to work safely, ensuring your own protection and also that of the equipment.

Every effort has been made to include specific safety-related procedures in this manual using the symbols described above. However, operating personnel are expected to follow all generally accepted safety procedures.

All personnel who are liable to operate the equipment described in this manual should be trained in the correct safety procedures.

Meggitt Sensing Systems does not accept any liability for injury or material damage caused by failure to obey any safety-related instructions or due to any modification, transformation or repair carried out on the equipment without written permission from Meggitt SA. Any modification, transformation or repair carried out on the equipment without written permission from Meggitt SA will invalidate any warranty.

Electrical safety and installation

WHEN INSTALLING A VM600 RACK, OBSERVE ALL SAFETY (WARNING AND CAUTION) STATEMENTS IN THIS MANUAL AND FOLLOW ALL NATIONAL AND LOCAL ELECTRICAL CODES.

ONLY TRAINED AND QUALIFIED PERSONNEL (SUCH AS A QUALIFIED/LICENSED ELECTRICIAN) SHOULD BE ALLOWED TO INSTALL OR REPLACE THIS EQUIPMENT.

CHECK NATIONAL AND LOCAL ELECTRICAL CODES, REGULATIONS AND DIRECTIVES BEFORE WIRING.

A VM600 RACK MUST BE DIRECTLY AND PERMANENTLY CONNECTED TO PROTECTIVE EARTH (PE), KNOWN AS AN EQUIPMENT GROUNDING CONDUCTOR IN THE US NATIONAL ELECTRICAL CODE, USING THE EARTH CONDUCTOR OF THE EXTERNAL MAINS POWER SUPPLY LEAD (POWER CORD), IN ORDER TO HELP PREVENT THE RISK OF ELECTRIC SHOCK.

SELECT CABLE WIRE SIZES AND CONNECTORS (CURRENT-CARRYING CAPACITY), INCLUDING THE EXTERNAL MAINS POWER SUPPLY LEAD (POWER CORD), TO MEET THE REQUIREMENTS OF THE APPLICATION IN ACCORDANCE WITH THE APPLICABLE NATIONAL AND LOCAL ELECTRICAL CODES.

CHECKS TO ENSURE ELECTRICAL SAFETY SHOULD BE CARRIED OUT BY A COMPETENT PERSON.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN DEATH, SERIOUS INJURY, AND/OR EQUIPMENT DAMAGE.

Hazardous voltages and the risk of electric shock

HAZARDOUS VOLTAGES EXIST WITHIN A VM600 RACK.

WHEN A CARD, PANEL OR POWER SUPPLY IS REMOVED FROM A VM600 RACK, THE RACK BACKPLANE – CONTAINING HAZARDOUS VOLTAGES – IS EXPOSED AND THERE IS THE RISK OF ELECTRIC SHOCK, AS INDICATED BY THE USE OF THE FOLLOWING WARNING LABEL ON THE EQUIPMENT:

REGARD ANY EXPOSED COMPONENT, CONNECTOR OR PRINTED CIRCUIT BOARD (PCB) AS A POSSIBLE SHOCK HAZARD AND DO NOT TOUCH WHEN ENERGISED.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN DEATH, SERIOUS INJURY, AND/OR EQUIPMENT DAMAGE.

Hot surfaces and the risk of burning

HOT SURFACES CAN EXIST WITHIN AND ON A VM600 RACK.

DEPENDING ON THE AMBIENT OPERATING TEMPERATURE AND POWER CONSUMPTION, AND THE INSTALLATION AND COOLING OF A VM600 RACK, THE TOP OF THE RACK CAN BECOME HOT TO TOUCH AND THERE IS THE RISK OF BURNING WHEN HANDLING THE RACK, AS INDICATED BY THE USE OF THE FOLLOWING WARNING LABEL ON THE EQUIPMENT:

REGARD THE TOP OF A VM600 RACK AS A HOT SURFACE AND DO NOT TOUCH UNLESS COOL.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN INJURY.

Heavy objects and the risk of injury

A POPULATED VM600 SYSTEM RACK WITH CARDS AND RACK POWER SUPPLIES INSTALLED IS A HEAVY OBJECT.

DEPENDING ON THE NUMBER OF VM600 CARDS AND RPS6U RACK POWER SUPPLIES INSTALLED, A VM600 SYSTEM RACK (ABE04x) CAN BE TOO HEAVY TO LIFT, LOWER OR OTHERWISE HANDLE MANUALLY AND THERE IS THE RISK OF INJURY DURING INSTALLATION OR REMOVAL.

REGARD A POPULATED VM600 SYSTEM RACK AS A HEAVY OBJECT AND DO NOT HANDLE MANUALLY UNTIL ANY RPS6U RACK POWER SUPPLIES (AND VM600 CARDS AS NECESSARY) HAVE BEEN REMOVED IN ORDER TO REDUCE THE WEIGHT, AS THESE ARE THE HEAVIEST SYSTEM COMPONENTS THAT CAN BE EASILY REMOVED.

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN INJURY.

Replacement parts and accessories

Use only approved replacement parts and accessories.

Do not connect with incompatible products or accessories.

Only use replacement parts and accessories intended for use with VM600 racks that have been approved by Meggitt SA.

Using incompatible replacement parts and accessories could be dangerous and may damage the equipment or result in injury.

For information on replacement parts and accessories:

- Visit the Meggitt Vibro-Meter® website at www.meggittsensing.com/energy
- Contact your local Meggitt Sensing Systems representative.

Handling precautions for electrostatic sensitive devices

Certain devices used in electronic equipment can be damaged by electrostatic discharges resulting from built-up static electricity. Because of this, special precautions must be taken to minimise or eliminate the possibility of these electrostatic discharges occurring.

Read the following recommendations carefully before handling electronic circuits, printed circuit boards or modules containing electronic components.

- Before handling electronic circuits, discharge the static electricity from your body by touching and momentarily holding a grounded metal object (such as a pipe or cabinet).
- Avoid the build-up of static electricity on your body by not wearing synthetic clothing material, as these tend to generate and store static electric charges. Cotton or cotton blend materials are preferred because they do not store static electric charges.
- Do not handle electronic circuits unless it is absolutely necessary. Only hold cards by their handles or panels.
- Do not touch printed circuit boards, their connectors or their components with conductive devices or with your hands.
- Put the electronic circuit, printed circuit board or module containing electronic components into an antistatic protective bag immediately after removing it from a VM600 rack.

TABLE OF CONTENTS

Part I: Functional description of VM600 MPS system

Part II: Installing VM600 MPS hardware and using the system

Part III: Maintenance and technical support

Part IV: Appendices

1 INTRODUCTION

1.1 Applications

The VM600 machinery protection system (MPS) is a digital machinery protection system designed for use in industrial applications. It is intended primarily for vibration monitoring to assure the protection of rotating machinery as used in, for example, the power generation, petro-chemical and petroleum industries as well as in marine related applications.

This equipment is intended to be used as CAT I, and not as CAT II, III or IV equipment.

All measurement input terminals, accessible from the rear panel, on IOC cards, are CAT I measurement circuitry. CAT I indicates measurements made on circuits not directly connected to the main power supply.

1.2 General overview

The VM600 series of machinery protection and monitoring systems from Meggitt Sensing Systems' Vibro-Meter® product line are based around a 19" rack (6U) containing various types of cards, depending on the application.

There are basically two types of system:

- Machinery protection system (MPS rack)
- Condition monitoring system (CMS rack).

It is also possible to integrate machinery protection and condition monitoring hardware into the same VM600 rack.

NOTE: This manual describes machinery protection system (MPS) hardware only. Further information on condition monitoring system hardware can be found in the *VM600 condition monitoring system (CMS) hardware manual* (MACMS-HW/E).

In its most basic configuration, a VM600 machinery protection system (MPS) consists of the following hardware:

1- ABE04x (19" x 6U) rack

NOTE: The ABE040 and ABE042 are identical apart from the position of the rack mounting brackets.

2- RPS6U rack power supply

3- MPC4 machinery protection card

4- IOC4T input/output card for the MPC4

5- AMC8 analog monitoring card

6- IOC8T input/output card for the AMC8.

The MPC4 and IOC4T cards form an inseparable pair and one cannot be used without the other. These cards are used primarily to monitor vibration for the purposes of machinery protection.

Similarly, the AMC8 and IOC8T cards form an inseparable pair. These cards are used primarily to monitor quasi-static parameters such as temperature, fluid level or flow rate for the purposes of machinery protection.

In general, a VM600 rack used for machinery protection can contain:

- Only MPC4 / IOC4T card pairs
- Only AMC8 / IOC8T card pairs
- A combination of MPC4 / IOC4T and AMC8 / IOC8T card pairs.

Depending on the application, the following type of card can also be installed in the rack:

7- RLC16 relay card (16 relays).

All the above items can be used to make a stand-alone MPS system, that is, one that is not connected to a network.

A networked version of the MPS will also contain the following hardware in the rack:

8- CPUM modular CPU card

9- IOCN input/output card for the CPUM.

Depending on the application (and irrespective of whether the rack is used in a stand-alone or a networked configuration), one or more of the following low-noise power supplies can be used outside an ABE04x rack:

- APF19x 24 V_{DC} power supplies
- Any equivalent low-noise power supply provided by the customer.

These devices must be used for GSI1xx galvanic separation units, GSV safety barriers and transducer and signal conditioner front-ends having a current requirement greater than 25 mA. They will often be mounted in the cubicle in which the rack is installed.

NOTE: Refer to the individual data sheets for full technical specifications of the MPS hardware (see Appendix B - Data sheets).

Finally, a combined machinery protection and condition monitoring system can integrate the following condition monitoring hardware in a VM600 rack:

- XMx16/XIO16T extended monitoring card pairs.

NOTE: Further information on the condition monitoring system hardware can be found in the *VM600 condition monitoring system (CMS) hardware manual*.

Figure 1-1 and Figure 1-2 show front and rear views of a typical VM600 rack containing machinery protection system (MPS) hardware.

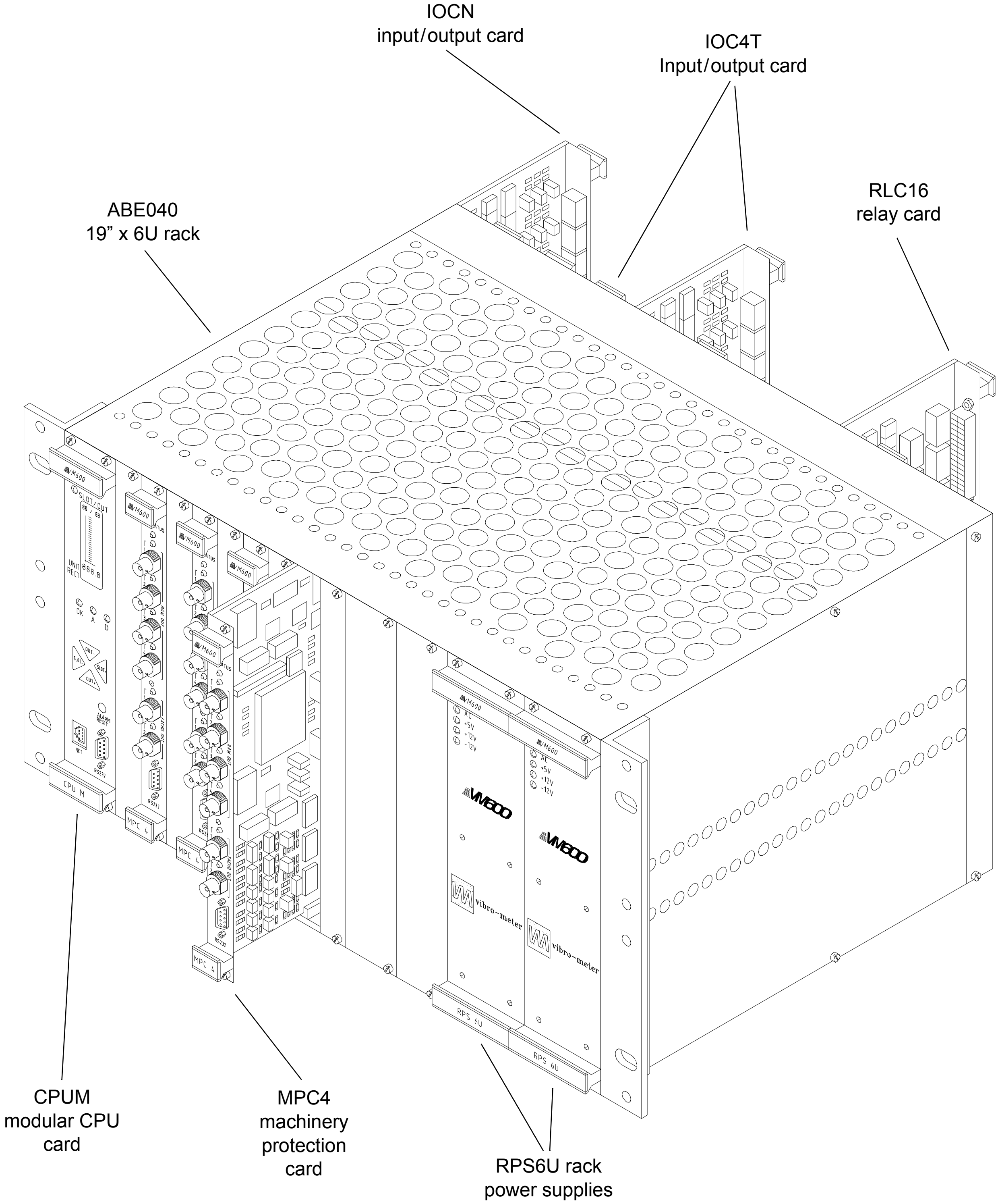

Figure 1-1: Front-view drawing of a typical VM600 MPS system featuring MPC4 / IOC4T card pairs

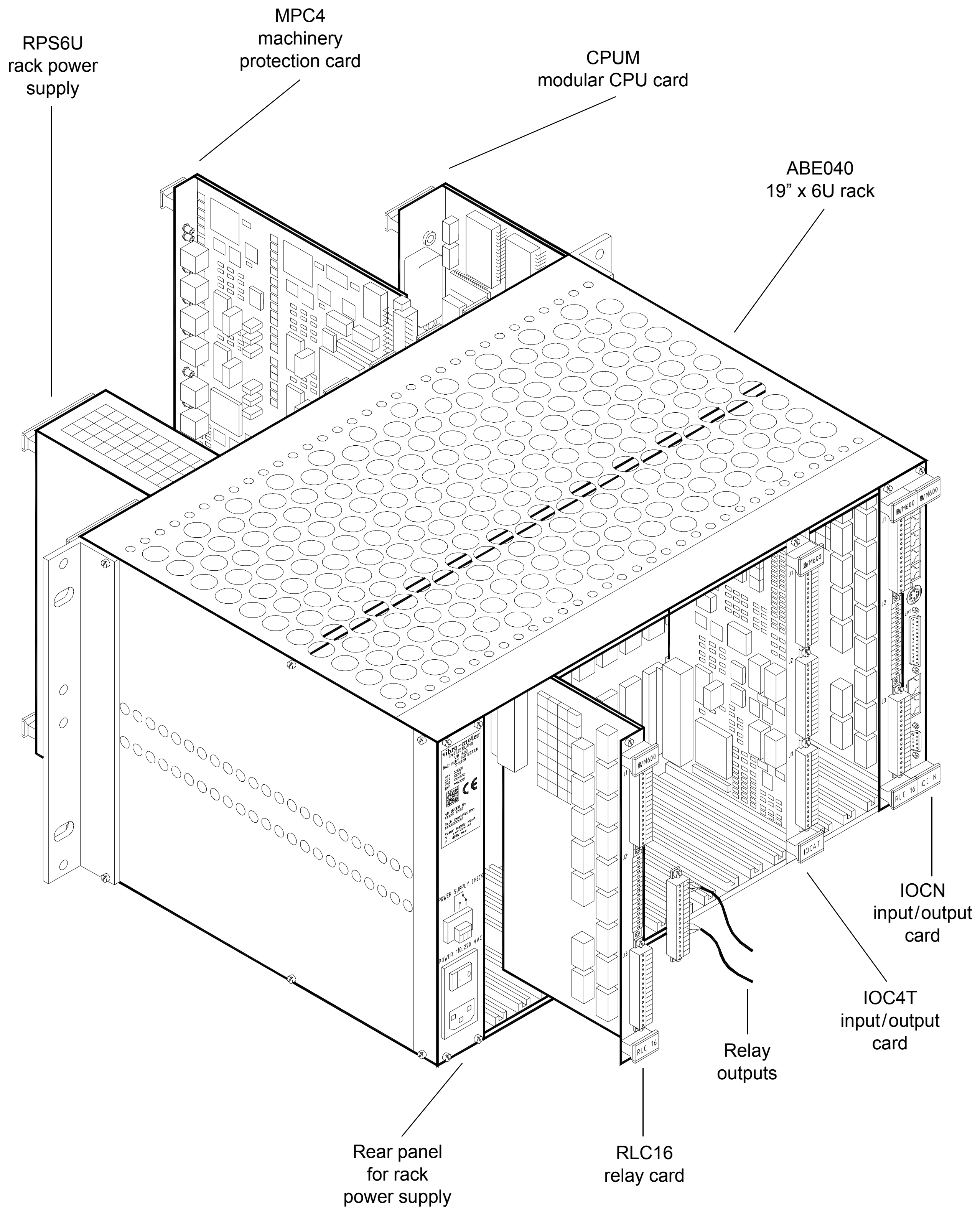

Figure 1-2: Rear-view drawing of a typical VM600 MPS system featuring MPC4/ IOC4T card pairs

1.3 Communicating with the VM600 MPS

A VM600 MPS can be configured in several ways, depending on the hardware installed in the system rack (ABE04x). Figure 1-3 shows the various possibilities for communicating with the system. In all cases, one of the VM600 MPS software packages (MPS1 or MPS2) is required to perform the configuration.

In general, VM600 MPS racks can be classified as operating either with or without a CPUM modular CPU card installed:

- A VM600 rack without a CPUM card, also known as a stand-alone rack, is a MPS system that is not connected to a network.

  In a stand-alone rack, each MPC4 and AMC8 card must be configured in turn using an RS-232 link to a computer running one of the VM600 MPS software packages (MPS1 or MPS2). The panels of MPC4 and AMC8 cards have a 9-pin D-sub connector for configuring the card when used in a stand-alone rack.

- A VM600 rack containing a CPUM card (and, optionally, its associated IOCN card), also known as a networked rack, is a MPS system that is connected to a network.

  In a networked rack, the CPUM card acts as a “rack controller” and allows an Ethernet link to be established between the rack and a computer running one of the VM600 MPS software packages (MPS1 or MPS2).

  In general, communication between the CPUM and the MPC4 and AMC8 cards takes place via a VME bus on the VM600 rack backplane. A networked rack allows all of the MPC4 and AMC8 cards in a rack to be configured in ‘one-shot’ using a direct Ethernet (or RS-232) connection to a computer running one of the VM600 MPS software packages.

NOTE: The MPC4 machinery protection card is available in different versions, including a standard version, a separate circuits version and a safety (SIL) version (see 4 MPC4 / IOC4T card pair).
The safety version of the MPC4 card (MPC4SIL) does not have a VME bus interface so it cannot communicate with a CPUM or any other cards in a VM600 rack. Accordingly, the MPC4SIL card can only be configured via the RS-232 connector on its panel.

Figure 1-3 (a) shows the simplest VM600 MPS configuration. This is a stand-alone rack, that is, one not containing a CPUM card. In this case, each MPC4 and AMC8 card in the rack must be programmed individually from a computer using an RS-232 link. This is done via a 9-pin D-sub connector on the panel of each of these cards.

Figure 1-3 (b) shows a networked rack containing a CPUM card. An Ethernet link can be established between the computer and the MPS via this card. The connection is made on the panel of the CPUM, hence at the front of the rack. Communication between the CPUM and the MPC4 and AMC8 cards takes place via a VME bus on the VM600 rack’s backplane – except for MPC4SIL cards as they do not have a VME bus interface and cannot communicate with a CPUM or any other cards in a VM600 rack.

Figure 1-3 (c) shows a rack containing a CPUM card and its associated IOCN input/output card. An Ethernet link can be established between the computer and the MPS via the IOCN. The connection is made on the IOCN panel, hence at the rear of the rack. Communication between the IOCN / CPUM and the MPC4 and AMC8 cards takes place via a VME bus on the VM600 rack’s backplane – except for MPC4SIL cards as they do not have a VME bus interface and cannot communicate with a CPUM or any other cards in a VM600 rack.

NOTE: A VM600 MPS in a 19″ system rack (ABE04x) containing a CPUM card can implement specific rack security features in order to limit the functionality of the MPS that are available via the CPUM to Ethernet-based connections, such as the VM600 MPSx software, the CPUM Configurator software or a Modbus TCP connection.
See 6 CPUM / IOCN card pair and refer to the *VM600 MPS1 software manual* for further information on VM600 MPS rack (CPUM) security.

NOTE: Refer to the *VM600 networking manual* for further information on networking VM600 racks.

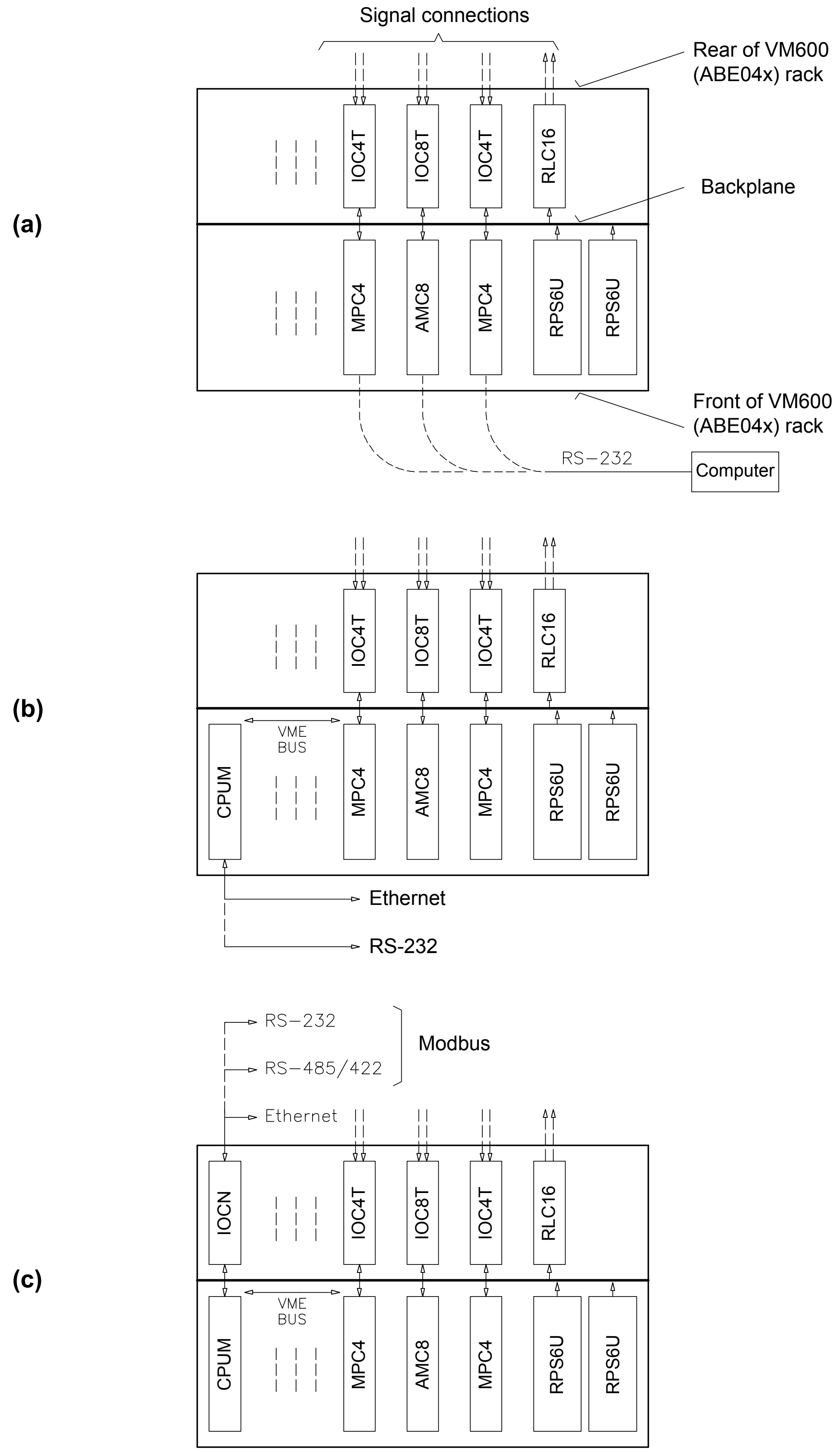

Figure 1-3: Methods of communicating with a VM600 MPS system

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2 OVERVIEW OF VM600 MPS HARDWARE

This chapter provides a brief overview of the physical appearance of VM600 MPS hardware. Functional information is also given for certain elements (push buttons, LEDs and so on) on the panels.

NOTE: Further information on specific elements can be found in the corresponding data sheets.

2.1 Racks

2.1.1 VM600 system rack – 19" rack with a height of 6U

A VM600 MPS can be housed in a 19 inch rack (84TE) with a height of 6U (6HE), known as the VM600 system rack. Two types of this rack exist: the ABE040 and the ABE042. These are identical, except for the position of the rack mounting brackets. An example of a MPS housed in an ABE040 rack is shown in Figure 2-1.

An ABE040 contains a front card cage and a rear card cage. The card cages are separated by the rack backplane.

The appearance of the front panel and rear panel of the rack depends entirely on the types of cards installed in the two card cages. These cards are presented in the following sections of this chapter.

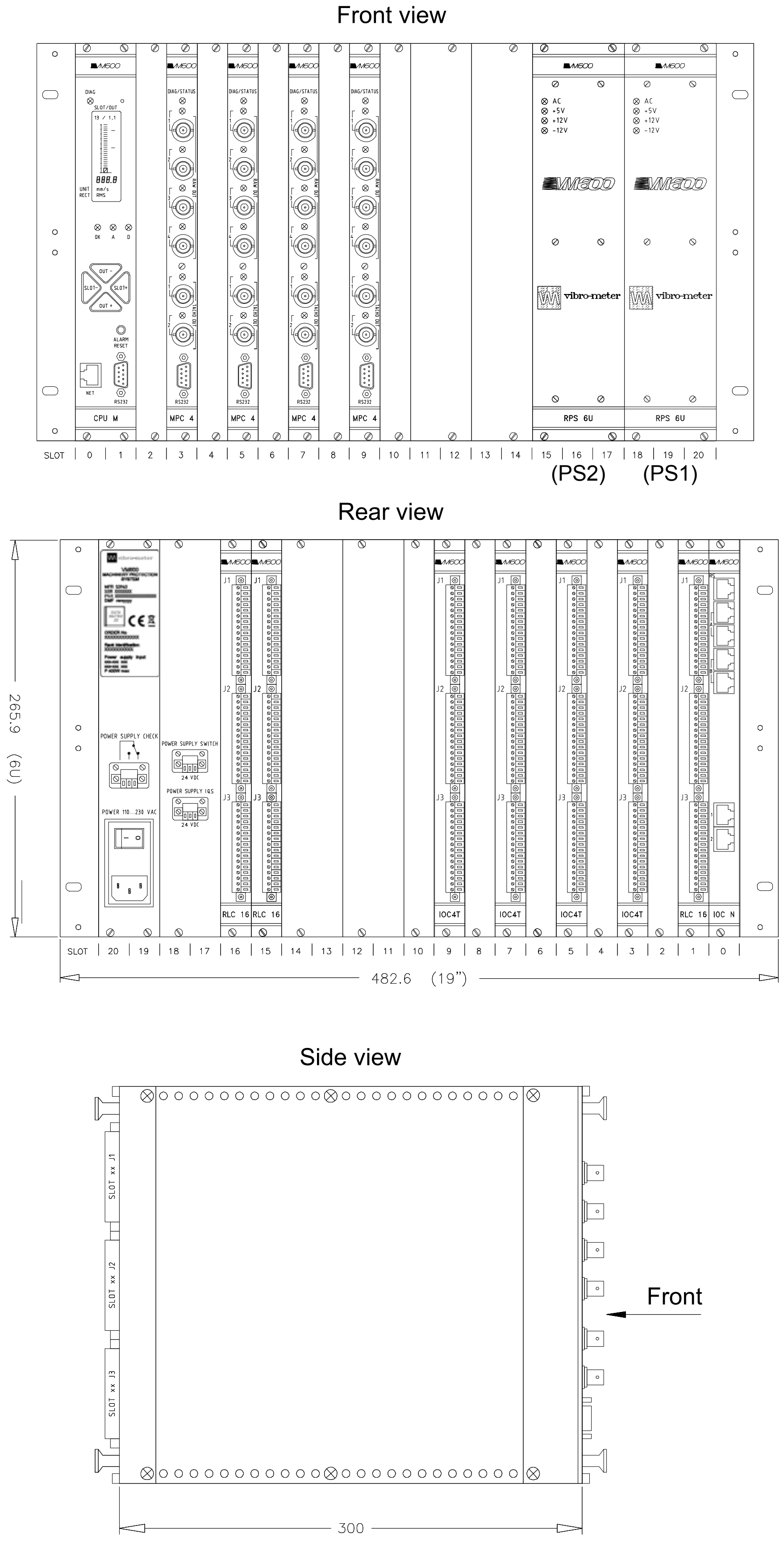


Figure 2-1: Views of a typical ABE040 rack with several cards installed (machinery protection cards only)

2.1.2 Slot number coding for cards in the rear of a rack

Most cards installed in the rear of a standard 19" rack (ABE04x) use an electronic keying mechanism to help ensure that the card is installed in the correct slot (for example, in the slot directly behind the associated processing card in the front of the rack). This includes IOC4T and IOC8T cards.

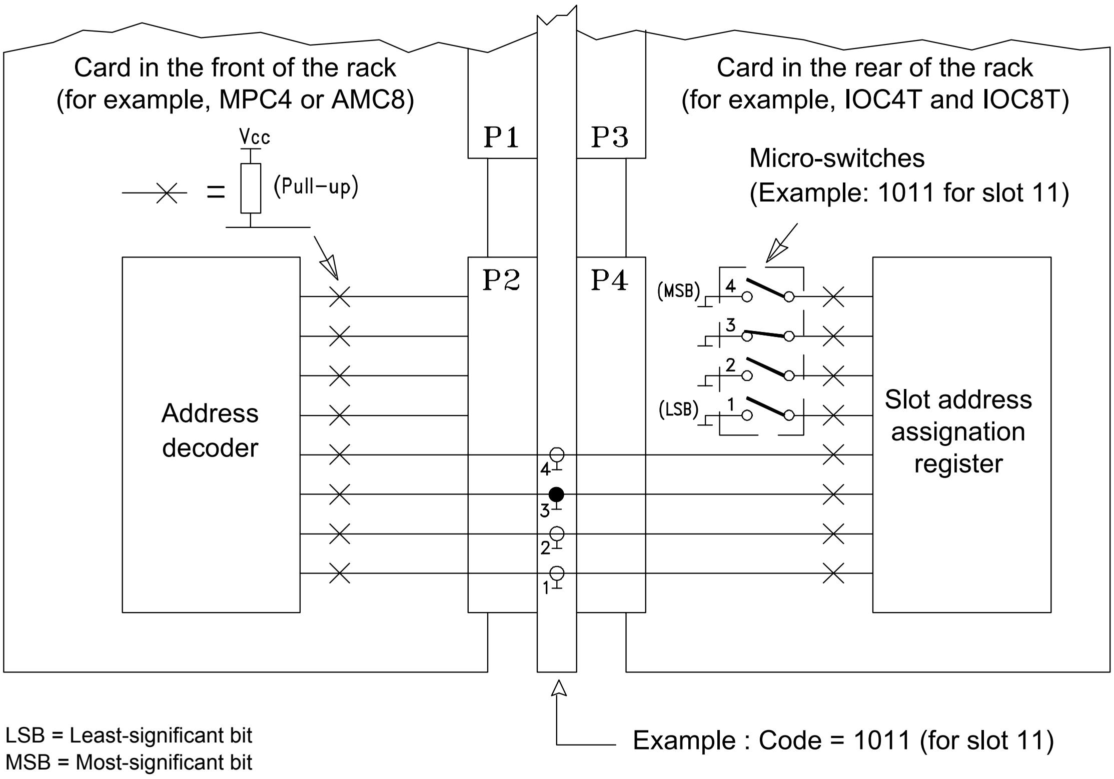
In ABE04x racks, each slot of the backplane has a unique, hard-wired 4-digit binary code (see Figure 2-2) as follows:

Slot 3	Code 0011
Slot 4	Code 0100
Slot 5	Code 0101
Slot 6	Code 0110
Slot 7	Code 0111
Slot 8	Code 1000
Slot 9	Code 1001
Slot 10	Code 1010
Slot 11	Code 1011
Slot 12	Code 1100
Slot 13	Code 1101
Slot 14	Code 1110.

Cards that implement this electronic keying mechanism have a bank of micro-switches that can be used to assign a slot number to the card (see Figure 2-2). This code is stored in the slot number (address) assignation register on the card (IOC4T and IOC8T).

Each card compares its slot number with the hard-wired slot number coded on the rack's backplane (see Figure 2-3). The result of the comparison is typically displayed on the SLOT ERROR LED on the cards panel:

- If the codes are identical, the LED is green.
- If the codes are not identical, the LED is red.



LSB = Least-significant bit
MSB = Most-significant bit

Figure 2-2: Electronic keying circuitry

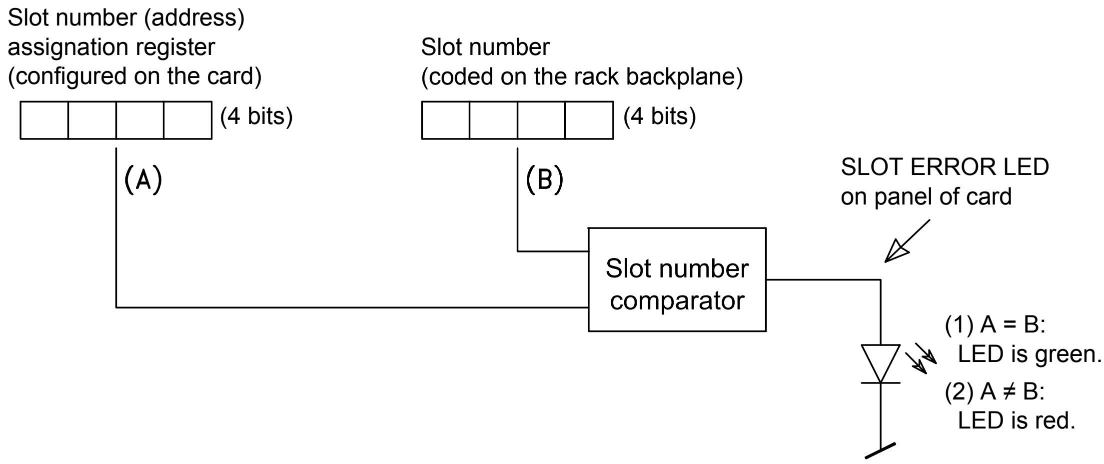


Figure 2-3: Slot number comparator and SLOT ERROR LED

2.2 MPC4 machinery protection card

The MPC4 card has the following panel elements (see Figure 2-5):

1- One global DIAG/STATUS indicator for the MPC4 / IOC4T card pair

This multi-coloured, multi-function LED is used to indicate:

- The status of the card configuration
- Whether special functions such as Trip Multiply (TM) or Danger Bypass (DB) are in use
- An MPC4 card failure due to a hardware or a software problem.

2- BNC connectors RAW OUT 1 to RAW OUT 4

A connector is present for each of the four measurement channels. Used to output raw analog signals (corresponding to, for example, vibration or dynamic pressure).

3- BNC connectors TACHO OUT 1 and TACHO OUT 2

A connector is present for each of the two rotational speed channels. Used to output speed/phase reference signals. These signals are TTL-conditioned.

4- Status indicators for the four measurement channels and the 2 rotational speed channels

Each multi-coloured, multi-function LED is used to indicate:

- Whether the signal input for that channel is valid
- The presence of an incoming signal in the Alert/Danger condition
- Whether the channel inhibit function is in use.

5- RS-232 connector

This 9-pin D-sub connector can be used to configure an MPC4 card in a stand-alone rack. This is done via an interface cable from a computer running one of the VM600 MPS software packages (MPS1 or MPS2). See Figure 2-4 for details of the interface cable.

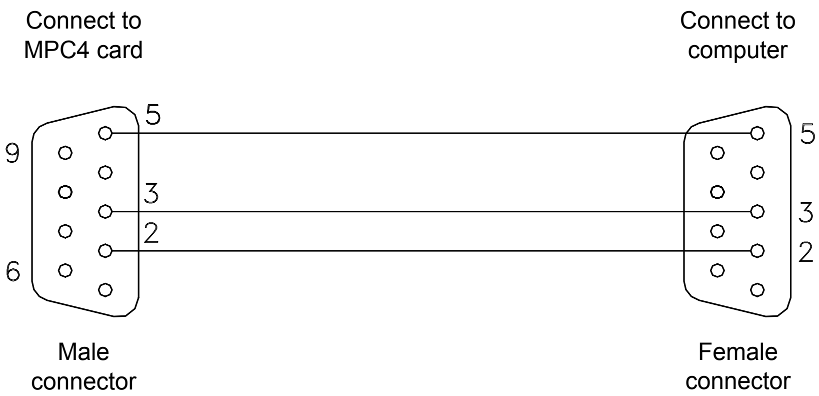
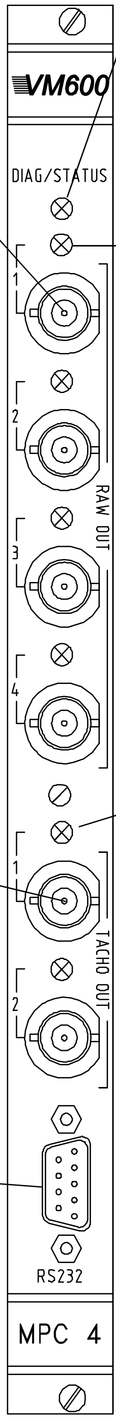


Figure 2-4: Interface cable used to connect the MPC4 (or AMC8) card to the serial port of a computer running the configuration software

NOTE: The MPC4 machinery protection card is available in different versions, including a standard version, a separate circuits version and a safety (SIL) version. See 4 MPC4 / IOC4T card pair for additional information.



BNC connector for the MPC4 / IOC4T card pair measurement channel 1.
Raw signal output.
Transfer function:
Voltage input: 1V/V
Current input: 0.3245 V/mA.

Status indicator and BNC connector for the MPC4 / IOC4T card pair measurement channels 2, 3 and 4.
Operation as per measurement channel 1.

BNC connector for the MPC4 / IOC4T card pair rotational speed channel 1 (TACHO 1).
Raw signal output (TTL compatible).

RS-232 connector.
Can be used to configure an MPC4 card in a stand-alone rack (without CPUM card) using the VM600 MPSx software.

Note: The safety version of the MPC4 card (MPC4SIL) does not have a VME bus interface so it can only be configured via this serial link (even in a networked VM600 rack).

DIAG/STATUS indicator for the MPC4 / IOC4T card pair.
The colours of the LED have the following significance:
* Green (continuous) – Normal operation (configuration valid with no active alarms and no errors).
* Green blinking – Configuration is being downloaded (stabilisation phase) and/or signal processing error.
* Yellow (continuous) – Trip Multiply (TM) function active.
* Yellow blinking – Configuration error and/or signal processing error.
* Red (continuous) – Danger Bypass (DB) function active.
* Red blinking – Hardware or input error.

Status indicator for the MPC4 / IOC4T card pair measurement channel 1.
The colours of the LED have the following significance:
* Off – Channel not configured (“Sensor Connected” set to “No” in the VM600 MPSx software) or card not configured.
* Green (continuous) – Signal input to the channel is valid and there are no active alarms.
* Green blinking – Signal input to the channel is not valid.
* Green blinking slowly – Channel inhibit function active.
* Yellow (continuous) – There is an active single-channel processing Alert level alarm ((A−) or (A+)).
* Yellow blinking – There is an active dual-channel processing Alert level alarm ((A−) or (A+)). Note: The status indicator LED for both channels will blink yellow at the same time.
* Red (continuous) – There is an active single-channel processing Danger level alarm ((D−) or (D+)).
* Red blinking – There is an active dual-channel processing Danger level alarm ((D−) or (D+)). Note: The status indicator LED for both channels will blink red at the same time.

Status indicator for the MPC4 / IOC4T card pair rotational speed channel 1 (TACHO 1).
The colours of the LED have the following significance:
* Off – Channel not configured (“Sensor Connected” set to “No” in. the VM600 MPSx software)
* Green (continuous) – Signal input to the channel is valid and there are no active alarms.
* Green blinking – Signal input to the channel is not valid.
* Green blinking slowly – Channel inhibit function active.
* Yellow (continuous) – There is an active single-channel processing Alert level alarm ((A−) or (A+)).

Status indicator and BNC connector for the MPC4 / IOC4T card pair rotational speed channel 2 (TACHO 2).
Operation as per speed channel 1 (TACHO 1).

Notes:
See also Table 4-1, Table 4-2 and Table 4-3 for further information on the behaviour of MPC4 card LEDs.

Figure 2-5: Elements on the MPC4

2.3 IOC4T input/output card

The IOC4T panel (rear of rack) contains three terminal strips, identified as J1, J2 and J3 (see Figure 2-6). Each strip consists of a socket and a mating connector, which contains 16 screw terminals. The screw terminals can accept wires with a cross section of ≤1.5 mm^2.

Figure 2-6 (a) shows the appearance of the IOC4T panel without the three mating connectors. In this configuration, the engraving showing the terminal definitions is clearly seen. Figure 2-6 (b) shows the appearance of the panel when the 3 mating connectors are inserted.

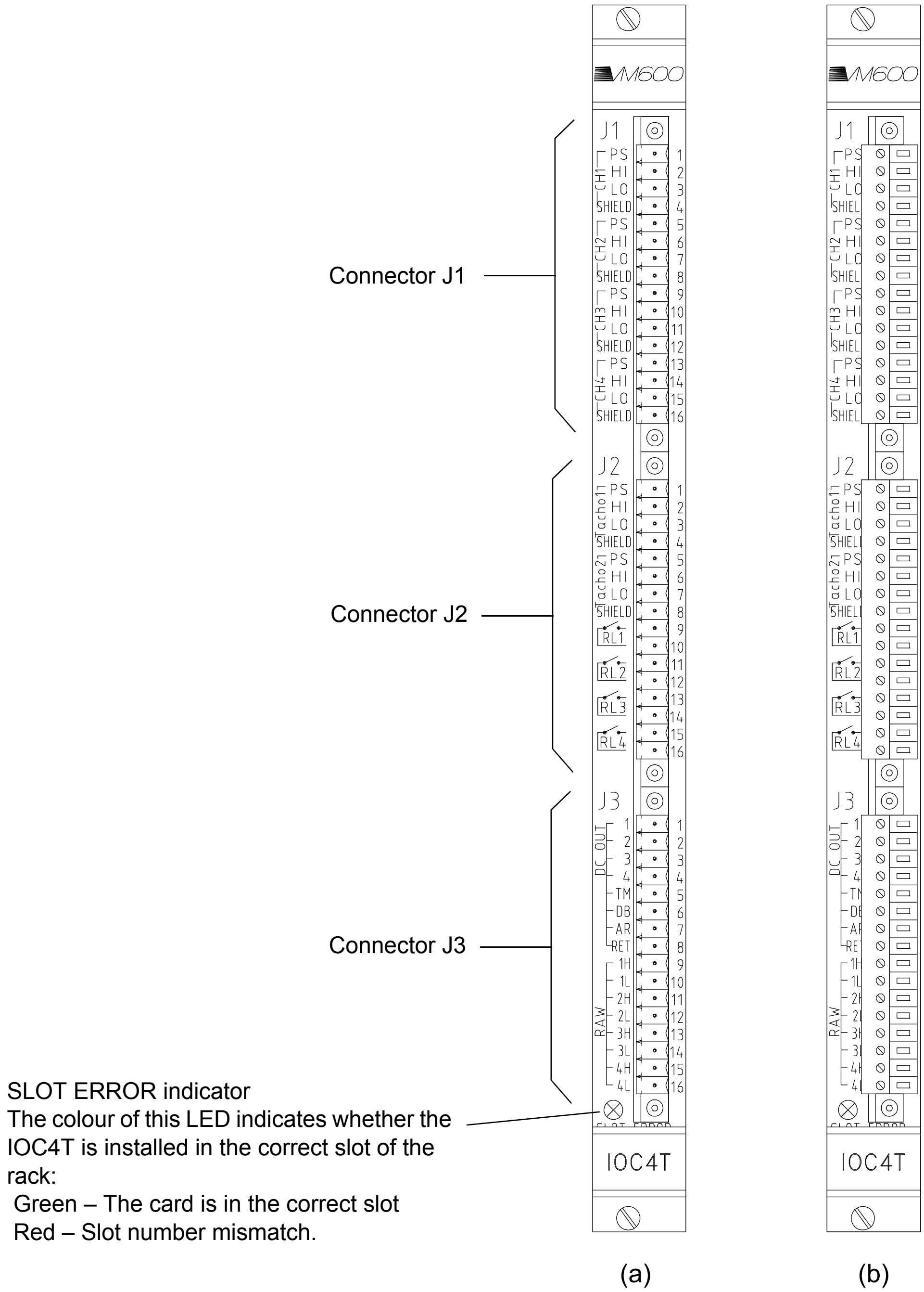


Figure 2-6: IOC4T panel (rear of ABE04x rack)

2.4 AMC8 analog monitoring card

The AMC8 card has the following panel elements (see Figure 2-7):

1- One global DIAG/STATUS indicator for the AMC8 / IOC8T card pair

This multi-coloured, multi-function LED is used to indicate:

- The status of the card configuration
- Possible hardware errors
- Whether the Danger Bypass (DB) special function is in use.

2- Status indicators for the 8 measurement channels

Each multi-coloured, multi-function LED is used to indicate:

- Whether the signal input for that channel is valid
- The presence of an incoming signal in the Alert/Danger condition
- Whether the channel inhibit function is in use.

3- RS-232 connector

This 9-pin D-sub connector can be used to configure an AMC8 card in a stand-alone rack. This is done via an interface cable from a computer running one of the VM600 MPS software packages (MPS1 or MPS2). See Figure 2-4 for details of the interface cable.

2.5 IOC8T input/output card

The IOC8T panel (rear of rack) contains four contact strips, identified as J1 to J4.

Strips J1 to J3 consist of a socket and a mating connector, which contains either 24 or 20 cage clamp terminals (see Figure 2-6). The terminals can accept wires with a cross section of between 0.08 and 1.0 mm^2.

Strip J4 consists of a socket and a mating connector, which contains 12 screw terminals. The terminals can accept wires with a cross section of $\leq 1.5\ mm^2$.

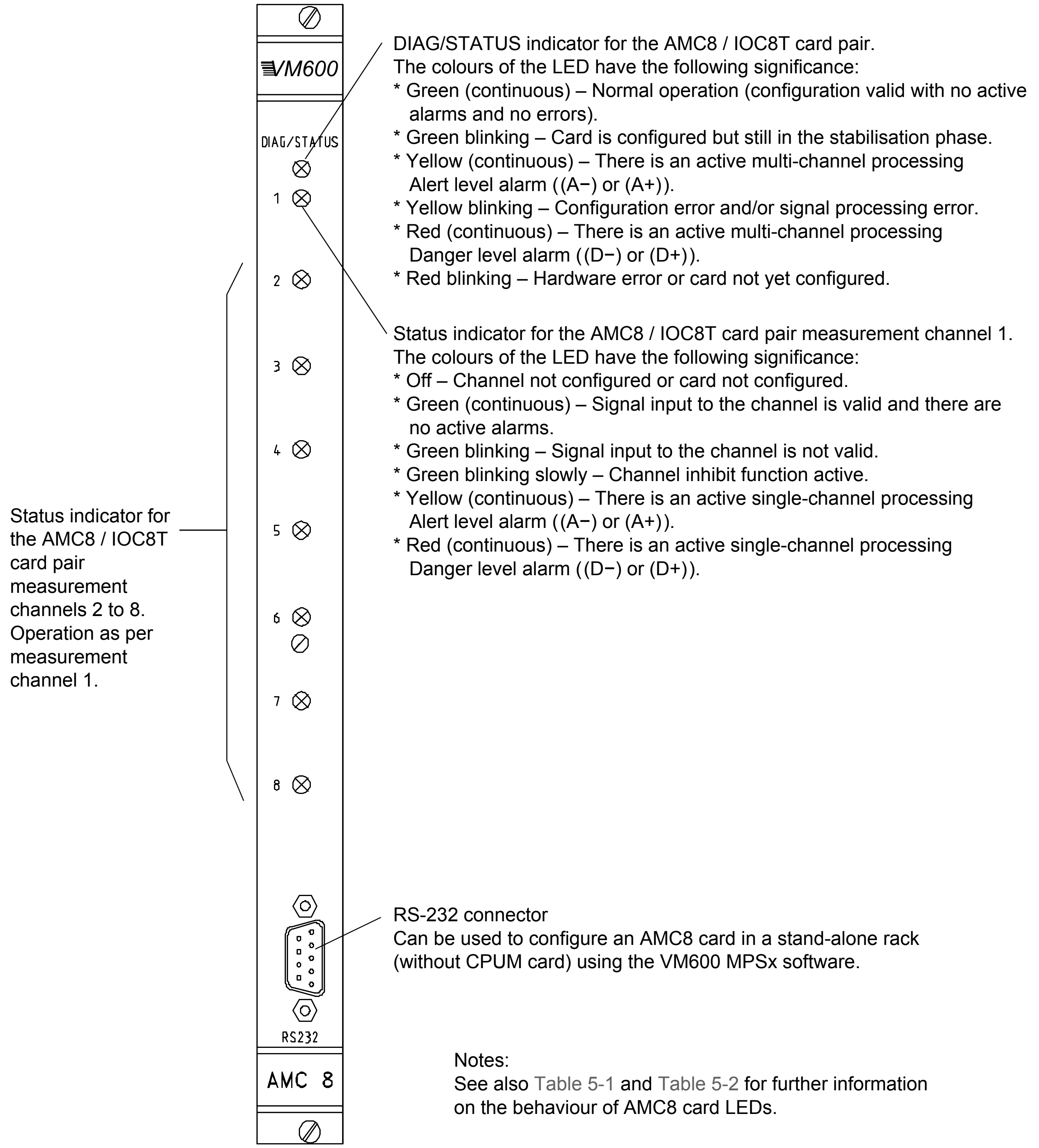


Figure 2-7: Elements on the AMC8

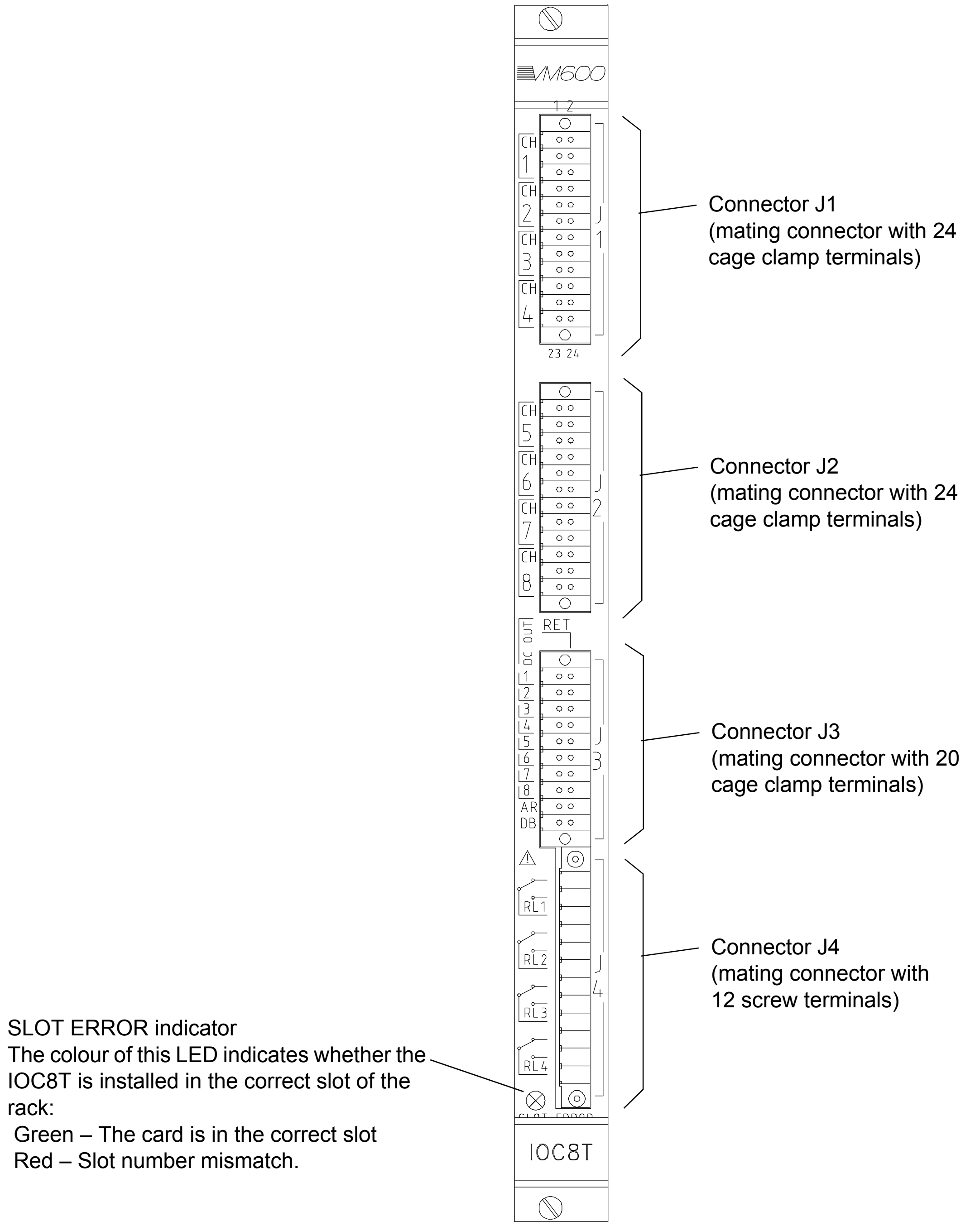


Figure 2-8: IOC8T panel (rear of ABE04x rack)

2.6 CPUM modular CPU card

See Figure 2-9 for details on the physical appearance of this card.

2.7 IOCN input/output card

See Figure 2-10 for details on the physical appearance of this card.

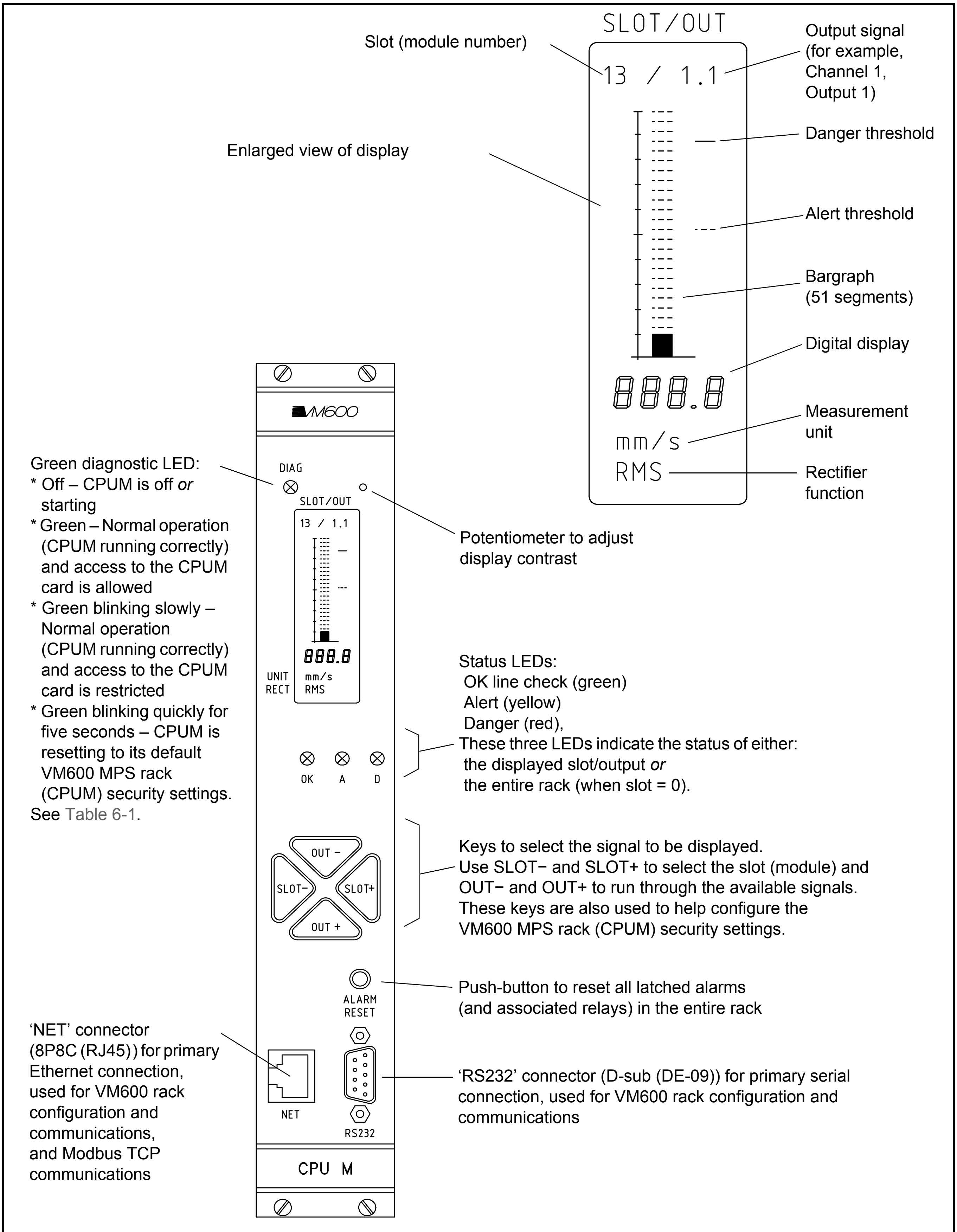


Figure 2-9: Elements on the CPUM

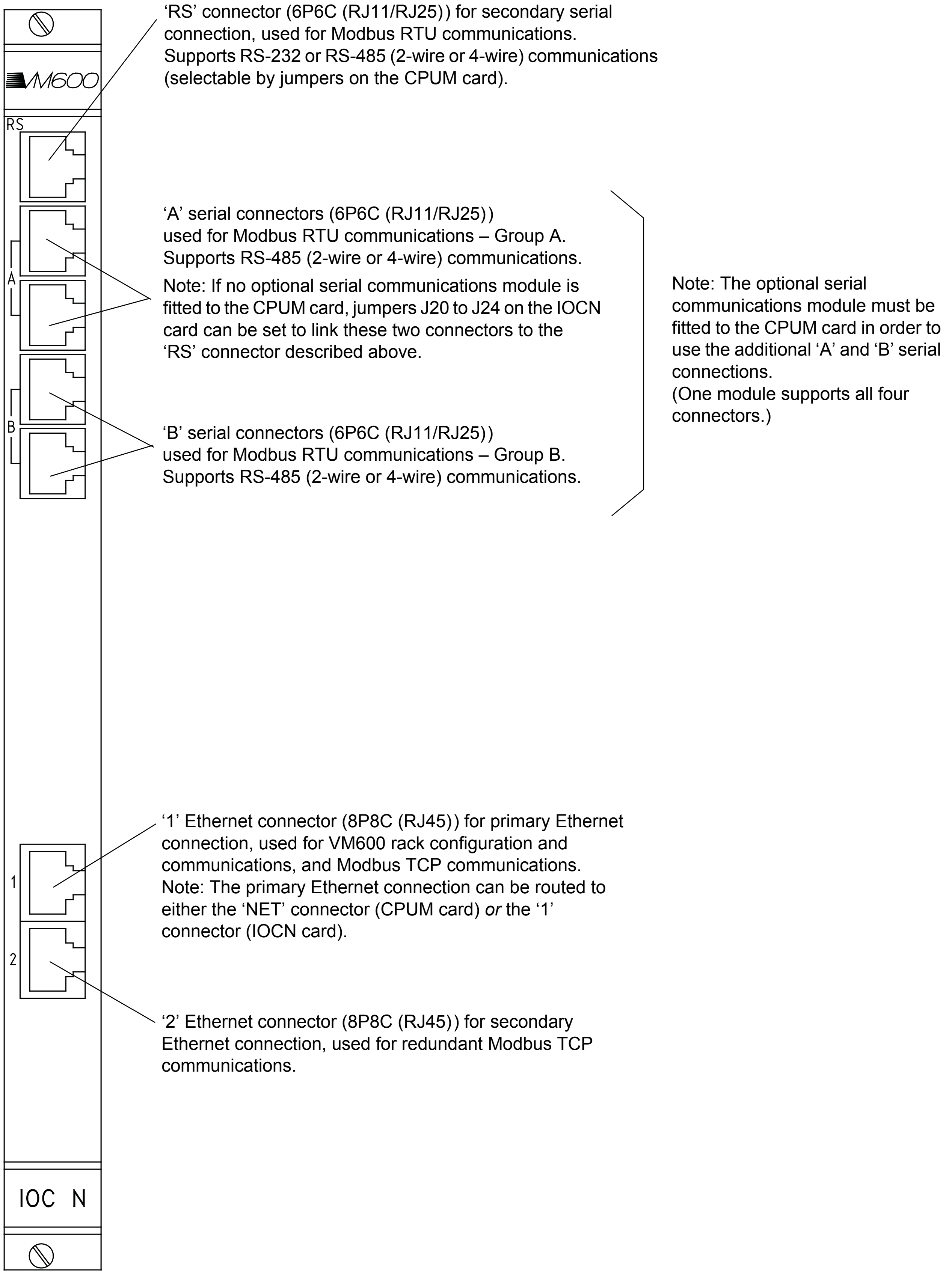


Figure 2-10: Elements on the IOCN

2.8 RLC16 relay card

The RLC16 panel (rear of rack) contains three terminal strips, identified as J1, J2 and J3 (see Figure 2-11). Each strip consists of a socket and a mating connector, which contains 16 screw terminals. The screw terminals can accept wires with a cross section of ≤1.5 mm^2.

Figure 2-11 (a) shows the appearance of the RLC16 panel without the three mating connectors. In this configuration, the engraving showing the terminal definitions is clearly seen. Figure 2-11 (b) shows the appearance of the panel when the three mating connectors are inserted.

These terminals may have a hazardous voltage (230 V_{AC} max).

Respect the safety installation rules when accessing these cards (see section 8.4.2.6.2).

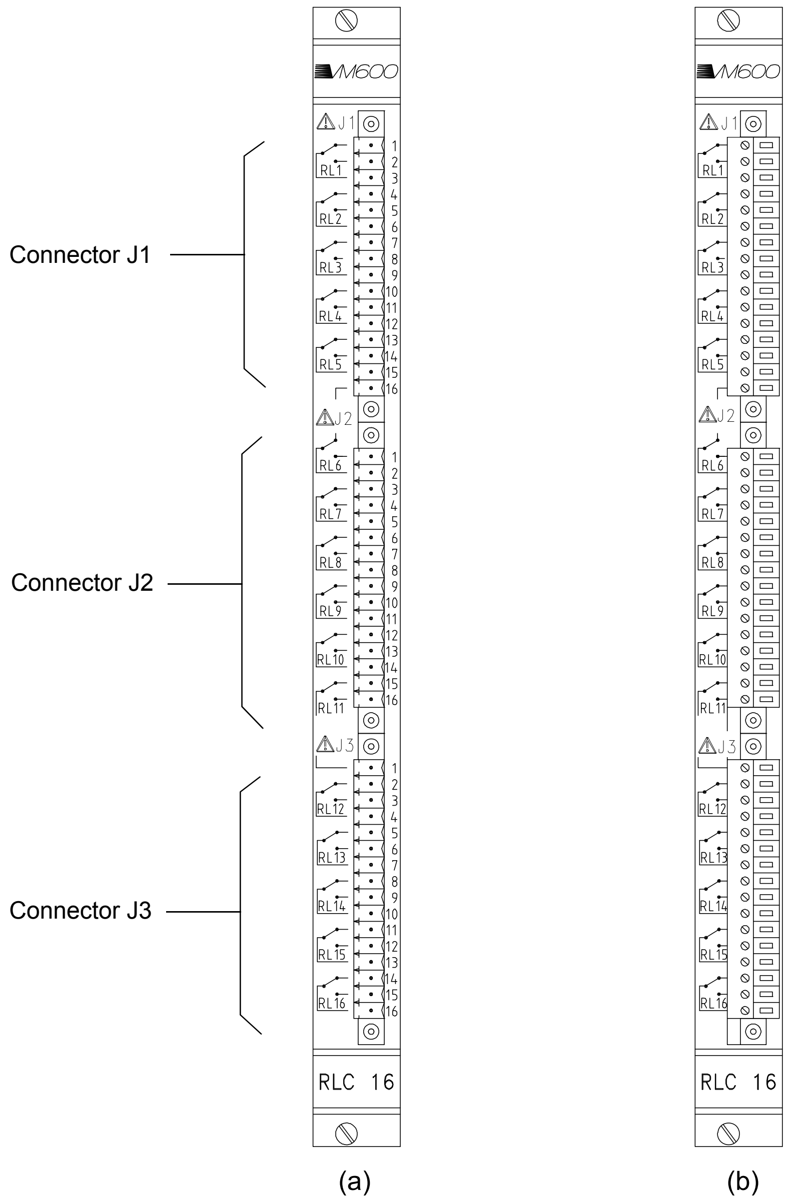


Figure 2-11: RLC16 panel (rear of ABE04x rack)

2.9 RPS6U rack power supply

2.9.1 Different versions of the RPS6U rack power supply

In 2016, the RPS6U rack power supply was improved to provide a higher output power of 330 W with higher-performance and higher-efficiency, which required a redesign of the underlying power supply circuitry.

The different versions of the RPS6U rack power supply in use are:

- Later versions of the RPS6U (PNR 200-582-x00-02h or later) that define the power as a total maximum output power of 330 W, with nominal output (supply) voltages of +5 V_{DC} up to 50 A, +12 V_{DC} up to 8 A and −12 V_{DC} up to 4 A.

NOTE: The total maximum output power of 330 W is a combination load for all outputs as the +5 V_{DC} and ±12 V_{DC} outputs are usually not simultaneously loaded to the maximum in practice.
For example, if the +5 V_{DC} output is at its maximum rated load (5.35 V × 50 A = 267.5 W), then the combined loads on the +12 V_{DC} and −12 V_{DC} outputs must not exceed 62.5 W.

- Earlier versions of the RPS6U (PNR 200-582-x00-01h or earlier) that define the power as a rated power of 300 W, with nominal output (supply) voltages of +5 V_{DC} up to 35 A, +12 V_{DC} up to 6 A and −12 V_{DC} up to 2 A.

STOP

The later versions of the RPS6U rack power supply (330 W) can provide significantly more current compared to the earlier versions of the RPS6U rack power supply (300 W), notably on the +5 V_{DC} output which can be up to 50 A (compared to the previous maximum of 35 A).

Accordingly, later versions of the RPS6U power supply (330 W, PNR 200-582-x00-02h or later) should be used only with later versions of the VM600 system rack (ABE040 PNR 204-040-100-015 or later, ABE042 PNR 204-042-100-015 or later), as these racks have been improved in order to support the higher currents available from a 330 W RPS6U power supply.

For reasons of obsolescence, earlier versions of the RPS6U power supply (300 W, PNR 200-582-x00-01h or earlier) in earlier versions of the VM600 system rack (ABE040 PNR 204-040-100-014 or earlier, ABE042 PNR 204-042-100-014 or earlier) can be replaced with later versions of the RPS6U power supply (330 W, PNR 200-582-x00-02h or later) when it is ensured that the load (current draw) on the replacement RPS6U power supply does not increase. For example, this can be ensured by not adding any additional cards to the rack and by not changing the configuration of the rack.

See 8.3.2 Circuit breaker and 8.3.3 Supply wiring for further information.

The improved RPS6U rack power supply (330 W) can supply a full rack of cards, such as 12 x MPC4/IOC4T card pairs or 12 x XMx16/XIO16T card pairs. This means that a VM600 rack with two RPS6U power supplies (330 W) installed and operating non-redundantly is usually only necessary for applications where the operating environment requires RPS6U output power derating. (A VM600 rack with two RPS6U power supplies (330 W) installed and operating redundantly is necessary for applications requiring rack power supply redundancy.)

In practice, this means that a single RPS6U rack power supply can now supply power to a VM600 rack full of machinery protection and/or condition monitoring cards under normal operating conditions. Although, with 12 x processing cards in a VM600 rack, forced-air cooling is highly recommended.

For an existing VM600 system, it is important to note that simply replacing an old RPS6U rack power supply (300 W) with a new one (330 W) should not be used as a way to increase the maximum output power available in order to add more cards to the rack – because the rack backplane may not support the additional currents involved. If you are considering this, please contact your Meggitt representative, who will help you to assess how many cards can be safely added to your system without replacing the rack.

For an existing VM600 system with rack power supply redundancy, it is possible to replace only one RPS6U rack power supply so that the old (300 W) and new (330 W) versions of the RPS6U operate together, although it is recommended to replace both in such a case.

2.9.2 Identifying different versions of the RPS6U rack power supply

The different versions of the RPS6U rack power can be visually identified from their panels, as an LED text label is different.

- For both the AC-input and DC-input versions of the higher-power RPS6U rack power supply (PNR 200-582-x00-02h or later) that provides 330 W, the text label of the LED (top) used to indicate the status of the external mains supply is labelled “IN”, as shown in Figure 2-12 (a).
- For the AC-input version of the original RPS6U rack power supply (PNR 200-582-x00-01h or earlier) that provides 300 W, the text label of the LED (top) used to indicate the status of the external mains supply is labelled “AC”, as shown in Figure 2-12 (b).

  For the DC-input versions of the original RPS6U rack power supply (PNR 200-582-x00-01h or earlier) that provide 300 W, the text label of the LED (top) used to indicate the status of the external mains supply is labelled “DC”, as shown in Figure 2-12 (b).

2.9.3 General overview

The following versions of higher-power RPS6U rack power supply are available:

- RPS6U power supply for use with an external AC-mains supply.
- RPS6U power supplies for use with different external DC-mains supplies.

The different versions are distinguished by their ordering number (refer to the *RPS6U rack power supply data sheet*).

The RPS6U rack power supply must be used with an appropriate connection panel mounted at the rear of the VM600 rack. Several types of these associated rear panels exist (see 2.9.9 Associated rear panels and refer to the *RPS6U rack power supply data sheet*) in order to allow the connection of external AC-mains and/or DC-mains power to the rack. See also 8.3 Rack safety requirements.

STOP

HAZARDOUS VOLTAGES EXIST WITHIN VM600 SYSTEM RACKS (ABE04X).

WHEN AN RPS6U RACK POWER SUPPLY, ASSOCIATED REAR PANEL OR CARD IS REMOVED FROM A VM600 SYSTEM RACK (ABE04X), THE RACK BACKPLANE – CONTAINING HAZARDOUS VOLTAGES – IS EXPOSED AND THERE IS THE RISK OF ELECTRIC SHOCK.

SEE ALSO HAZARDOUS VOLTAGES AND THE RISK OF ELECTRIC SHOCK ON PAGE XIII.

One or two RPS6U power supplies can be installed in an ABE04x rack, as shown in Figure 2-1. When two RPS6Us are installed in a rack, the RPS6U on the right (slots 18 to 20) is power supply 1 (PS1) and the RPS6U on the left (slots 15 to 17) is power supply 2 (PS2).

A rack can have two RPS6U power supplies installed for different reasons:

- In order to support rack power supply redundancy
  See 2.9.5 Racks with two RPS6U rack power supplies in order to support rack power supply redundancy.
- In order to supply power to the cards (non-redundantly)
  See 2.9.6 Racks with two RPS6U rack power supplies in order to supply power to the cards.

NOTE: A VM600 rack configuration with two RPS6U power supplies (330 W) operating non-redundantly to supply power to the cards is typically only necessary for a full rack of cards in an application where the operating environment requires RPS6U output power derating.

The number and type of RPS6U power supplies installed in a VM600 rack, together with the number of cards installed and the environmental conditions, helps determine the mode of operation of the RPS6U power supplies as either redundant or non-redundant.

NOTE: To verify that a VM600 rack containing two RPS6U rack power supplies is a non-redundant or a redundant rack power supply configuration, contact Meggitt Sensing Systems.

2.9.4 RPS6U rack power supply and VM600 card considerations

The maximum number of cards that can be installed in a VM600 system rack (ABE04x) depends on RPS6U rack power supply considerations:

- The number of RPS6U supplies installed in the rack: one or two.
- The power capability of the RPS6U supplies installed in the rack: 330 or 300 W.
- When two RPS6U supplies are installed in the rack, the mode of operation of the RPS6U supplies: redundant or non-redundant.
- The operating temperature of the environment where the VM600 rack is installed: RPS6U power supplies require either output power derating and/or forced-air cooling for operating temperatures of 50 °C (122 °F) or higher.

The maximum number of cards that can be installed in a VM600 system rack (ABE04x) also depends on individual VM600 card considerations, for example, the configuration of sensor power supplies and DC outputs for MPC4 / IOC4T card pairs. In general:

- A VM600 system rack with one RPS6U power supply (330 W) operates non-redundantly (that is, without rack power supply redundancy and supports a full rack of cards, for example, up to 12x MPC4/IOC4T or 12 x XMx16/XIO16T card pairs or any other combination of cards, for operating temperatures up to 50 °C (122 °F).
- A VM600 system rack with two RPS6U power supplies (330 W) operating redundantly (that is, with rack power supply redundancy) supports a full rack of cards, for example, up to 12x MPC4/IOC4T or 12 x XMx16/XIO16T card pairs or any other combination of cards, for operating temperatures up to 50 °C (122 °F).

  When two RPS6U rack power supplies operate redundantly to supply power to the cards in a VM600 rack, the maximum current available for use by the cards is limited to the current available from a single RPS6U power supply.
- A VM600 system rack with two RPS6U power supplies (330 W) operating non-redundantly (that is, without rack power supply redundancy) supports any

combination of cards under all circumstances, including operating temperatures up to 70°C (158°F).

When two RPS6U rack power supplies operate non-redundantly to supply power to the cards in a VM600 rack, the maximum current available for use by the cards is limited to approximately 125% (x 1.25) the current available from a single RPS6U power supply.

NOTE: A VM600 rack configuration with two RPS6U power supplies (330 W) operating non-redundantly to supply power to the cards is typically only necessary for a full rack of cards in an application where the operating environment requires RPS6U output power derating.

For a VM600 rack configuration that contains more than ten processing cards (MPC4/IOC4T, AMC8/IOC8T and/or XMx16/XIO16T) together with a CPUM/IOCN "rack controller" and/or RLC16 relay cards, the power consumption of the rack should be calculated in order to determine the number of RPS6U power supplies required and the permitted modes of operation. Contact Meggitt Sensing Systems for further information.

2.9.5 Racks with two RPS6U rack power supplies in order to support rack power supply redundancy

A VM600 rack with two RPS6U power supplies installed can operate redundantly (with rack power supply redundancy) for a full rack of cards. This means that if one RPS6U fails, the other will provide 100% of the power requirement and the rack will continue to operate, thereby increasing the availability of the machinery monitoring system.

NOTE: This is known as a redundant RPS6U rack power supply configuration.

When two RPS6U rack power supplies operate redundantly to supply power to the cards in a VM600 rack, the maximum current available for use by the cards is limited to the current available from a single RPS6U power supply.

During the normal operation of a rack with two RPS6U power supplies installed, each supply typically provides 50% of the power requirement. In practice, the current load share can be anywhere between 20 to 80% (and 80 to 20%) due to imbalances. This is the case for all VM600 racks with two RPS6U rack power supplies installed, whether "redundant" or not.

However, if one power supply fails on a redundant rack, the other will provide 100% of the power requirement and the rack will continue to operate, thereby increasing the availability of the machinery monitoring system.

2.9.6 Racks with two RPS6U rack power supplies in order to supply power to the cards

A VM600 rack with two RPS6U power supplies installed can operate non-redundantly (without rack power supply redundancy). Typically, this is only necessary for a full rack of cards in applications where the operating environment requires RPS6U output power derating.

NOTE: Even though two RPS6U rack power supplies are installed in the rack, this is not a redundant rack power supply configuration.

When two RPS6U rack power supplies are used to supply power to the cards in a VM600 rack, the maximum current available for use by the cards is limited to approximately 125%

(x 1.25) the current available from a single RPS6U because of the way in which the power supplies share the load. In practice, the current load share can be anywhere between 20 to 80% (and 80 to 20%) due to imbalances.

The later versions of the RPS6U power supply (330 W) can support a full rack of cards, for example, 12 x MPC4/IOC4T or 12 x XMx16/XIO16T card pairs can be supported by one 330 W RPS6U for operating temperatures up to 50°C (122°F). This means that a VM600 rack with two 330 W RPS6U power supplies installed and operating non-redundantly is only typically only necessary for applications where the operating environment requires RPS6U output power derating.

The earlier versions of the RPS6U power supply (300 W) cannot support a full rack of cards, for example, 9 x MPC4/IOC4T or 6 x XMx16/XIO16T card pairs can be supported by one 300 W RPS6U for operating temperatures up to 60°C (140°F). This means that a VM600 rack with two 300 W RPS6U power supplies installed and operating non-redundantly is typically necessary for applications using more than nine cards. Contact Meggitt Sensing Systems for further information

2.9.7 Racks supporting external mains power-supply system redundancy

It is important to note the difference between RPS6U power supply redundancy and external mains power-supply system redundancy:

- RPS6U rack power supply redundancy requires that two RPS6U power supplies are installed in the VM600 rack, so that should one power supply fail, then the other power supply can continue to supply power the cards in the rack.

  For information on the associated rear panels that can be used by a VM600 rack with or without rack power supply redundancy, see 2.9.9.1 and 2.9.9.3.
- External mains power-supply system redundancy requires that two external mains supplies (AC or DC) are used to supply power to the VM600 rack (which can have one or two RPS6U power supplies installed). Should one of the external mains supplies fail, then the other external mains supply can continue to supply power to the cards in the rack.

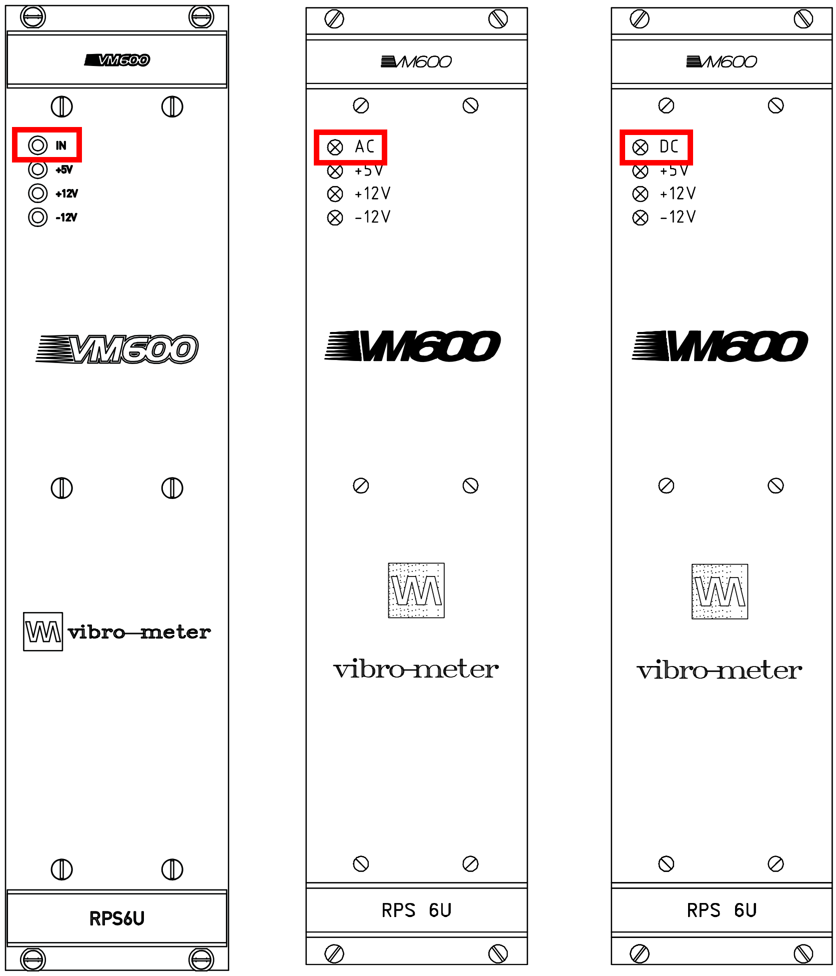
  For information on the associated rear panels that are required by a VM600 rack for external mains power-supply system redundancy, see 2.9.9.2 and 2.9.9.4.

2.9.8 Front panels

Figure 2-12 shows the panels of RPS6U rack power supplies with different inputs: AC or DC.

IN, **AC** or **DC** LED:
Green indicates that the external mains supply is present and is within the normal range.
This LED is on when the RPS6U is operating normally.

+5V, **+12V** and **−12V** LEDs:
Yellow indicates that the corresponding internal supply voltage is being generated and is within the normal range.
These LEDs are on when the RPS6U is operating normally.



(AC-input version) (DC-input version)

(a) Panel of later (higher-power) version of the RPS6U rack power supply

(b) Panels of earlier (original) version of the RPS6U rack power supply: AC-input version (left) and DC-input version (right)

Figure 2-12: Front panels for the different versions of the RPS6U rack power supply

2.9.9 Associated rear panels

2.9.9.1 DC-input panel with a common input

NOTE: For a VM600 system rack (ABE04x) operating with an external DC-mains supply, the DC-input panel with a common input is the standard associated rear panel.

This rear panel has one DC input with a screw-terminal connector that provides a common input to DC-input versions of the RPS6U power supplies in a VM600 rack.

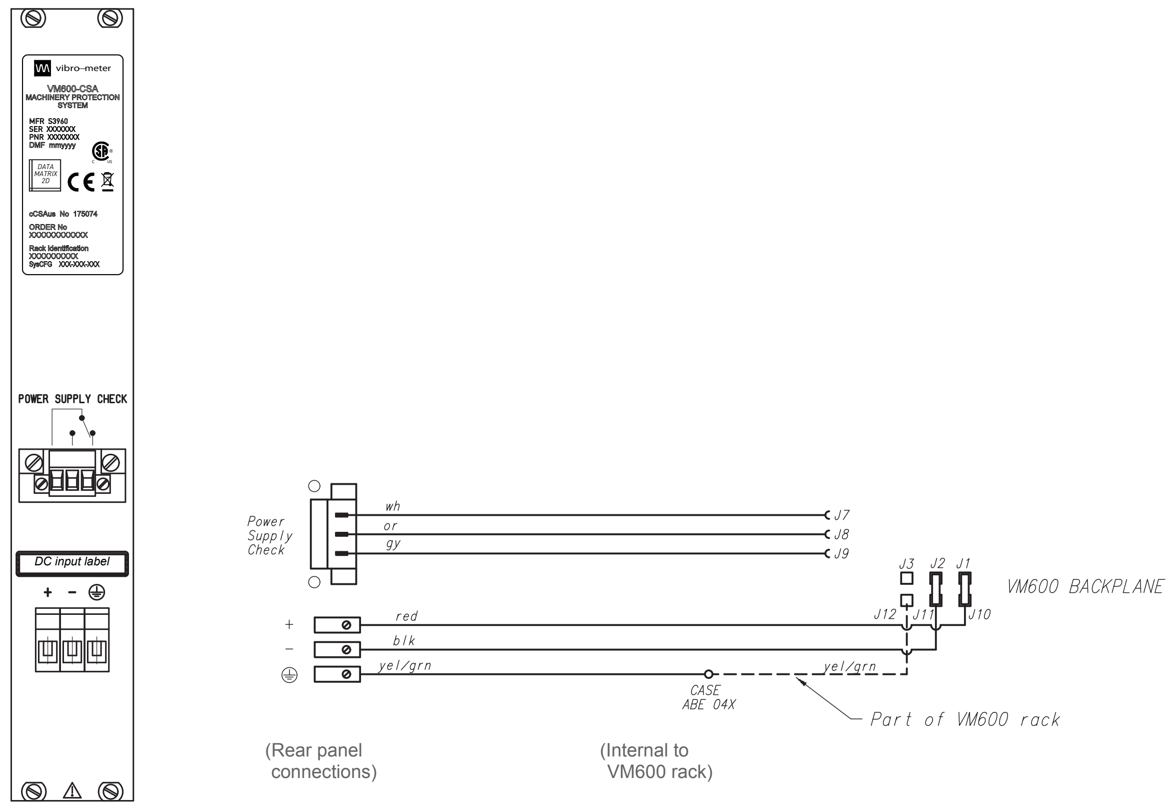
Figure 2-13 shows:

a. The associated panel at the rear of the ABE04x rack
Rear panel ordering number: 200-582-920-NHh
(equivalent VM600SYS order option code: F200).

b. Details of the associated VM600 rack power supply wiring.

(The front panel of the DC-input versions of the RPS6U rack power supply is shown in Figure 2-12.)

A VM600 rack power supply solution using this DC-input panel is intended for use with one DC-mains supply, that is, a non-redundant external power-supply system.



(a) Rear panel (b) Wiring details

Figure 2-13: DC-input panel with a common input

2.9.9.2 DC-input panel with individual inputs supporting external mains power supply redundancy

This rear panel has two DC inputs with screw-terminal connectors that provide a common input to DC-input versions of the RPS6U power supplies in a VM600 rack.

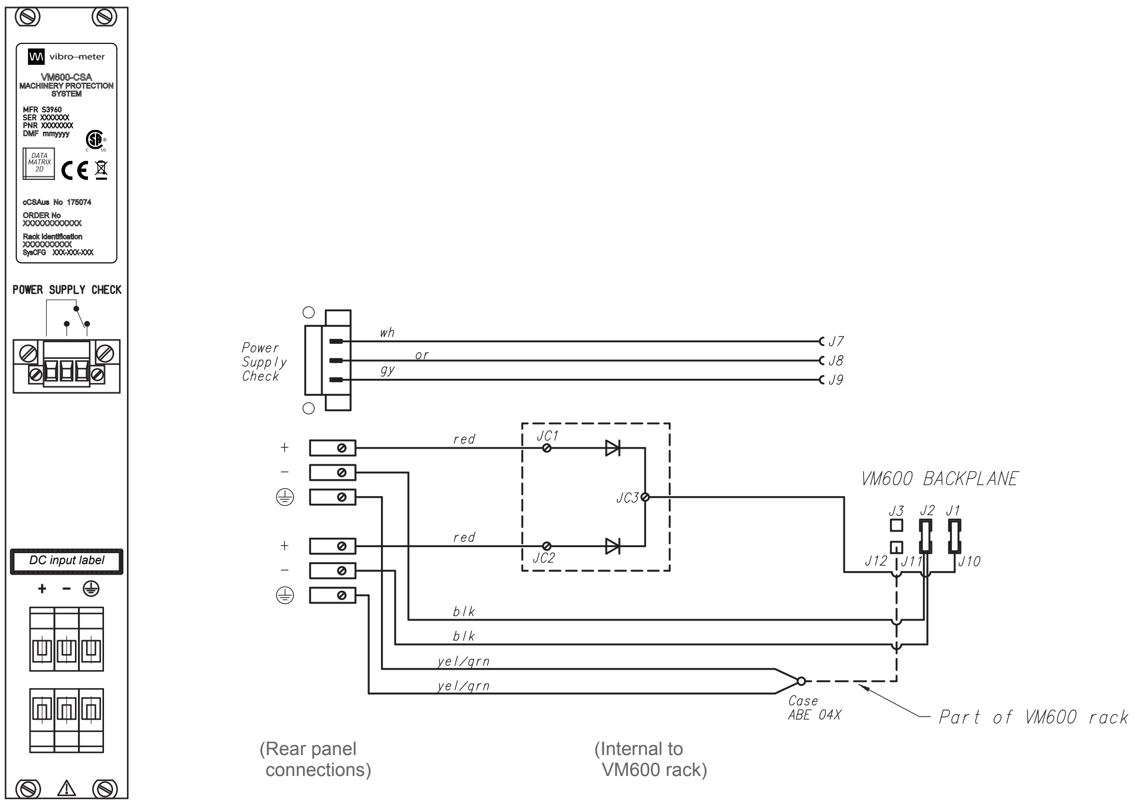
Figure 2-14 shows:

a. The associated panel at the rear of the ABE04x rack
   Rear panel ordering number: 200-582-990-NHh
   (equivalent VM600SYS order option code: F900).

b. Details of the associated VM600 rack power supply wiring.

(The front panel of the DC-input versions of the RPS6U rack power supply is shown in Figure 2-12.)

A VM600 rack power supply solution using this DC-input panel is intended for use with two DC-mains supplies arranged as a redundant external power-supply system (see 2.9.7 Racks supporting external mains power-supply system redundancy).



(a) Rear panel (b) Wiring details

Figure 2-14: DC-input panel with individual inputs supporting external mains power supply redundancy

2.9.9.3 AC-input (120/230 V_{AC}) panel with a common input (mains socket and on/off switch)

NOTE: For a VM600 system rack (ABE04x) operating with an external AC-mains supply, the AC-input panel with a common input is the standard associated rear panel.

This rear panel has one AC input (120/230 V_{AC}) with mains socket and on/off switch that provides a common input to the AC-input version of the RPS6U power supplies in a VM600 rack.

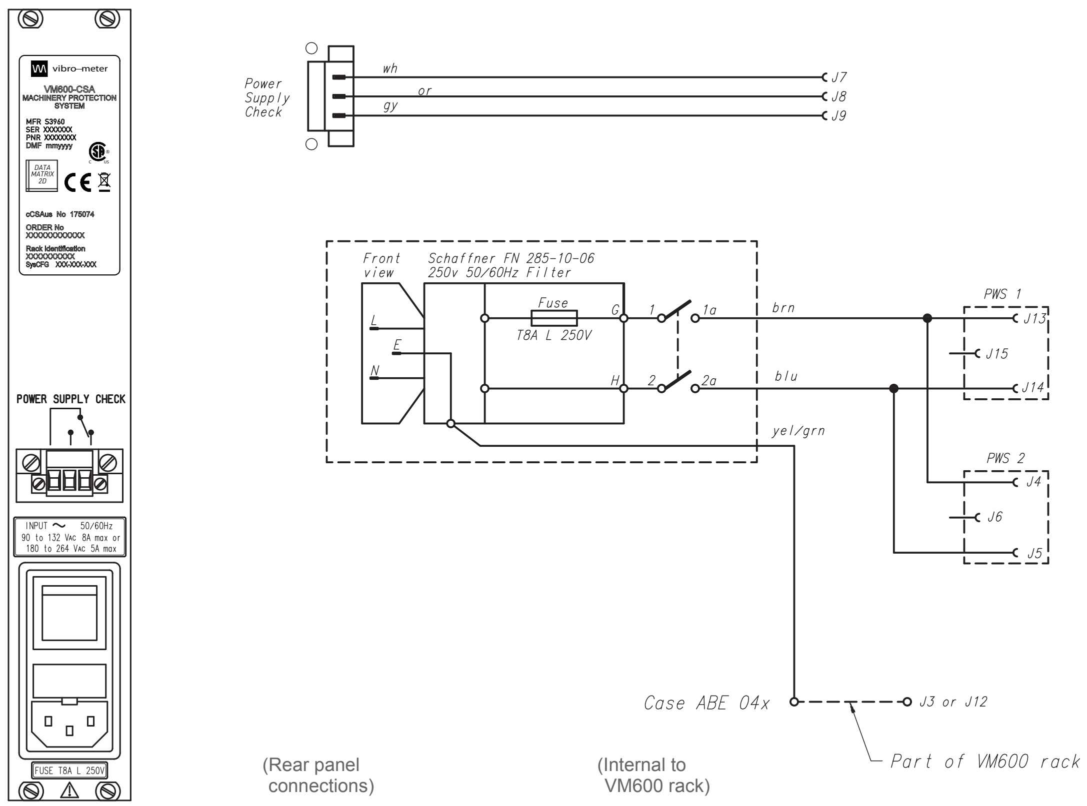
Figure 2-15 shows:

a. The associated panel at the rear of the ABE04x rack
   Rear panel ordering number: 200-582-910-NHh
   (equivalent VM600SYS order option code: F100).

b. Details of the associated VM600 rack power supply wiring.

(The front panel of the AC-input version of the RPS6U rack power supply is shown in Figure 2-12.)

A VM600 rack power supply solution using this AC-input panel is intended for use with one AC-mains (120/230 V_{AC}) supply, that is, a non-redundant external power-supply system.



(a) Rear panel (b) Wiring details

Figure 2-15: AC-input (120/230 V_{AC}) panel with a common input (mains socket and on/off switch)

2.9.9.4 AC-input (120 V_{AC} only) panel with individual inputs supporting external mains power supply redundancy

This rear panel has two AC inputs (120 V_{AC} only) with mains sockets and on/off switches that provide a common input to the AC-input version of the RPS6U power supplies in a VM600 rack.

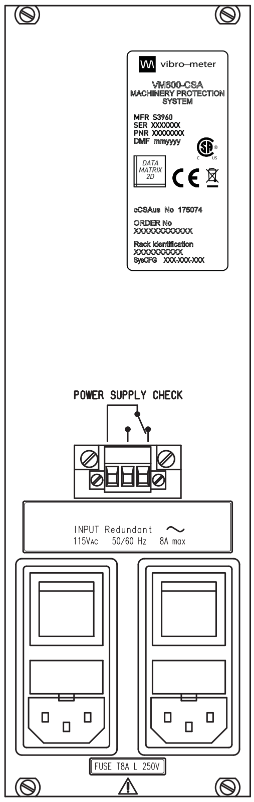
Figure 2-16 shows:

a. The associated panel at the rear of the ABE04x rack
   Rear panel ordering number: 200-582-962-NHh
   (equivalent VM600SYS order option code: F620).

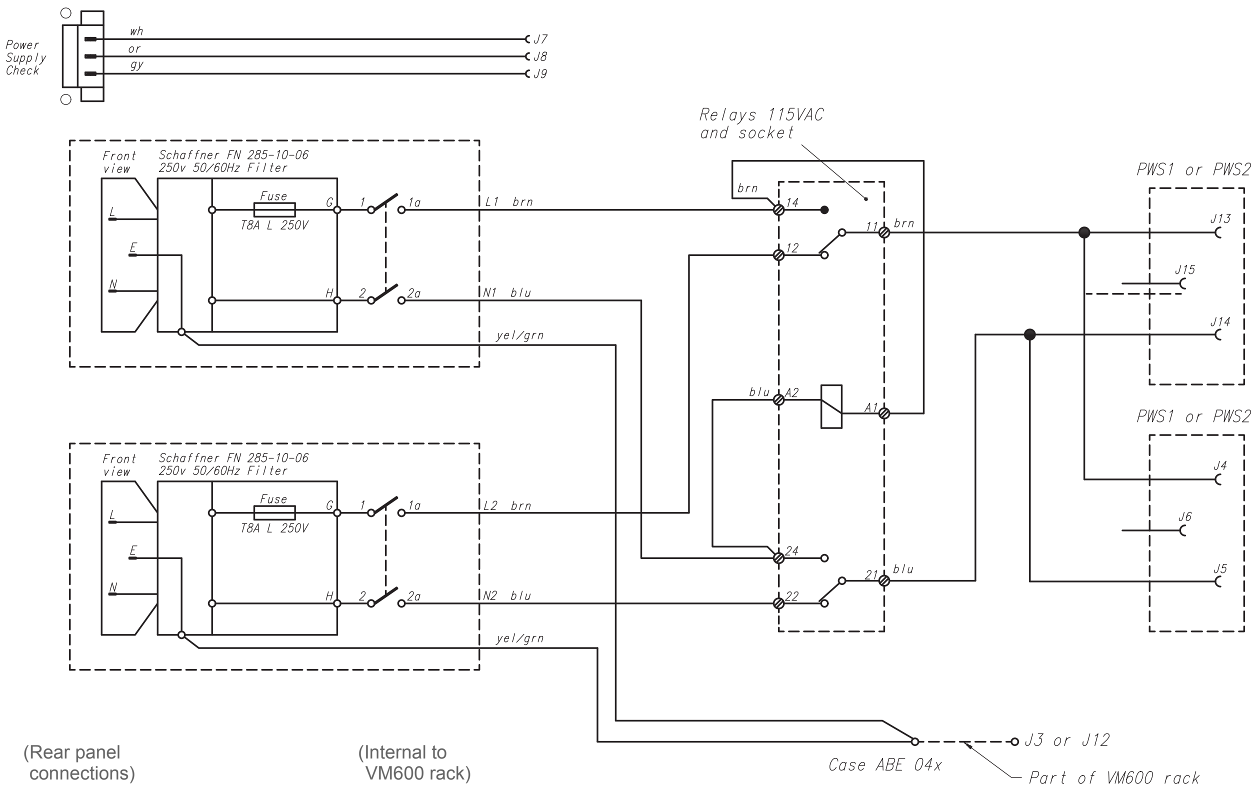
b. Details of the associated VM600 rack power supply wiring.

(The front panel of the DC-input versions of the RPS6U rack power supply is shown in Figure 2-12.)

A VM600 rack power supply solution using this AC-input panel is intended for use with two AC-mains (120 V_{AC} only) supplies arranged as a redundant external power-supply system (see 2.9.7 Racks supporting external mains power-supply system redundancy).



(a) Rear panel



(b) Wiring details

Figure 2-16: AC-input (120 V_{AC} only) panel with individual inputs supporting external mains power supply redundancy

2.9.10 Power supply check relay

The power supply check relay provides an indication that the +5 V, +12 V and −12 V supplies are being correctly generated and delivered by the RPS6U rack power supply or supplies to the VM600 system rack (ABE04x) backplane. The connector for the power supply check relay is available at the rear of the rack, on the rear panel associated with the RPS6U power supply or supplies.

STOP

THE POWER SUPPLY CHECK RELAY IS SPECIFIED FOR OPERATION WITH SEPARATED OR SAFETY EXTRA-LOW VOLTAGE (SELV) SYSTEM VOLTAGE LEVELS:

- **MAXIMUM SWITCHING VOLTAGE OF ±30 V_{RMS} / ±42.4 $V_{AC(PEAK)}$ OR 60 V_{DC}.**

NOTE: Refer to the *VM600 system rack (ABE040 and ABE042) data sheet* for further information on the power supply check relay.

As shown in Figure 2-17, the connector for the power supply check relay has three pins that provide access to the relay contacts, defined from left to right as COM, NO and NC.

Apart from the power supply check relay connector, the other components shown in Figure 2-17 are mounted on the VM600 rack (ABE04x) backplane.

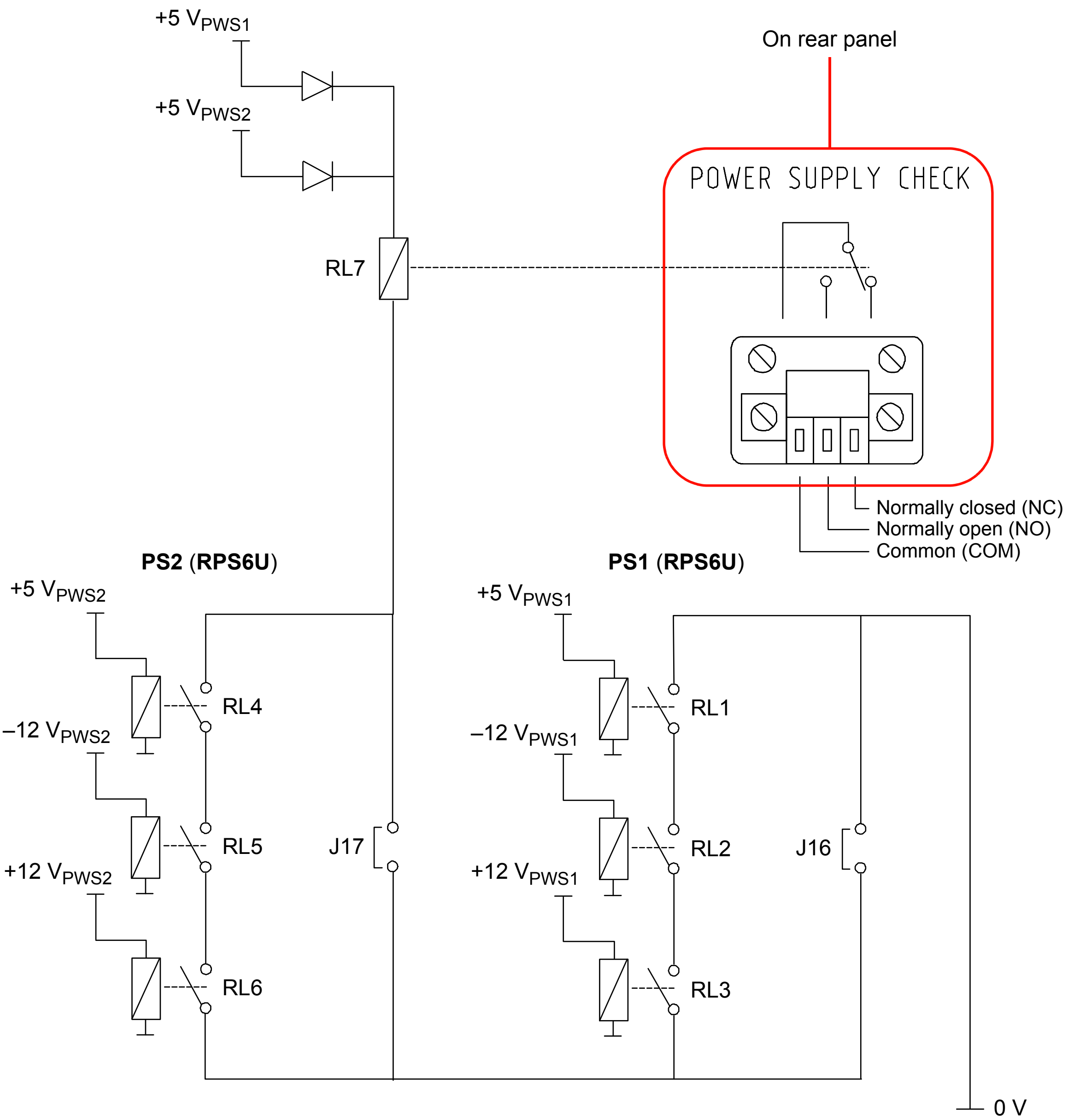


Figure 2-17: Operation of the power supply check relay for the RPS6U power supplies installed in a VM600 rack (ABE04x)

Notes

1- General Remarks:

- Jumpers J16 and J17 have to be set according to which RPS6U rack power supplies are used (PS1, PS2 or both).
- Relays RL1 to RL6 are closed when the corresponding supply voltage (+5 V, −12 V or +12 V) is present and correct.
- When no problem is detected, relay R7 is energised and contact is made between the power supply check relay's COM and NO contacts.
- If a problem is detected, relay R7 is de-energised and contact is made between the power supply check relay's COM and NC contacts.

2- When only the first RPS6U (PS1) is installed (slots 18 to 20):

- Jumper J16 must be left open
- Jumper J17 must be closed.

3- When only the second RPS6U (PS2) is installed (slots 15 to 17):
  - Jumper J16 must be closed
  - Jumper J17 must be left open.

4- When both RPS6Us (PS1 and PS2) are installed:
  - Jumper J16 must be left open
  - Jumper J17 must be left open.

2.9.11 Power supply labelling

Information regarding the DC and AC inputs for the RPS6U rack power supplies used by a VM600 system rack (ABE04x) is available as follows:

- For later versions of VM600 system racks:
  - Input labels close to the input connectors on the associated rear panels provide the specifications for the RPS6U power supply inputs (see 2.9.9 Associated rear panels).
  - A VM600SYS label on a rear panel provides additional information about the VM600 system such as order number and system configuration (SysCFG) number (see Figure 2-18).
- For earlier versions of VM600 system racks, a VM600SYS label on a rear panel provides the specifications for the RPS6U power supply inputs and additional information about the VM600 system such as order number (see Figure 2-19).

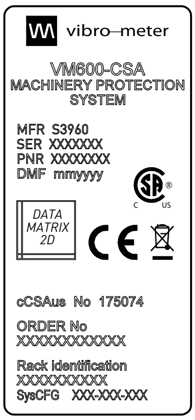


Figure 2-18: Example VM600SYS label (later versions of VM600 system racks)

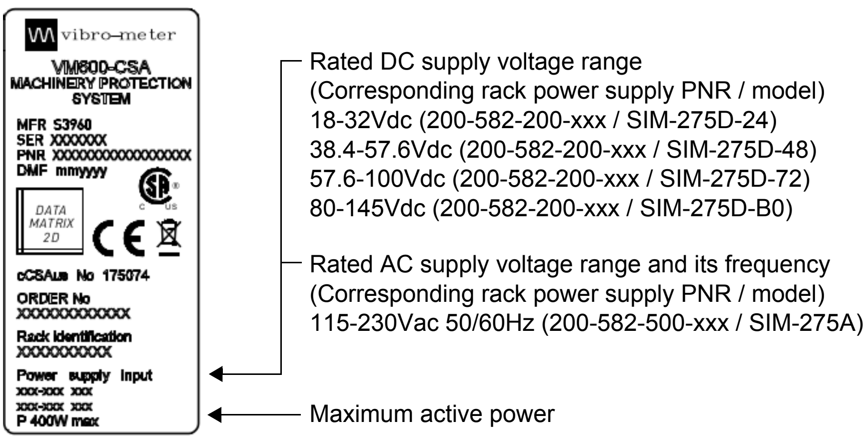


Figure 2-19: Example VM600SYS label (earlier versions of VM600 system racks)

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3 GENERAL SYSTEM DESCRIPTION

3.1 System elements

In order to gain an understanding of the operation of a VM600 machinery protection system (MPS), it is necessary to consider the interaction of the principal elements making up this system, namely:

1- ABE04x (19" x 6U) rack

2- RPS6U rack power supply

3- MPC4 machinery protection card

4- IOC4T input/output card for the MPC4

5- AMC8 analog monitoring card

6- IOC8T input/output card for the AMC8

7- RLC16 relay card (16 relays).

An ABE04x rack can also contain the following:

8- CPUM modular CPU card

9- IOCN input/output card for the CPUM.

As outlined in 1.3 Communicating with the VM600 MPS, the number of different elements used depends on the complexity of the system and the specific application. However, a rack necessarily has one of the following possibilities:

- Only MPC4 / IOC4T card pairs
- Only AMC8 / IOC8T card pairs
- A combination of MPC4 / IOC4T and AMC8 / IOC8T card pairs.

A networked ABE04x has one of the following additional possibilities:

- A CPUM card on its own
- A CPUM / IOCN card pair.

3.2 Rack with MPC4 / IOC4T card pairs

Figure 3-1 shows a block diagram of a networked rack featuring MPC4 / IOC4T card pairs. It shows the interaction between these two cards as well as between them and other cards in the rack.

The signals coming from measurement transducers and devices (such as accelerometers, pressure transducers, proximity transducers, RTD thermometers and flow meters) are connected to the IOC4T via the inputs CH1, CH2, CH3 and CH4, which are accessible at the rear of the ABE04x rack. These raw signals are available to the user on BNC connectors (named RAW OUT) on the panel of the MPC4 card. They are also available on the IOC4T connector (raw outputs RAW 1H and RAW 1L, RAW 2H and RAW 2L, RAW 3H and RAW 3L, and RAW 4H and RAW 4L).

The raw signals are processed by the MPC4 card using both analog signal processing and digital signal processing. This card handles the management of signals, alarm levels, signal processing and so on. The user is able to modify parameters concerning these operations by using one of the VM600 MPS software packages (MPS1 or MPS2), from Meggitt Sensing Systems' Vibro-Meter product line.

Four alarm levels can be set for each channel, typically called Alert− (A−), Alert+ (A+), Danger− (D−) and Danger+ (D+). These alarms, or combinations of them, can be used to drive alarm outputs (relay outputs) on the IOC4T card. The OC Bus or Raw Bus can be used to drive relays on an optional RLC16 card.

A DC output is available on the IOC4T card for each of the four measurement channels. These outputs (DC OUT 1 to DC OUT 4) can be calibrated by software and configured by jumpers to provide either a current-based signal (4 to 20 mA) or voltage-based signal (0 to 10 V).

Three discrete signal interface (DSI) control inputs are available on the IOC4T card:

- Danger Bypass (DB) – To inhibit relay outputs associated with the Danger levels (D− and D+).
- Trip Multiply (TM) – To selectively increase the Alert and Danger levels by a programmable multiplying factor.
- Alarm Reset (AR) – To reset (clear) latched alarms.

The TACHO 1 and TACHO 2 inputs on the IOC4T card are intended for the connection of rotational speed measurement systems. These signals (suitably shaped to be TTL-compatible) are available on the BNC connectors (named TACHO OUT 1 and TACHO OUT 2) on the panel of the MPC4 card. They can also be routed under software control to other cards in the MPS rack via the Tacho Bus.

The VM600 MPS software packages and Modbus can be used to send channel inhibit commands to individual MPC4 channels (measurement and speed) in order to temporarily bypass a sensor, that is, to temporarily inhibit the protection offered by any associated relays.

NOTE: The safety version of the MPC4 card (MPC4SIL) does not does not support the danger bypass (DB), trip multiply (TM) and channel inhibit functions.

The CPUM card acts as a "rack controller". In general, it communicates with the MPC4 / IOC4T card pairs over the VME bus.

NOTE: The safety version of the MPC4 card (MPC4SIL) does not have a VME bus interface so it cannot communicate with a CPUM or any other cards in a VM600 rack (see 4 MPC4 / IOC4T card pair).

The CPUM, and therefore the rack, can communicate with the outside world over RS-232 and Ethernet links. The CPUM can operate on its own in the rack, but it is generally used with the associated IOCN card. Depending on the options installed, the IOCN allows communication with a host computer or computer network over one or several RS 232, RS-422, RS-485 or Ethernet links.

See 4 MPC4 / IOC4T card pair for more detailed information on the MPC4 / IOC4T card pair.

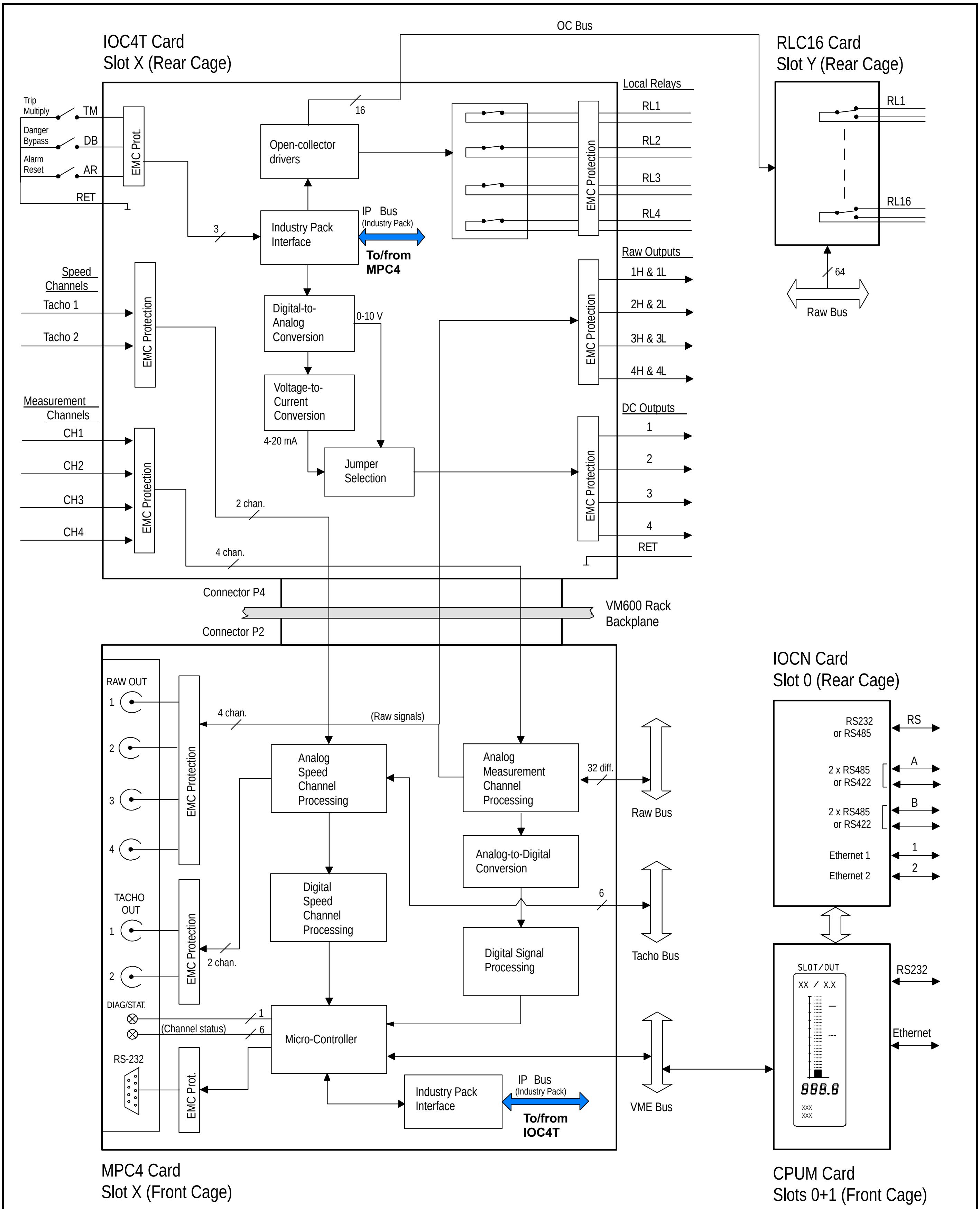


Figure 3-1: Block diagram of cards in a VM600 MPS (configuration based on MPC4 / IOC4T card pairs)

3.3 Rack with AMC8 / IOC8T card pairs

Figure 3-2 shows a block diagram of a networked rack featuring AMC8 / IOC8T card pairs. It shows the interaction between these two cards as well as between them and other cards in the rack.

The signals coming from measurement transducers and devices (such as RTD thermometers, flow meters and proximity transducers) are connected to the IOC8T via the inputs CH1 to CH8, which are accessible at the rear of the ABE04x rack.

The raw signals are processed by the AMC8 card using both analog signal processing and digital signal processing. This card handles the management of signals, alarm levels, signal processing and so on. The user is able to modify parameters concerning these operations by using one of the VM600 MPS software packages (MPS1 or MPS2), from Meggitt Sensing Systems' Vibro-Meter product line.

Four alarm levels can be set for each channel, typically called Alert− (A−), Alert+ (A+), Danger− (D−) and Danger+ (D+). These alarms – or combinations of them – can be used to drive alarm outputs (relay outputs) on the IOC8T card. The OC Bus or Raw Bus can be used to drive relays on an optional RLC16 card.

A DC output is available on the IOC8T card for each of the eight measurement channels. These outputs (DC OUT 1 to DC OUT 8) can be calibrated by software and configured to provide a current-based signal (4 to 20 mA) or voltage-based signal (0 to 10 V). The choice between current and voltage is made by setting solder bridges on the IOC8T card. This operation is normally done in the factory before delivery. The default setting provides a current-based output.

Two discrete signal interface (DSI) control inputs are available on the IOC8T card:

- Danger Bypass (DB) – To inhibit relay outputs associated with the Danger levels (D− and D+).
- Alarm Reset (AR) – To reset (clear) latched alarms.

The VM600 MPS software packages and Modbus can be used to send channel inhibit commands to individual AMC8 channels in order to temporarily bypass a sensor, that is, to temporarily inhibit the protection offered by any associated relays.

The CPUM card acts as a “rack controller”. It communicates with the AMC8 / IOC8T card pairs over the VME bus. The CPUM, and therefore the rack, can communicate with the outside world over RS-232 and Ethernet links. The CPUM can operate on its own in the rack, but it is generally used with the associated IOCN card. Depending on the options installed, the IOCN allows communication with a host computer or computer network over one or several RS-232, RS-422, RS-485 or Ethernet links.

See 5 AMC8 / IOC8T card pair for more detailed information on the AMC8 / IOC8T card pair.

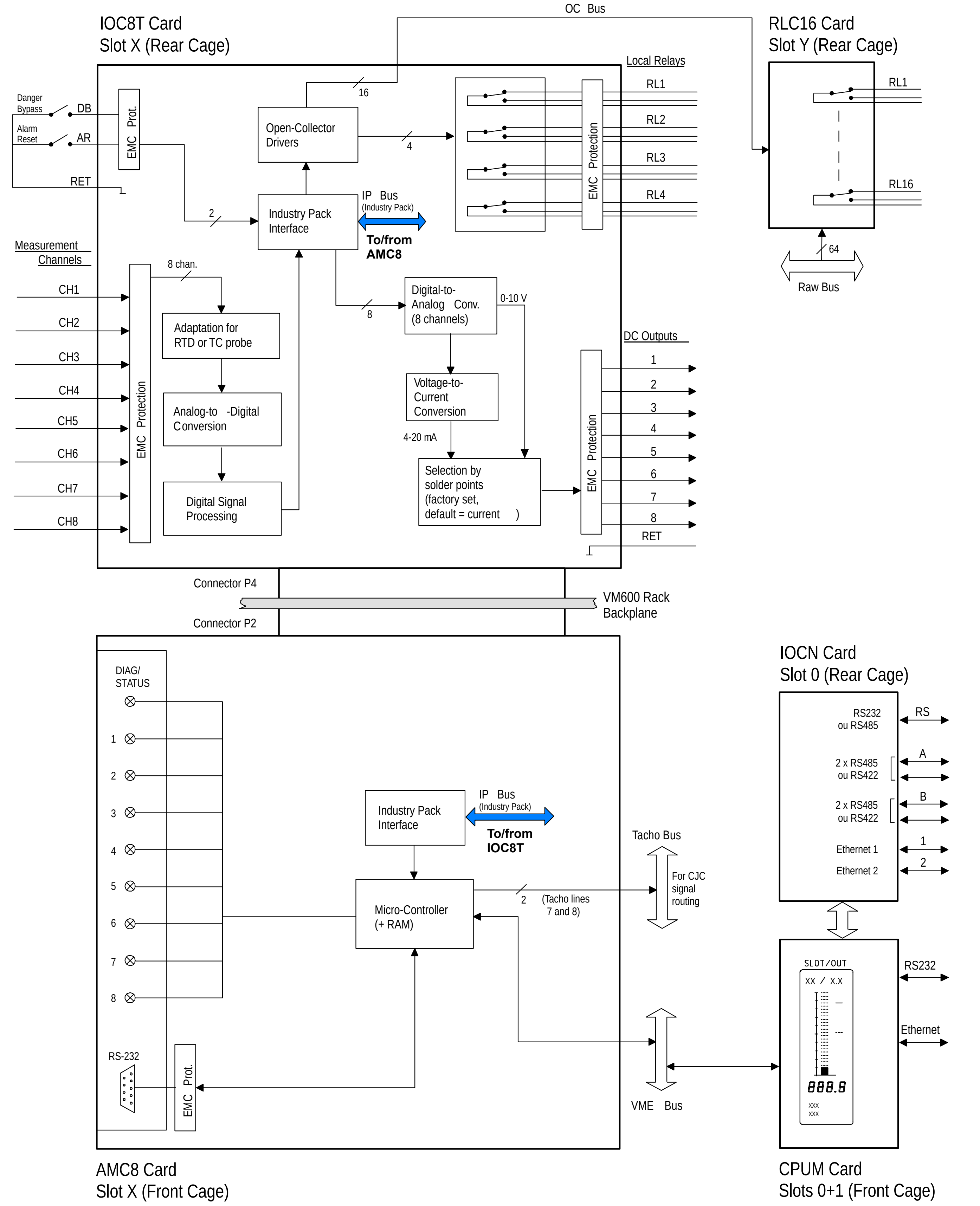


Figure 3-2: Block diagram of cards in a VM600 MPS (configuration based on AMC8 / IOC8T card pairs)

3.4 VM600 rack backplane

3.4.1 General overview

The VM600 MPS uses a 6U 19" system rack (ABE04x) with a custom-designed backplane combining features of a VME backplane and other special features to support Meggitt Sensing Systems' Vibro-Meter product line (see Figure 3-3 and Figure 3-4).

This backplane consists of 3 different systems:

- A VME bus (P1)
- An analog bus (P3)
- Through connections between P2 and P4.

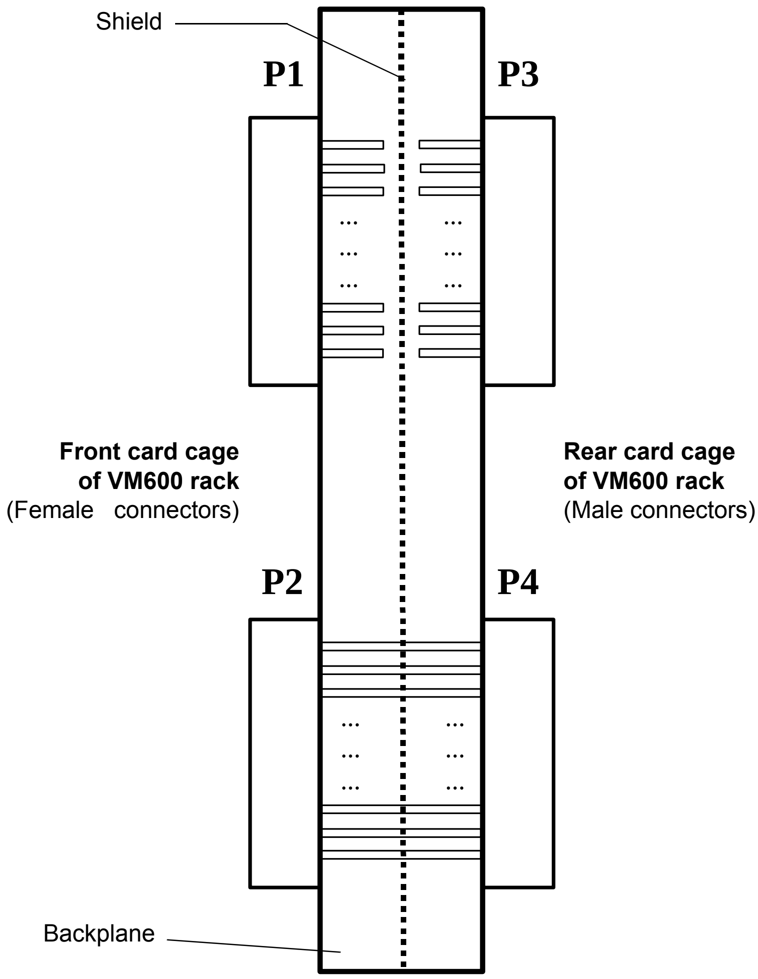


Figure 3-3: Cross-section of a VM600 rack (ABE04x) backplane showing the four buses and connectors

The P1 bus, on the front side of the backplane, is used for slots 0 to 14 in order to implement a standard VME bus on the front side of the backplane. This corresponds to the VME 16 specifications and allows 24-bit address and 16-bit data transfers between cards in the rack.

NOTE: The safety version of the MPC4 card (MPC4SIL) does not have a VME bus interface so it cannot communicate with a CPUM or any other cards in a VM600 rack (see 4 MPC4 / IOC4T card pair).

The P2 and P4 connectors are used for slots 0 to 14 in order to connect the card in the front card cage to the card immediately behind it in the rear card cage (through connections).

Slots 15 and 18 of the rack are reserved for RPS6U rack power supplies. The backplane is equipped with special high-current connectors (type H15) for these power supplies.

The P3 bus, on the rear side of the backplane, actually consists of the following three buses:

1- The Tacho Bus

This is composed of eight lines. These lines have passive terminations.
The Tacho Bus is common to all slots in the rack. It is intended for the transfer of speed and phase reference signals between cards.

See 3.4.2 Tacho Bus for further information.

2- The Open Collector (OC) Bus

This is composed of 96 open collector (“ground/open") lines. These lines do not have terminations.

The OC Bus is sub-divided into 6 buses each having 16 lines (these buses are called OCA, OCB, OCC, OCD, OCE, OCF). Each of these six buses is associated with three slots (with each slot associated with only one bus).

See 3.4.3 Open Collector Bus for further information.

3- The Raw Bus

This is composed of 32 x 2 lines. These lines do not have terminations.

The Raw Bus is common to all slots in the rack.

See 3.4.4 Raw Bus for further information.

The Tacho Bus, the Open Collector Bus and the Raw Bus are not buses in the microcomputing sense of the term, that is, there is no protocol, handshaking, timing and so on. Rather, they should be thought of as groups of lines that can be used to transmit signals.

NOTE: See Appendix C - Definition of backplane connector pins for full details on the P1, P2, P3 and P4 connectors.

See also 8.2 Attribution of slots in the rack for further information on which VM600 cards can be installed in which slots of a VM600 rack (ABE04x).

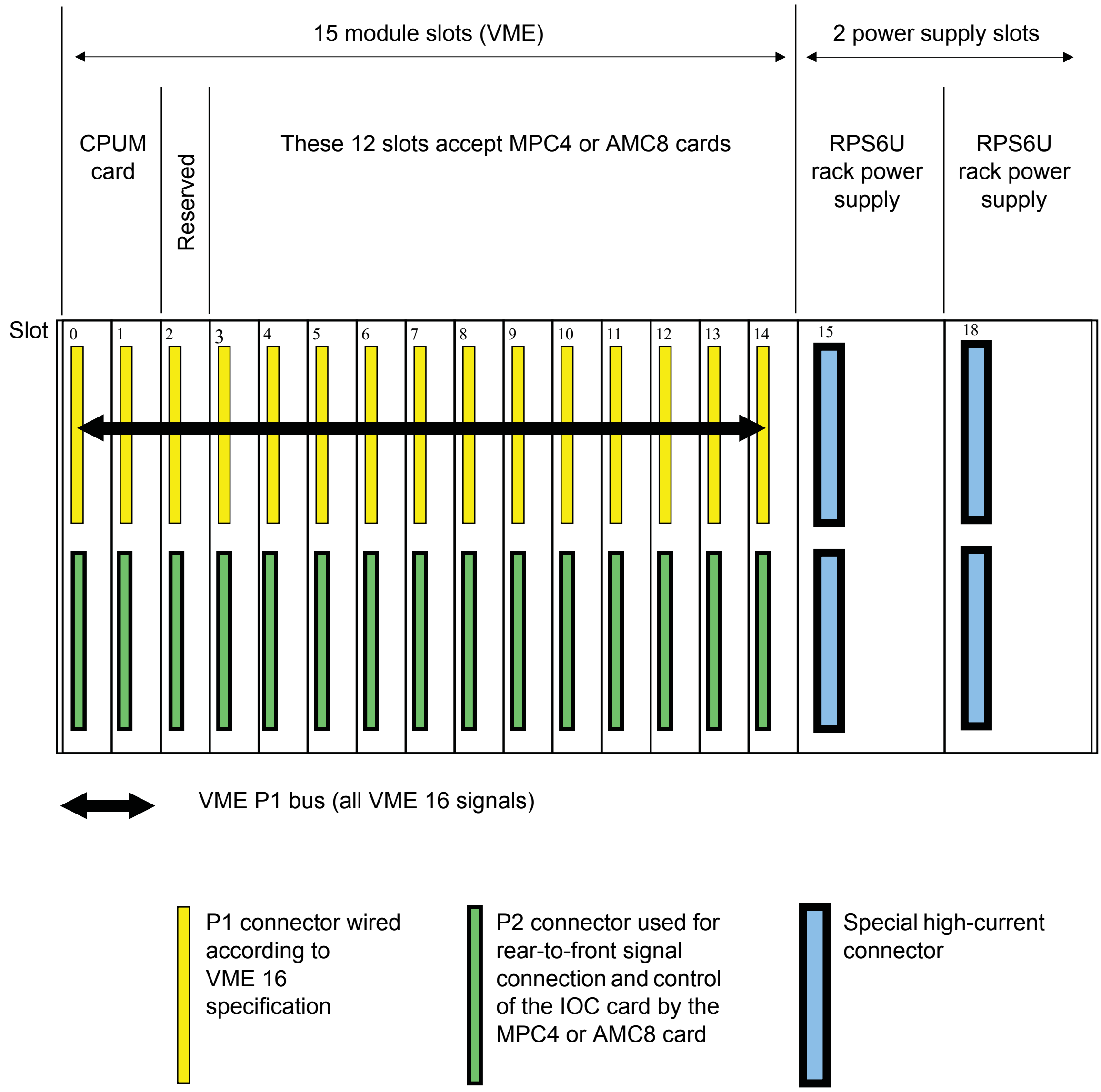


Figure 3-4: Diagram of VM600 rack (ABE04x) backplane showing the arrangement of the connectors

3.4.2 Tacho Bus

The Tacho Bus has eight lines and is common to all slots in the rack. It is intended for the transfer of speed signals between cards.

Speed signals can be put onto the Tacho Bus from an IOC4T card. This is done by multiplexers that are under software control (see Figure 3-5). These multiplexers allow one or both of the “local" speed signals on IOC #A to be sent to another card, for example to IOC #B. Software-controlled demultiplexers on IOC #B allow the speed signal to be brought off the bus and onto the card. Once on IOC #B, these signals can be used by the corresponding MPC4 card (MPC #B). This technique is known as using “remote" speed signals.

The VM600 MPSx software ensures that two or more speed signals are not sent to the same Tacho Bus line. A signal on a given Tacho Bus line can be used by more than one card.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

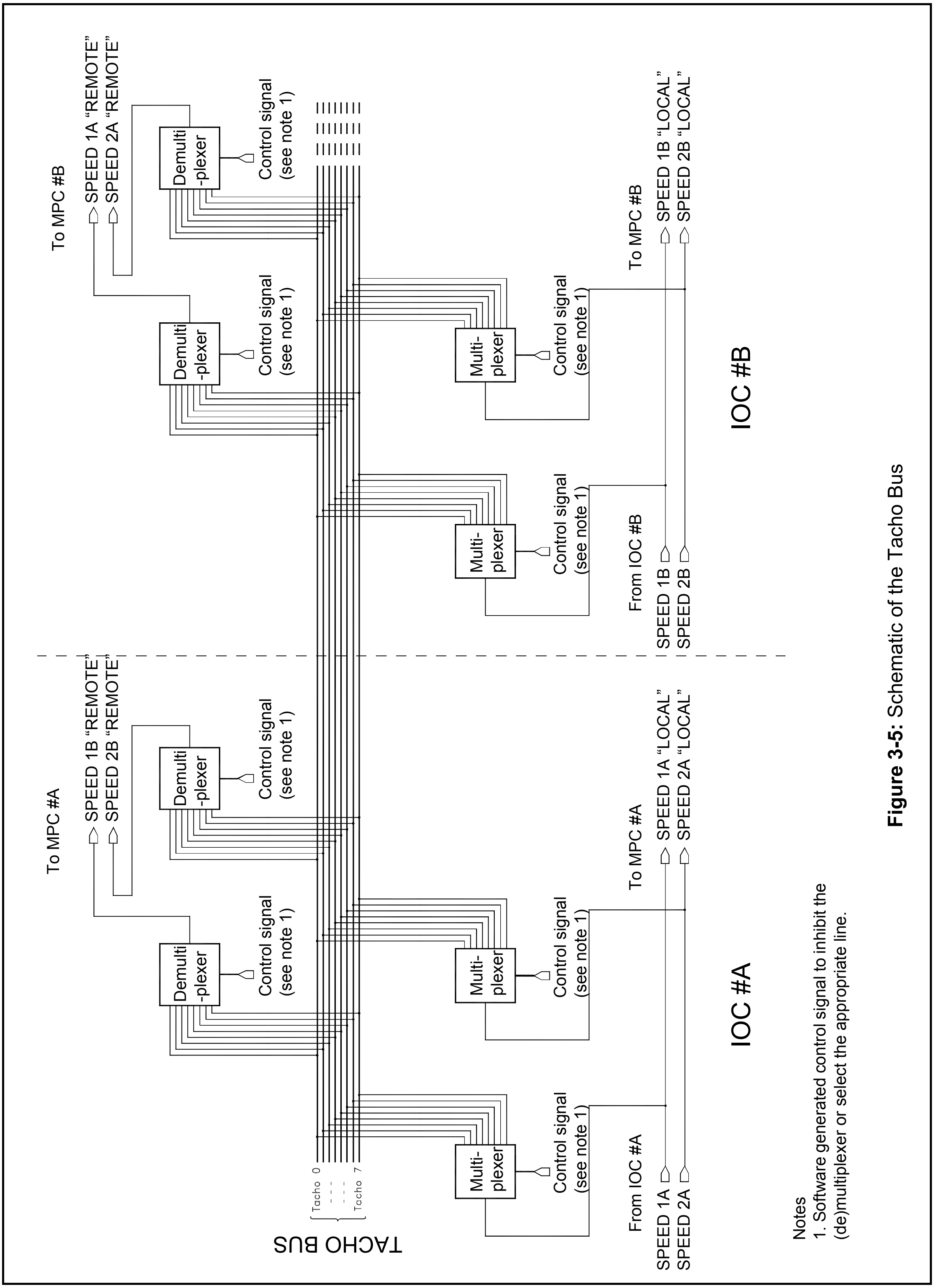


Figure 3-5: Schematic of the Tacho Bus

3.4.3 Open Collector Bus

Each Open Collector Bus (OC Bus) contains 16 parallel bus lines and is a dedicated bus linking one specific RLC16 card to two specific IOC4T or IOC8T cards (see Figure 3-6).

The OC buses are reserved for sending alarm signals from an MPC4 / IOC4T card pair or an AMC8 / IOC8T card pair to an RLC16 card. These signals are then used to switch relays on the RLC16.

The ABE04x rack contains the following dedicated OC Buses:

Table 3-1: Slots linked by the various OC Buses

OC Bus name	RLC16 slot location	IOC4T or IOC8T slot location
OC Bus A	Slot 1	Slots 3 and 4
OC Bus B	Slot 2	Slots 5 and 6
OC Bus C	Slot 15	Slots 7 and 8
OC Bus D	Slot 16	Slots 9 and 10
OC Bus E	Slot 17	Slots 11 and 12
OC Bus F	Slot 18	Slots 13 and 14

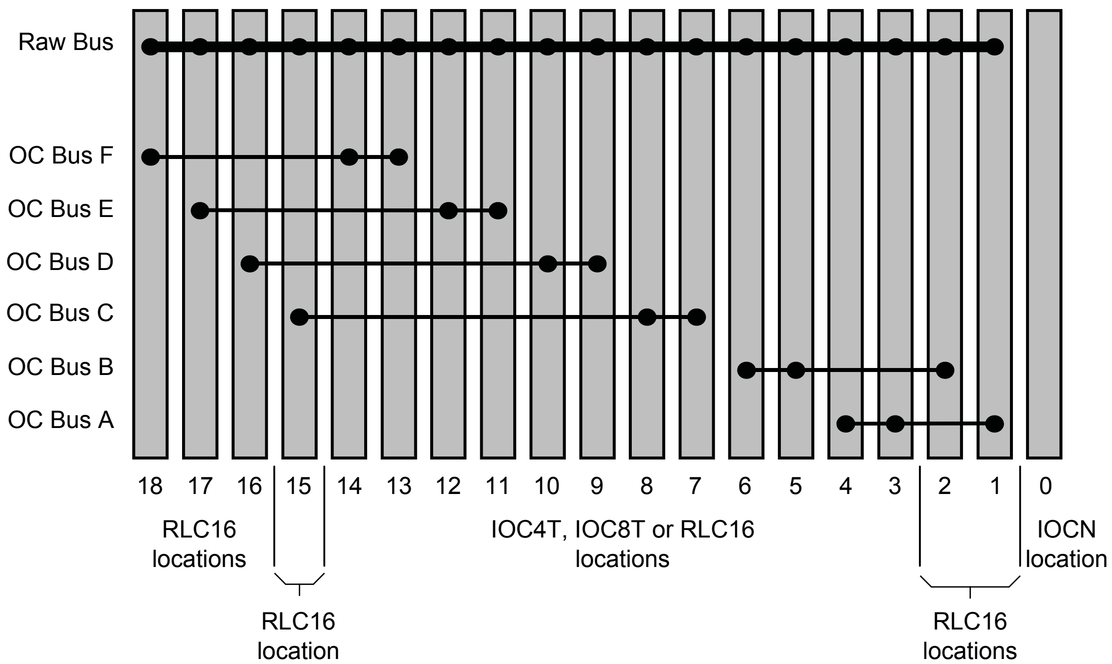


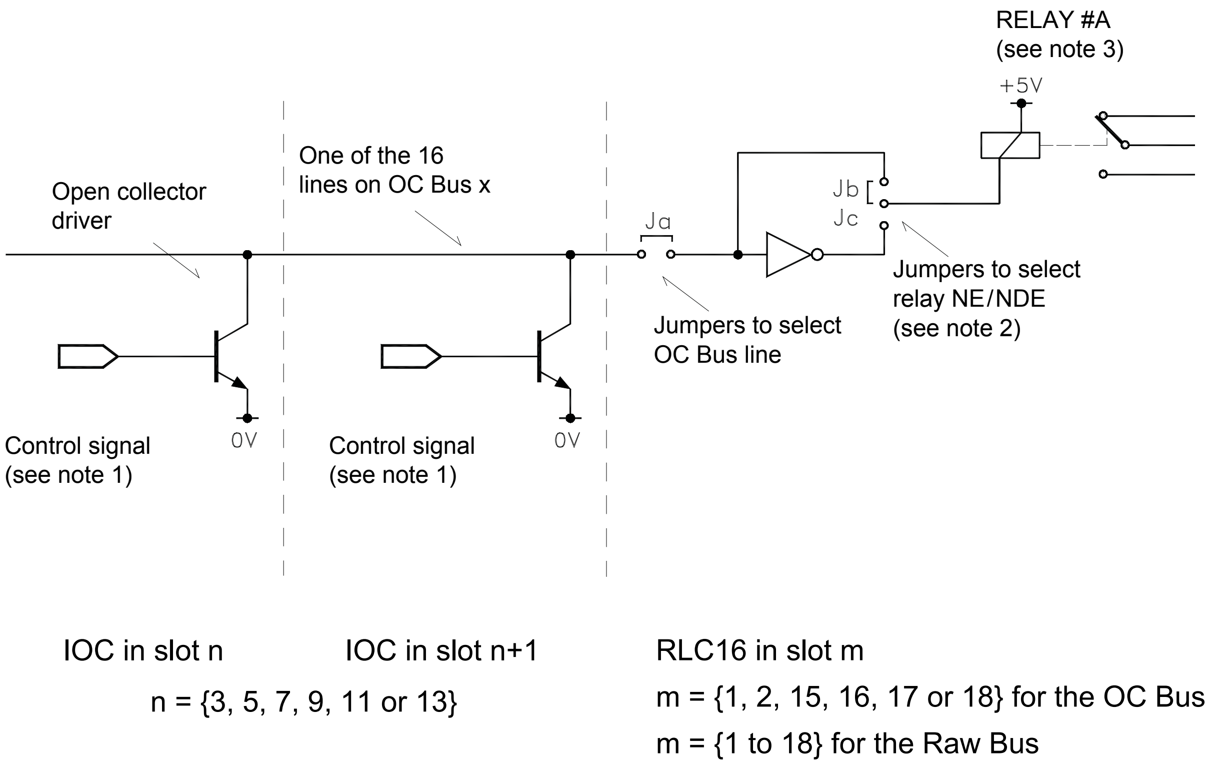
Figure 3-6: Rear view of rack showing the six dedicated OC Buses and the Raw Bus (top)

The IOC card drives the OC Bus lines using open collector driver circuitry (see Figure 3-7). In the event of an alarm, the bus driver control signal goes high.

The attribution of a specific alarm signal (generated by an MPC4 / IOC4T card pair or an AMC8 / IOC8T card pair) to an OC Bus line is done under software control.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

The attribution of a specific line on the OC Bus to a specific relay on the RLC16 is done by setting jumpers on the RLC16. This is described in 9.12.1 Using the Open Collector Bus (OC Bus) to switch relays and 10.8.1 Using the Open Collector Bus (OC Bus) to switch relays.



Notes
1. Specific alarms (A+, D− and so on) are attributed to the OC Bus lines using the MPS configuration software.
   See Table 9-4 for information on the normal state of the control signal.
2. For a normally energized (NE) relay, select an inverted relay control line by placing jumper Jc.
   For a normally de-energized (NDE) relay, select jumper Jb.
   Either Jb or Jc must be selected (that is, it is not possible to select both or to select neither).
3. Relay #A represents one of the 16 relays (RL1 to RL16) on the RLC16 card.

Figure 3-7: Using of one of the 16 OC Bus lines to switch a relay on a RLC16 card

3.4.4 Raw Bus

The Raw Bus contains 64 parallel bus lines, arranged as 32 differential line pairs. The ABE04x system rack contains a single bus of this type which is common to all cards located in slots 1 to 18 (see Figure 3-6). As such, this is a flexible bus allowing the transfer of data between various cards in the rack (see Figure 3-6). Its principal applications are to:

- Share raw analog signals input on channels 1 to 4 of an IOC4T card with other cards in the rack (for example, to CMC16, XMC16 or XMV16 cards installed in a rack featuring both MPS and CMS hardware). An example of this is shown in Figure 3-8.

  NOTE: The XMVS16 card has the same capabilities and features as the XMV16 card, except that the XMVS16 cannot access and therefore cannot configure anything on the VM600 raw bus.

  Use of the Raw Bus for this purpose is described further in 9.11 Using the Raw Bus to share measurement channel inputs.
- Supplement the OC Bus by allowing additional alarm signals to be routed to the relays on an RLC16 card.

  Use of the Raw Bus for this purpose is described further in 9.12.2 Using the Raw Bus to switch relays and 10.8.2 Using the Raw Bus to switch relays.

Signals are placed on the Raw Bus by setting jumpers on an IOC4T (see Figure 3-8). If the signals are required by a CMC16 card, the appropriate switches must also be set on the corresponding IOC16T card.

If the signals are required by a XMC16 or XMV16 card, the corresponding XIO16T card is configured using the VibroSight® software (that is, the XIO16T hardware is fully software configurable).

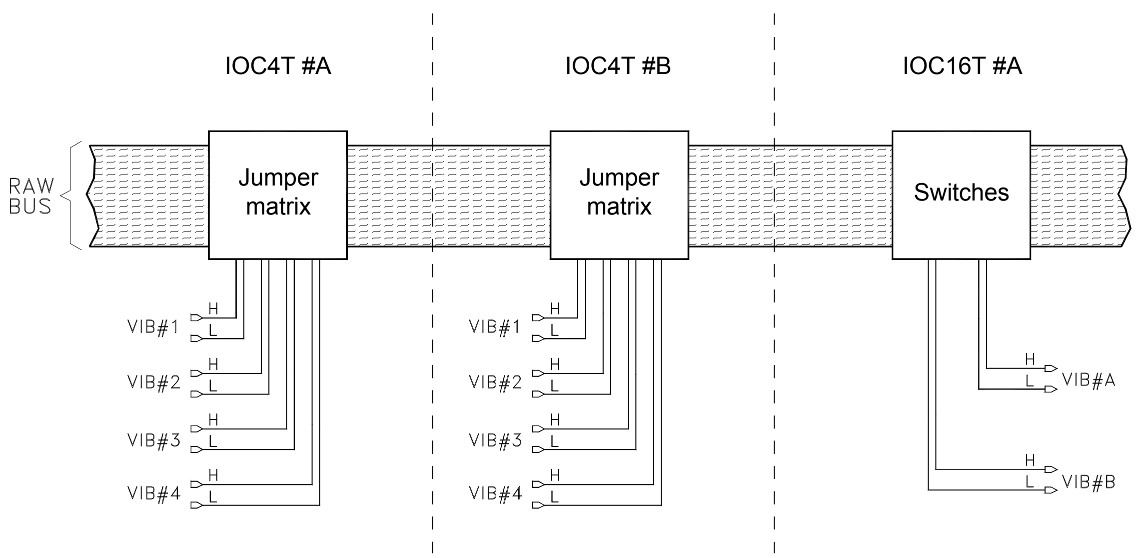


Figure 3-8: Use of the Raw Bus to transfer analog signals between cards

NOTE: The IOC8T card does not support the Raw Bus, so sharing an analog signal between an AMC8 / IOC8T card pair and a condition monitoring card pair (such as the CMC16 / IOC16T) requires that either:
- A DC output from the IOC8T is connected to a dynamic input channel of the IOC16T using external cabling
- Modbus is used to communicate the analog values (which requires that a CPUM card is also installed in the rack).

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Part I: Functional description of VM600 MPS system

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4 MPC4 / IOC4T CARD PAIR

4.1 Different versions of the MPC4 card

The MPC4 machinery protection card is available in different versions, including a standard version, a separate circuits version and a safety (SIL) version.

NOTE: Both the standard and the safety (SIL) versions of the MPC4 card are certified to IEC 61508 and ISO 13849. The MPC4SIL version was developed to permit a wider range of installation options.

The original IEC 61508 and ISO 13849 certification process targeted a VM600 rack for safety-related system (SRS) applications with a limited range of cards, that is, standard MPC4 / IOC4T card pairs and RLC16 relay cards (see 4.1.1 Standard version of the MPC4).

Then Meggitt Sensing Systems decided to safety certify another system with additional functionality, such as monitoring. To safety certify such a VM600 rack, it was necessary to ensure that there is no possibility of the configuration being inadvertently modified. The safety version of the MPC4 card (MPC4SIL) overcomes this potential configuration issue by not implementing a VME bus interface, so data corruption via the VM600 rack backplane's VME bus is impossible.

4.1.1 Standard version of the MPC4

The standard MPC4 card is the original version, intended for systems using a VM600 rack with a limited range of cards, that is, standard MPC4 / IOC4T card pairs and RLC16 relay cards.

The standard MPC4 has a VME-compatible slave interface and is software configurable via RS-232 (on the panel of the MPC4 card) or via VME for a networked VM600 rack. It also supports all processing modes (see Table 7-1).

4.1.2 Separate circuits version of the MPC4

The separate circuits version of the MPC4 card is intended for systems using a separate circuits version of the VM600 rack. The separate circuits MPC4 was developed in accordance with the CEI/IEC 60255-5 standard: “Insulation coordination for measuring relays and protection equipment – Requirements and tests” and has slightly different circuitry (see 9.10 Grounding options).

Like the standard MPC4, the separate circuits MPC4 has a VME-compatible slave interface and is software configurable via RS-232 (on the panel of the MPC4 card) or via VME for a networked VM600 rack. It also supports all processing modes (see Table 7-1).

4.1.3 Safety version of the MPC4

The safety (SIL) version of the MPC4 card, that is the MPC4SIL, was developed to permit a wider range of installation options with a single VM600 rack, for example, condition monitoring in addition to machinery protection. To safety certify these systems, it was necessary to ensure that the safety MPC4 is isolated from the other cards in a VM600 rack, so that there is no possibility of its configuration being inadvertently modified.

As the safety MPC4 (MPC4SIL) does not have a VME bus interface, corruption of its configuration is impossible as it is only software configurable via RS-232 (on the panel of the MPC4 card). Therefore, it is now possible to define a single VM600 rack configuration containing condition monitoring cards (such as the CMC16 and XMx16) and relay cards (such as the RLC16) in addition to safety-related machinery protection in the form of safety MPC4 cards.

However, the safety MPC4 card (MPC4SIL) does not support all of the processing modes supported by the standard and the separate circuits versions of the MPC4 cards (see Table 7-1). For example, the MPC4 SIL card does not support the speed/phase reference (tachometer) input channels, the Narrow Band (Tracking) Vibration and S_{max} processing functions, and it does not support the danger bypass (DB), trip multiply (TM) and channel inhibit functions.

In addition, the use of standard MPC4 cards or safety MPC4 cards in a machinery monitoring system for a safety-related application requires that the complete system configuration is manually reviewed in order to:

- Ensure that the VM600 rack configuration is permitted.
- Avoid possible conflict from additional cards.
- Ensure that the MPC4 cards' configurations are permitted.

NOTE: Refer to the *VM600 safety manual* for further information.

4.1.4 Identifying different versions of the MPC4 card

The different versions of the MPC4 card can be visually identified from their panels, as the lower handle on the panel is different.

- For the standard and separate circuits versions of the MPC4 card, the label on the lower handle of the panel displays the text "MPC 4" against a blue background, as shown in Figure 4-1 (a).
- For the safety (SIL) version of the MPC4 card, the label on the lower handle of the panel displays the circular TÜV Nord logo and text "MPC 4" against an orange background, as shown in Figure 4-1 (b).

The ordering number (PNR) for a MPC4 card is in given in the format 200-510-SSS-**x**Hh.

In this PNR, **x** represents the version of the MPC4 card as follows:

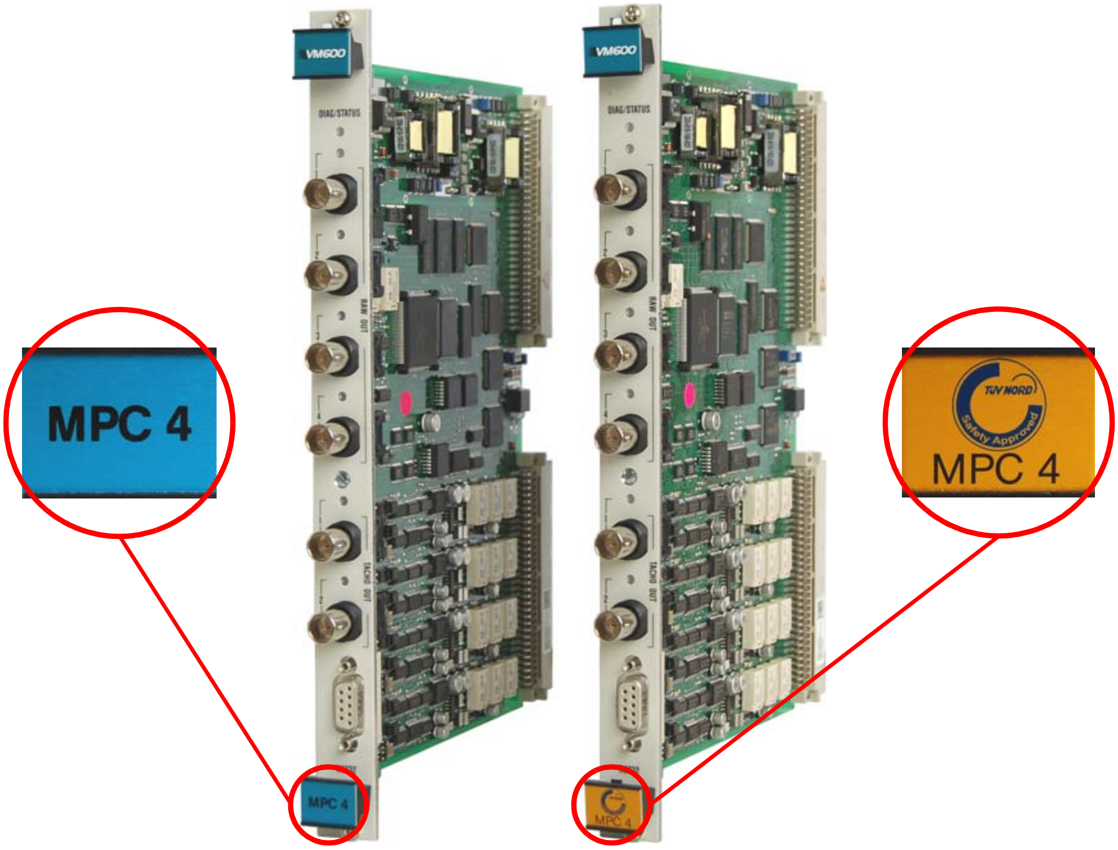
- 1 indicates the standard version of the card.
- 2 indicates the separate circuits version of the card.
- 3 indicates the safety (SIL) version of the card.

NOTE: Refer to the *MPC4 machinery protection card data sheet* for further information.

In the VM600 MPSx software (version 2.6.x or later):

- MPC4 is used to refer to the standard and separate circuits versions of the MPC4 card.
- MPC4SIL is used to refer to safety version of the MPC4 card.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.



(a) Standard version and separate circuits version of the MPC4 card

(b) Safety version of the MPC4 card (that is, the MPC4SIL)

Figure 4-1: Different versions of the MPC4 card

4.2 General block diagram

A block diagram of the MPC4, IOC4T and RLC16 cards is shown in Figure 4-2. This shows schematically the backplane, which physically divides the ABE04x rack into a front card cage and a rear card cage.

The MPC4 (shown on the left of Figure 4-2) is mounted in the front card cage. This card effects the signal processing functions for the MPS. Its panel contains BNC connectors to output the raw measurement signals (for example, corresponding to vibration or dynamic pressure) and speed signals. An LED indicator (DIAG/STATUS) shows the hardware status of the MPC4 / IOC4T card pair. Additional LED indicators are present to provide information on the status of each individual channel (such as signal valid or the presence of alarms). The panel also has a 9-pin D-sub connector for configuring an MPC4 card used in a stand-alone rack, that is, one not containing a CPUM card.

Each MPC4 card is necessarily connected (via the backplane) to an IOC4T input/output card mounted in the rear card cage. The IOC4T card's panel (rear of rack) has screw terminals for connecting the signal transmission lines coming from the transducers (for example, from vibration and speed transducers). Other screw terminals are used to output raw signals as well as processed signal values (0 to 10 V or 4 to 20 mA).

The IOC4T contains 4 local relays with outputs available on the screw terminal strip. In applications needing more than the four relays provided by the IOC4T, an RLC16 relay card can be installed in the rack.

The RLC16 card contains 16 relays and has a terminal strip with 48 screw terminals (3 strips each having 16 terminals).

Abbreviations:
ADC = Analog-to-digital converter, AR = Alarm Reset, DAC = Digital-to-analog converter,
DB = Danger Bypass, DSP = Digital signal processor,
EMC = Electromagnetic compatibility, IP = Industry pack, I/P = Input,
JS = Jumper selectable, OC = Open Collector, TM = Trip Multiply,
SW = Software, VME = VERSAbus module eurocard.

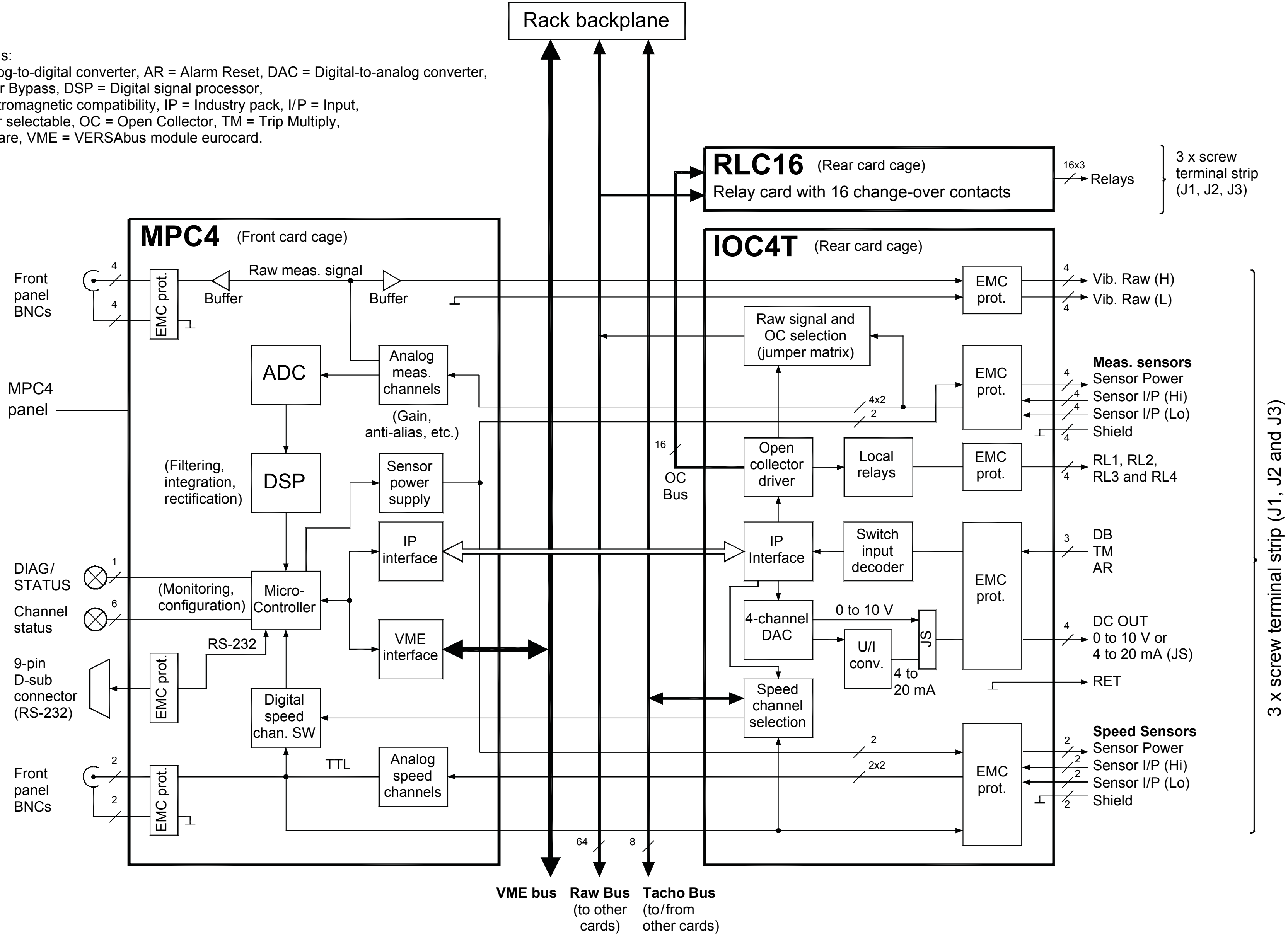
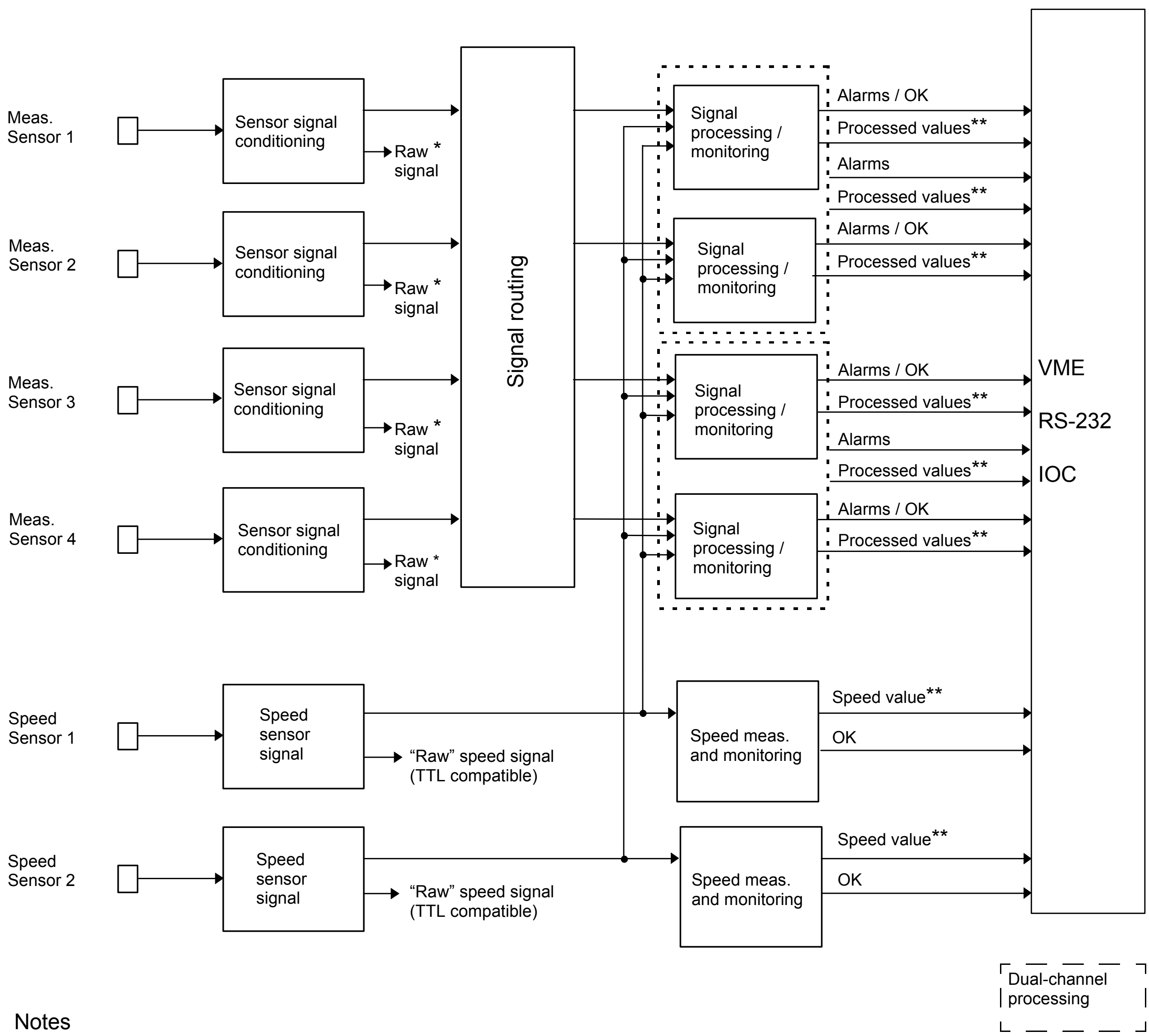


Figure 4-2: Block diagram of MPC4, IOC4T and RLC16 cards

4.3 Overview of MPC4 operation

The MPC4 card implements a variety of signal processing and monitoring functions, each of which requires real-time continuous processing of the inputs. It can execute up to a maximum of four processes simultaneously, either on one sensor or on a combination of up to four sensors.

The block diagram in Figure 4-3 summarises the operation of the MPC4 card.



Notes
*The raw measurement signals and TTL-conditioned speed signals are output on the MPC4 card's panel BNC connectors and are also sent to the IOC4T.
**The "processed values" include the two "monitored" values. They also include the OK levels of the sensors. The "speed values" are also monitored and include the OK value of the sensor.

Figure 4-3: Operation of MPC4 machinery protection card

4.3.1 Sensor signal conditioning

This block (see Figure 4-3) acts as a signal interface and is used to:

- Acquire a dynamic signal from the connected sensor.
- Check for signal overload (independently of the OK line check).
- Power the connected sensor.
- Output the raw signals. These are available on BNC connectors on the panel of the card (for example, for connection to an oscilloscope). Refer to the *MPC4 machinery protection card data sheet* for buffer specifications.

4.3.2 Signal routing

This block (see Figure 4-3) enables flexible connection of signals. It allows the system to:

- Connect any sensor to any signal processing/monitoring channel input.
- Connect any sensor to two, three or four signal processing/monitoring channels. This enables several processing/monitoring functions to be performed on the same sensor signal.

4.3.3 Signal processing and monitoring

This block (see Figure 4-3) assures the following:

1- Selection of the Processing Function

The processing functions include the following types of monitoring: Absolute Bearing Vibration, Relative Shaft Vibration (and Gap), Absolute Shaft Vibration, S_{max}, Eccentricity, Broad-Band Pressure, Temperature and so on.

See 7 Processing modes and applications for all the possibilities available.

2- Rectification

The rectification techniques available are described in 4.5 Rectification techniques.

3- Monitoring

The rectified values are monitored and alarms generated if the thresholds are exceeded. These alarms can be used to set relays.

The block also allows logical combinations of alarms to be configured. In addition, it handles the Adaptive Monitoring and Direct Trip Multiply functions.

The monitoring possibilities are described in 4.6 Alarm monitoring.

4- Sensor OK Level Detection

This function monitors the OK levels for the sensor to check for hardware problems (for example, faulty sensor or signal conditioner, or defective transmission line).

OK level detection is described in 4.7 System self-checks.

The MPS allows single and dual processing (the latter indicated by the dashed lines in Figure 4-3). The following dual processing options can be software configured:

- Dual Processing Channels 1 & 2
- Dual Processing Channels 3 & 4.

4.4 Inputs and outputs

4.4.1 Measurement signal inputs

The sensors connected to the four measurement channel inputs (that is, the CH1, CH2, CH3 and CH4 terminals on the IOC4T) deliver conditioned signals to the MPC4 card. These conditioned inputs are composed of AC signals with or without a DC component. Typically, signals from accelerometers, velocity transducers, proximity probes or dynamic pressure probes are handled. Hardware associated with the sensors such as signal conditioners and optional safety barriers or galvanic separations are not implemented within the MPS, but externally.

Both voltage-based and current-based input signals are accepted by the MPS. Depending on the sensor and signal conditioner type used, 2-wire or 3-wire transmission lines can be connected to the inputs.

The MPC4 sends buffered input signals to the backplane for use by other cards in the system, as well as to the BNC connectors on the MPC4 card's panel for analysis (for example, with an oscilloscope).

The sensors and associated electronic hardware are normally powered by the MPS. An external power supply is required to power GSI galvanic separation units, GSV safety barriers, and transducer and signal conditioner systems requiring a supply >25 mA.

NOTE: See 9 Configuration of MPC4 / IOC4T cards for further information on powering sensors and associated electronic hardware.

4.4.1.1 Overview of MPC4 signal processing

The signal is processed as shown in the block diagram in Figure 4-4. This applies only to hardware versions 200-510-100-03x, 200-510-100-1xx and 200-510-100-2xx.

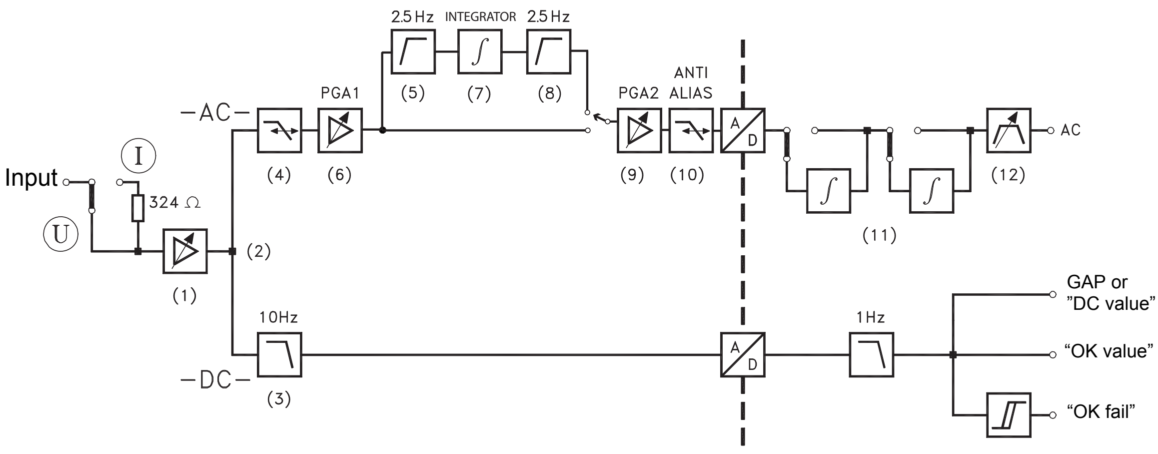


Figure 4-4: Signal processing in the MPC4 card

(1) Signal input

If the input signal is current-based, it is read on a 324 Ω resistor to obtain a voltage-based signal.

The signal then undergoes a first stage of amplification/attenuation (Figure 4-4, Ref. 1).

The DC and AC components of the signal are processed by two separate paths (Figure 4-4, Ref. 2). These are described below.

(2) Processing of DC component

The DC component is filtered by a low-pass filter (Figure 4-4, Ref. 3) having a cut-off frequency of 10 Hz. The resulting signal is processed by an analog-to-digital converter (A/D), which samples this signal every 10 milliseconds.

The signal is then low-pass filtered again by the DSP to reduce its bandwidth to 1 Hz. The GAP value (or any other DC function) can now be measured and the OK levels monitored by comparators.

(3) Processing of AC component

The first stage in the AC path is a low-pass pre-filter (Figure 4-4, Ref. 4) whose cut-off frequency is controlled by the analog-to-digital converter (A/D). The anti-aliasing filter (Ref. 10) is also controlled in this manner.

The first programmable gain amplifier (PGA, see Ref 6) is followed by either i) an integrator stage with high-pass filters having a fixed cut-off frequency of 2.5 Hz (Refs 5 and 8) or ii) directly connected through the second PGA (Ref. 9). The amplifier gains are software controlled (namely by the FSD or Signal Dynamic parameters, whichever leads to the higher signal-to-noise ratio).

The analog integrator (Ref. 7) is switched on when the BBAB function is selected and if the raw vibration (in a natural unit such as "g") is not required. Otherwise, if the measurement is required in the natural unit, then the analog integrator is by-passed and the integration is done digitally by the firmware on the DSP (Ref. 11) if required. This last solution, however, results in a higher noise level.

The selection of analog or digital integration is transparent to the user. A warning message may appear if the noisier solution is selected.

Finally, the digital signal is broad-band filtered (Ref. 12). Several stages of multi-rate finite impulse response (FIR) digital filters are used.

Rectification (RMS, RMS scaled to Peak, True Peak, True Peak-to-Peak) is performed on the digitised and filtered signal.

The AC signal component is used in the following processing functions:

- Broad-band absolute bearing vibration (BBAB)
- Broad-band pressure (BBP)
- Narrow-band (tracking) vibration (NB)
- Relative shaft vibration (RS) – output 1
- Eccentricity (EC) with peak-peak rectifier.

The DC signal component is used in the following processing functions:

- Eccentricity (EC) with “peak-to-peak per revolution” rectifier
- Relative shaft vibration (RS) – output 2
- Position (PS)
- Absolute housing expansion (HE)
- Relative shaft expansion with pendulum (SEP)
- Quasi-static pressure (QSP).

4.4.1.2 Voltage-based input signal

Two types of voltage-based signals (AC+DC) can be considered, differing only in the meaning of the DC component:

1- DC component is used for OK line check

In this case there is an AC signal with a DC component, where the latter represents a level only used for the OK system check (it must be compared against fixed OK levels). This is applicable to systems using accelerometers, velocimeters or dynamic pressure probes. The DC voltage can be positive or negative, depending on the polarity of the sensor and/or signal conditioner's power supply. The AC signal is extracted and amplified separately.

2- DC component represents gap and is used for OK line check

In this case, the DC voltage contains information. This is applicable to proximity probes, where the DC signal represents the gap (distance between the probe tip and the shaft), and the AC signal represents the shaft vibration. The AC and DC components are both available for processing.

As in case (1), the DC component is used for the OK line check.

4.4.1.3 Current-based input signal

The current-based inputs fall into two categories:

1- DC component is used for OK line check

In this case there is an AC current-based signal with a DC component, where the latter represents the supply current of the sensor (standing current). The DC component is only used for the OK system check (it must be compared with fixed OK levels). This is applicable to systems using accelerometers, velocity transducers or dynamic pressure probes. Either polarity can be handled by the MPS, depending on the polarity of the sensor and/or signal conditioner's power supply. The AC current-based signal is processed separately.

2- DC component represents gap and is used for OK line check

In this case, the DC current contains information. This is applicable to proximity probes (for example, the current output of IQS45x signal conditioner), where the DC signal represents the gap (distance between the probe tip and the shaft), and the AC signal represents the shaft vibration. The AC and DC components are both available for processing.

As in case (1), the DC component is used for the OK line check.

4.4.1.4 Unpowered sensors

An OK line check is performed on sensors that do not require a power supply. For this, a resistor is internally connected between the signal high input (HI) and the unused sensor power supply terminal (PS). This is configured automatically by the VM600 MPSx software when the **Sensor Power Supply** field is set to **No Supply**. This technique enables open circuits to be detected, but not short circuits.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

4.4.2 Speed signal inputs

These inputs (TACHO 1 and TACHO 2) handle several kinds of speed and phase reference transducers:

- Proximity probes (TQ/IQS type) delivering a conditioned voltage or current signal.
  A power supply of −27.2 V_{DC} is available for these probes.
- Magnetic pulse pick-up sensors (SP type) delivering a voltage whose amplitude varies widely with speed.
- Systems delivering a TTL output.

Only the input signal frequency is of interest for tacho processing, that is, the speed inputs are used only to detect the edges of the signal. The edge of detection (rising or falling) is software selectable.

The speed inputs can handle either a "one per revolution" (1/REV) phase signal coming from a protrusion or notch on the shaft, or a speed signal generated by a toothed wheel (more than one impulse per revolution).

Depending on the sensor and/or signal conditioner type used, 2-wire or 3-wire transmission lines can be connected to the speed/phase reference inputs of an MPC4 / IOC4T card pair.

NOTE: See 9 Configuration of MPC4 / IOC4T cards for further information on powering sensors and associated electronic hardware.

4.4.2.1 Trigger thresholds

As shown in Figure 4-5, the trigger thresholds for a speed/phase reference input signal depend on the peak to peak amplitude of the input signal.

VT+, the trigger threshold on the falling edge of the input signal, is calculated as follows:

$$VT+ = V_{PEAK-} + ⅔ (V_{PEAK+} - V_{PEAK-})$$

VT−, the trigger threshold on the rising edge of the input signal, is calculated as follows:

$$VT- = V_{PEAK-} + ⅓ (V_{PEAK+} - V_{PEAK-})$$

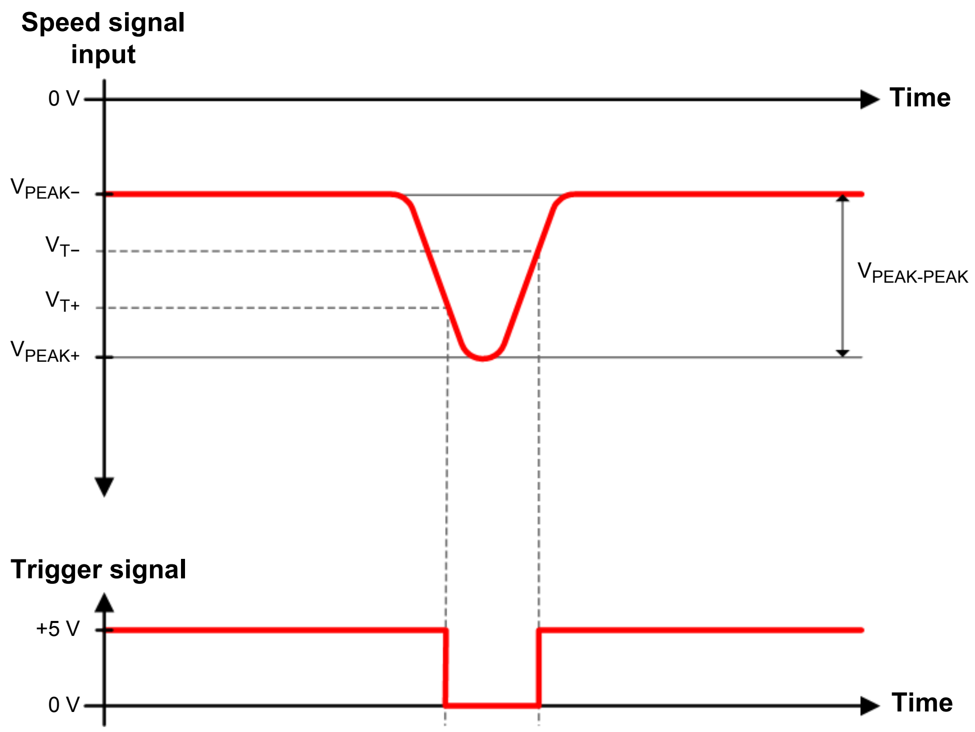


Figure 4-5: Trigger thresholds derived from speed/phase reference inputs

For example, with an input signal that pulses from −7 V to −15 V (that is, 8 $V_{PEAK-PEAK}$):

$$VT+ = -7\ V + ⅔ ((-15\ V) - (-7\ V)) = -7\ V + ⅔ (-8\ V) = -12.33\ V$$

$$VT- = -7\ V + ⅓ ((-15\ V) - (-7\ V)) = -7\ V + ⅓ (-8\ V) = -9.66\ V$$

4.4.3 Analog outputs

The MPC4 and IOC4T card pair provides a buffered transducer “raw” output for each of its four dynamic signal inputs and the two tachometer (speed) inputs.

For the dynamic signal inputs, each buffered output is an analog signal that is a replica of the transducer input signal for the channel including both AC and DC components (single-ended, referenced to ground).

The transfer ratio for the buffered outputs of dynamic channels depends on the configured signal transmission mode for the input:

- For a voltage input, the transfer ratio is 1 V/V.

  That is, with a dynamic channel configured for a voltage input, the signal level (amplitude) of the buffered output is the same as the input signal from the transducers.
- For a current input, the transfer ratio is 0.3245 V/mA.

  That is, with a dynamic channel configured for a current input, the signal level (amplitude) of the buffered output is a product of the transmitted current and the current measuring resistor (324.5 Ω) at the dynamic signal input.

For the dynamic signal inputs, the buffered outputs are available on BNC connectors on the MPC4 card (see 4.4.3.1 Front panel analog outputs (MPC4)) and on screw-terminal connectors on the IOC4T card (see 4.4.3.2 Rear panel analog outputs (IOC4T)).

For the tachometer (speed) signal inputs, each buffered output is a digital signal that is a level-shifted replica of the transducer input signal for the channel (single-ended, referenced to ground).

For a speed channel, the signal level (amplitude) of the buffered output is a 0 to 5 V TTL-compatible signal.

For the speed signal inputs, the buffered outputs are available on BNC connectors on the MPC4 card (see 4.4.3.1 Front panel analog outputs (MPC4)).

NOTE: All of the analog outputs are buffered and can support short-circuits or input pulses without internal interference.

4.4.3.1 Front panel analog outputs (MPC4)

The MPC4 panel is equipped with 6 BNC connectors, intended for the connection of laboratory instruments:

- Four connectors for raw dynamic signals (AC and DC, if applicable).
  These are named RAW OUT 1, RAW OUT 2, RAW OUT 3 and RAW OUT 4.
- Two connectors for processed speed outputs (TTL format).
  These are named TACHO OUT 1 and TACHO OUT 2.

4.4.3.2 Rear panel analog outputs (IOC4T)

Buffered raw signals from the sensors (for example, corresponding to vibration) are available for connection to external racks or other equipment for further analysis such as condition monitoring.

These differential outputs (RAW 1H and RAW 1L, RAW 2H and RAW 2L, RAW 3H and RAW 3L, and RAW 4H and RAW 4L) are accessible on the IOC4T card.

The same bandwidth and accuracy specifications apply as per the BNC outputs on the MPC4 panel.

4.4.4 DC outputs (IOC4T)

Four DC outputs (DC OUT 1, DC OUT 2, DC OUT 3 and DC OUT 4) are available on the IOC4T card. These can output fully-processed values from single or dual channels.

Jumpers allow each of these outputs to be individually set to provide a current-based or a voltage-based signal, that is, the specified DC output signal range can be either 4 to 20 mA or 0 to 10 V. Outputs are configured using the VM600 MPS software. For example, a 4 to 20 mA DC output corresponding to a 0 to 500 µm signal.

The actual value of a DC output can go outside the specified output signal range, depending on the processed value (signal). For example, if the configured 0 to 500 µm signal actually goes from −25 to 525 µm, the output signal should remain linear outside of the specified DC output signal range (up to the circuitry limits of approximately 0 to 23.1 mA and −2.5 to 11.9 V).

The DC outputs (DC OUT 1, DC OUT 2, DC OUT 3 and DC OUT 4) share a common reference/return with the discrete signal interface (DSI) inputs (AR, DB and TM). This common reference/return is known as RET and is available on Connector J3, Terminal 8 (see 9.5 Configuring the four DC outputs and 9.7 DSI control inputs (DB, TM, AR)).

4.5 Rectification techniques

RMS, Mean, Peak or Peak-Peak rectification is available for acceleration, velocity or displacement values. The following formulae apply:

1- RMS Value

$$U_{out} = U_{RMS} = \sqrt{\frac{1}{T}\int_0^T (U_{in})^2 \cdot dt}$$

The above value (U_{RMS}) can also be scaled to obtain the Scaled Mean and Scaled Peak values

- Scaled Mean

$$U_{out} = 2\frac{\sqrt{2}}{\pi} \times U_{RMS} = 0.900 \times U_{RMS}$$

- Scaled Peak

$$U_{out} = \sqrt{2} \times U_{RMS}$$

- Scaled Peak-to-Peak

$$U_{out} = 2 \times \sqrt{2} \times U_{RMS}$$

2- Mean Value

$$U_{out} = \frac{1}{T}\int_0^T |U_{in}| \cdot dt$$

3- True Peak Value

$$U_{out} = |U_{in}| peak$$

4- True Peak-to-Peak Value

$$U_{out} = U_{in}peak_{positive} - U_{in}peak_{negative}$$

Notes

1. The averaging time T can be software-configured in order to maintain a relationship with the fundamental frequency.
2. True Peak or True Peak-to-Peak values can be calculated for proximity probe measuring chains.
3. The RMS value is the standard calculation for accelerometer-based measuring chains.

4.6 Alarm monitoring

4.6.1 Monitoring possibilities

For each measurement (for example, vibration) channel, the MPC4 can compare the measured value against user-configurable Alert and Danger levels. For each of these, a high limit and a low limit can be set:

- Danger+, the upper Danger level (for an increasing signal)
- Alert+, the upper Alert level (for an increasing signal)
- Alert−, the lower Alert level (for a decreasing signal)
- Danger−, the lower Danger level (for a decreasing signal).

For each speed channel, the following alarm levels can be set:

- Alert+, the upper Alert level (for an increasing signal)
- Alert−, the lower Alert level (for a decreasing signal).

A time delay (Δt) can be software configured for each Alert or Danger level. The signal level must be over (or under, in the case of low-level alarms) the alarm level (including the hysteresis value) for more than Δt before an alarm is generated.

A hysteresis value can be software configured for each Alert or Danger level.

The alarm events can be latched if required. The alarm latches can be reset either externally or via the CPUM card (if installed).

The example given in Figure 4-6 illustrates alarm latching when Δt = 3 seconds.

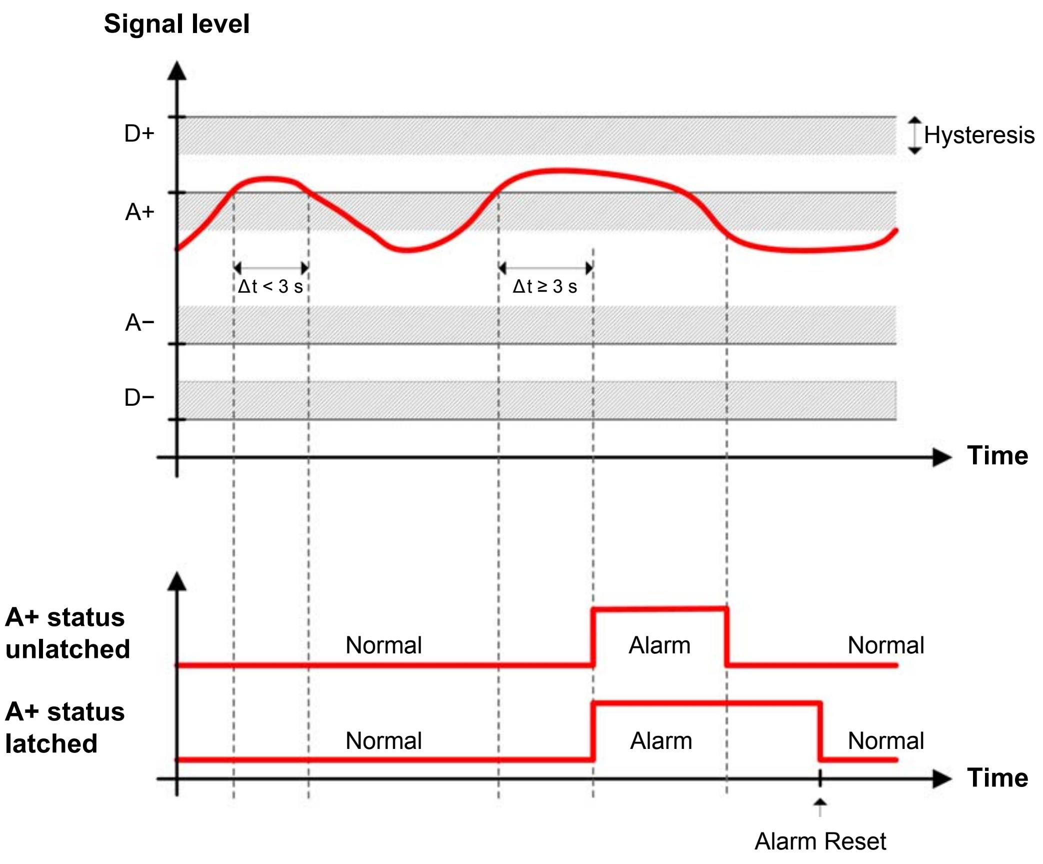


Figure 4-6: Illustration of unlatched and latched alarms

4.6.2 Logical combinations of alarms

The MPS allows logical combinations of alarms to be configured under software control.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Two types of alarm combination functions exist:

- Basic functions.
- Advanced functions.

Both types of logically combined alarms can be used to set relays.

4.6.2.1 Basic functions

Up to eight basic logic functions can be programmed. Each basic logic function can act on two or more of the following individual alarms:

- Alert+, Alert−, Danger+, Danger− generated by any of the four individual channels (that is, Channel 1, Channel 2, Channel 3 and Channel 4)
- Alert+, Alert−, Danger+, Danger− generated by either of the two dual channels (that is, Channels 1 & 2 and Channels 3 & 4)
- Alert+, Alert− generated by either of the two speed channels
- The Common Alert, the Common Danger and Common OK alarms
- Various hardware and software related alarms (such as Track Lost, DSP Saturation Error, Input Saturation Error and so on).

The following logic operations can be applied:

- AND
- OR
- Voting logic, for example, any 3 (or more) out of 9 possible alarms.

NOTE: The voting logic operation for the MPC4 is different to that for the AMC8. The MPC4 uses “more than x” and the AMC8 uses “more than or equal to x”.
Compare with 5.7.2.1 Basic functions.

This is illustrated in the example given in Figure 4-7. In this example:

Basic Function 3 = Speed Ch.1 Alert+ **OR** Speed Ch.2 Alert+

4.6.2.2 Advanced functions

Up to four advanced logic functions can be programmed. Each advanced logic function can act on two or more of the eight basic logic functions described above.

The following logic operations can be applied:

- AND
- OR.

In the example given in Figure 4-7:

Advanced Function 1 = Basic Function 1 **OR** Basic Function 2

= (Ch.1, Out.1 Alert+ **AND** Ch.3, Out.1 Alert+ **AND** Ch.4, Out.2 Alert−)

OR

“More than 1 of 3” (Ch.1, Out.2 Danger+ ; Ch.2, Out.2 Danger+ ; Ch.3, Out.2 Danger−)

Note that the use of advanced logic functions is equivalent to placing brackets in the equation above.

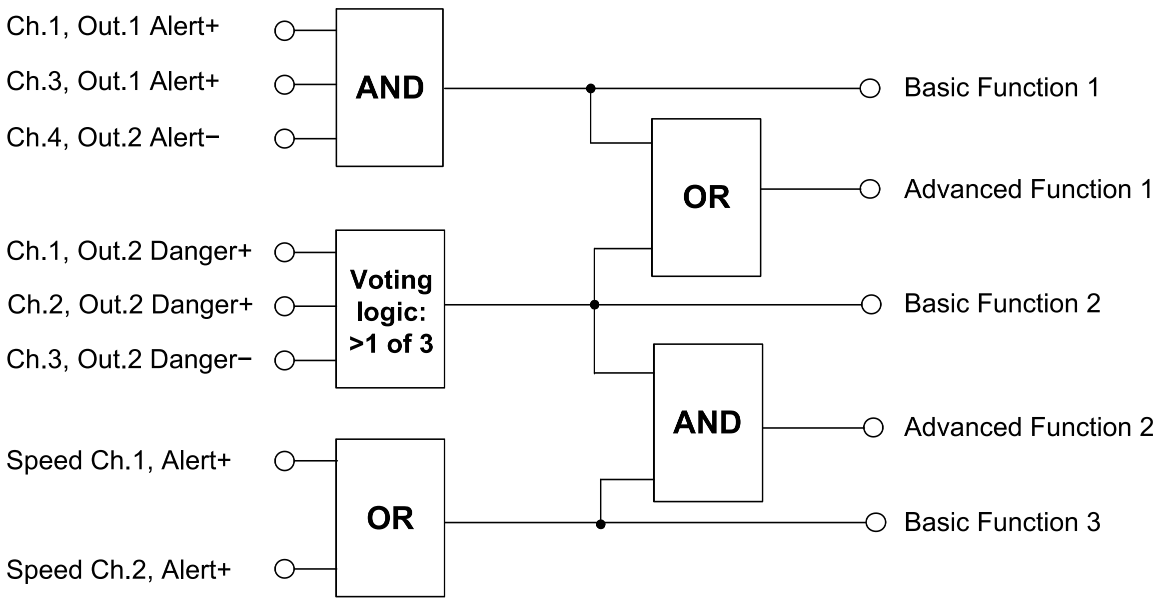


Figure 4-7: Example showing basic and advanced logic functions

4.6.3 Adaptive monitoring

This technique allows the Alert and Danger levels to be dynamically set as a function of an adaptive parameter. The adaptive parameter can be:

- Speed, as measured on one of the two “local” speed inputs (that is, from the card pair in question).
- Any other control/process parameter such as load or water head measured on one of the two “local” speed inputs (that is, from the card pair in question), for example, by using an external current loop or voltage to frequency converter device.

NOTE: When using an external analog signal to frequency converter device, the measured “speed” is proportional to the control/process parameter to be used for the adaptive monitoring.

Adaptive monitoring is particularly useful for run-ups and coast-downs where the adaptive parameter is speed.

The alarm levels (Alert and Danger) are multiplied by a coefficient depending on the parameter (in this case, speed), as illustrated in Figure 4-8. For example, for the nominal speed of the machine (after s6), this coefficient is equal to 1.0. However, in the speed range s1 < speed < s2, the Alert and Danger levels are multiplied by 1.2 in order to avoid a machine shutdown when the machine crosses its first critical speed (see Figure 4-8).

NOTE: Multiplier coefficients are always applied to Danger+ and Alarm+ (high) levels. Multiplier coefficients are applied to Danger− and Alarm− (low) levels only when their values are negative. When they are positive and the multiplier coefficient is not equal to 1.0, both Danger− and Alarm− are disabled.

Up to 10 parameter ranges (for example, speed) can be defined (s1, s2 and so on, in Figure 4-8).

Up to 10 multiplier coefficients can be configured (for example, 0.5, 0.8, 1.2 and so on, in Figure 4-8).

These coefficients can be chosen in the range 0.1 to 5.0, in steps of 0.1.

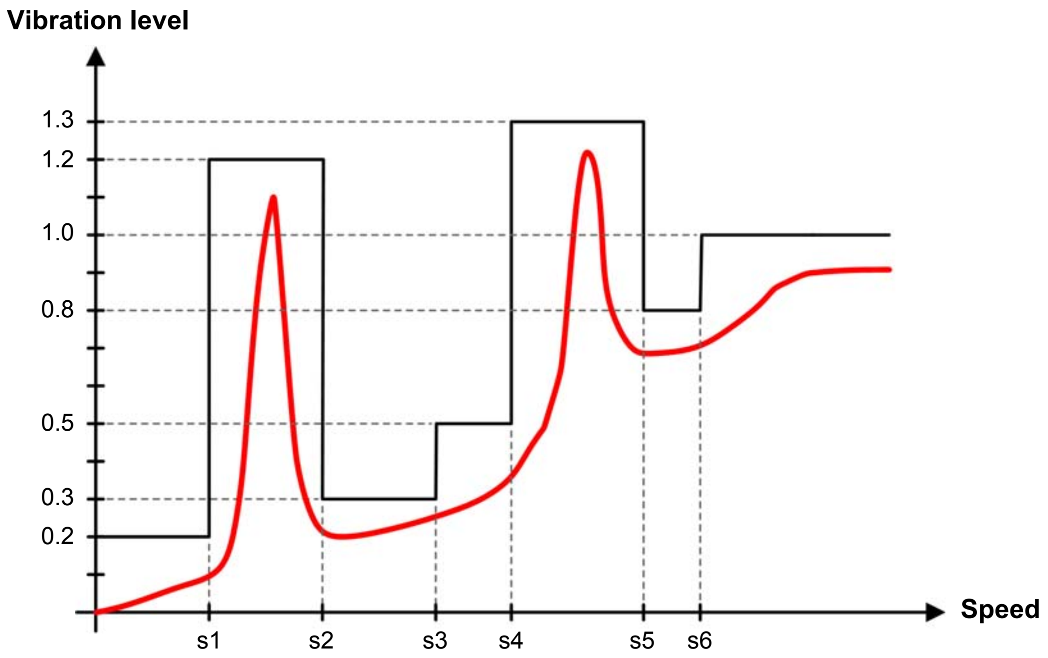


Figure 4-8: Illustration of adaptive monitoring technique

In order to use the Adaptive Monitoring function, it must first be activated using the VM600 MPSx software (using the Adaptive Monitoring property sheet of the relevant Processed Output tab for the appropriate Processing Channel node).

4.6.4 Direct Trip Multiply

NOTE: The safety version of the MPC4 card (MPC4SIL) does not does not support the trip multiply (TM) function.

This is a simplified version of adaptive monitoring. In this case there are only two different level coefficients, one of which is 1.0. The other coefficient can be chosen in the range 0.1 to 5.0, in steps of 0.1. This is illustrated in Figure 4-9.

The level coefficient is switched by an external signal applied to the Trip Multiply (TM) input on the IOC4T card. When this input is held low (0V), the scaling coefficient is effective. When it is floating, a default scaling factor of 1.0 is used.

NOTE: The level coefficient is always applied to Danger+ and Alarm+ (high) levels. The level coefficient is applied to Danger− and Alarm− (low) levels only when their values are negative. When they are positive and the level coefficient is not equal to 1.0, both Danger− and Alarm− are disabled.

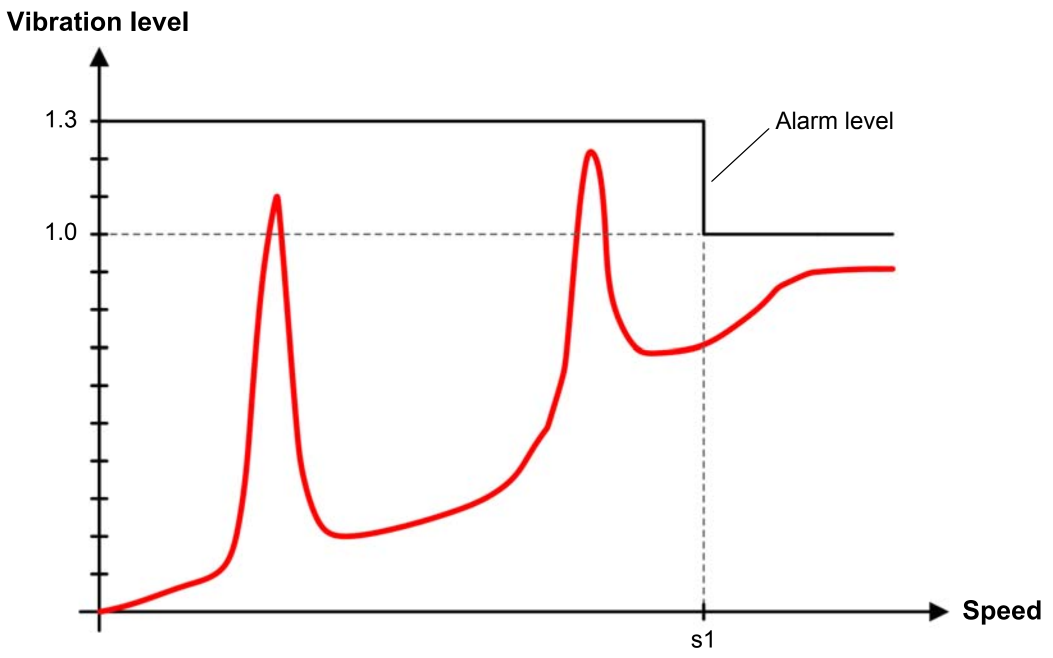


Figure 4-9: Illustration of direct Trip Multiply technique

In order to use the Trip Multiply function, it must first be activated using the VM600 MPSx software (using the Adaptive Monitoring property sheet of the relevant Processed Output tab for the appropriate Processing Channel node).

4.6.5 Danger Bypass function

NOTE: The safety version of the MPC4 card (MPC4SIL) does not does not support the danger bypass (DB) function.

This function allows Danger relays to be inhibited, even when a Danger condition occurs. The Danger information remains available to the MPS, but the Danger relays are de-activated to prevent the monitored machine from being shut down.

The Danger conditions inhibited are the following individual alarms:

- The Danger+ and Danger− generated by the four individual measurement channels.
- The Danger+ and Danger− generated by the two dual measurement channels.

The outputs of any logic functions using these Danger conditions as inputs will be affected by the use of the Danger Bypass function as the individual alarms are set to inactive for the duration of a Danger Bypass.

The Danger Bypass function is activated when a low (0V) external signal is applied to the Danger Bypass (DB) input on the IOC4T card.

See also 4.6.6 Channel inhibit function.

4.6.6 Channel inhibit function

NOTE: The safety version of the MPC4 card (MPC4SIL) does not does not support the channel inhibit function.

The channel inhibit function allows individual MPC4 channels (measurement and speed) to be temporarily bypassed, that is, it temporarily inhibits the protection offered by any associated relays.

The channel inhibit function is intended to allow a component in a measurement system front-end, such as a sensor/transducer or signal conditioner, to be replaced for an individual channel while the other machinery monitoring channels and functions continue to operate as normal.

This allows the machinery being monitored to continue to operate (if the protection offered by the other machinery monitoring channels and functions is adequate). It also allows any control system using the relays to avoid false trips during such maintenance activity.

When the channel inhibit function is activated for an MPC4 channel:

- The channel continues its processing as per its configuration but inhibits the protection offered by any associated relays.

  This allows the effect of any changes to the measurement system front-end to be observed. In this way, it can also be ensured that there are no ongoing alarm conditions before the de-activation of the channel inhibit.
- The sensor power supply output for the channel remains turned on, if enabled.
- Any DC output functionality associated with the channel continues, if enabled.
- The following flags (bits) for the channel processing are forced to a known state:
  - For a measurement channel, the error bit (Err), OK system check (SOK), alarm (A+, A−) and danger (D+, D−) flags are all forced to a normal state.
    The sensor bypassed (SBP) flag and the invalid output flags are also set active (=1).
  - For a speed channel, the error bit (Err), OK system check (SOK) and alarm (A+, A−) flags are all forced to a normal state.
    The sensor bypassed (SBP) flag and the invalid output flags are also set active (=1).

NOTE: The MPS1 and MPS2 software packages use the SBP (sensor bypassed) flag to refer to the channel inhibit function.

- Any processing channels that depend on the channel are automatically bypassed.

  For example, if a speed channel is inhibited, any processing that uses the speed channel as an input will also be inhibited, in addition to the speed processing itself.
- The measurement channel's status indicator (LED) on the panel of the MPC4 card slowly blinks green for the duration of the channel inhibit (approximately once per second).

NOTE: For a speed channel, the channel inhibit function affects "local" speed signals only. When channel inhibit is used with a "local" speed signal, the speed signal is still shared remotely using the Tacho Bus, if configured (see 3.4.2 Tacho Bus).
The channel inhibit function cannot be used with "remote" speed signals, that is, "remote" speed signals cannot be temporarily bypassed using the channel inhibit function.

When the channel inhibit function is de-activated for an MPC4 channel, the card:

- Waits 2 seconds for signal stabilisation, in addition to the OK system check recovery time. This gives a total recovery time of 2.1 seconds for MPC4 cards running firmware version 070 or earlier and of 12 seconds for MPC4 cards running firmware version 071 or later.(see 4.7.1 OK system checking and Figure 4-10).
- Resets (clears) any latched alarms.
- Stops forcing the flags for the channel processing to a normal state, so that the true status of the machinery monitoring system is returned again. The sensor bypassed (SBP) flag is also set inactive (=0).
- The channel's status indicator (LED) on the panel of the MPC4 card indicates the operational status of the card.

NOTE: When an MPC4 card is configured (using the VM600 MPS software), the channel inhibit function is automatically de-activated for any channels where it is active.

The status of the channel inhibit function for the individual input channels of an MPC4 card can be used as an input to a basic function (see 4.6.2 Logical combinations of alarms).

See also 4.6.5 Danger Bypass function and 9.8 Channel inhibit function.

4.7 System self-checks

4.7.1 OK system checking

The OK System monitors the input signal from the sensor in order to verify if the sensor is connected and operating normally. To do this, the DC signal level is compared against two user-configurable OK levels: a minimum normal level and a maximum normal level. This is shown in Figure 4-10.

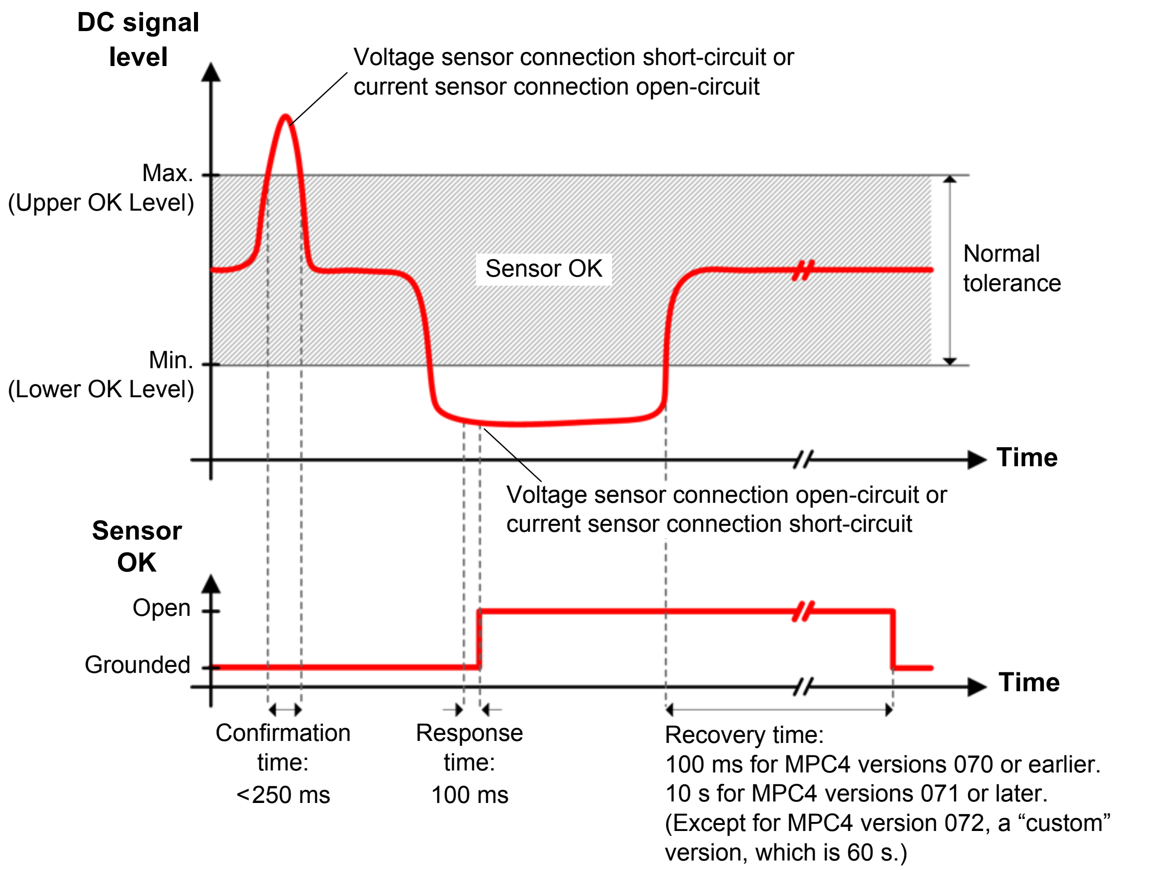


Figure 4-10: Maximum and minimum signal levels allowed by the OK System

Any problem with the transducer and/or signal conditioner or connecting cable that causes the signal to deviate beyond these OK levels will cause an individual alarm for the input channel (corresponding to the individual Sensor OK bit) and a common alarm for the MPC4 card (corresponding to the common Sensor OK bit).

As shown in Figure 4-10:

- The "confirmation time" is a fixed firmware time delay used so that only an input signal that is outside the configured OK levels for a time period greater than 250 ms is detected as an OK system failure. This is used to ensure that noise ("spikes") on the DC signal level are not accidentally recognised as failures.
- The "response time" is the maximum time delay from the time that an OK system failure is detected until the corresponding alarms are set (Sensor OK bit for the input channel and Common Sensor OK bit alarm for the MPC4 card). The actual time delay depends on the processor load of the card but is less than 100 ms.

NOTE: The behaviour of the OK system checking is the same above and below the configured OK levels.

In practice, it can take up to 350 ms (“confirmation time” + “response time”) after an input signal goes outside the configured OK levels before it is confirmed and acted upon in a VM600 system as an OK System failure.

When there is an OK System failure on an MPC4 card:

- For the channel in question, the corresponding status indicator (LED) on the panel of the card blinks green and an OK level alarm (corresponding to the individual Sensor OK bit) is signalled.
- For the card in question, a common OK level alarm (corresponding to the common Sensor OK bit) is signalled.

For example, these can be used to switch a relay on the IOC4T or RLC16 card.

NOTE: Any alarms (A+, D+ and so on) associated with the corresponding monitoring channel are not inhibited, but remain active.

Most types of monitoring can be performed, however, for passive sensors providing a voltage-based output (such as velocimeters), only open circuits can be monitored.

4.7.2 Built-in test equipment (BITE)

The MPC4 features built-in test equipment (BITE) which provides information about the operational state of the system:

1- Continuous checks (watchdog)

A software watchdog informs the CPUM (if installed in rack) that the MPC4 card is halted.

2- Power-up test

The MPC4 hardware (such as the memory and timers) is tested on power-up. Any failure will cause the MPC4 to be halted.

4.7.3 Overload checking

Overload protection is provided for each channel. Errors are flagged and can be read using the VM600 MPSx software.

4.8 MPC4 power-up sequence

The MPC4 card's power-up sequence is initiated by either of the following events:

- The MPC4 being inserted into the ABE04x rack when the latter is powered up (that is, the "live insertion" situation).
- Power being re-established after a power-down or a power failure.

4.8.1 Power-up after live insertion

A +5 V_{DC} pre-charge supply is used to enable live insertion of MPC4 cards. This voltage is supplied to the MPC4 from the system backplane. It is passed to the MPC4 module via three pins on connector P1 (see Figure 3-3). These pins are slightly longer than the other VME bus connector pins.

When a module is inserted into a MPS rack that is powered up, these longer pins make contact first (typically 200 ms before the other pins). During this time, the +5 V_{DC} pre-charge supply is used to power up all the +5 V_{DC} parts on the module. This ensures that when the bus driver makes contact with the running VME bus, the circuitry is already at approximately the correct voltage. In this way no glitches are produced on the VME bus power, address or data pins.

Once the rest of the pins (including the standard +5 V_{DC} supply) make contact, no further power is drawn from the +5 V_{DC} pre-charge supply.

4.9 Operation of LEDs on MPC4 panel

4.9.1 Global DIAG/STATUS indicator LED for the card

This multi-function, multi-colour LED is used for the following purposes:

- To indicate normal operation.
- To indicate the activation of special functions (Trip Multiply and Danger Bypass).
- To indicate an MPC4 hardware or software failure.

Table 4-1 provides detailed information on the behaviour of the MPC4 DIAG/STATUS LED for the card.

NOTE: In Table 4-1, events are presented in decreasing order of priority for an MPC4 / IOC4T card pair (that is, “Red blinking” has the highest priority).

Table 4-1: Behaviour of DIAG/STATUS LED for the card

Behaviour of card DIAG/STATUS LED	Event(s)
Red blinking	MPC4 hardware failure. This includes: * Power supply fail * DSP RAM, DPRAM and/or FLASH memory fail * Acquisition watchdog fail and/or software common task fail * Internal version incompatibility (monitoring not running)
Red blinking	MPC4 powered up but not yet configured (monitoring not running)
Yellow blinking	Configuration error *or* IOC4T slot number mismatch (monitoring not running)
Green blinking	MPC4 configured but in stabilisation phase (monitoring not running)
Green blinking	At least one channel has an input signal error. This includes: * Vibration input saturation error * Vibration out of common mode range * Speed out of limit * Speed out of common mode range (monitoring running)
Yellow blinking	At least one channel has an input signal error. This includes: * Vibration out of scale * Tracking out of range * Track lost * DSP overload (monitoring running)
Red (continuous)	Danger Bypass (DB) function active
Yellow (continuous)	Trip Multiply (TM) function active
Green (continuous)	Normal card operation – MPC4 configuration is running correctly with no alarms and no errors

4.9.2 Individual status indicator LEDs for measurement channels

Table 4-2 provides detailed information on the behaviour of the MPC4 status indicator LEDs for the four individual measurement channels.

NOTE: In Table 4-2, events are presented in decreasing order of priority for an MPC4 / IOC4T card pair (that is, “Off” has the highest priority).

Table 4-2: Behaviour of status indicator LEDs for individual measurement channels

Behaviour of measurement channel status LED	Event(s)
Off	Channel is not configured *or* MPC4 configuration is not running
Green blinking	Signal input to the channel is not valid (either the lower or the upper “OK Level” has been exceeded)
Green blinking slowly (approximately once per second)	The channel inhibit function is activated for the channel
Red blinking	Note: Applies to dual-channel processing only. When there is an active dual-channel processing alarm, the status indicator LED for both channels will blink red at the same time. For Danger level alarms configured as **not latched**: indicates that a signal is below the lower Danger level (D−) or above the upper Danger level (D+). That is, there is a currently active processing alarm. For Danger level alarms configured as **latched**: indicates that a signal was below the lower Danger level (D−) or above the upper Danger level (D+) and was latched but has not yet been reset, or that a signal is below the lower Danger level or above the upper Danger level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Red (continuous)	Note: Applies to single-channel processing only. For Danger level alarms configured as **not latched**: indicates that a signal is below the lower Danger level (D−) or above the upper Danger level (D+). That is, there is a currently active processing alarm. For Danger level alarms configured as **latched**: indicates that a signal was below the lower Danger level (D−) or above the upper Danger level (D+) and was latched but has not yet been reset, or that a signal is below the lower Danger level or above the upper Danger level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.

Table 4-2: Behaviour of status indicator LEDs for individual measurement channels (continued)

Behaviour of measurement channel status LED	Event(s)
Yellow blinking	Note: Applies to dual-channel processing only. When there is an active dual-channel processing alarm, the status indicator LED for both channels will blink yellow at the same time. For Alert level alarms configured as **not latched**: indicates that a signal is below the lower Alert level (A−) or above the upper Alert level (A+). That is, there is a currently active processing alarm. For Alert level alarms configured as **latched**: indicates that a signal was below the lower Alert level (A−) or above the upper Alert level (A+) and was latched but has not yet been reset, or that a signal is below the lower Alert level or above the upper Alert level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Yellow (continuous)	Note: Applies to single-channel processing only. For Alert level alarms configured as **not latched**: indicates that a signal is below the lower Alert level (A−) or above the upper Alert level (A+). That is, there is a currently active processing alarm. For Alert level alarms configured as **latched**: indicates that a signal was below the lower Alert level (A−) or above the upper Alert level (A+) and was latched but has not yet been reset, or that a signal is below the lower Alert level or above the upper Alert level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Green (continuous)	Normal channel operation – channel is configured and signal input is valid (not exceeding lower or upper “OK Levels”). That is, there are no active single-channel processing or dual-channel processing alarms.

4.9.3 Individual status indicator LEDs for speed channels

Table 4-3 provides detailed information on the behaviour of the MPC4 status indicator LEDs for the two individual speed (Tacho) channels.

NOTE: In Table 4-3, events are presented in decreasing order of priority for an MPC4 / IOC4T card pair (that is, “Off” has the highest priority).

Table 4-3: Behaviour of status indicator LEDs for individual speed (Tacho) channels

Behaviour of speed channel status LED	Event(s)
Off	Channel is not configured *or* MPC4 configuration is not running
Green blinking	Signal input to the channel is not valid (either the lower or the upper “OK Level” has been exceeded)
Green blinking slowly (approximately once per second)	The channel inhibit function is activated for the channel
Yellow (continuous)	For Alert level alarms configured as **not latched**: indicates that a signal is below the lower Alert level (A−) or above the upper Alert level (A+). That is, there is a currently active processing alarm. For Alert level alarms configured as **latched**: indicates that a signal was below the lower Alert level (A−) or above the upper Alert level (A+) and was latched but has not yet been reset, or that a signal is below the lower Alert level or above the upper Alert level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Green (continuous)	Normal channel operation – channel is configured and signal input is valid (not exceeding lower or upper “OK Levels”). That is, there are no active processing alarms.

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5 AMC8 / IOC8T CARD PAIR

5.1 General block diagram

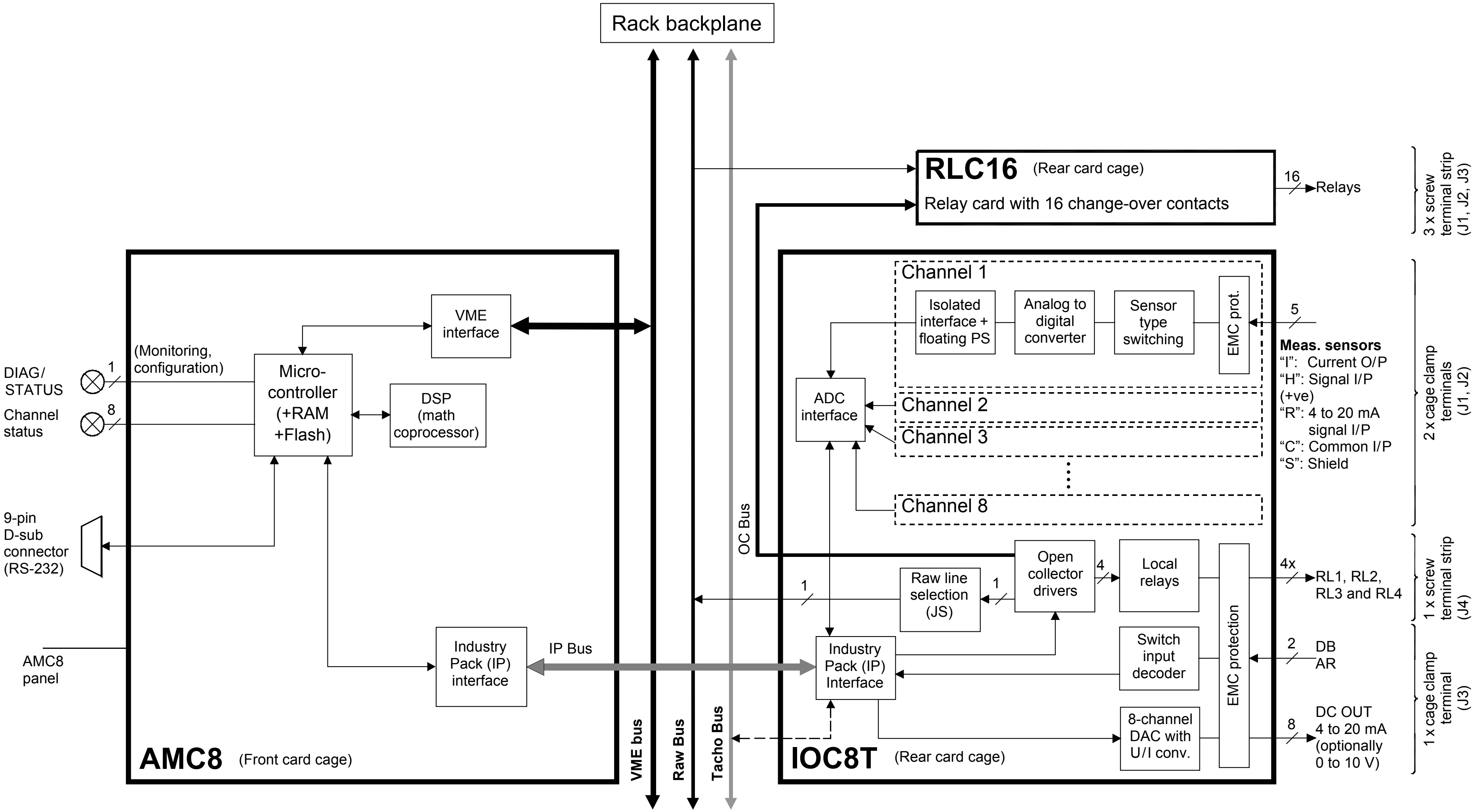
A block diagram of the AMC8, IOC8T and RLC16 cards is shown in Figure 5-1. This shows schematically the backplane, which physically divides the ABE04x rack into a front card cage and a rear card cage.

The AMC8 (shown on the left of the diagram) is mounted in the front card cage. This card effects the signal processing functions for the MPS. Its panel contains an LED indicator (DIAG/STATUS) showing the hardware status of the AMC8 / IOC8T card pair. Additional LED indicators are present to provide information on the status of each individual channel (such as signal valid or the presence of alarms). The panel also has a 9-pin D-sub connector for configuring an AMC8 card used in a stand-alone rack, that is, a rack not containing a CPUM card.

Each AMC8 card is necessarily connected (via the backplane) to an IOC8T input/output card mounted in the rear card cage. The IOC8T card's panel (rear of rack) has terminals for connecting the signal transmission lines coming from measurement sensors, such as RTD devices, thermocouples and flow rate detectors). Other terminals are used to output processed signal values (4 to 20 mA, with 0 to 10 V optionally available).

The IOC8T contains 4 local relays with outputs available on a screw terminal strip. In applications needing more than the 4 relays provided by the IOC8T, an RLC16 relay card can be installed in the rack.

The RLC16 card contains 16 relays and has a terminal strip with 48 screw terminals (3 strips each having 16 terminals).



Abbreviations:
ADC = Analog-to-digital converter, AR = Alarm Reset, DAC = Digital-to-analog converter, DB = Danger Bypass, DSP = Digital signal processor, EMC = Electromagnetic compatibility, IP = Industry pack, I/P = Input, JS = Jumper selectable, OC = Open Collector, O/P = Output, PS = Power supply, SPDT = Single-pole double-throw, SW = Software, U/I conv. = Voltage-to-current converter, VME = VERSAbus module eurocard, +ve = Positive.

Figure 5-1: Block diagram of AMC8, IOC8T and RLC16 cards

5.2 Overview of AMC8 / IOC8T operation

The AMC8 implements a variety of signal processing and monitoring functions, each of which requires real-time continuous processing of the inputs.

The block diagram in Figure 5-2 summarises the operation of the AMC8 card.

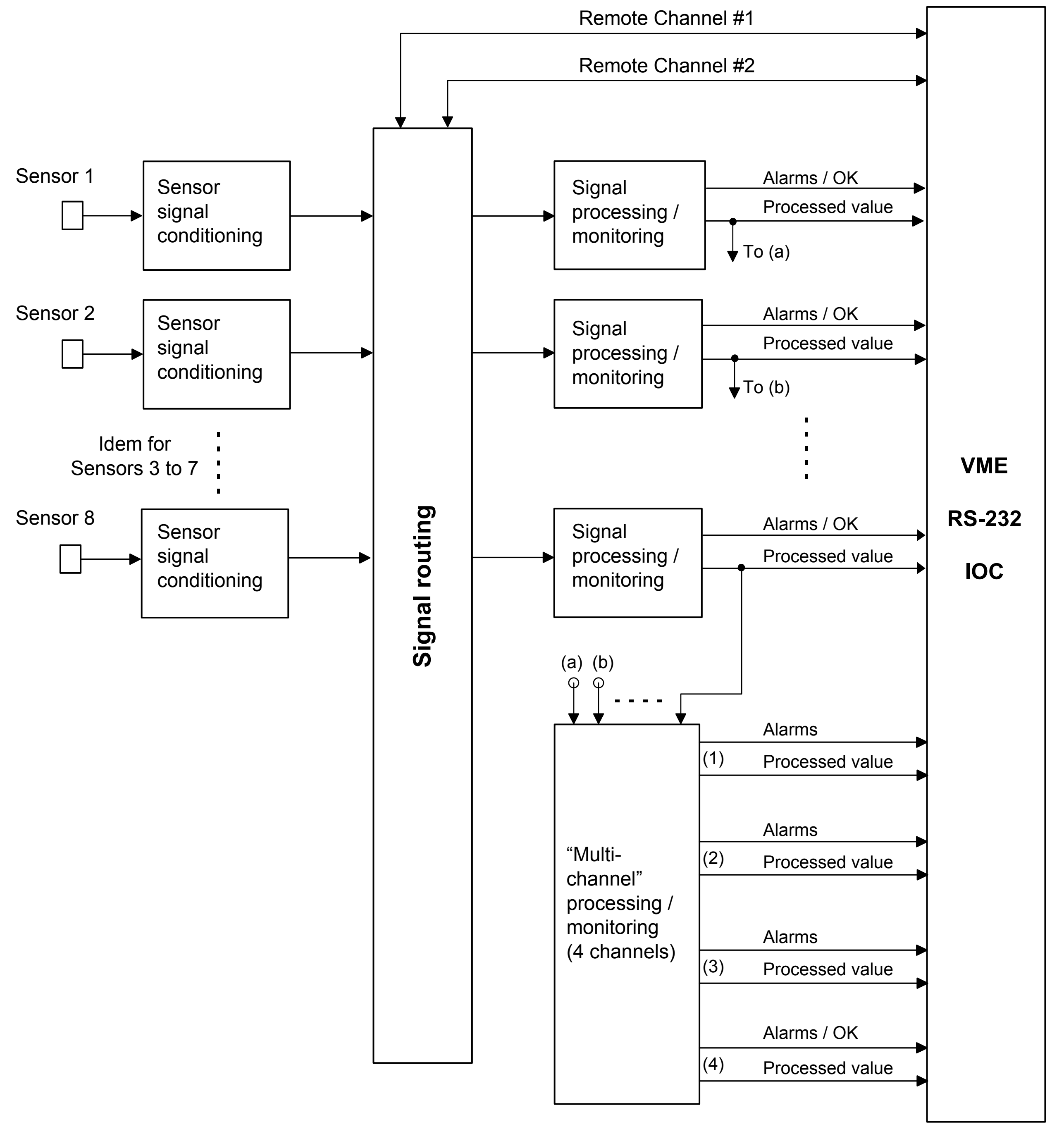


Figure 5-2: Operation of AMC8 / IOC8T card pair

5.2.1 Sensor signal conditioning

This block (see Figure 5-2) acts as a signal interface and is used to:

- Acquire a signal from the connected sensor.
- Check for signal overload (independently of the OK line check).

The AMC8 card does not have the ability to power external measuring devices. Where necessary, an external power supply must be used.

See 5.3 Inputs and outputs.

5.2.2 Signal routing

This block (see Figure 5-2) is used only if cold-junction compensation (CJC) is required for channels having a thermocouple connected.

The block enables a “cold junction” (CJ) temperature signal (generally obtained using an RTD) to be routed to another channel on the card. One of two remote CJ signals can also be selected. These come from other cards in the rack over Tacho Bus lines 7 and 8.

5.2.3 Signal processing and monitoring

This block (see Figure 5-2) assures the following:

1- Definition of “multi-channels”

Based on the eight single channels, four “multi-channels” can be defined. These can group between two and eight single channels and perform various mathematical operations on them, such as obtain the minimum, maximum or average value. The difference between two individual channels can also be calculated.

See 5.4 Multi-channel processing functions.

2- Selection of the time-domain processing function

The functions include the following: direct output (bypass), average over a period of time, maximum value over a period of time, minimum value over a period of time.
See 5.5 Time-domain processing functions.

3- Linearity compensation

Linear and non-linear sensor compensation can be applied for thermocouples and RTD devices.

See 5.6 Linearity compensation.

4- Monitoring

For single channels and “multi-channels”, the signal values (suitably processed and compensated) are monitored and alarms generated if the thresholds are exceeded. These alarms can be used to set relays.

Logical combinations of alarms can also be configured.

See 5.7 Alarm monitoring.

5- Sensor OK Level Detection

This function monitors the OK levels for the sensor to check for hardware problems (for example, faulty sensor or signal conditioner, or defective transmission line).

See 5.8 System self-checks.

5.3 Inputs and outputs

5.3.1 Measurement signal inputs

The following sensor types can be used with the AMC8 / IOC8T card pair:

- Thermocouples (type E, type J, type K, type T or user defined)
- RTD devices (Pt100, Cu10, Ni120 or user defined)
- Other measurement systems (for example, flow rate detectors or power indicators) providing a quasi-static signal. This can be a current-based signal (typically 4 to 20 mA, but an extended range of 0 to 25 mA can also be processed) or a voltage based signal (0 to 10 V).

RTD devices can be connected in a 2-wire, 3-wire or 4-wire arrangement.

A 50 Ω measuring resistor is used for systems providing a current-based signal. The input is protected by a self-resetting 50 mA fuse.

For voltage-based signals, only unipolar signals can be processed. Negative signals can be measured simply by reversing the polarity of the input wires.

Hardware associated with the sensors such as power supplies, signal conditioners, optional safety barriers or galvanic separations are not implemented within the MPS rack, but externally.

NOTE: See 10 Configuration of AMC8 / IOC8T cards for further information on connecting sensors.

5.3.2 DC outputs

Eight DC outputs (DC OUT 1 to DC OUT 8) are available on the IOC8T card. These can output fully-processed values from single channels or multi-channels.

By default, these outputs provide current-based signals. However, solder bridges can be configured to provide voltage-based signals on all eight outputs (which must be set in the factory). That is, the specified DC output signal range can be either 4 to 20 mA or 0 to 10 V.

NOTE: The solder bridges on the IOC8T card select either current or voltage for all outputs. It is not possible to have a mixture of current-based and voltage-based outputs.

Outputs are configured using the VM600 MPS software. For example, a 4 to 20 mA output corresponding to a 77 to 212 °F (25 to 100 °C) signal.

The actual value of a DC output can go outside the specified output signal range, depending on the processed value (signal). For example, if the configured 77 to 212 °F (25 to 100 °C) signal actually goes from 68 to 221 °F (20 to 105 °C), the output signal should remain linear outside of the specified DC output signal range (up to the circuitry limits of approximately 0 to 25 mA and 0 to 13 V).

5.4 Multi-channel processing functions

Four “multi-channel” processing functions are available. Each is able to process the following functions on the 8 single channels:

- Minimum of 2 to 8 values
- Maximum of 2 to 8 values
- Average of 2 to 8 values
- Difference between two values.

5.5 Time-domain processing functions

These functions are somewhat analogous to the rectifier functions available for the MPC4 / IOC4T card pair.

A time-domain processing function can be applied to a single channel or a “multi-channel”. The following possibilities exist:

- Direct output (bypass)
- Average over a period of time
- Maximum value over a period of time
- Minimum value over a period of time.

The time period can be set under software control to a value between 0.1 and 10.0 seconds. The output is updated at this rate.

5.6 Linearity compensation

The VM600 MPS software allows linearity compensation for thermocouples and RTD devices.

For linear compensation, an offset and sensitivity value can be defined.

For non-linear compensation, a table of polynomial values can be entered or downloaded.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

5.7 Alarm monitoring

5.7.1 Monitoring possibilities

For each single channel or "multi-channel", the AMC8 can compare the measured value against user-configurable Alert and Danger levels. For each of these, a high limit and a low limit can be set:

- Danger+, the upper Danger level (for an increasing signal)
- Alert+, the upper Alert level (for an increasing signal)
- Alert−, the lower Alert level (for a decreasing signal)
- Danger−, the lower Danger level (for a decreasing signal).

A time delay (Δt) can be software configured for each Alert or Danger level. The signal level must be over (or under, in the case of low-level alarms) the alarm level (including the hysteresis value) for more than Δt before an alarm is generated.

A hysteresis value can be software configured for each Alert or Danger level.

The alarm events can be latched if required. The alarm latches can be reset either externally or via the CPUM card (if installed).

The example given in Figure 5-3 illustrates alarm latching when Δt = 3 seconds.

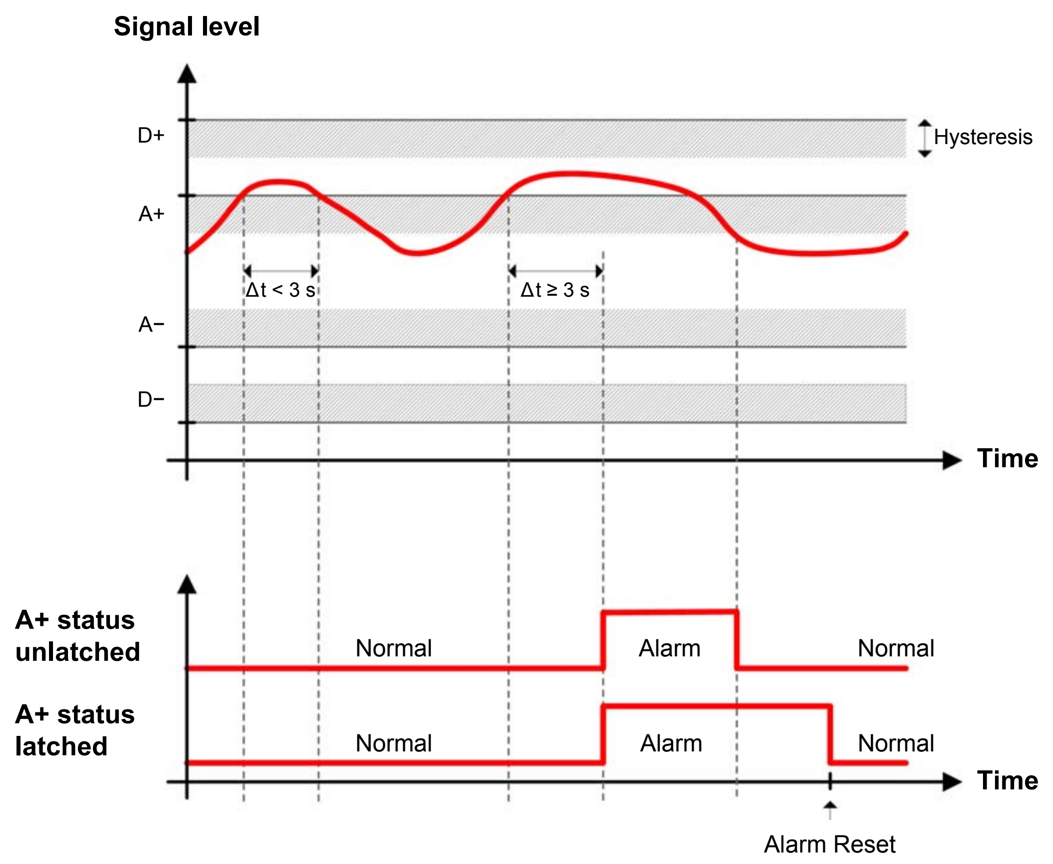


Figure 5-3: Illustration of unlatched and latched alarms

5.7.2 Logical combinations of alarms

The MPS allows logical combinations of alarms to be configured under software control.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Two types of alarm combination functions exist:

- Basic functions
- Advanced functions.

Both types of logically combined alarms can be used to set relays.

5.7.2.1 Basic functions

Up to 16 basic logic functions can be programmed. Each basic logic function can act on two or more of the following individual alarms:

- Alert+, Alert−, Danger+, Danger− generated by any of the eight single channels (that is, Channel 1 to Channel 8)
- Alert+, Alert−, Danger+, Danger− generated by any of the four “multi-channels” (that is, Multi-Channel 1 to Multi-Channel 4)
- Global Channel OK failure
- Various hardware-related and software-related alarms and statuses (for example, AMC Configuration Not Running, Status Latched, Danger Bypass, Alarm Reset).

The following logic operations can be applied:

- AND
- OR
- Voting logic, for example, any 3 (or more) out of 9 possible alarms.

NOTE: The voting logic operation for the AMC8 is different to that for the MPC4. The AMC8 uses “more than or equal to x” and the MPC4 uses “more than x”. Compare with 4.6.2.1 Basic functions.

This is illustrated in the example given in Figure 5-4. In this example:

Basic Function 1 = Channel 5 Alert− **AND** Channel 6 Alert−

Basic Function 2 = Multi-Channel 1 Alert+ **AND** Channel 4 Alert+

In this example, Multi-Channel 1 is obtained from calculating the **Average of** (Channel 1, Channel 2 and Channel 3).

Basic Function 3 = **Negation of** Channel 7 Danger+
(also known as **NOT** Channel 7 Danger+)

5.7.2.2 Advanced functions

Up to 8 advanced logic functions can be programmed. Each advanced logic function can act on two or more of the 16 basic logic functions described above.

The following logic operations can be applied:

- AND
- OR
- Voting logic (for example, any 2 of 3).

In the example given in Figure 5-4:

Advanced Function 1 = Basic Function 1 **OR** Basic Function 2

= (Channel 5 Alert− **AND** Channel 6 Alert−)

OR

(Multi-Channel 1 Alert+ **AND** Channel 4 Alert+)

Note that the use of advanced logic functions is equivalent to placing brackets in the equation above.

Advanced Function 2 =
"Any 2 or more of 3" (Basic Function 1 **;** Basic Function 2 **;** Basic Function 3)

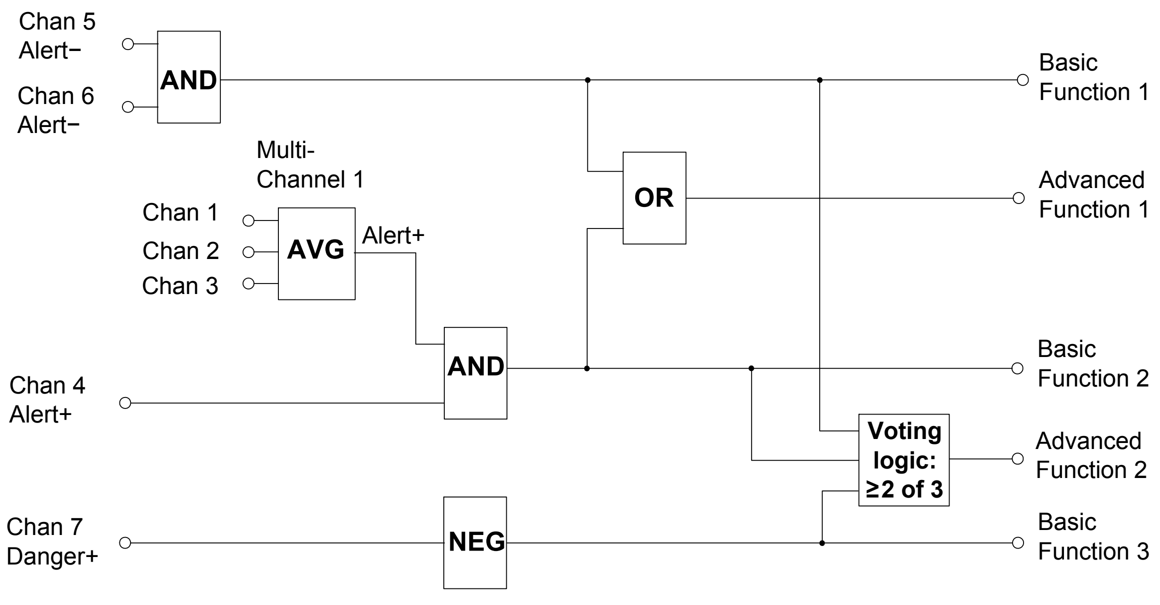


Figure 5-4: Example showing basic and advanced logic functions, as well as "multi-channel" usage

5.7.3 Danger Bypass function

This function allows Danger relays to be inhibited, even when a Danger condition occurs. The Danger information remains available to the MPS, but the Danger relays are de-activated to prevent the monitored machine from being shut down.

The Danger conditions inhibited are the following individual alarms:

- The Danger+ and Danger− generated by the eight individual measurement channels.
- The Danger+ and Danger− generated by the four multi-channel measurement channels.

The outputs of any logic functions using these Danger conditions as inputs will be affected by the use of the Danger Bypass function as the individual alarms are set to inactive for the duration of a Danger Bypass.

The Danger Bypass function is activated when a low (0 V) external signal is applied to the Danger Bypass input on the IOC8T card.

See also 5.7.4 Channel inhibit function.

5.7.4 Channel inhibit function

The channel inhibit function allows individual AMC8 channels to be temporarily bypassed, that is, it temporarily inhibits the protection offered by any associated relays.

The channel inhibit function is intended to allow a component in a measurement system front-end, such as a sensor/transducer or signal conditioner, to be replaced for an individual channel while the other machinery monitoring channels and functions continue to operate as normal.

This allows the machinery being monitored to continue to operate (if the protection offered by the other machinery monitoring channels and functions is adequate). It also allows any control system using the relays to avoid false trips during such maintenance activity.

When the channel inhibit function is activated for an AMC8 channel:

- The channel continues its processing as per its configuration but inhibits the protection offered by any associated relays.

  This allows the effect of any changes to the measurement system front-end to be observed. In this way, it can also be ensured that there are no ongoing alarm conditions before the de-activation of the channel inhibit.
- Any DC output functionality associated with the channel continues, if enabled.
- The following flags (bits) for the channel processing are forced to a known state:
  - The error bit (Err), OK system check (SOK), alarm (A+, A−) and danger (D+, D−) flags are all forced to a normal state (which is false, that is =0).
    The sensor bypassed (SBP) flag and the global channel OK fail flags are also set active.

  NOTE: The VM600 MPS1 and VM600 MPS2 software packages use the SBP (sensor bypassed) flag to refer to the channel inhibit function.

- Any processing channels that depend on the channel are automatically bypassed.
- The channel's status indicator (LED) on the panel of the AMC8 card slowly blinks green for the duration of the channel inhibit (approximately once per second).

When the channel inhibit function is de-activated for an AMC8 channel, the card:

- Waits 12 seconds for signal stabilisation (total recovery time).
- Resets (clears) any latched alarms.
- Stops forcing the flags for the channel processing to a normal state, so that the true status of the machinery monitoring system is returned again. The sensor bypassed (SBP) flag is also set inactive.

NOTE: When an AMC8 card is configured (using the VM600 MPS software), the channel inhibit function is automatically de-activated for any channels where it is active.

The status of the channel inhibit function for the individual channels of an AMC8 card can be used as an input to a basic function (see 5.7.2 Logical combinations of alarms).

Se also 5.7.3 Danger Bypass function and 10.6 Channel inhibit function.

5.8 System self-checks

5.8.1 OK system checking

The OK System monitors the input signal from the sensor in order to verify if the sensor is connected and operating normally. To do this, the DC signal level is compared against two user-configurable OK levels: a minimum normal level and a maximum normal level. This is shown in Figure 5-5.

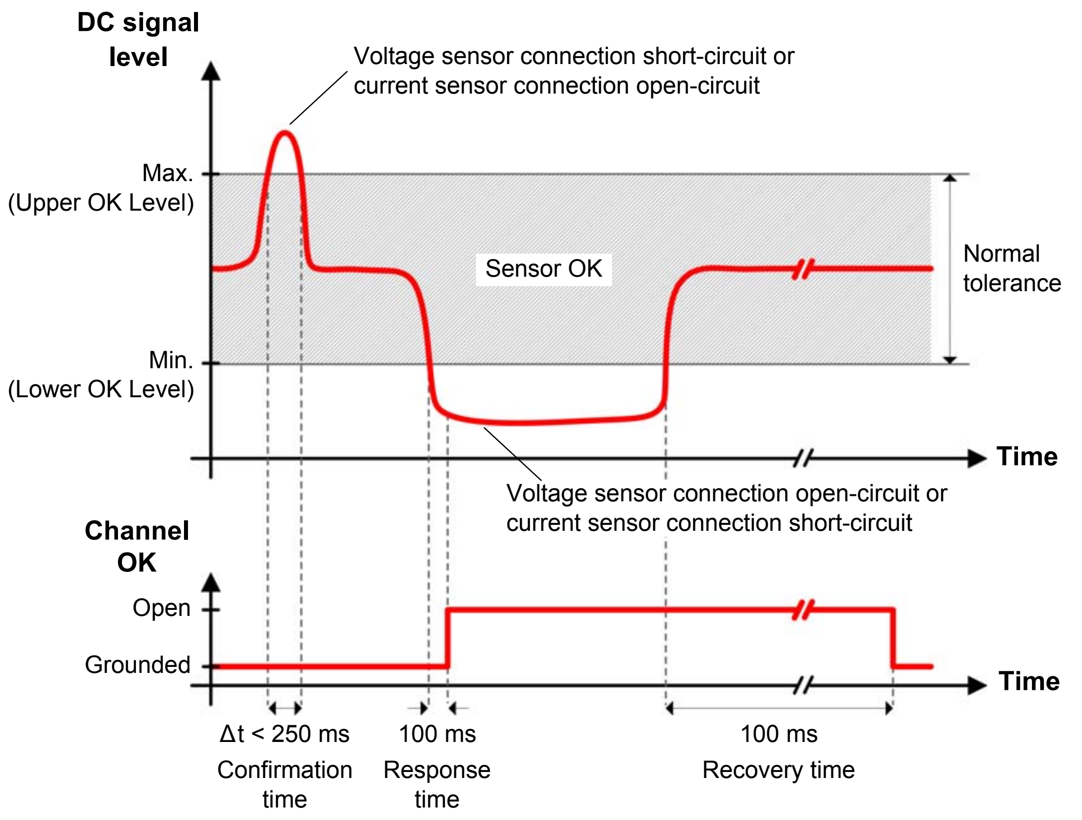


Figure 5-5: Maximum and minimum signal levels allowed by the OK System

Any problem with the transducer and/or signal conditioner or connecting cable that causes the signal to deviate beyond these OK levels will cause an individual alarm for the input channel (corresponding to the individual Global Channel OK bit).

As shown in Figure 5-5:

- The “confirmation time” is a fixed firmware time delay used so that only an input signal that is outside the configured OK levels for a time period greater than 250 ms is detected as an OK system failure. This is used to ensure that noise (“spikes”) on the DC signal level are not accidentally recognised as failures.
- The “response time” is the maximum time delay from the time that an OK system failure is detected until the corresponding alarms are set (Global Channel OK bit for the input channel). The actual time delay depends on the processor load of the card but is less than 100 ms.

NOTE: The behaviour of the OK system checking is the same above and below the configured OK levels.

In practice, it can take up to 350 ms (“confirmation time” + “response time”) after an input signal goes outside the configured OK levels before it is confirmed and acted upon in a VM600 system as an OK System failure.

When there is an OK System failure on an AMC8 card:

- For the channel in question, the corresponding status indicator (LED) on the panel of the card blinks green and an OK level alarm (corresponding to the individual Global Channel OK bit) is signalled.

For example, this can be used to switch a relay on the IOC4T or RLC16 card.

NOTE: Any alarms (A+, D+ and so on) associated with the corresponding monitoring channel are not inhibited, but remain active.

The following types of monitoring can be performed:

1- RTD devices:
Detection of open circuits and short circuits.

2- Thermocouples:
Detection of open circuits.

3- Voltage-based and current-based signals:
Detection of open circuits and short circuits.

5.8.2 Built-in self test (BIST)

The AMC8 and IOC8T feature built-in self test (BIST) circuitry which provides information about the operational state of the system. There are basically three types:

1- Global Board BIST

This tests the IOC as a whole and includes a logic watchdog.

2- Channel BIST

This checks each channel to establish whether:

- The shield (S) terminal is incorrectly connected to the sensor (S) terminal
- The linear regulator voltage is correct
- The DC-DC output voltage is correct.

3- Sensor-Specific BIST

Depending on whether a thermocouple, RTD device, voltage-based sensor or current-based sensor is connected, performs various tests such as:

- Current source checks
- Line checks (to monitor for broken lines)
- Line resistance mismatch (for 3-wire RTD measurements)
- Correct setting of jumper J805.

Errors detected by the BIST are used to set flags that can then be used by the VM600 MPS software to switch relays and so on.

5.9 AMC8 power-up sequence

The AMC8 card's power-up sequence is initiated by either of the following events:

- The AMC8 being inserted into the ABE04x rack when the latter is powered up (that is, the "live insertion" situation).
- Power being re-established after a power-down or a power failure.

5.9.1 Power-up after live insertion

A +5 V_{DC} pre-charge supply is used to enable live insertion of AMC8 cards. This voltage is supplied to the AMC8 from the system backplane. It is passed to the AMC8 module via three pins on connector P1 (see Figure 3-3). These pins are slightly longer than the other VME bus connector pins.

When a module is inserted into a MPS rack that is powered up, these longer pins make contact first (typically 200 ms before the other pins). During this time, the +5 V_{DC} pre-charge supply is used to power up all the +5 V_{DC} parts on the module. This ensures that when the bus driver makes contact with the running VME bus, the circuitry is already at approximately the correct voltage. In this way no glitches are produced on the VME bus power, address or data pins.

Once the rest of the pins (including the standard +5 V_{DC} supply) make contact, no further power is drawn from the +5 V_{DC} pre-charge supply.

5.10 Operation of LEDs on AMC8 panel

5.10.1 Global DIAG/STATUS indicator LED for the card

This multi-function, multi-colour LED is used for the following purposes:

- To indicate normal operation.
- To indicate the alarm status of “multi-channels”
- To indicate an AMC8 hardware failure.

Table 5-1 provides detailed information on the behaviour of the AMC8 DIAG/STATUS LED for the card.

NOTE: In Table 5-1, events are presented in decreasing order of priority for an AMC8 / IOC8T card pair (that is, “Red blinking” has the highest priority).

Table 5-1: Behaviour of DIAG/STATUS LED for the card

Behaviour of card DIAG/STATUS LED	Event(s)
Red blinking	AMC8 hardware failure *or* AMC8 powered up but not yet configured (monitoring not running)
Yellow blinking	Configuration error *or* IOC8T slot number mismatch (monitoring not running)
Green blinking	AMC8 configured but in stabilisation phase (monitoring not running)
Red (continuous)	Note: Applies to multi-channel processing only. For Danger level alarms configured as **not latched**: indicates that a signal is below the lower Danger level (D−) or above the upper Danger level (D+). That is, there is a currently active processing alarm. For Danger level alarms configured as **latched**: indicates that a signal was below the lower Danger level (D−) or above the upper Danger level (D+) and was latched but has not yet been reset, or that a signal is below the lower Danger level or above the upper Danger level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Yellow (continuous)	Note: Applies to multi-channel processing only. For Alert level alarms configured as **not latched**: indicates that a signal is below the lower Alert level (A−) or above the upper Alert level (A+). That is, there is a currently active processing alarm. For Alert level alarms configured as **latched**: indicates that a signal was below the lower Alert level (A−) or above the upper Alert level (A+) and was latched but has not yet been reset, or that a signal is below the lower Alert level or above the upper Alert level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Green (continuous)	Normal card operation – AMC8 configuration is running correctly with no alarms and no errors

5.10.2 Individual status indicator LEDs for measurement channels

Table 5-2 provides detailed information on the behaviour of the AMC8 status indicator LEDs for the eight individual measurement channels.

NOTE: In Table 5-2, events are presented in decreasing order of priority for an AMC8 / IOC8T card pair (that is, "Off" has the highest priority).

Table 5-2: Behaviour of status indicator LEDs for individual measurement channels

Behaviour of measurement channel status LED	Event(s)
Off	Channel is not configured *or* AMC8 configuration is not running
Green blinking	Signal input to the channel is not valid (either the lower or the upper "OK Level" has been exceeded)
Green blinking slowly (approximately once per second)	The channel inhibit function is activated for the channel
Red (continuous)	Note: Applies to single-channel processing only. For Danger level alarms configured as **not latched**: indicates that a signal is below the lower Danger level (D−) or above the upper Danger level (D+). That is, there is a currently active processing alarm. For Danger level alarms configured as **latched**: indicates that a signal was below the lower Danger level (D−) or above the upper Danger level (D+) and was latched but has not yet been reset, or that a signal is below the lower Danger level or above the upper Danger level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Yellow (continuous)	Note: Applies to single-channel processing only. For Alert level alarms configured as **not latched**: indicates that a signal is below the lower Alert level (A−) or above the upper Alert level (A+). That is, there is a currently active processing alarm. For Alert level alarms configured as **latched**: indicates that a signal was below the lower Alert level (A−) or above the upper Alert level (A+) and was latched but has not yet been reset, or that a signal is below the lower Alert level or above the upper Alert level. That is, either there was a previously active processing alarm that has not been reset or there is a currently active processing alarm.
Green (continuous)	Normal channel operation – channel is configured and signal input is valid (not exceeding lower or upper "OK Levels"). That is, there are no active single-channel processing or multi-channel processing alarms.

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6 CPUM / IOCN CARD PAIR

6.1 Different versions of the CPUM card

In 2015, the CPUM card was updated to use a new PC/104 CPU module (PFM-541I or equivalent) that supports two Ethernet interfaces by default, which required updates to the underlying carrier board.

Previously, the CPUM card was fitted with a CPU module (MSM586SEN or equivalent) that supported one Ethernet interface by default and required an additional Ethernet controller module (MSME104 or equivalent) to be fitted in order to be Ethernet redundant.

So the different versions of the CPUM card in use are:

- Later versions of the CPUM card (PNR 200-595-076-HHh or later) fitted with the PFM-541I or equivalent CPU module (see Figure 6-1).
- Earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier) fitted with the MSM586EN or equivalent CPU module (see Figure 6-2).

NOTE: Due to changes to the underlying CPUM carrier board, the later versions of the CPUM card are not compatible with the earlier versions of the CPUM card. Accordingly, the PFM-541I or equivalent CPU module can only be used with the later versions of the CPUM card (PNR 200-595-076-HHh or later) and the MSM586EN or equivalent CPU module can only be used with the earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier).

6.2 General overview

The CPUM is a modular CPU (central processing unit) card that acts as “rack controller” in a networked VM600 system. Depending on system requirements, the CPUM can be used either alone in the rack (installed in the front card cage) or in conjunction with the associated IOCN input/output card (installed in slot 0 of the rear card cage, directly behind the CPUM).

The CPUM card consists of a carrier board with two PC/104 type slots that can accept different PC/104 modules: a CPU module and an optional serial communications module.

All CPUM cards are fitted with a CPU module that supports two Ethernet connections (primary and secondary) and two serial connections (primary and secondary). That is, both the Ethernet redundant and serial redundant versions of the card.

The CPUM card with the CPU module provides:

- Primary Ethernet communications via the ‘**NET**’ connector (8P8C (RJ45)) on the CPUM card’s panel *or* the ‘**1**’ connector (8P8C (RJ45)) on the IOCN card’s panel, if used.

  NOTE: The ‘**NET**’ connector on the CPUM card and the ‘**1**’ connector on the IOCN card are mutually exclusive, that is, only one can be used at any one time (configured using jumpers on the CPUM).

- Secondary Ethernet communications via the ‘**2**’ connector (8P8C (RJ45)) on the IOCN card’s panel, if used.
- Primary RS-232 communications via the ‘**RS232**’ connector (D-sub (DE-09)) on the CPUM card’s panel.
- Secondary RS-232 or RS-485 communications via the ‘**RS**’ connector (6P6C (RJ11/RJ25)) on the IOCN card’s panel, if used.

NOTE: The primary Ethernet connection is used for communication with the VM600 MPSx software via a network and for Modbus TCP communications.The secondary Ethernet connection is used for redundant Modbus TCP communications.
The primary serial connection is used for communication with the VM600 MPSx software via a direct connection. The secondary serial connection is used for Modbus RTU communications.

Optionally, a CPUM card can be fitted with a serial communications module (in addition to the CPU module) in order to support additional serial connections. This is the serial redundant version of the card.

The CPUM card with the optional serial communications module provides:

- RS-485 (115.2 kbps) communications as either half-duplex (2-wire) or full-duplex (4-wire) via the '**A**' and '**B**' connectors (6P6C (RJ11/RJ25)) on the IOCN card's panel.

NOTE: The additional '**A**' and '**B**' serial connections can be used to configure multi-drop RS-485 networks of VM600 racks using Modbus RTU communications.

A diagnostic LED (named DIAG) on the panel of the CPUM indicates the CPUM card status, such as normal operation and whether VM600 MPS rack (CPUM) security is being used. The CPUM card's panel also contains an LCD display for showing the level of a selected monitored output in bar-graph and digital form. The Alert and Danger levels are also indicated on the bar graph.

Coloured LEDs (named OK, A and D) on the panel of the CPUM indicate the OK, Alert and Danger status for the signal selected for display (see Figure 2-9). If slot 0 is selected, these LEDs will indicate the general rack status.

SLOT and OUT (output) keys on the panel are used to select which signal to display. The ALARM RESET button on the panel resets all latched alarms (and associated relays) for the entire rack.

Possibilities allowed by the CPUM / IOCN pair include:

- 'One-shot' configuration of all VM600 cards using a direct Ethernet or RS-232 serial connection from an external computer (laptop, notebook, pen-computer, industrial computer or flat-panel computer) running the VM600 MPSx software, from Meggitt Sensing Systems' Vibro-Meter product line.
- 'One-shot' configuration of all VM600 cards via Ethernet from a networked computer running the VM600 MPSx software.
- Visualisation of signal levels and alarm limits using the display on the CPUM card's panel.
- External communication with third party devices such as a DCS or PLC.
- VM600 MPS rack (CPUM) security.

6.3 VM600 MPS rack (CPUM) security

A VM600 MPS in a 19″ system rack (ABE04x) containing a CPUM card can implement specific rack security features in order to limit the functionality of the MPS that are available via the CPUM to Ethernet-based connections, such as the VM600 MPSx software, the CPUM Configurator software or a Modbus TCP connection.

The use of the CPUM security features is recommended in order to help prevent accidental or unauthorised access to a VM600 MPS configuration and other MPS system functionality, thereby reducing the possibility of interference in the operation of the MPS and the machinery being monitored.

NOTE: Refer to the *VM600 MPS1 software manual* for further information on VM600 MPS rack (CPUM) security.

6.4 Block diagrams

Figures 6-1 and 6-2 show block diagrams of the different versions of the CPUM card with their different CPU modules:

- Later versions of the CPUM card (PNR 200-595-076-HHh or later) fitted with the PFM-541I or equivalent CPU module (see Figure 6-1).
- Earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier) fitted with the MSM586EN or equivalent CPU module (see Figure 6-2).

Figures 6-3 shows a block diagram of the IOCN card.

See 12 Configuration of CPUM / IOCN cards for information on how to use the jumpers on the CPUM and IOCN cards to modify the operation of the external communications interfaces.

6.5 Serial port naming

For the CPUM card:

- The RS-232 serial port on the card's panel, shown as **RS-232** (COM0) in Figures 6-1 and 6-2, corresponds to the RSFRONT device in the `modbusDefault.cfg` configuration file.
  (RSFRONT corresponds to the ser2 device driver of the QNX operating system used by the CPUM card. This is the primary serial communications port.)

For the IOCN card:

- The serial port on the card's panel, shown as **RS** (COM1) in Figure 6-3, corresponds to the RS device in the `modbusDefault.cfg` configuration file.
  (RS corresponds to the ser3 device driver of the QNX operating system used by the CPUM card. This is the secondary RS-serial communications port.)
- The serial ports on the card's panel, shown as **A** (COM2) in Figure 6-3, correspond to the SERIAL_A device in the `modbusDefault.cfg` configuration file.
  (SERIAL_A corresponds to the ser4 device driver of the QNX operating system used by the CPUM card. This is the first of the additional serial communications ports and requires that the optional serial communications module is fitted.)
- The serial ports on the card's panel, shown as **B** (COM3) in Figure 6-3, correspond to the SERIAL_B device in the `modbusDefault.cfg` configuration file.
  (SERIAL_B corresponds to the ser5 device driver of the QNX operating system used by the CPUM card. This is the second of the additional serial communications ports and requires that the optional serial communications module is fitted.)

NOTE: Refer to the *VM600 networking manual* for further information.

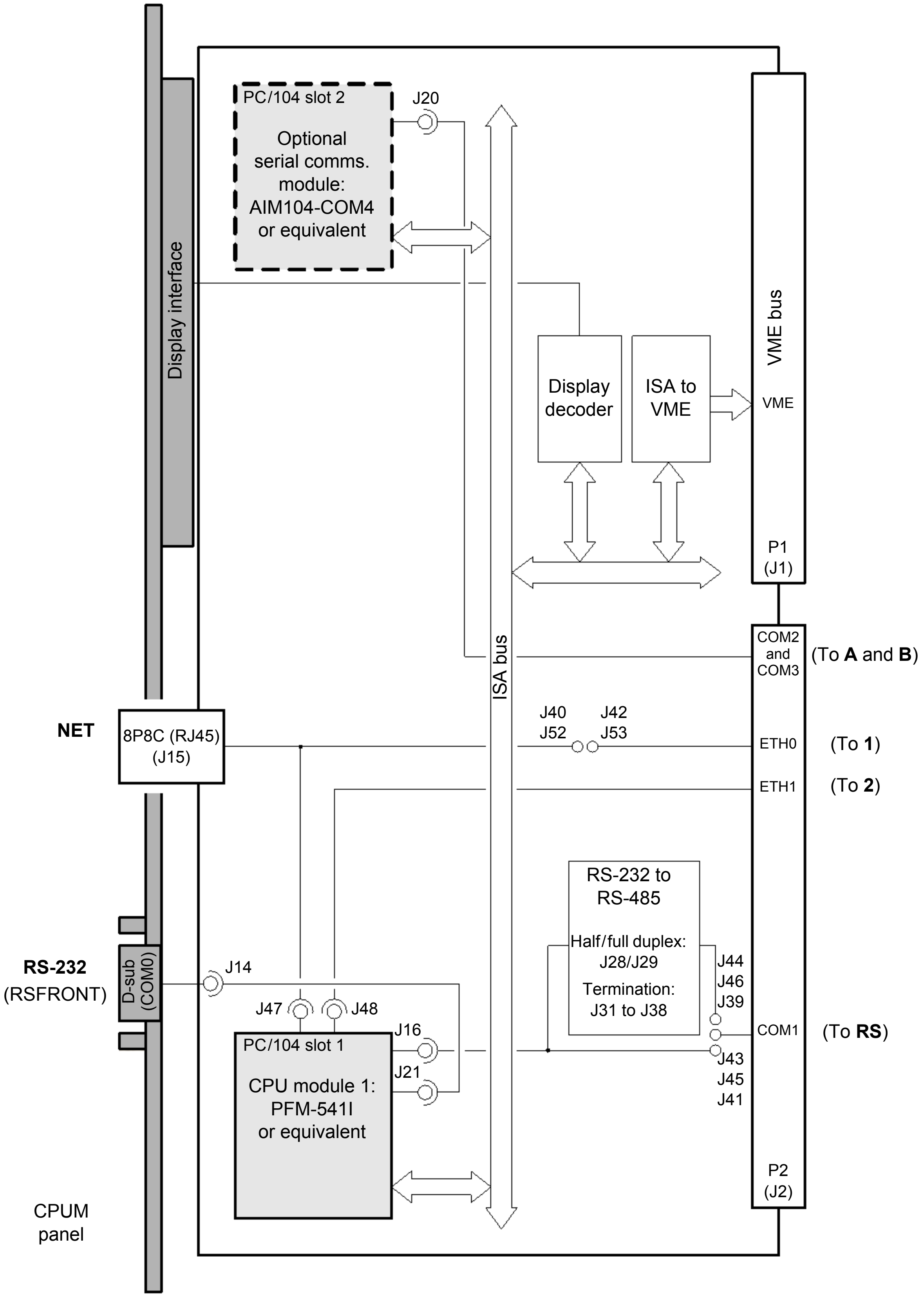

Figure 6-1: Block diagram of CPUM card fitted with the PFM-541I or equivalent CPU module (PNR 200-595-076-HHh or later)

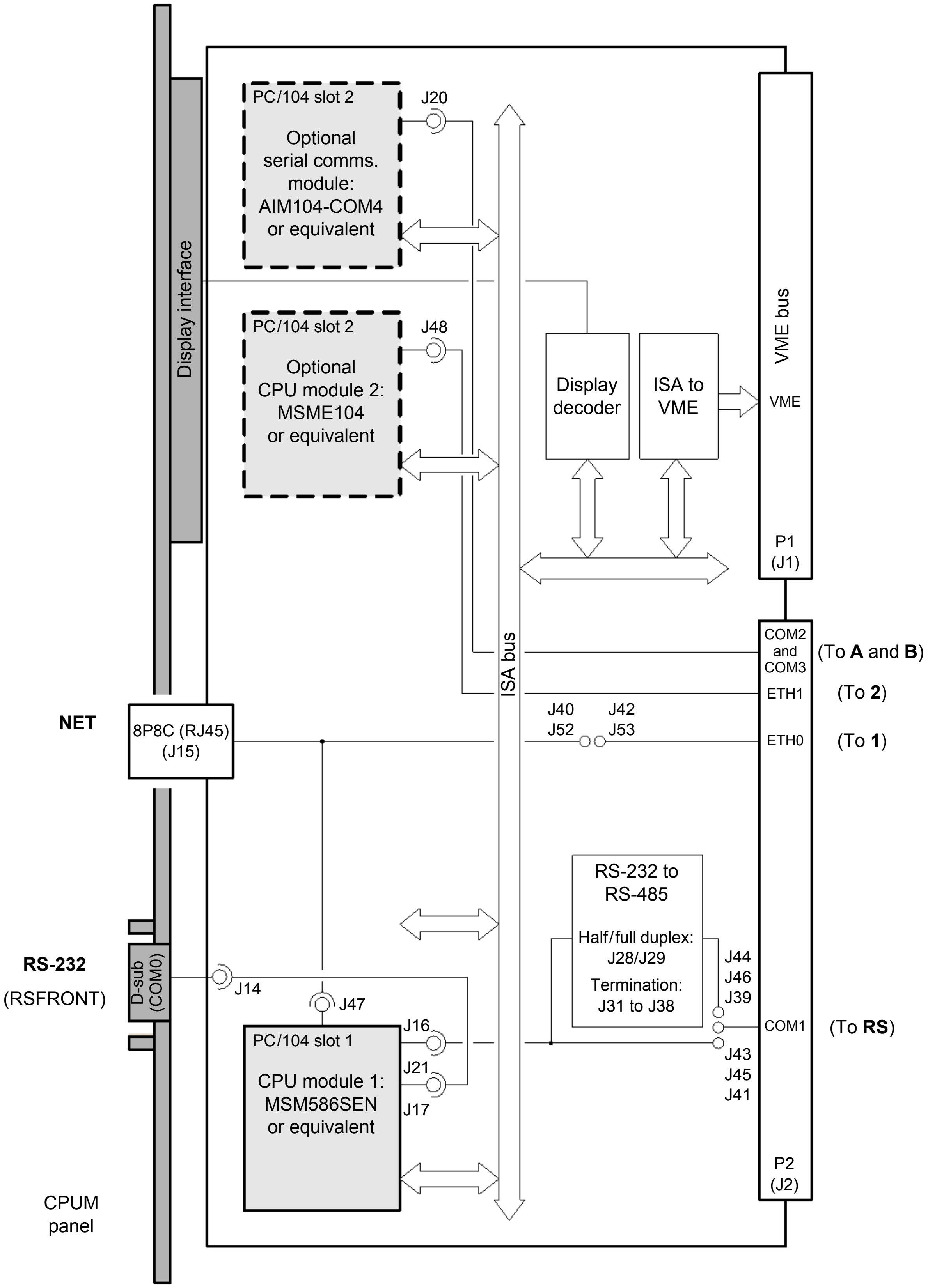

Figure 6-2: Block diagram of CPUM card fitted with the MSM586SEN or equivalent CPU module (PNR 200-595-075-HHh or earlier)

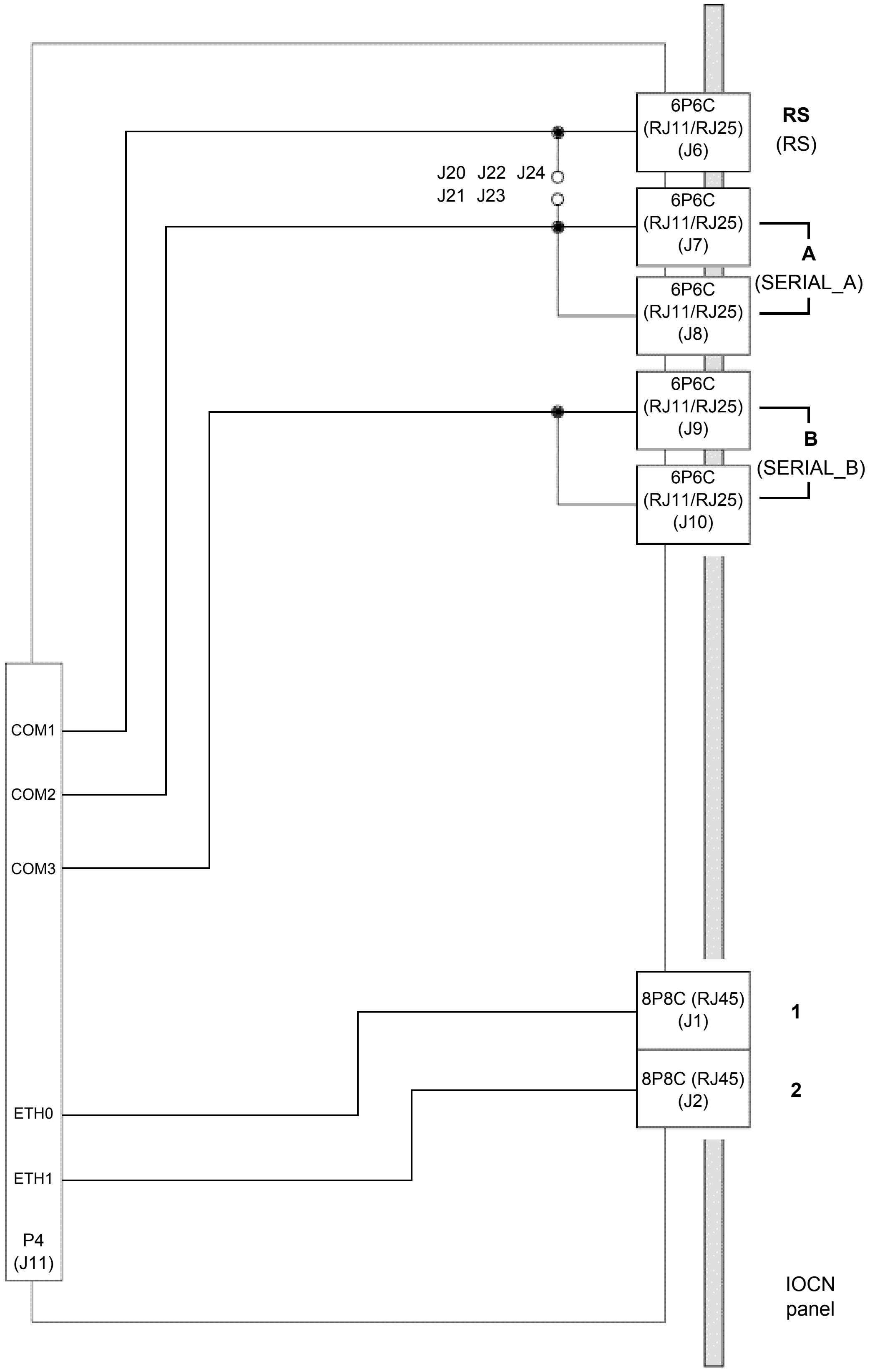

Figure 6-3: Block diagram of IOCN card

6.6 Operation of LEDs on CPUM panel

6.6.1 DIAG LED

The CPUM card's DIAG LED is used for the following purposes:

- To indicate normal operation.
- To indicate the activation of special functions (related to CPUM security settings).

Further information is given in Table 6-1.

Table 6-1: Behaviour of DIAG LED

Behaviour of DIAG LED	Event(s)
Off (continuous)	The CPUM is off *or* starting
Green (continuous)	The CPUM is operating normally and access to the CPUM card is allowed (**CPUM Access Lock**: **Unlocked**). That is, VM600 MPS rack (CPUM) security is not being used.
Green blinking slowly (approximately once per second)	The CPUM is operating normally but access to the CPUM card is restricted (**CPUM Access Lock**: **Locked**). That is, VM600 MPS rack (CPUM) security is being used.
Green blinking quickly (approximately twice per second) for five seconds	The CPUM card is resetting to its default security settings. That is, VM600 MPS rack (CPUM) security will not be used.

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7 PROCESSING MODES AND APPLICATIONS

This chapter describes the processing modes that can be configured on the VM600 MPS (for example, shaft relative vibration, broad-band pressure). Additional background information is provided on the types of measurements that can be performed in these modes.

The MPS is generally fully configured in the factory before delivery and can be employed as is. In some cases one of the VM600 MPS software packages (MPS1 or MPS2) can be used to allow further configuration of system parameters, or to reconfigure the MPS if it is extended by the addition of MPC, IOC or relay cards (such as the RLC16).

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

7.1 Different versions of the MPC4 card

The MPC4 machinery protection card is available in different versions, including a standard version, a separate circuits version and a safety (SIL) version, as described in 4 MPC4 / IOC4T card pair.

However, the safety MPC4 card (that is, the MPC4SIL) does not provide all of the signal processing capabilities supported by the standard and the separate circuits versions of the MPC4 (see Table 7-1).

Table 7-1: Overview of processing modes available on different version of the MPC4 card

Processing mode				Supported?	
VM600 MPSx software processing function	**Description**	**Single-channel**	**Dual-channel**	**MPC4**	**MPC4SIL**
(BBAB) Broad Band Absolute Bearing Vibration	See 7.2 Broad-band absolute bearing vibration	S		Yes	Yes
(NB) Narrow Band (Tracking) Vibration	See 7.3 Tracking (narrow-band vibration analysis)	S		Yes	No
(RS) Relative Shaft Vibration	See 7.4 Shaft relative vibration with gap monitoring	S		Yes	Yes
(AS) Absolute Shaft Vibration	See 7.5 Shaft absolute vibration		D	Yes	Yes
(PS) Position	See 7.6 Position measurement	S		Yes	Yes
(SMAX) Smax	See 7.7 Smax measurement		D	Yes	No
(EC) Eccentricity	See 7.8 Eccentricity measurements	S		Yes	No
(SEP) Relative Shaft Expansion with Pendulum	See 7.9.4 Pendulum method	S		Yes	No

Table 7-1: Overview of processing modes available on different version of the MPC4 card (continued)

Processing mode				Supported?	
VM600 MPSx software processing function	**Description**	**Single-channel**	**Dual-channel**	**MPC4**	**MPC4SIL**
(RST) Relative Shaft Expansion (Shaft taper)	See 7.9.2 Double shaft taper method and 7.9.3 Single shaft taper method		D	Yes	No
(RSC) Relative Shaft Expansion (Shaft collar)	See 7.9.1 Shaft collar method		D	Yes	No
(HE) Absolute Housing Expansion	See 7.10 Absolute housing expansion	S		Yes	No
(DHE) Differential Housing Expansion	See 7.11 Differential housing expansion		D	Yes	No
(BBP) Broad band Pressure	See 7.12 Broad-band pressure monitoring	S		Yes	No
(QSP) Quasi-Static Pressure	See 7.13 Quasi-static pressure monitoring	S		Yes	No
(DQSP) Delta-Quasi-Static Pressure	See 7.14 Differential quasi-static pressure monitoring		D	Yes	No
(QST) Quasi-Static Temperature	See 7.15 Quasi-static temperature monitoring	S		Yes	No
(DQST) Delta-Quasi-Static Temperature	See 7.16 Differential quasi-static temperature monitoring		D	Yes	No
(DMF) Dual Mathematical Function	See 7.17 Dual mathematical function		D	Yes	Yes
(NBFS) Narrow Band Fixed Frequency	See 7.18 Narrow-band fixed frequency	S		Yes	No

Notes
The safety MPC4 card (MPC4SIL) does not support the two speed/phase reference (tachometer) input channels that are available on the standard and the separate circuits versions of the MPC4 card (MPC4).

For example, although the narrow-band (tracking) vibration processing mode is available for the MPC4 card (standard and the separate circuits versions), it is not available for the MPC4SIL card (safety version).

NOTE: Refer to the *VM600 safety manual* for further information.

7.2 Broad-band absolute bearing vibration

(1) Description

Absolute vibration is generally measured with seismic transducers mounted on a machine bearing housing or other mechanical structure. A number of transducers (and matching signal conditioners) are available from Meggitt Sensing Systems' Vibro-Meter product line for this purpose. The following front-end components are the most commonly used:

- CAxxx accelerometer + IPCxxx signal conditioner + GSIxxx galvanic separation
- CExxx accelerometer (current output) with built-in or integrally attached electronics + GSIxxx galvanic separation
- CExxx accelerometer (voltage output) with built-in electronics
- CVxxx velocity transducer.

Each of the above configurations produces a raw voltage-based signal where the AC component of the output voltage is directly proportional to the physical quantity measured (absolute acceleration or absolute velocity).

The MPS is used to process the raw (AC/DC) signal provided by the transducer (and its signal conditioner). The AC component of the raw signal is proportional to the absolute vibration. The DC component is used by the MPC4 card's built-in "OK System" to monitor the correct functioning of the measuring chain between the transducer and the MPC4 itself. It may therefore be used to detect a problem in the transducer, signal conditioner, galvanic separation or connecting cables (such as a defective component, short-circuit or open circuit).

An optional broad-band filter can be added to each channel to reduce unwanted parts of the frequency spectrum.

It is possible to perform one or two integrations on a signal proportional to absolute acceleration in order to obtain outputs corresponding to absolute velocity or absolute displacement. Alternatively, no integration need be performed.

NOTE: The broad-band processing technique is applicable to dynamic pressure processing as well as vibration processing.

(2) Block diagram

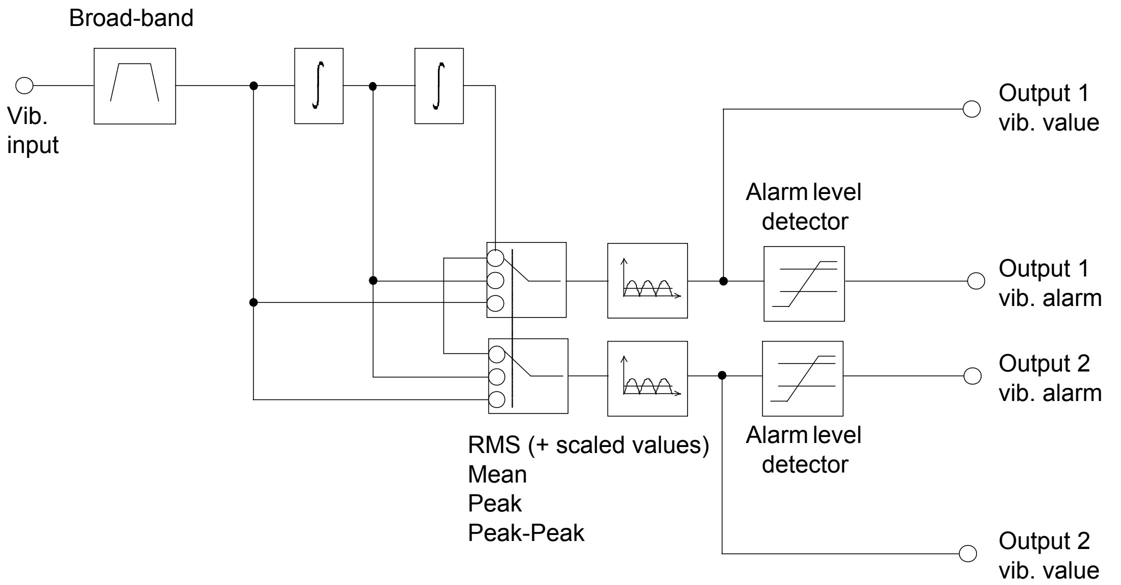


Figure 7-1: Block diagram showing broad-band absolute bearing vibration processing

Principal features:

- Configurable band-pass filtering (HP/LP) from 0.1 Hz to 10 kHz
- LP/HP ratio: up to 500 (up to 100 with double integration)
- Slope: up to 60 dB/octave
- Cut-off frequency: defined at −0.1 dB
- Unity gain: max. ±0.3 dB
- Pass-band ripple: max. ±0.1 dB
- Stop-band rejection: min. 50 dB
- Acceleration output (g or m/s^2 or $inch/s^2$)
- Velocity value processing (g or m/s^2 or $inch/s^2$ converted to mm/s or inch/s)
- Displacement value processing (g or m/s^2 or $inch/s^2$ converted to mm or mils).

Between 3 kHz and 10 kHz there can be some restrictions on the LP/HP ratio and filter slope due to the demand on processing power required by the four MPC channels. Depending on the MPC configuration, simultaneous processing on all four channels may cause processing overload. See 13.7 Checking the MPC4 for processing overload for further information.

The processing selects for output two parameters per channel, which can be acceleration, velocity or displacement. Each can be expressed as a rectified value of the type RMS, (True) Mean, (True) Peak or (True) Peak-Peak. In addition, the following scaled RMS values are available: Scaled Mean, Scaled Peak.

When one or two integrators are used in the processing, the broad-band filtering stage must include at least one high-pass filter, having a minimum slope of 12 dB/octave.

7.3 Tracking (narrow-band vibration analysis)

(1) Description

The tracking technique allows specific machine vibrations to be isolated and followed, for example a particular shaft speed. This is a useful tool for machine condition monitoring, particularly for the surveillance and balancing of critical, variable-speed, multiple-shaft machines such as gas turbines.

(2) Block diagram

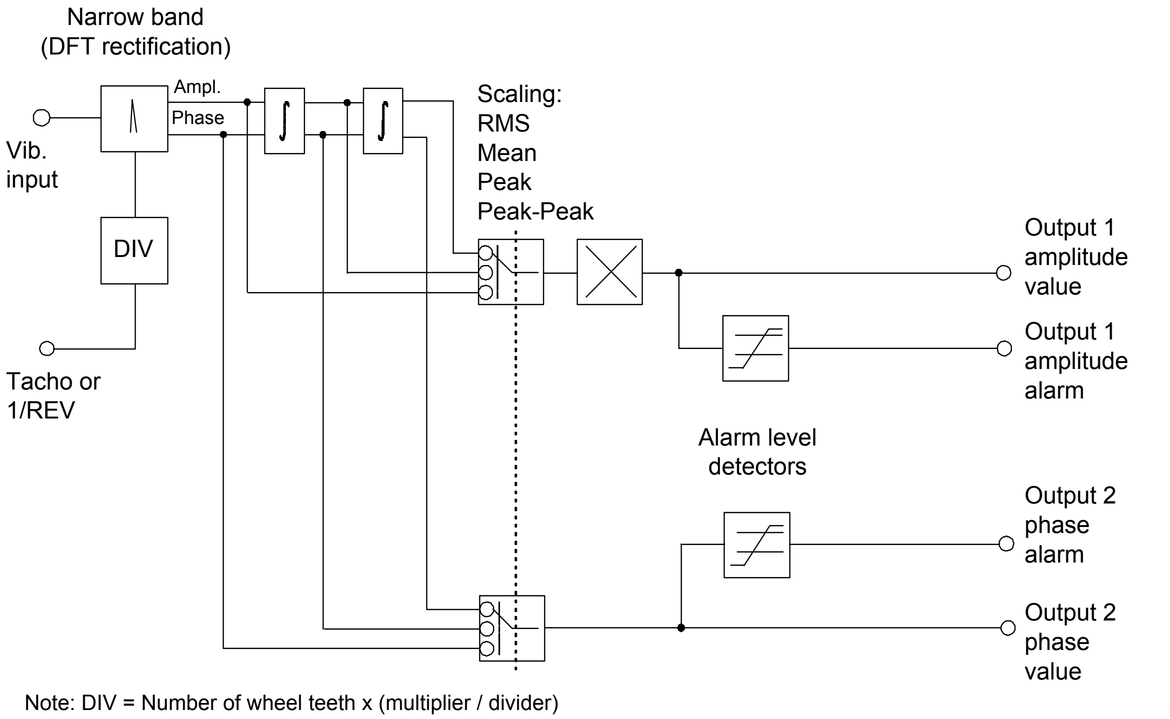


Figure 7-2: Block diagram showing tracking (narrow-band vibration analysis) processing

Principal features:

- Calculation of 1X, 2X, 3X, 4X amplitude and phase, or amplitude only (if no 1/REV input)
- For analysis, calculation of 1/3 X, 1/2 X amplitude
- Wheel teeth can be set in the range 1 to 255
- Configurable fractional tacho ratio, where the multiplier (numerator) and the divider (denominator) can be set in the range 1 to 65535
- Tacho range input from 0.3 Hz to 50 kHz
- Narrow-band filter with a high Q-factor (Q = 28)
  Note: The Q-factor of 28 is a fixed value (hard-coded constant)
- Acceleration output (g, m/s^2 or inch/s^2)
- Velocity value processing (g, m/s^2 or inch/s^2 converted to mm/s or inch/s).

For a given harmonic, the processing outputs the amplitude and phase. However, the phase is available only if the 1/REV input is present.

The tracking processing is able to operate in the frequency range 0.1 Hz to 10 kHz.

The ratio between the maximum and minimum fundamental frequencies that can be tracked should not be greater than 25:1. For example, if the minimum tracked frequency is 4 Hz, the maximum tracked frequency cannot be greater than 100 Hz.

7.4 Shaft relative vibration with gap monitoring

(1) Description

The relative movement between machine parts can be measured by non-contacting proximity probes. The frequency range of these devices (for example, the TQ4xx series from Meggitt Sensing Systems' Vibro-Meter product line) is typically DC to 10 kHz, so they can be used in both position and vibration measuring systems.

Shaft relative (relative shaft) vibration is measured with the proximity probe mounted on the machine bearing. This measures the radial vibration of the shaft relative to the bearing.

The following front-end components are the most commonly used:

- TQxxx proximity transducer + IQS signal conditioner
- TQxxx proximity transducer + IQS signal conditioner + (Intrinsically safe) GSV power supply and safety barrier (applications).

The MPC4 allows the following two types of analysis:

a. Vibration monitoring, that is, the analysis of the AC component of the signal.

b. Gap monitoring, that is, the analysis of the DC component of the signal.
(Note: The gap is the initial distance between the transducer and the target).

(2) Block diagram

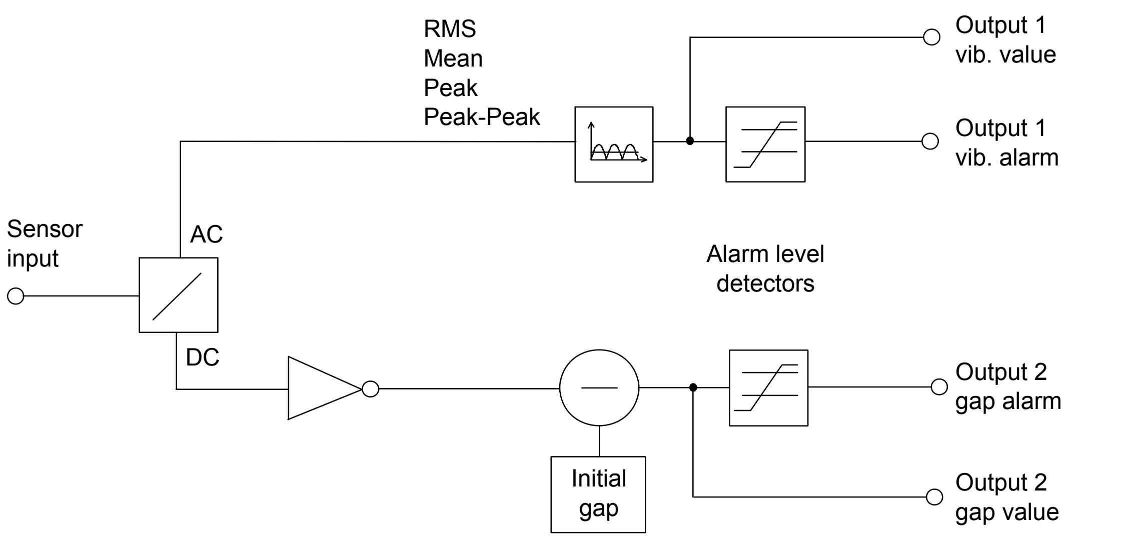


Figure 7-3: Block diagram showing relative shaft vibration with gap monitoring processing

The processing performs AC-component and DC-component separation. This provides signals corresponding to the vibration and gap values, respectively. Vibration processing is done with a 10 kHz bandwidth and DC processing with a 1 Hz bandwidth. The low-pass cut-off frequency can be set between 250 Hz and 10 kHz using the VM600 MPSx software.

The processing outputs one of two values per channel: either rectified displacement or rectified velocity.

RMS, Mean, True Peak or True Peak-Peak rectification are possible on the AC displacement or velocity value. The averaging time T can be configured using the VM600 MPS software.

7.5 Shaft absolute vibration

(1) Description

Absolute vibration is generally measured with seismic transducers (for example, accelerometers, velocity transducers) mounted on a machine bearing housing or other mechanical structure. Clearly, this technique cannot be used to measure vibrations on a rotating shaft. Instead, the measurement is made as follows:

a. The relative shaft vibration (RS) is measured using a non-contacting proximity transducer mounted on the machine bearing (see Figure 7-4). The transducer and its signal conditioner output a voltage-based signal proportional to the distance between the transducer tip and the rotating shaft. This corresponds to the relative displacement between the shaft and the bearing.

b. The absolute bearing vibration (AB) is measured using a seismic transducer mounted on the machine bearing. This will normally be an accelerometer, which provides a voltage-based signal proportional to the absolute acceleration of the bearing.

c. The absolute bearing vibration (AB) is processed by the MPS to provide a signal proportional to the absolute displacement of the bearing.

   The RS and AB values must be expressed in the same measuring units. For example, if the AB signal is expressed in terms of acceleration, the MPS must perform two integration operations on the AB signal to convert the relative acceleration into a relative displacement.

d. The shaft relative displacement found in step (a) and the broad-band absolute bearing displacement found in step (c) are summed. The resulting signal is proportional to the absolute shaft displacement (AS).

The following front-end components are most commonly used for measuring the shaft relative vibration (see Figure 7-5):

- TQxxx proximity transducer + IQSxxx signal conditioner.

The following front-end components are most commonly used for measuring the absolute bearing vibration (see Figure 7-5):

- CAxxx accelerometer + IPCxxx signal conditioner + GSIxxx galvanic separation
- CVxxx velocity transducer.

NOTE: If different low-pass (LP) cut-off frequencies are defined for the RS and AB measurements, the lowest frequency will be used for both processes.

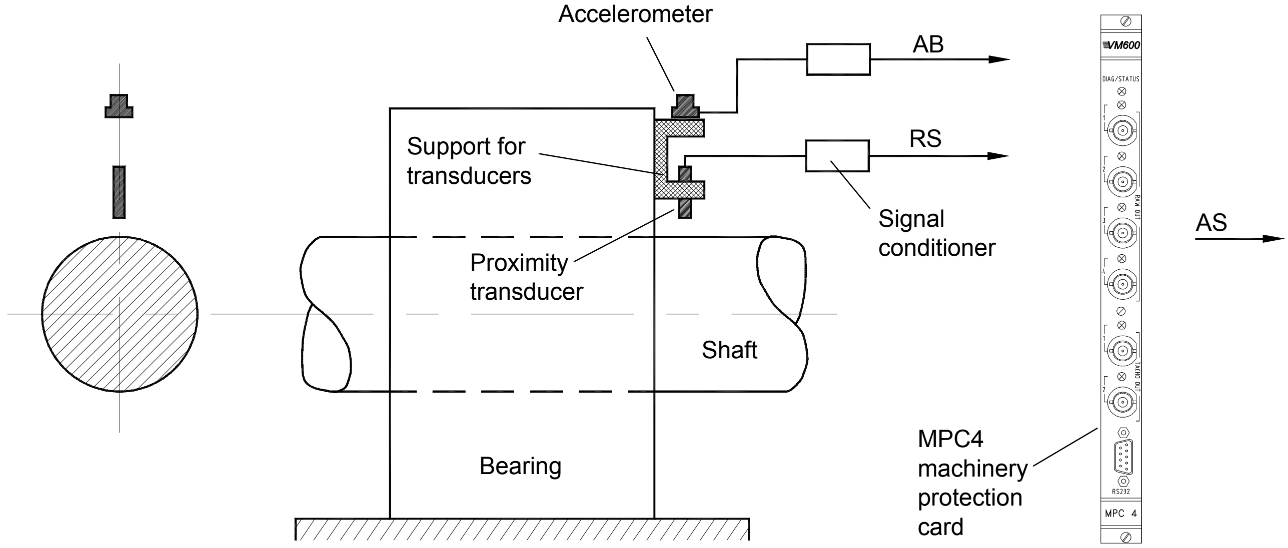


Figure 7-4: Mounting of transducers for measuring shaft absolute vibration

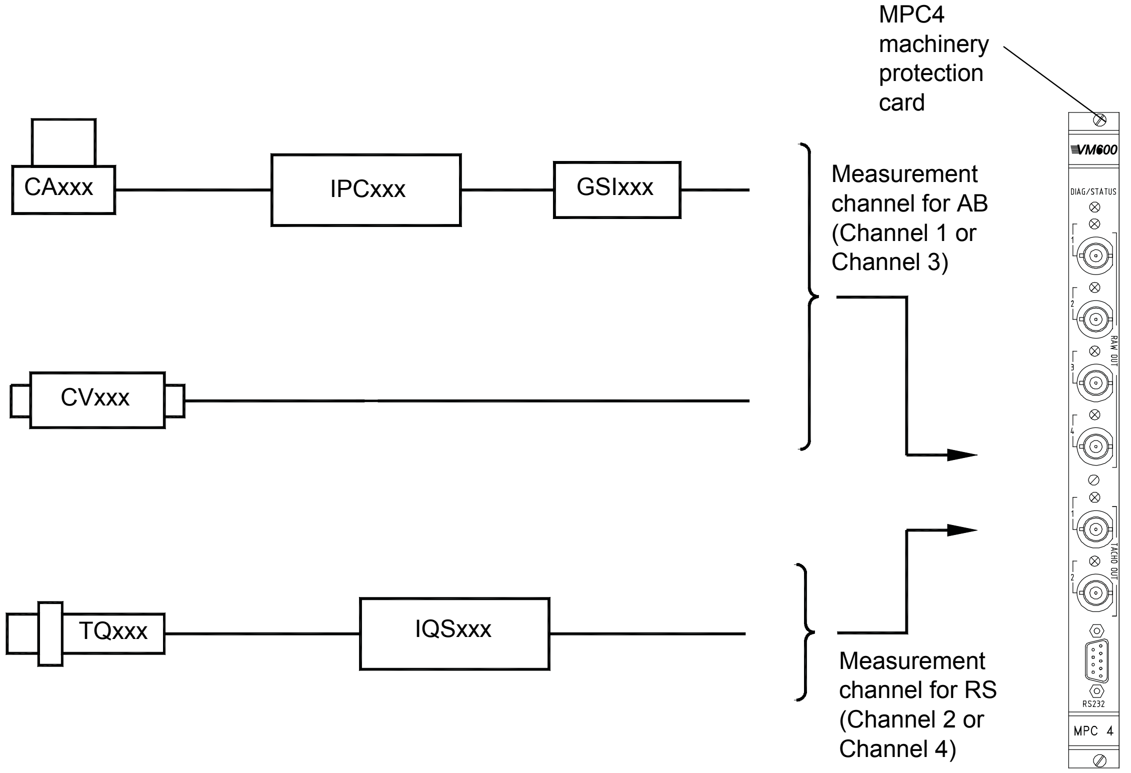


Figure 7-5: Typical measuring chain configurations for shaft absolute vibration measurement

(2) Block diagram

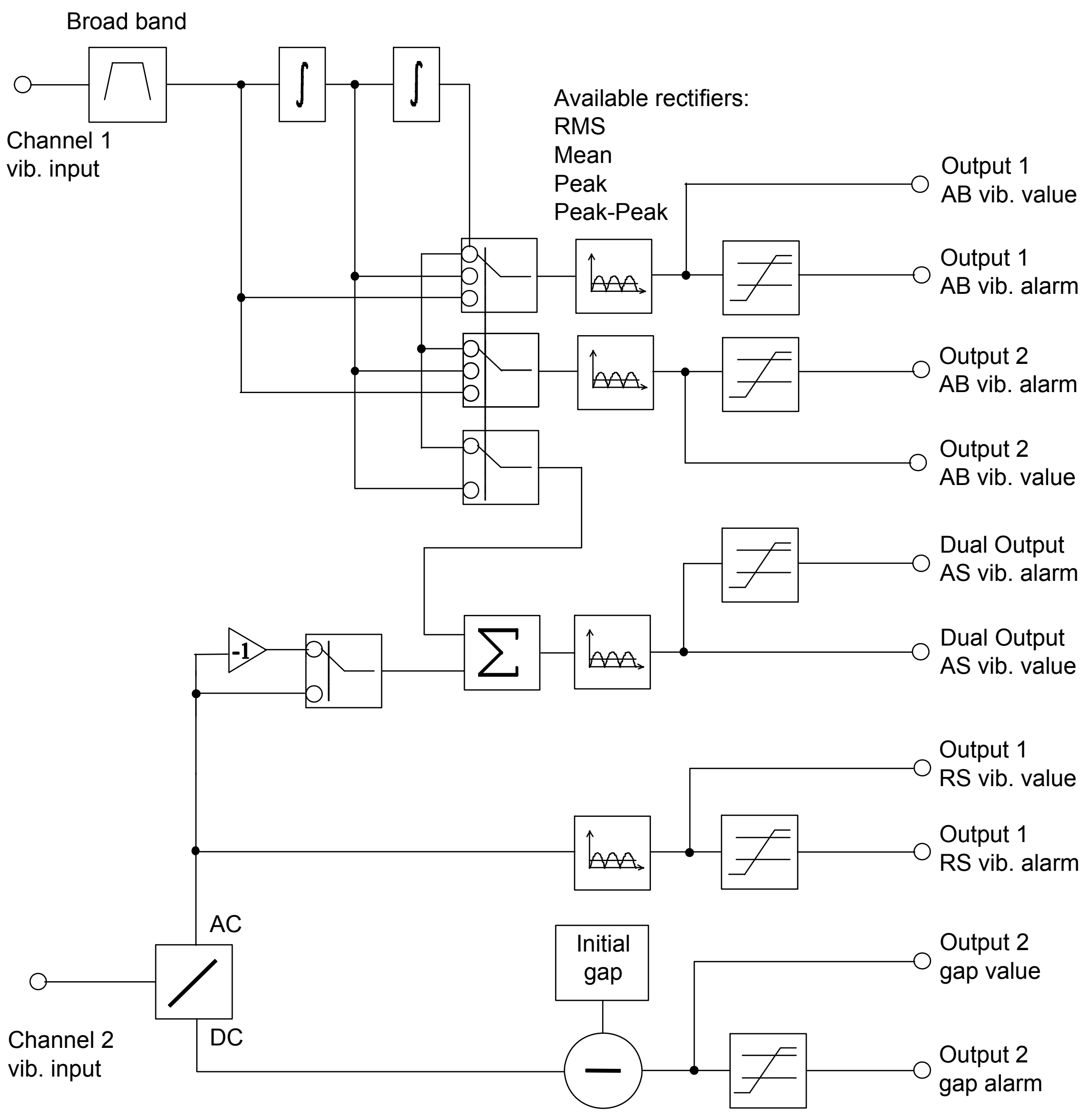


Figure 7-6: Block diagram showing absolute shaft vibration processing

The absolute shaft vibration function (AS) is a two-channel function where an absolute bearing vibration signal (AB) is added to a relative shaft vibration signal (RS). The sum of these (gain and phase correctly set) gives the shaft absolute vibration. The original RS and AB values are also available.

NOTE: It should be remembered that when a signal is integrated, the output signal lags the input signal by 90° (that is, the output signal is 90° behind the input signal).

AS = AB + RS (with sensors at the same location,)

AS = AB − RS (with sensors diametrically opposed,)

7.6 Position measurement

(1) Description

The relative position of a shaft can be measured by placing a proximity probe on the bearing. This type of measurement is particularly applicable to fluid-film thrust bearings where it is necessary to measure the axial motion of the shaft relative to the bearing.

The following front-end components are the most commonly used:

- TQxxx proximity transducer + IQSxxx signal conditioner
- TQxxx proximity transducer + IQSxxx signal conditioner + (Intrinsically safe) GSVxxx power supply and safety barrier (applications).

(2) Block diagram

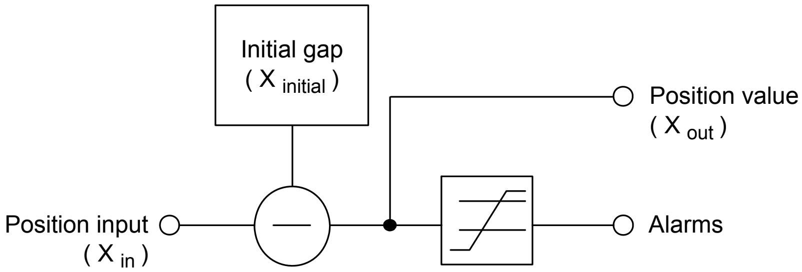


Figure 7-7: Block diagram showing position processing

With a proximity probe connected to the MPS, the position processing function calculates the position of the target relative to a reference point.

The initial target position (gap) must be stored (or configured). This will be used as a reference position for measurement purposes. This value ($X_{initial}$) depends on the physical probe placement, and must be subtracted from the measured value (X_{in}) in order to give the target position relative to the reference position:

$$X_{out} = X_{in} - X_{initial}$$

7.7 S_{max} measurement

(1) Description

S_{max} is a vibration measurement used in machinery monitoring systems, defined in ISO 7919-1 as the maximum vibratory displacement in the plane of measurement.

S_{max} monitoring is a special case of shaft relative vibration monitoring that measures the radial motion of the shaft. Like shaft relative vibration, it is typically measured using two proximity transducers (X and Y) mounted on the machine bearing at approximately 90° to each other (see Figure 7-8).

In general, the two proximity transducer (X and Y) values are added vectorially to provide the S_{max} (maximum displacement) value as defined in ISO 7919-1. However, there are different methods of calculating S_{max}, defined as methods A, B and C in ISO 7919-1 Annex B.

Method C – Measuring the real maximum displacement value (Smax) directly from the orbit

According to ISO 7919-1 method C, the value of $S_{max(pk)}$ the maximum value of displacement, can be calculated directly from the orbit using the following equation:

$S_{max(pk)} = \text{Maximum} \{ (X(t)^2 + Y(t)^2)^{0.5} \}$

This also allows the value of $S_{max(pp)}$ (that is, peak to peak) to be approximated from the following equation:

$S_{max(pp)} = 2 \times S_{max(pk)}$

NOTE: The S_{max} processing on VM600 MPC4 cards, VM600 XMV16 cards and VibroSmart VSV300 modules all use ISO 7919-1 method C to calculate the value of S_{max}.
However, since the actual signal processing implemented by VM600 MPC4 cards, VM600 XMV16 cards and VibroSmart VSV300 modules is different, the calculated S_{max} values obtained from their respective S_{max} processing functions can be slightly different.

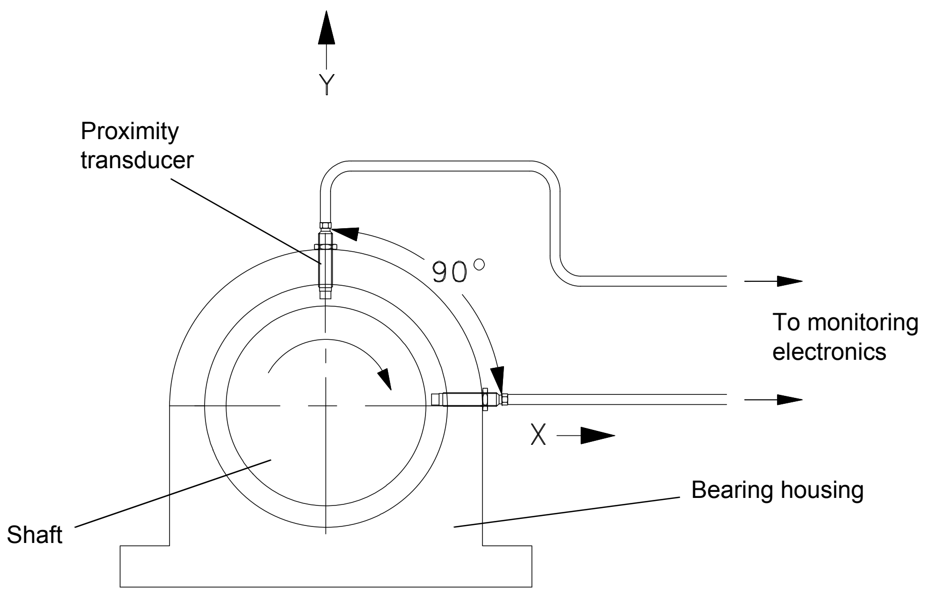


Figure 7-8: Measurement of S_{max} using two proximity probes

(2) Block diagram

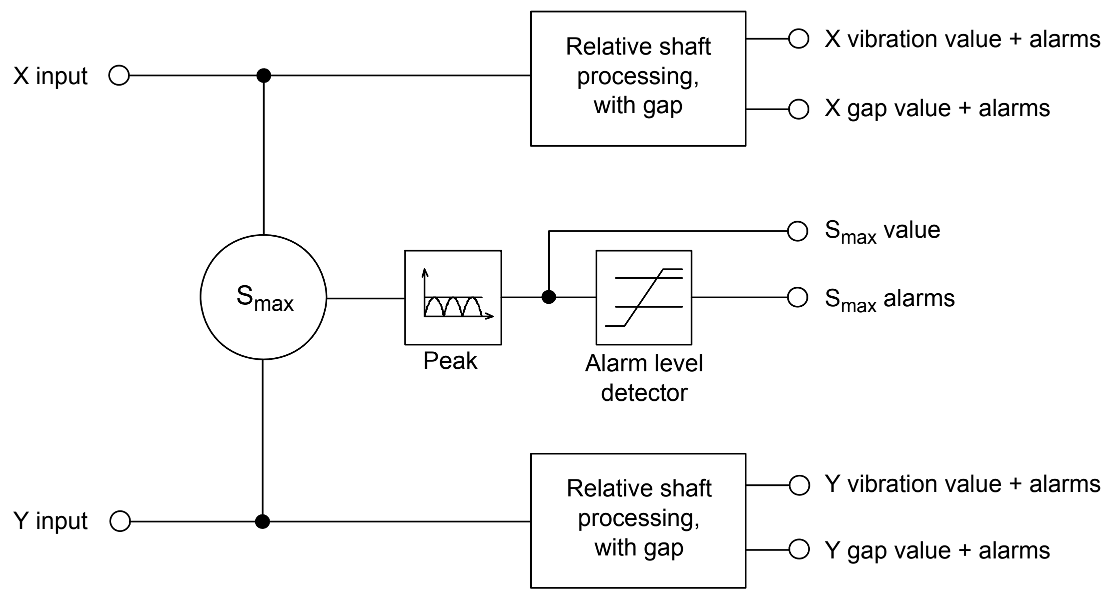


Figure 7-9: Block diagram showing S_{max} processing

7.8 Eccentricity measurements

(1) Description

In addition to knowing the vibration of a shaft, it is sometimes useful to know the bow in a shaft due to gravity or temperature gradients. This is a measure of the eccentricity of the shaft. One of the proximity probes used for shaft relative vibration measurement can additionally provide data to a processor having a low-pass filter and peak-to-peak value rectifier. The low-frequency excursion of the shaft is measured when the shaft passes through low speeds, for example, while the rotating machine is in its start-up phase or during run-down.

The following front-end components are the most commonly used:

- TQxxx proximity transducer + IQSxxx signal conditioner
- TQxxx proximity transducer + IQSxxx signal conditioner + (Intrinsically safe) GSVxxx power supply and safety barrier (applications).

(2) Block diagram

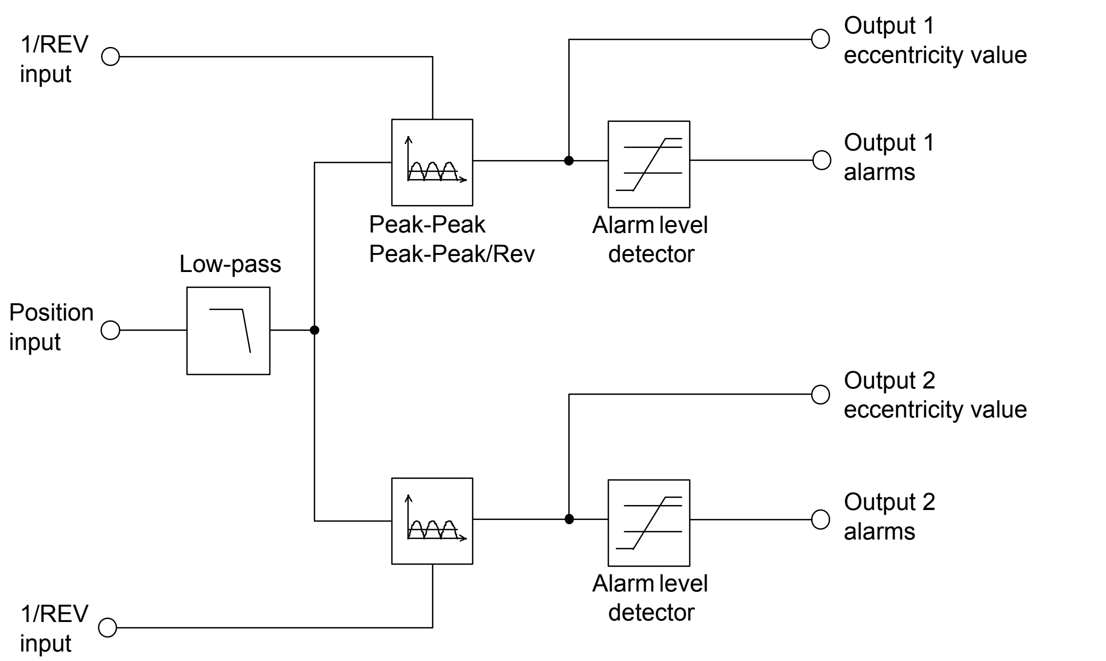


Figure 7-10: Block diagram showing eccentricity processing

Eccentricity processing characteristics:

- Low-pass filtering: Frequency up to LPF Hz (where LPF = 5 Hz by default, software settable in the range 5 to 10 Hz)
- Cut-off slope = 24 dB/octave
- Ripple = 0.5 dB
- True Peak-to-Peak rectification used for continuous eccentricity measurement
- Peak-to-Peak per Revolution rectification used for triggered eccentricity measurement. For this type of measurement, the 1/REV tacho input must be available.

7.9 Shaft relative expansion

In larger, high-temperature machines, the temperature difference between the rotor and the housing (stator) leads to relative expansion between these two elements. This may cause problems (for example, retaining clearances), which is why a shaft relative expansion measuring system is recommended for such machines.

The relative expansion value can be several tens of millimetres, which is beyond the measuring range of a single proximity probe. For this reason, Meggitt Sensing Systems' Vibro-Meter product line offers four types of measurement systems that offer an extended measuring range. Three of these use a double sensor arrangement which can be easily processed by a single MPC4 card configured for dual channel processing. The various probe configurations and their related mathematical functions are described in this section.

7.9.1 Shaft collar method

(1) Description

Two probes are used in this configuration, with one probe placed on each side of a shaft collar (see Figure 7-11). Two possibilities exist:

- Both probes are operating in their measuring range at the same time.
- The probes are operating alternately, with only one probe in its measuring range at a given time. This doubles the measuring range that is possible with a single probe.

a. When both probes are in their operating range at the same time:

If $GAP1_i$ and $GAP2_i$ are the respective initial gaps, then:

$$\Delta L = (GAP1 - GAP2) / 2 - (GAP1_i - GAP2_i) / 2$$

If initial gaps are equal, the differential expansion is:

$$\Delta L = (GAP1 - GAP2) / 2$$

b. When the probes are operating alternately:

$$\Delta L = (GAP1 - GAP1_i) \text{ in the operating range of probe 1.}$$

$$\Delta L = (GAP2_i - GAP2) \text{ in the operating range of probe 2.}$$

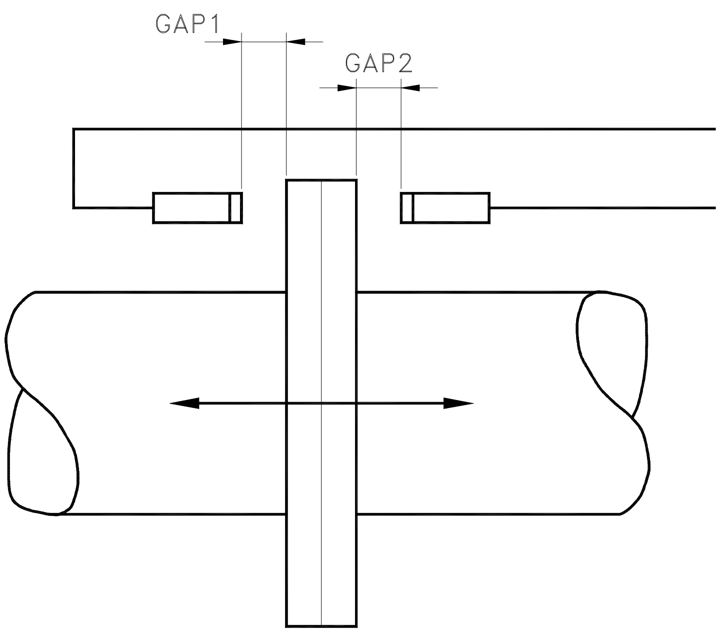


Figure 7-11: Two proximity probes mounted near a shaft fitted with a collar

(2) Block diagram

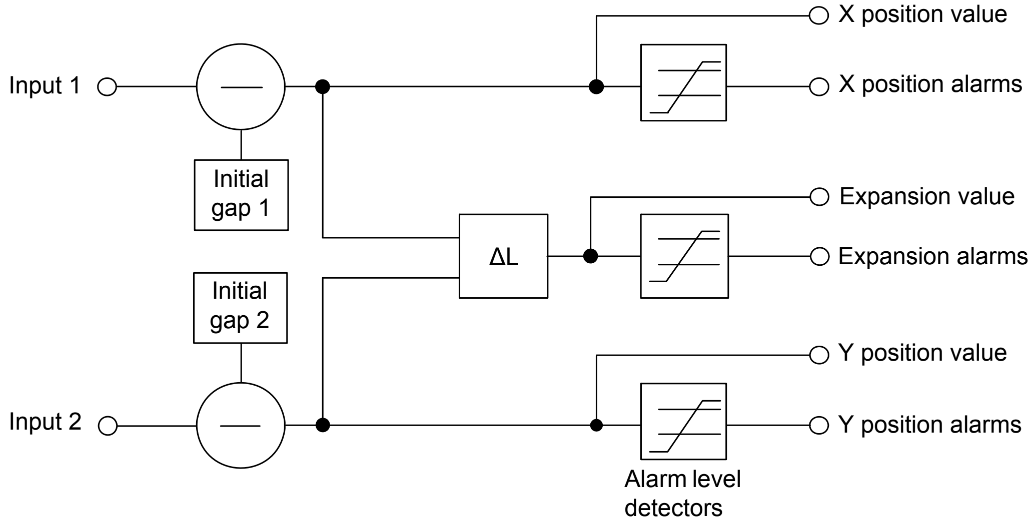


Figure 7-12: Block diagram showing processing for shaft collar method

7.9.2 Double shaft taper method

(1) Description

Two probes are used in this configuration, with each probe facing one side of a double shaft taper (see Figure 7-13). This solution is simple and effective, allowing large measuring ranges if the taper angle is small (for example, for a taper angle of 5°, the measuring range is increased about nine-fold).

This method allows the measuring range to be extended by a factor of $1 / \sin\alpha$:

$$\Delta L = \Delta G1 / \sin\alpha = -\Delta G2 / \sin\alpha$$

$$\Rightarrow \quad 2\Delta L = (\Delta G1 - \Delta G2) / \sin\alpha$$

$$\Rightarrow \quad \Delta L = (\Delta G1 - \Delta G2) / 2\sin\alpha$$

finally,

$$\Delta L = [\,(GAP1 - GAP1_i) - (GAP2 - GAP2_i)\,] / 2\sin\alpha$$

where GAP_i is the initial gap value.

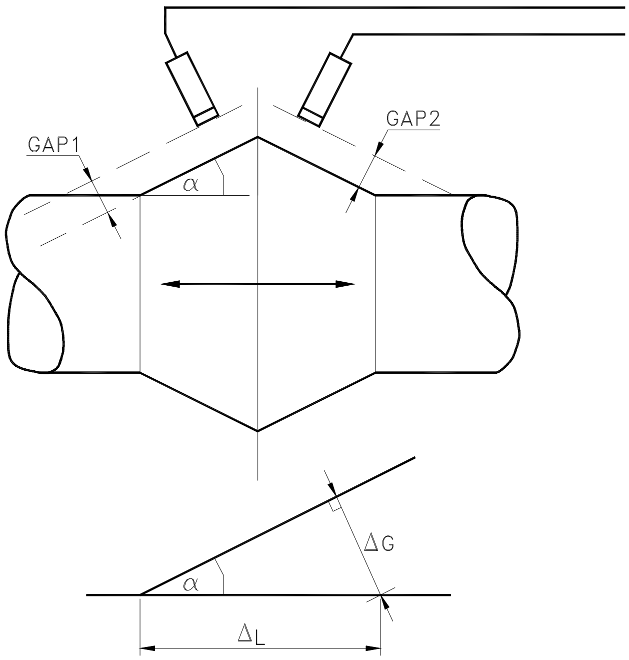


Figure 7-13: Two proximity probes mounted near a shaft fitted with a double taper

(2) Block diagram

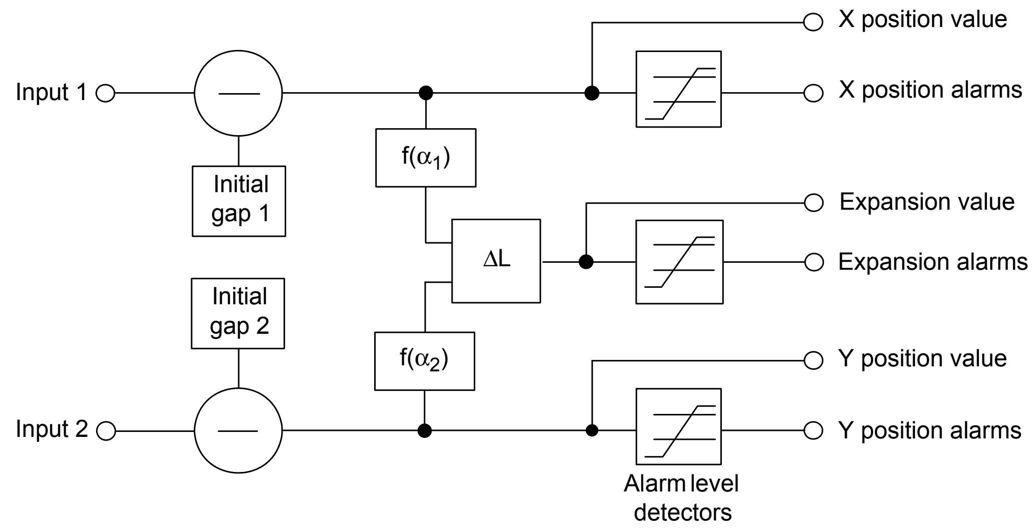


Figure 7-14: Block diagram showing processing for double shaft taper method

7.9.3 Single shaft taper method

(1) Description

Two probes are used in this configuration (see Figure 7-15). The first probe is placed perpendicularly to a single shaft taper and measures expansion. The second probe is placed perpendicularly to the axis of rotation to compensate for any radial motion of the shaft which could introduce an error in the measured expansion value. Both probes operate within their measuring range at the same time.

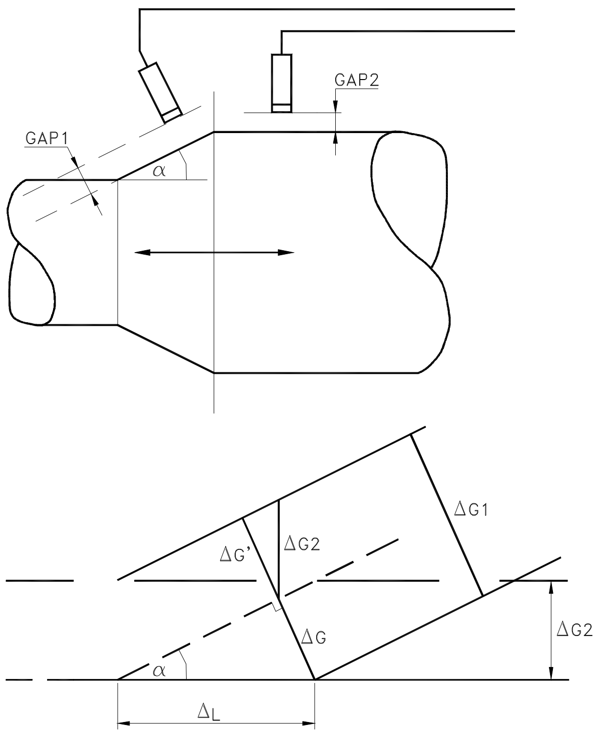


Figure 7-15: Two proximity probes mounted near a shaft fitted with a single taper

For this configuration the following formulae apply:

$$\Delta L = \Delta G / \sin\alpha$$

$$\Delta G = \Delta G1 - \Delta G'$$

$$\Delta G' = \Delta G2 \cos\alpha$$

$$\Rightarrow \quad \Delta L = (\Delta G1 - \Delta G2 \cos\alpha) / \sin\alpha$$

finally,

$$\Delta L = [\,(GAP1 - GAP1_i) - (GAP2 - GAP2_i) \cos\alpha\,] / \sin\alpha$$

where GAP_i is the initial gap value.

(2) Block diagram

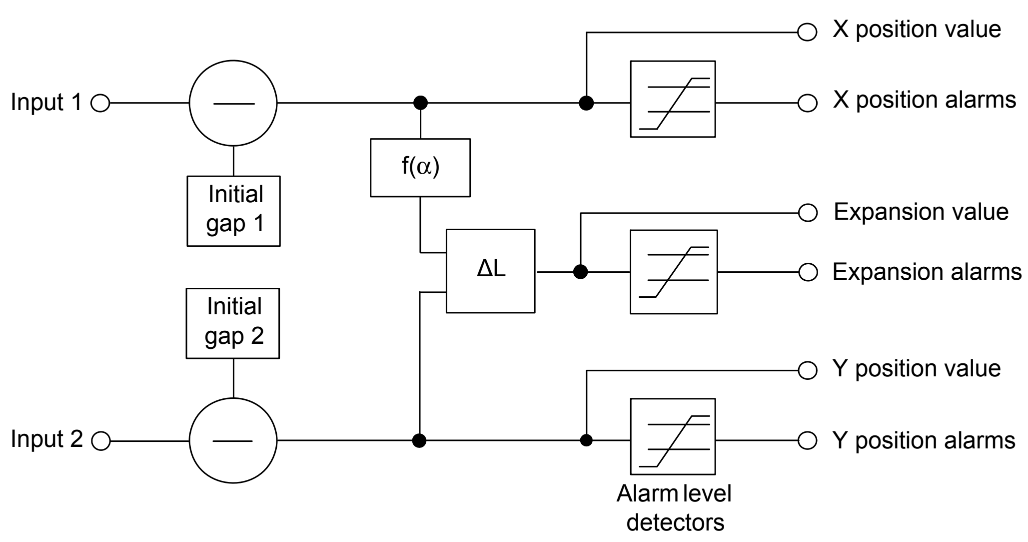


Figure 7-16: Block diagram showing processing for single shaft taper method

7.9.4 Pendulum method

(1) Description

With this configuration a magnet on a lever arm is used to follow the movement of the shaft collar (see Figure 7-17). The lever arm ratio (L1 / L2) enables the measuring range to be extended well beyond that of a transducer used on its own.

$\Delta L = GAP - GAP_i$ where GAPi is the initial gap.

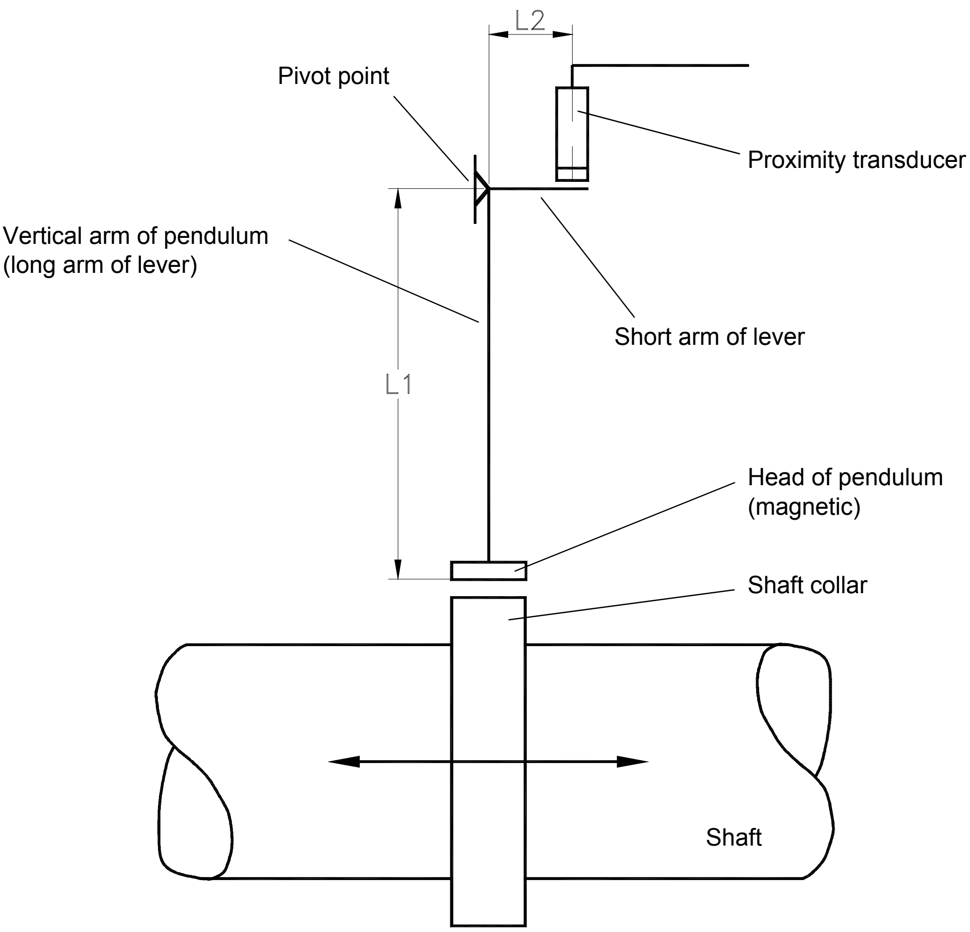


Figure 7-17: A measuring system using a pendulum with magnetic head installed near a shaft collar

(2) Block diagram

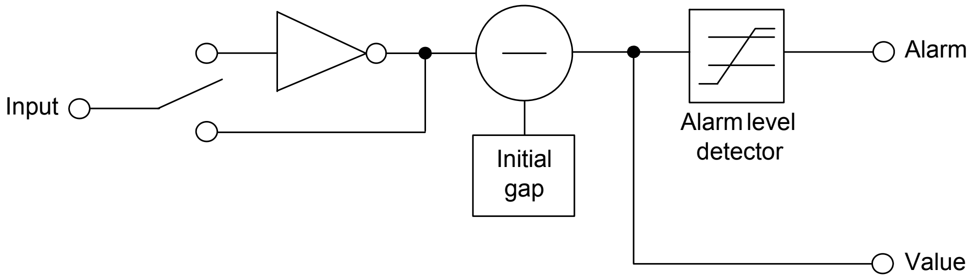


Figure 7-18: Block diagram showing processing for pendulum method

7.10 Absolute housing expansion

(1) Description

All thermal machines are subject to absolute expansion due to variations in their temperature. The measurement of this parameter is performed on the machine at one or two critical points on the housing using an absolute expansion probe, such as the AE119 (measuring range up to 50 or 100 mm) from Meggitt Sensing Systems' Vibro-Meter product line. The body of this probe is attached to a fixed reference and its measuring element makes physical contact with the machine housing.

In Figure 7-19 below, two probes are used to measure two different (independent) machine bodies, for example, the HP and LP turbine housings. The MPC4 is set up for single channel processing. One MPC4 channel is required for each probe.

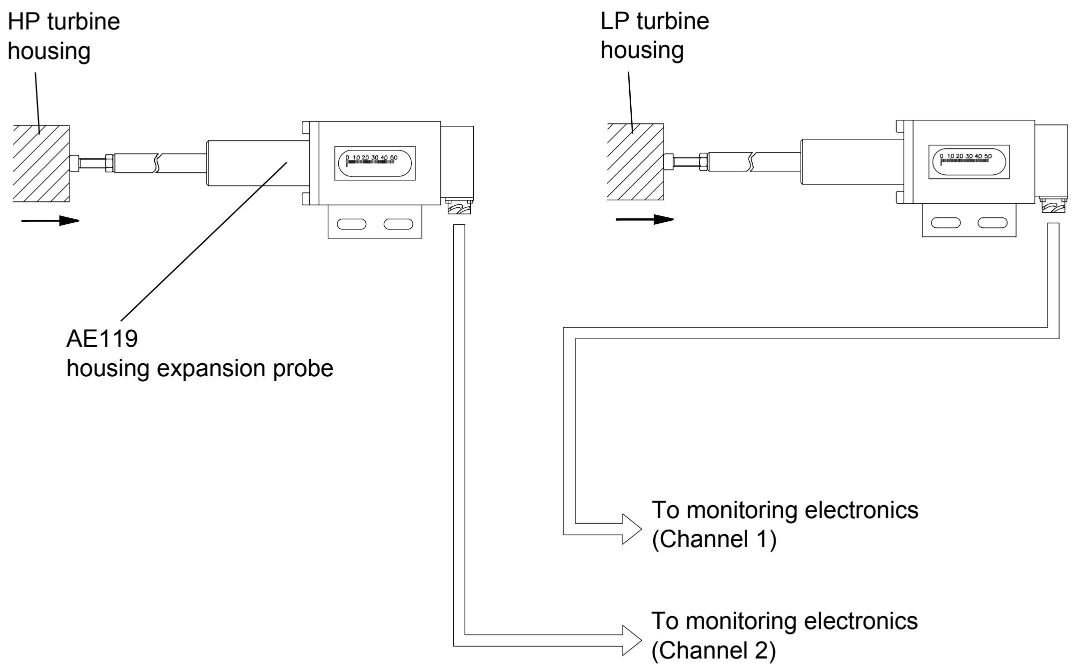


Figure 7-19: Measuring the absolute housing expansion on two different bodies

Figure 7-20 shows the processing performed for a single AE119 housing expansion probe.

(2) Block diagram

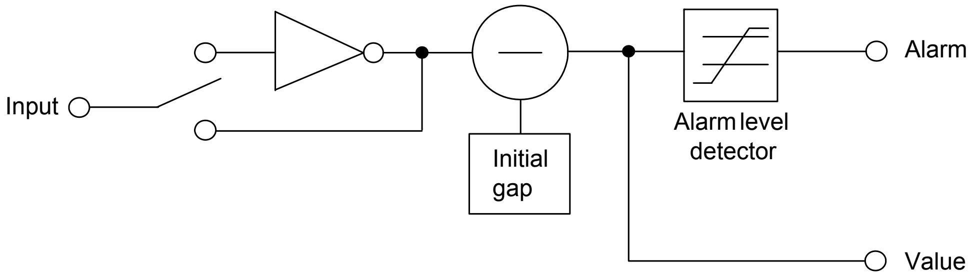


Figure 7-20: Block diagram showing absolute housing expansion processing

7.11 Differential housing expansion

(1) Description

In this situation (see Figure 7-21), two probes measure on opposite sides of the same machine body (for example, the HP or the LP turbine housing). The MPC4 is set up for dual-channel processing.

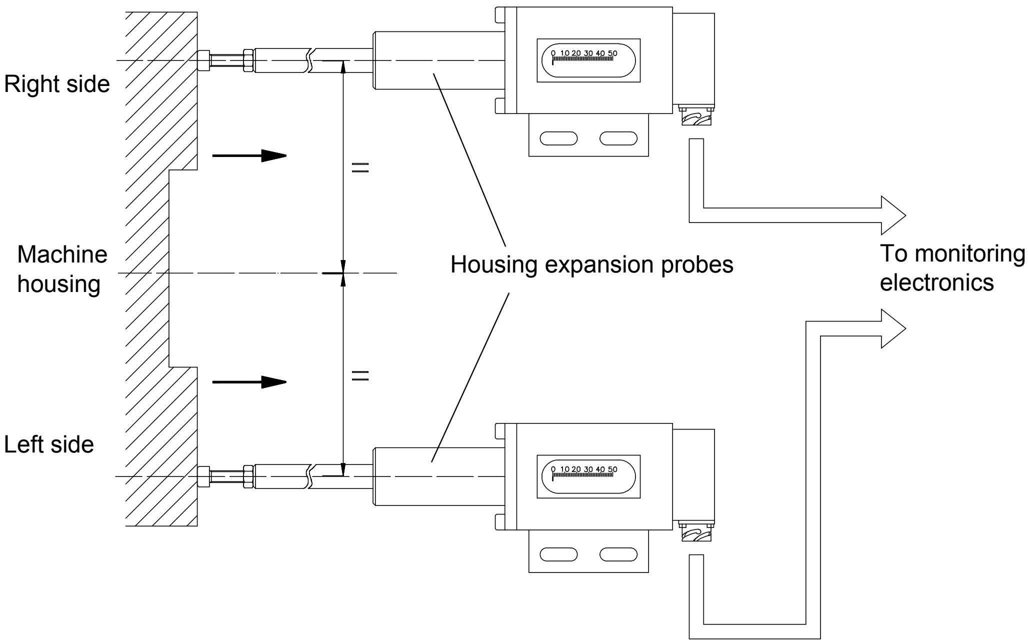


Figure 7-21: Measuring the differential housing expansion on two parts of the same body

2) Block diagram

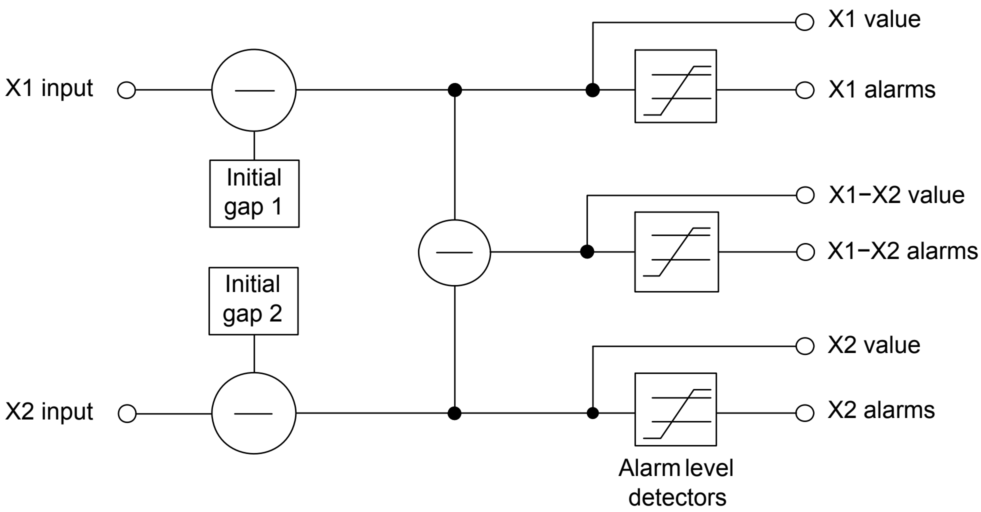


Figure 7-22: Block diagram showing differential housing expansion processing

The difference in expansion measured on each side of the machine is calculated as follows:

$$\Delta X = (X1 - \text{Initial GAP1}) - (X2 - \text{Initial GAP2})$$

7.12 Broad-band pressure monitoring

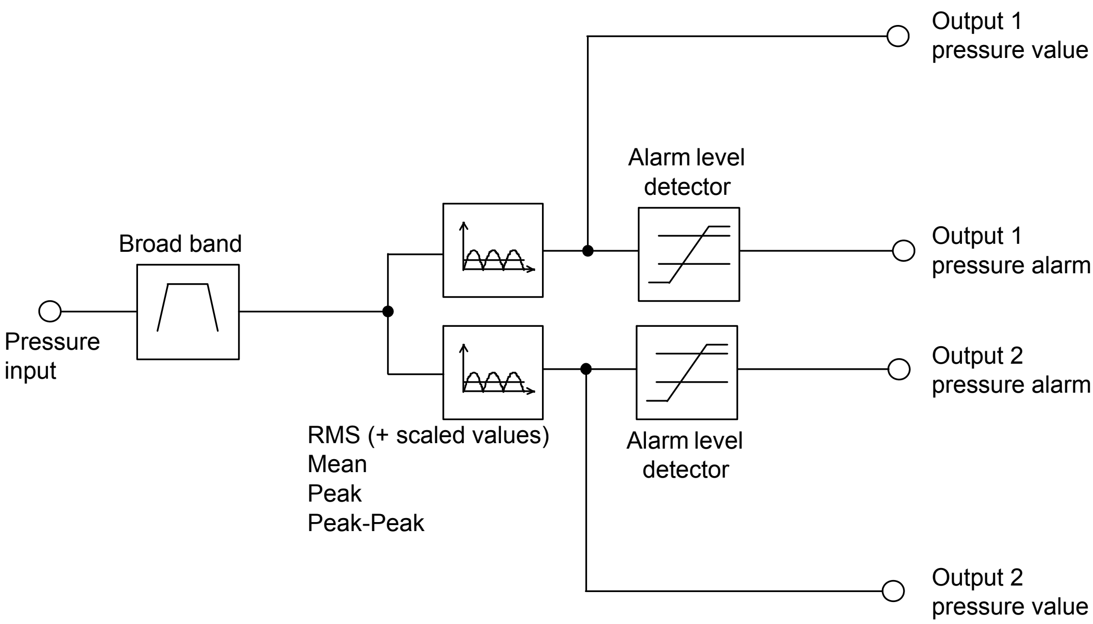


Figure 7-23: Block diagram showing broad-band pressure processing

Principal features:

- HP and LP cut-off frequencies for band-pass filtering can be set in the range 0.1 Hz to 10 kHz
- HP/LP ratio: up to 500
- Slope: up to 60 dB/octave
- Cut-off frequency: defined at −0.1 dB
- Unity gain: max. ±0.3 dB
- Pass-band ripple: ±0.1 dB
- Stop-band rejection: min. 50 dB
- Pressure processing (mbar, bar, psi, Pa) => pressure unit (mbar or bar or psi or Pa)
- User-defined input unit => User-defined output units (scaled 1 to 1).

The processing selects for output two parameters per channel. Each can be expressed as a rectified value of the type (True) RMS, (True) Mean, (True) Peak or (True) Peak-Peak. In addition, the following scaled RMS values are available: Scaled Mean, Scaled Peak.

Any of the four pressure units (mbar, bar, psi, Pa) can be selected, provided the unit is defined for the input channel.

7.13 Quasi-static pressure monitoring

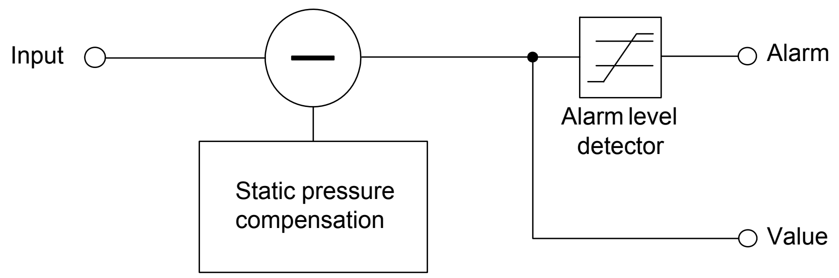


Figure 7-24: Block diagram showing quasi-static pressure processing

This type of processing is equivalent to that used for absolute housing expansion processing (see 7.10 Absolute housing expansion).

7.14 Differential quasi-static pressure monitoring

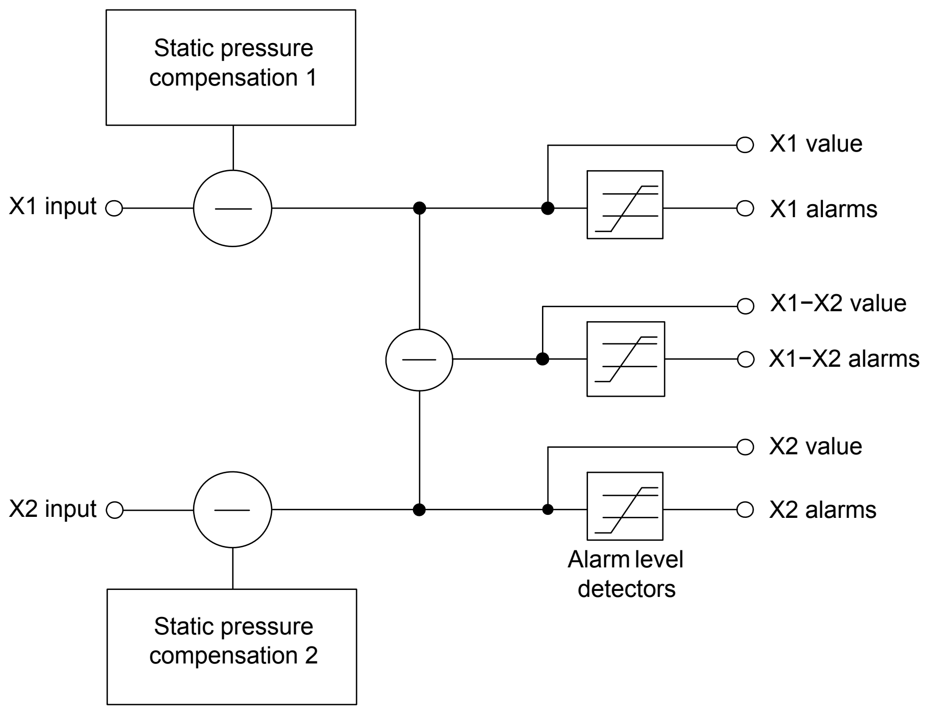


Figure 7-25: Block diagram showing differential quasi-static pressure processing

This type of processing is equivalent to that used for differential housing expansion processing. See 7.11 Differential housing expansion.

7.15 Quasi-static temperature monitoring

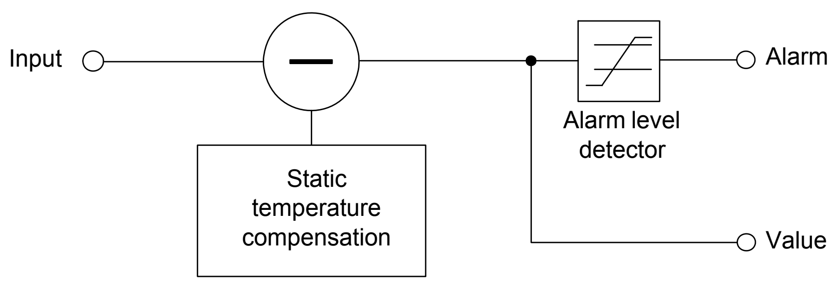


Figure 7-26: Block diagram showing quasi-static temperature processing

This type of processing is equivalent to that used for absolute housing expansion processing (see 7.10 Absolute housing expansion), but using a temperature unit expressed in °C.

7.16 Differential quasi-static temperature monitoring

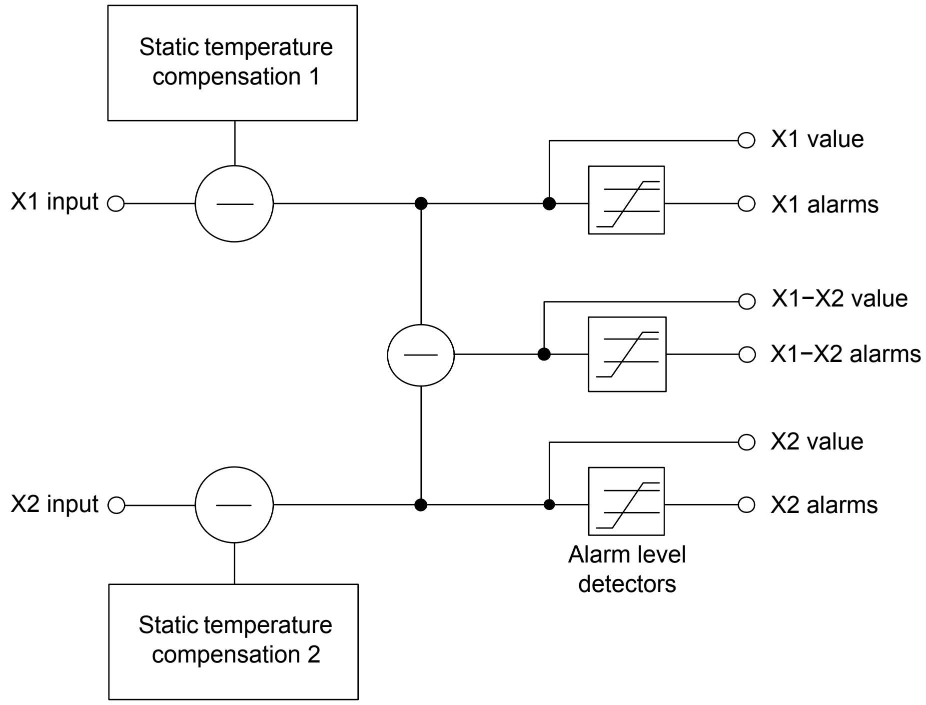


Figure 7-27: Block diagram showing differential quasi-static temperature processing

This type of processing is equivalent to that used for differential housing expansion processing. See 7.11 Differential housing expansion.

In this situation, two temperature probes are used and the MPC4 is set up for dual-channel processing. The differential output is given by:

$$\Delta X = X1 - X2$$

7.17 Dual mathematical function

(1) Description

Dual mathematical function (DMF) processing provides a range of dual-channel mathematical functions that operate on the single-channel processed outputs of the measurement channel inputs on an MPC4 card (see Figure 7-28).

The mathematical functions provided include basic mathematical operations (addition and subtraction) and discriminator operations that select the minimum value or the maximum value from the two input channels.

NOTE: DMF processing only operates on the first processed outputs from the single-channel processings (shown as Out 1 in Figure 7-28).

The mathematical functions are:

- **RMS Sum** which performs the RMS addition of two single-processing input channels: $((\text{Channel } 1)^2 + (\text{Channel } 2)^2)^{0.5}$ or $((\text{Channel } 3)^2 + (\text{Channel } 4)^2)^{0.5}$

  The **RMS Sum** function requires that both input channels are configured with an RMS rectifier.
- **RMS Subtraction** which performs the RMS subtraction of two single-processing input channels: $((\text{Channel } 1)^2 - (\text{Channel } 2)^2)^{0.5}$ or $((\text{Channel } 3)^2 - (\text{Channel } 4)^2)^{0.5}$

  The **RMS Subtraction** function requires that both input channels are configured with an RMS rectifier.

  NOTE: For **RMS Subtraction**, if $(\text{Channel } 2)^2 > (\text{Channel } 1)^2$ or $(\text{Channel } 4)^2 > (\text{Channel } 3)^2$ then zero (0.0) is returned.
- **SUM** which performs the addition of two single-processing input channels: *(Channel 1 + Channel 2)* or *(Channel 3 + Channel 4)*

  The **SUM** function requires that both input channels are configured with the same rectifier.
- **SUBTRACTION** which performs the subtraction of two single-processing input channels: *(Channel 1 − Channel 2)* or *(Channel 3 − Channel 4)*

  The **SUBTRACTION** function requires that both input channels are configured with the same rectifier.
- **X & Y MIN** which selects the smaller value from two single-processing input channels: *Minimum { (Channel 1 , Channel 2) }* or *Minimum { (Channel 3 , Channel 4) }*

  The **X & Y MIN** function requires that both input channels are configured with the same rectifier.
- **X & Y MAX** which selects the larger value from two single-processing input channels: *Maximum { (Channel 1 , Channel 2) }* or *Maximum { (Channel 3 , Channel 4) }*

  The **X & Y MAX** function requires that both input channels are configured with the same rectifier.

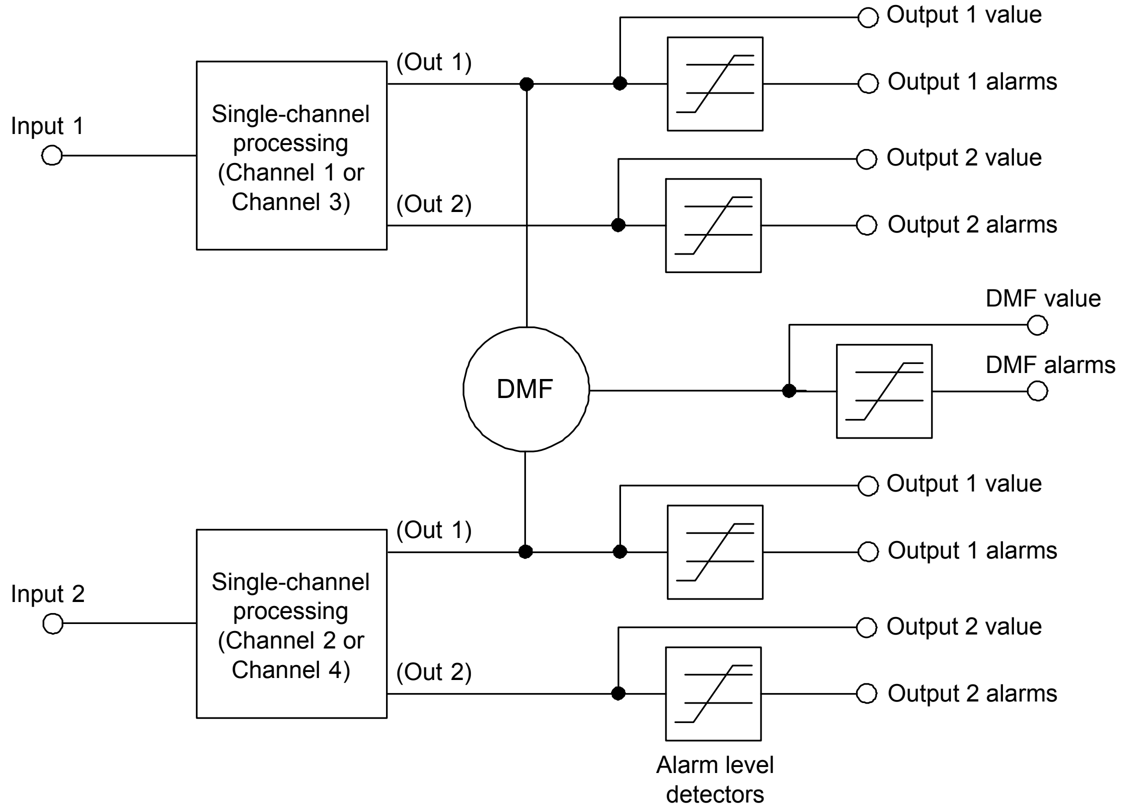
NOTE: In order to use dual mathematical function (DMF) processing with two single-processing input channels, both single-processing input channels (channel 1 and channel 2, or channel 3 and channel 4) must be configured with the same single-channel processing function (for example, broad-band absolute bearing vibration (BBAB)) and with rectifiers from the same rectifier group (for example, AVG, RMS or True).

As shown in Figure 7-28 as Out 1, dual mathematical function processing only operates on the first processed outputs from the single-channel processings:

- DMF for Measurement Input Channels 1 & 2 operates on the first processed outputs of Channel 1 and Channel 2.
- DMF for Measurement Input Channels 3 & 4 operates on the first processed outputs of Channel 3 and Channel 4.

NOTE: The Dual mathematical function processing implemented on VM600 MPC4 cards can be configured as **X & Y MAX** in order to use ISO 7919-1 method B to calculate an S_{max} value. See also 7.7 Smax measurement.

(2) Block diagram



Note: The DMF (dual mathematical function) processing function can be: **RMS Sum**, **RMS Subtraction**, **SUM**, **SUBTRACTION**, **X & Y MAX** or **X & Y MIN**.

Figure 7-28: Block diagram showing DMF processing

7.18 Narrow-band fixed frequency

1) Description

Narrow-band fixed frequency tracking (NBFS) processing is similar to narrow-band (tracking) vibration (NB) processing in that it uses a narrow-band filter with a high Q-factor (Q=28) in order to allow specific machine vibrations to be isolated. However, this technique uses a fixed frequency narrow-band filter that is defined in terms of a particular shaft speed (so it does not track the machine speed).

(2) Block diagram

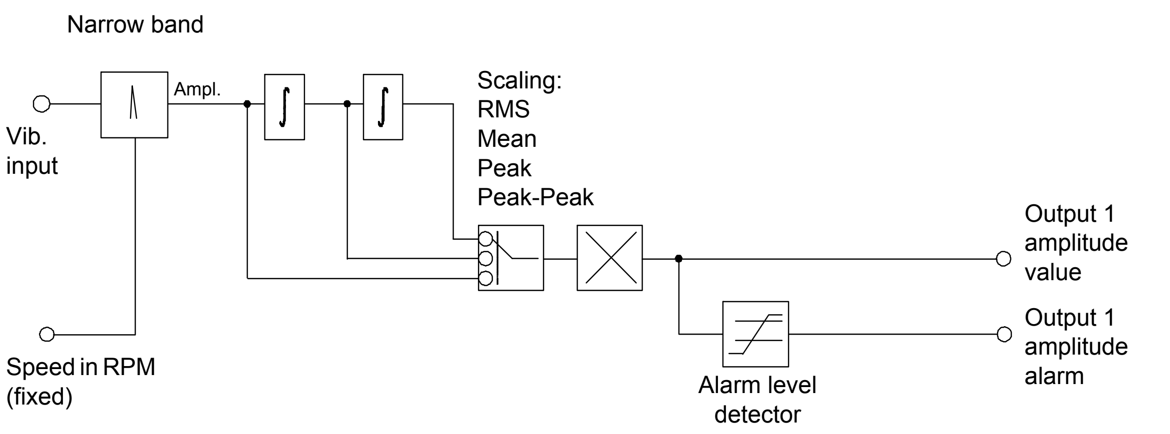


Figure 7-29: Block diagram showing narrow-band fixed frequency processing

Principal features:

- Calculation of amplitude only (no 1/REV input)
- Fixed-frequency narrow-band filter with a high Q-factor (Q = 28)
  Note: The Q-factor of 28 is a fixed value (hard-coded constant)
- Acceleration output (g, m/s^2 or inch/s^2)
- Velocity value processing (g, m/s^2 or inch/s^2 converted to mm/s or inch/s).

The frequency of interest is defined in terms of a fixed machine speed (Center Speed in RPM), as follows:

Centre frequency, $f_0 = \textit{Center Speed in RPM} / 60$

Bandwidth, $BW = f_0 / Q$, *where Q = 28*

The centre frequency f_0 is the geometric mean of the bandwidth, defined by the −3 dB cutoff frequencies: lower cut-off frequency (f_1) and upper cut-off frequency (f_2).

Bandwidth, $BW = f_0 / Q = f_2 - f_1$, *where Q = 28*

Which allows the cutoff frequencies be calculated using:

Lower cut-off frequency, $f_1 = f_0 \left(\left(1 + (1 / 4Q^2) \right)^{0.5} - (1 / 2Q) \right)$, *where Q = 28*

Upper cut-off frequency, $f_2 = f_0 \left(\left(1 + (1 / 4Q^2) \right)^{0.5} + (1 / 2Q) \right)$, *where Q = 28*

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Part II: Installing VM600 MPS hardware and using the system

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8 INSTALLATION

Before installing or otherwise working with a VM600 rack, it is important to refer to the information given in the Safety section of this manual, including:

- Electrical safety and installation on page xiv
- Hazardous voltages and the risk of electric shock on page xv
- Hot surfaces and the risk of burning on page xv
- Heavy objects and the risk of injury on page xv
- Replacement parts and accessories on page xvi
- Environmental specifications on page A - 3.

8.1 Introduction

The VM600 MPS is a modular system with cards being installed in a 19" x 6U rack (type ABE040 or ABE042). ABE040 and ABE042 racks have 21 VME slots, designated slot 0 to slot 20 (from left to right, as seen from the front).

The front and rear card cages of the rack are partitioned by a backplane. Each side of the backplane is equipped with connectors allowing modules and cards to be quickly and easily installed.

The following elements are connected to the backplane by installing them from the front of the rack:

- RPS6U rack power supply
- MPC4 machinery protection card
- AMC8 analog monitoring card
- CPUM modular CPU card.

The following elements are connected to the backplane by installing them from the rear of the rack:

- IOC4T input/output card, for use with the MPC4
- IOC8T input/output card, for use with the AMC8
- IOCN input/output card, for use with the CPUM
- RLC16 relay card.

If the ABE04x rack is intended for use as a condition monitoring system (CMS) as well as an machinery protection system (MPS), it can contain additional hardware.

A CMS using the VM600 CMS software from Meggitt Sensing Systems can use the following hardware:

- CMC16 condition monitoring card
- IOC16T input/output card, for use with the CMC16.

NOTE: Further information on this CMS hardware can be found in the *VM600 condition monitoring system (CMS) hardware manual* (MACMS-HW/E).

A CMS using the VibroSight® software from Meggitt Sensing Systems can use the following hardware:

- XMC16 extended monitoring card for combustion
- XMV16 extended monitoring card for vibration
- XMVS16 extended monitoring card for vibration
- XIO16T extended input/output card, for use with the XMC16, XMV16 or XMVS16.

NOTE: Further information on this CMS hardware can be found in the *VibroSight* help (VibroSight.chm).

8.2 Attribution of slots in the rack

Table 8-1 show the installation restrictions that apply to the ABE040 and ABE042 racks.

Table 8-1: Attribution of slots in an ABE04x rack

VME slot no.	Card/system component accepted in front card cage	Card/system component accepted in rear card cage
0	Reserved for CPUM	Reserved for IOCN
1		RLC16
2	Reserved for VME 32 card	RLC16
3 to 14	MPC4, AMC8, CMC16, XMC16, XMV16 or XMVS16	Associated IOC4T, IOC8T, IOC16T or XIO16T. Or RLC16.
15	Reserved for RPS6U (that is, PS2) (Power supply 2, PS2) (Width of RPS6U = 3 slots)	RLC16
16		RLC16
17		RLC16
18	Reserved for RPS6U (that is, PS1) (Power supply 1, PS1) (Width of RPS6U = 3 slots)	RLC16
19		Reserved for rear panel associated with the rack power supply (one or two RPS6Us)
20		

Notes

An MPC4 card must have an IOC4T card installed directly behind it in the rack.

An AMC8 card must have an IOC8T card installed directly behind it in the rack.

A CMC16 card must have an IOC16T card installed directly behind it in the rack.

An XMC16, XMV16 or XMVS16 card must have an XIO16T card installed directly behind it in the rack.

One or two RPS6U rack power supplies can be installed in a VM600 system rack. A rack can have two RPS6U rack power supplies installed for different reasons: in order to support rack power supply redundancy (2.9.5 Racks with two RPS6U rack power supplies in order to support rack power supply redundancy) or in order to supply power to the cards (2.9.6 Racks with two RPS6U rack power supplies in order to supply power to the cards).

8.3 Rack safety requirements

8.3.1 Adequate ventilation

VM600 19" racks do not contain any ventilation units (fans). They therefore rely on either forced ventilation by fans in the cabinet or on natural ventilation (convection) for their cooling. All require the free flow of air in an upward direction, with air entering the rack through the vents in the base of the rack and leaving it through the vents on the top of the rack.

Always ensure the following instructions are observed to allow proper natural ventilation.

A VM600 rack can overheat if it is not properly ventilated. This will affect the correct operation of the system, and the temperature of the top panel of the rack may increase to over 158°F (70°C).

When a rack is installed in a cabinet or enclosure, a space of at least 50 mm should be present below and above each rack (see Figure 8-1, Case A).

To prevent warm air flowing from one rack to another, inclined plates must be placed between them in order to deflect the airflow (see Figure 8-1, Case B).

See Appendix A - Environmental specifications for details about the maximum permitted operating temperature according to the configuration of the VM600 and the type of ventilation used.

If a rack is assembled with empty slots between the processing cards, these should be spaced evenly between positions 3 to 14, inclusive.

In a case where forced ventilation by fan units is used, the airflow must not be less than 480 m^3/h or 280 CFM, and the units must be placed as shown in Figure 8-1.

HAZARDOUS TEMPERATURES CAN EXIST WITHIN AND ON VM600 SYSTEM RACKS (ABE04X).

DEPENDING ON THE AMBIENT OPERATING TEMPERATURE, NUMBER OF CARDS AND POWER SUPPLIES INSTALLED (AND THEIR CONFIGURATION AND OPERATION), THE INSTALLATION AND COOLING (FORCED OR NATURAL VENTILATION), THE TOP OF A VM600 RACK CAN BECOME HOT AND THERE IS THE RISK OF BURNING WHEN HANDLING THE RACK.

SEE ALSO HOT SURFACES AND THE RISK OF BURNING ON PAGE XV.

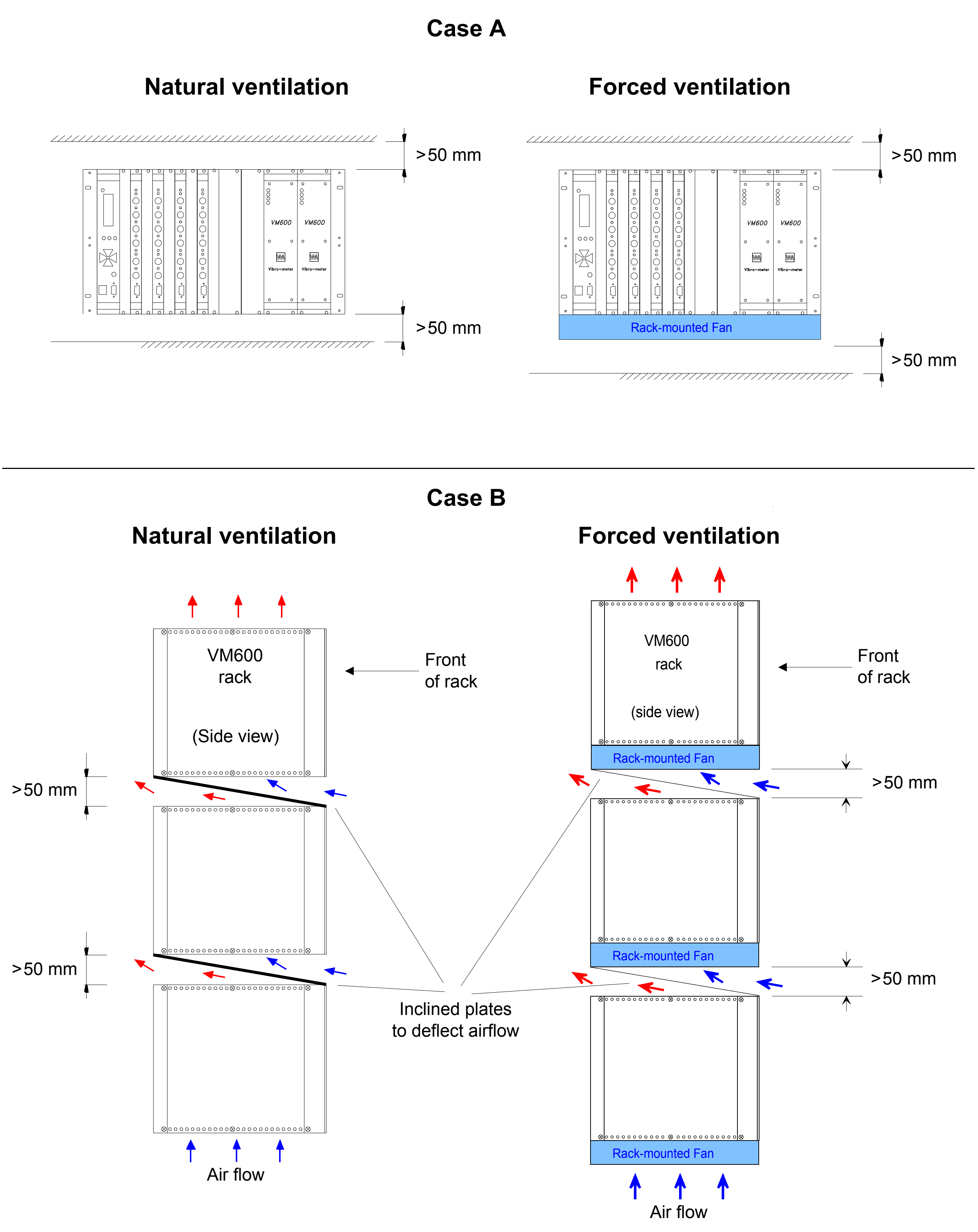


Figure 8-1: Minimum required spacing below, above and between ABE04x racks in an enclosure using natural or forced ventilation

8.3.2 Circuit breaker

In some circumstances the operator must ensure a switch or circuit breaker is provided in order to comply with the IEC/EN 61010-1 standard. This standard stipulates that permanently connected equipment (such as a VM600 ABE04x rack) must employ a switch or circuit breaker in each of the + and − leads, as a means of disconnection from the mains supply in case of an over-current condition.

VM600 racks employing an AC-input version of the RPS6U rack power supply already have an ON/OFF switch or switches (and a fuse or fuses) at the rear of the rack.

However, this is not the case for the DC-input versions of the RPS6U rack power supply, so an appropriately rated external circuit breaker or equivalent must be used.

For a VM600 rack using a DC-input version of the RPS6U rack power supply, the mains power supply lead (power cord) linking the VM600 rack to the mains supply must pass through an external switch or circuit breaker.

The switch or circuit breaker must be installed and used in accordance with the manufacturer's instructions in order to ensure the correct and reliable protection of the VM600 rack.

The switch or circuit breaker shall comply with the IEC 60947-1 and IEC 60947-3 standards.

The switch or circuit breaker shall be identified as the supply switch for the VM600 rack and have the appropriate ON/OFF indications.

The switch or circuit breaker must be chosen in accordance with the version of the DC-input RPS6U rack power supply (DC power module) used, and in particular the maximum permitted input current and output power.

For later versions of the RPS6U (PNR 200-582-x00-02h or later) that define the power as a total maximum output power of 330 W, the recommendations are:
- **A 30 A circuit breaker for an RPS6U rack power supply with a 24 V_{DC} input**
- **A 6 A circuit breaker for an RPS6U rack power supply with a 110 V_{DC} input.**

For earlier versions of the RPS6U (PNR 200-582-x00-01h or earlier) that define the power as a rated power of 300 W, the recommendations are:
- **A 23 A circuit breaker for an RPS6U rack power supply with a 24 V_{DC} input**
- **A 5 A circuit breaker for an RPS6U rack power supply with a 110 V_{DC} input.**

(See 2.9.1 Different versions of the RPS6U rack power supply for further information.)

The operator must have easy access to the switch or circuit breaker at all times.

When thermal fuses are used as a circuit breaker, they must be CSA or UL certified.

8.3.3 Supply wiring

A VM600 rack using the AC-input version of the RPS6U rack power supply is supplied with a mains power supply lead (power cord). Power supply rear panels with two AC inputs for independent mains supplies are supplied with two mains cables. However, no lead (cable) is supplied with a VM600 rack using the DC-input version of the RPS6U.

NOTE: Refer to the *RPS6U rack power supply data sheet* and *VM600 system rack (ABE04x) data sheet* for further information on the mains power supply lead (power cord) supplied with a VM600 rack.

In general, for a VM600 rack, the mains power supply lead (power cord) used must be of sufficient cross-section to meet the power requirements of the connected equipment.

The AC-input rear panels with mains sockets used by VM600 racks have a power entry module that requires temperature derating when a rack operates in environments with temperatures greater than 122°F (50°C). See Appendix A.4 - Temperature derating for the power entry module of a VM600 rack for further information.

For a VM600 rack using an AC-input version of the RPS6U rack power supply, the AC-mains power supply lead (power cord) must meet the following requirements.

For later versions of the RPS6U (PNR 200-582-x00-02h or later) that define the power as a total maximum output power of 330 W, the requirements are:

- **The AC-mains power supply lead shall be rated for 6.4 A_{RMS} minimum current at 113°F (45°C) for an RPS6U using a 115 V_{AC} input.**

For earlier versions of the RPS6U (PNR 200-582-x00-01h or earlier) that define the power as a rated power of 300 W, the requirements are:

- **The AC-mains power supply lead shall be rated for 6 A_{RMS} minimum current at 113°F (45°C) for an RPS6U.**

For all versions of the RPS6U (PNR 200-582-x00-02h and PNR 200-582-x00-01h), additional requirements are:

- **The AC-mains power supply lead should have a maximum length of 3 m.**
- **The AC-mains power supply leads shall be at least no. 16 AWG (1 mm^2) and it shall also conform to the following standards, where applicable:**

  ANSI/UL 817 (USA): Standard for cord sets and power-supply cords.

  CSA C22.2 No. 21 (Canada): Cord sets and power-supply cords.

  IEC 60227: Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V.

  IEC 60245: Rubber insulated cables – Rated voltages up to and including 450/750 V.

  IEC 60799: Requirements for cord sets and interconnection cord sets for household and similar general purpose equipment.

For a VM600 rack using a DC-input version of the RPS6U rack power supply, the DC-mains power supply lead (power cord) must meet the following requirements.

For later versions of the RPS6U (PNR 200-582-x00-02h or later) that define the power as a total maximum output power of 330 W, the requirements are:

- **The DC-mains power supply lead shall be rated for 30 A_{DC} minimum current at 221°F (105°C) for an RPS6U with a 24 V_{DC} input.**
- **The DC-mains power supply lead shall be rated for 6 A_{DC} minimum current at 221°F (105°C) for an RPS6U with a 110 V_{DC} input.**

For earlier versions of the RPS6U (PNR 200-582-x00-01h or earlier) that define the power as a rated power of 300 W, the requirements are:

- **The DC-mains power supply lead shall be rated for 23 A_{DC} minimum current at 221°F (105°C) for an RPS6U with a 24 V_{DC} input.**
- **The DC-mains power supply lead shall be rated for 5 A_{DC} minimum current at 221°F (105°C) for an RPS6U with a 110 V_{DC} input.**

For all versions of the RPS6U (PNR 200-582-x00-02h and PNR 200-582-x00-01h), additional requirements are:

- **The DC-mains power supply lead shall be at least no. 12 AWG (2.5 mm^2) for an RPS6U with a 24 V_{DC} input.**
- **The DC-mains power supply lead shall be at least no. 16 AWG (1 mm^2) for an RPS6U with a 110 V_{DC} input, support 2700 V_{AC} / 1 minute and have a minimum insulation thickness of 0.4 mm.**
- **In the case of the non-detachable DC-mains supply cord, the protective earth wire must be connected first.**
- **The non-detachable DC-mains supply cord has to be mounted using a handler as shown in Figure 8-1.**

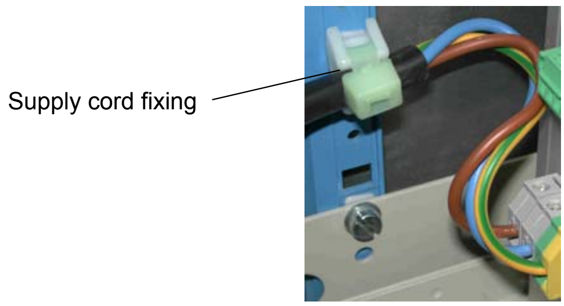


Figure 8-1 : Main supply cord fixing

8.3.4 Connections to supply and other equipment

Before connecting plug terminals to the VM600, the operator must:

Measure the voltage from all hazardous live voltage sources.

Check they are within the permitted operating range.

The measurement chain attached to the VM600 has to be uninterrupted during its usage.

Interruption of the measurement chain is possible after it has been turned off.

8.3.5 Instructions for locating and mounting

A POPULATED VM600 SYSTEM RACK WITH CARDS AND RACK POWER SUPPLIES INSTALLED IS A HEAVY OBJECT.

DEPENDING ON THE NUMBER OF VM600 CARDS AND RPS6U RACK POWER SUPPLIES INSTALLED, A VM600 SYSTEM RACK (ABE04x) CAN BE TOO HEAVY TO LIFT, LOWER OR OTHERWISE HANDLE MANUALLY BY A SINGLE PERSON AND THERE IS THE RISK OF INJURY DURING INSTALLATION OR REMOVAL.

SEE ALSO **HEAVY OBJECTS AND THE RISK OF INJURY ON PAGE XV.**

The positioning of the VM600 shall allow easy access to the on/off switch for the main supply.

A fully equipped VM600 rack can weigh 51 lb (23 kg), so the following instructions apply:

- **Two people are required to carry or mount the VM600 rack in its cabinet.**
- **Shelves, guide rails and other devices used to support a VM600 rack must be strong enough to bear the weight of the rack.**
- **The cabinet should be equipped with the guide rail shown in Figure 8-2, or equivalent.**

The VM600 rack must be mounted securely to a rigid metallic support or cabinet.

This support or cabinet must support a minimum weight of 200 lb (90 kg).

No fluid hose shall be located on the top panel of the VM600.

Instructions for interconnection to other accessories and equipment are given in 8.3.4 Connections to supply and other equipment.

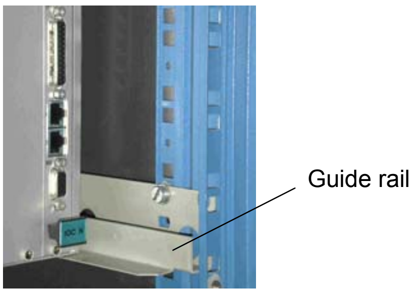


Figure 8-2 : Cabinet guide rail

Inclined plates can be used with a VM600 rack in order to deflect airflow and prevent warm air flowing into a rack. See 8.3.1 Adequate ventilation.

8.4 Installation procedure for cards

Hazardous voltages exist within VM600 system racks (ABE04x).

When an RPS6U rack power supply, associated rear panel or card is removed from a VM600 system rack (ABE04x), the rack backplane – containing hazardous voltages – is exposed and there is the risk of electric shock, as indicated by the use of the following warning label on the equipment:

See also Hazardous voltages and the risk of electric shock on page xv**.**

Hazardous temperatures can exist within and on VM600 system racks (ABE04x).

Depending on the ambient operating temperature, number of cards and power supplies installed (and their configuration and operation), the installation and cooling (forced or natural ventilation), the top of a VM600 rack can become hot and there is the risk of burning handling the rack, as indicated by the use of the following warning label on the equipment:

See also Hot surfaces and the risk of burning on page xv**.**

Operating personnel should remember to observe the handling precautions mentioned in Handling precautions for electrostatic sensitive devices on page xvi **when handling cards.**

Failure to do this may result in cards becoming damaged by electrostatic discharges.

Before inserting a card in the rack, check visually that none of the connector pins are bent.

8.4.1 First-time installation of the MPS

The initial insertion of elements in the ABE04x rack should be done with the rack powered down.

8.4.1.1 Hardware

When a VM600 MPS is installed for the first time, the MPC4 / IOC4T and/or AMC8 / IOC8T card pairs that it contains must be configured according to their intended application.

The IOC4T and IOC8T cards have adjustable hardware elements (micro-switches and jumpers) that have to be set up before insertion in the rack. See 9 Configuration of MPC4 / IOC4T cards and 10 Configuration of AMC8 / IOC8T cards for further information.

NOTE: The elements on the IOC4T and IOC8T cards are normally configured in the factory before delivery of the MPS.

8.4.1.2 Software

A VM600 MPS rack containing MPC4 and/or AMC8 card pairs must be configured using one of the VM600 MPS software packages (MPS1 or MPS2) before the system can be used. This is done once the rack is powered up.

For a stand-alone rack, the configuration can be downloaded from a computer to each MPC4 and/or AMC8 card in turn via an RS-232 link. For a networked rack, the configuration for all MPC4 and/or AMC8 cards can be downloaded in 'one-shot' via an Ethernet link. See 1.3 Communicating with the VM600 MPS for further information.

The majority of parameters are normally configured in the factory before delivery. The user is nevertheless able to modify certain parameters if required using one of the VM600 MPS software packages.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

8.4.2 Subsequent installation of cards ("hot-swapping" capability)

For a networked rack (that is, a rack containing a CPUM card and, optionally, its associated IOCN card), the behaviour of the CPUM card after it detects a change of configuration for an MPC4 or AMC8 card – for example, after the hot swap of a card or the reconfiguration of an individual card via an RS-232 link – depends on:

- The version of the CPUM card's firmware.
- And for CPUM firmware version 067 or later – the setting of the CPUM's "configuration master" parameter.

See also 8.4.2.6.3 Cards in a stand-alone rack and 8.4.2.6.4 Cards in a networked rack.

8.4.2.1 CPUM cards running firmware version 066 or earlier

In a networked rack, how the CPUM running firmware version 066 or earlier reacts after it detects a change of configuration for a card is always the same, as the CPUM is always the configuration master:

- When this version of the CPUM detects a change of configuration for an MPC4 or AMC8 card, the CPUM will use the configuration for the card stored in the CPUM's non-volatile memory to reconfigure the card. That is, in the case of a configuration conflict, the CPUM's copy of the card's configuration is the master.

8.4.2.2 CPUM cards running firmware version 067 or later

In a networked rack, how the CPUM running firmware version 067 or later reacts after it detects a change of configuration for a card is determined by the setting of the CPUM's configuration master parameter, as shown in Figure 8-3.

The CPUM's configuration master parameter selects one of two modes of operation:

- If VM600 cards (MPC4 and AMC8) are set as the configuration master, when the CPUM detects a change of configuration for a card, the CPUM will read the configuration from the card and save it in the CPUM's non-volatile memory for future use. That is, in the case of a configuration conflict, the card's own copy of its configuration is the master.
- If the CPUM card is set as the configuration master, when the CPUM detects a change of configuration for a card, the CPUM will use the configuration for the card stored in the CPUM's non-volatile memory to reconfigure the card. That is, in the case of a configuration conflict, the CPUM's copy of the card's configuration is the master.

NOTE: By default, the configuration master parameter for CPUM cards running firmware version 067 or later is set to VM600 cards (MPC4 and AMC8).

For example, in a networked VM600 rack with a CPUM card running firmware version 067, the default behaviour is that VM600 cards are the configuration master. In such a rack, if an MPC4 or AMC8 card's configuration is changed using the RS-232 link on the panel of the card or a card is replaced by another card of the same type with a different configuration (keeping the same slot number), and the power supply to the rack is turned off and then turned on, then the card's configuration will remain the "new" configuration (see Figure 8-3).

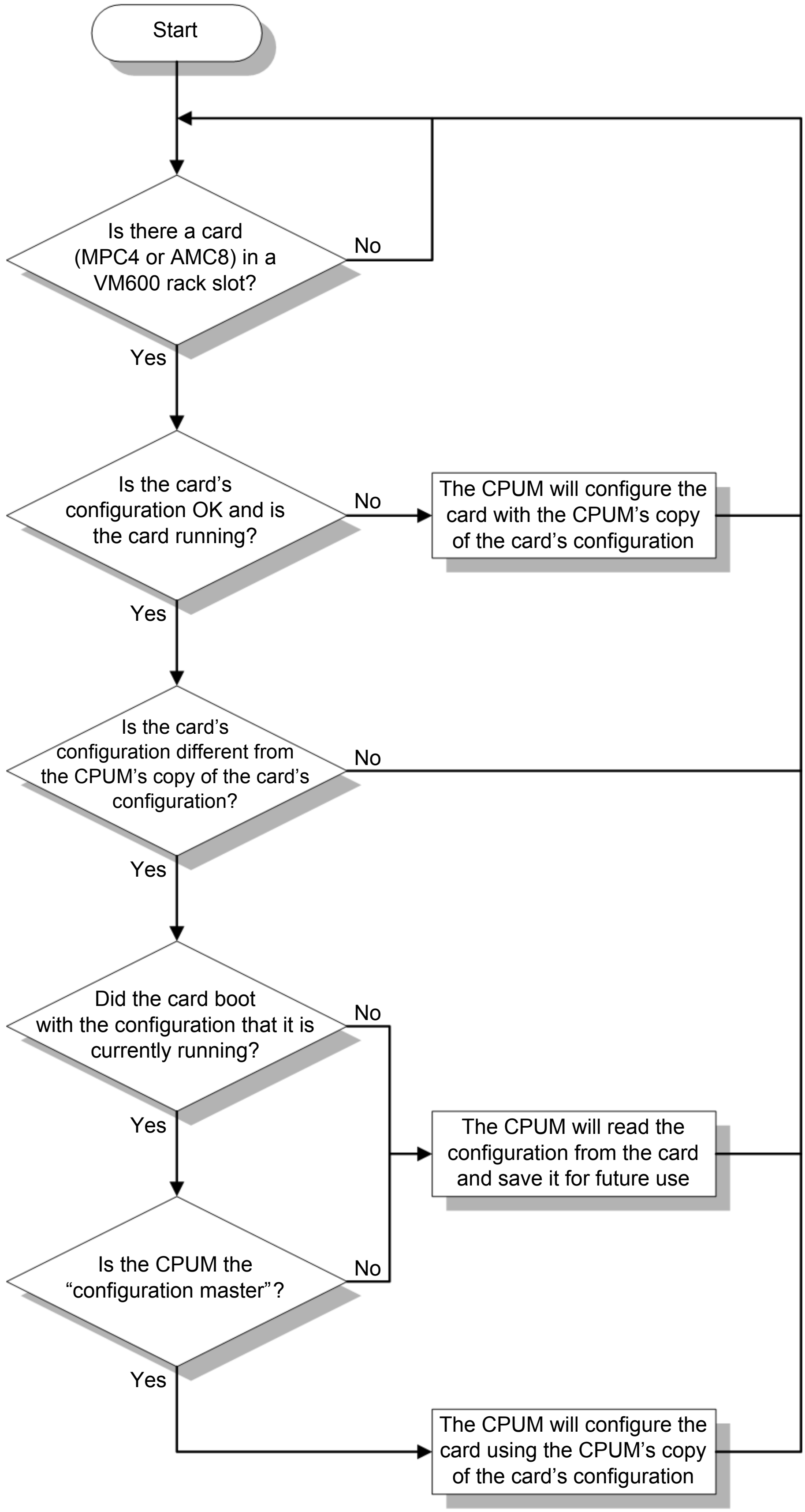


Figure 8-3: Hot-swap behaviour for a networked VM600 rack with CPUM firmware version 067 or later

8.4.2.3 Hot swapping a card in the front of a VM600 rack

The procedure for hot swapping a card in the front of a VM600 rack is as follows.

In the front of the rack:

1- Disconnect the external cables connected to the card, if any.

2- Remove the card from the rack (see 13.6.2 Replacing a suspect card).

3- Insert the replacement card in the front of the rack.

4- Reconnect any cables to the card.

8.4.2.4 Hot swapping a card in the rear of a VM600 rack

⚠ **Before "hot swapping" a card in the rear of a VM600 rack, any associated processing card in the corresponding slots in the front of the rack must be disconnected from the rack's backplane.**

See 13.6.2 Replacing a suspect card.

The procedure for hot swapping a card in the rear of a VM600 rack is as follows.

First, in the front of the rack:

1- Remove any associated processing card in the corresponding slot in the front of the rack from the rack's backplane.

Then, in the rear of the rack:

2- Disconnect all external cables connected to the card.

3- Remove the card from the rear of the rack (see 13.6.2 Replacing a suspect card).

4- Insert the replacement card in the rear of the rack.

5- Reconnect all of the cables to the card.

Finally, in the front of the rack:

6- Reinsert the associated processing card in the corresponding slot in the front of the rack (to the rack's backplane).

8.4.2.5 Which card types can be hot swapped?

It is necessary to power down the ABE04x rack before inserting or removing any of the following elements:

- CPUM
- RPS6U, in racks employing a single power supply.

The following elements have "hot swapping" capability, that is, they can be removed from and inserted into the MPS rack while it is powered up (a technique sometimes referred to as "live insertion"):

- MPC4 and its associated IOC4T card (see 8.4.2.6 Hot swapping MPC4 and AMC8 cards)
- AMC8 and its associated IOC8T card (see 8.4.2.6 Hot swapping MPC4 and AMC8 cards)
- RLC16
- RPS6U.

  A single RPS6U rack power supply can be replaced in racks employing two such power supplies to support rack power supply redundancy (see 2.9.5 Racks with two RPS6U rack power supplies in order to support rack power supply redundancy).

8.4.2.6 Hot swapping MPC4 and AMC8 cards

8.4.2.6.1 General remarks on MPC4 / IOC4T and AMC8 / IOC8T card pairs

The configuration of an MPC4 card and its associated IOC4T, or an AMC8 card and its associated IOC8T is specific to a given slot in the rack. It depends on the type of transducer and signal conditioner connected, as well as the desired signal routing to other cards (for example, for the control of relays on an RLC16 card).

The MPC4 and AMC8 cards each contain a flash memory that is used to store the configuration for a given slot in the rack. The memory also contains the intended slot for the card (for example, slot *nn*).

Problems can occur if an MPC4 / IOC4T or AMC8 / IOC8T card configured for slot *mm* is installed in slot *nn*. Hardware damage can occur either to the card itself or to transducers and/or signal conditioners in the measuring chain.

To avoid damage occurring when swapping these cards, carefully read 8.4.2.6.3 Cards in a stand-alone rack and 8.4.2.6.4 Cards in a networked rack.

In general, careless “hot swapping" of IOC4T or IOC8T cards can lead to measurement errors or incorrect functioning of relays.

All screws on removable boards and panels must be tightened. To remove these modules, a no. 0 or no. 1 screwdriver is required.

8.4.2.6.2 Instructions for replacing IOC and relay cards

Access to these removable cards, on the back panel of the VM600, is only permitted for maintenance.

8.4.2.6.3 Cards in a stand-alone rack

NOTE: The following remarks concern stand-alone racks. These do not contain a CPUM card are not connected to a network.

As stated in 8.4.2.6.1 General remarks on MPC4 / IOC4T and AMC8 / IOC8T card pairs, hardware damage can occur if a card intended for slot *mm* is inserted in slot *nn*.

Because of this, a new MPC4 or AMC8 card must only be installed "live" and without reconfiguration if its configuration is known to be identical to that of the card previously removed.

See 8.4.2.6.5 Reading the configuration of a card for further information.

8.4.2.6.4 Cards in a networked rack

NOTE: The following remarks concern networked racks. These contain a CPUM card (and, optionally, its associated IOCN card) and are connected to a network.

For a networked rack, if a card originally used in slot *mm* is inserted in slot *nn*, the CPUM card recognises that the card’s configuration does not match the slot.

The behaviour of the CPUM card after it detects a change of configuration for a card depends on:

- The version of the CPUM card's firmware.
- And for CPUM firmware version 067 or later – the setting of the CPUM's configuration master parameter.

See 8.4.2.1 CPUM cards running firmware version 066 or earlier and 8.4.2.2 CPUM cards running firmware version 067 or later for further information.

Problems can occur if a card taken from slot *nn* of rack x is inserted into slot *nn* of rack y, as slot *nn* can be used for totally different functions in each rack.

This form of hot swapping should be avoided unless you are certain that the cards in slot *nn* of each rack have exactly the same configuration.

More generally, if you do not know how a card is configured, you should not install it before finding its configuration as stated in 8.4.2.6.5 Reading the configuration of a card.

8.4.2.6.5 Reading the configuration of a card

The following procedure can be used:

1- Disconnect the front-end components (that is, transducer, signal conditioner, probe and cables) from the rack by unfastening the connectors on the IOC4T or IOC8T card installed in slot *nn*.

2- Insert into slot *nn* the MPC4 or AMC8 card whose configuration you want to read.

3- Use the VM600 MPS software to read the configuration of the card in slot *nn* (see example in Figure 8-4, in which the card in slot 3 is selected).

4- Modify the card configuration if necessary using the VM600 MPSx software.

5- Reconnect the front-end components to the connectors on the IOC4T or IOC8T card installed in slot *nn*.

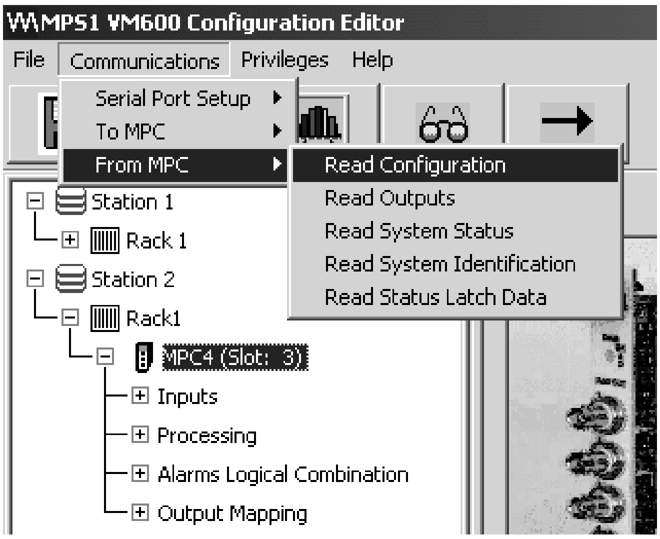


Figure 8-4: VM600 MPS software menu bar commands used to read the configuration of a card

8.4.3 Setting the IP address of the CPUM card

The IP address of the CPUM must be defined for networked racks.

Each CPUM is given the IP address of 10.10.56.56 in the factory before delivery of the MPS system. However, it is strongly recommended to change this IP address, which is done using a VT100 terminal (or emulator from the Windows environment).

NOTE: Refer to the *VM600 networking manual* for further information.

9 CONFIGURATION OF MPC4 / IOC4T CARDS

This chapter describes the connectors on the IOC4T card. These are accessed from the rear of a VM600 MPS rack.

Typical connection diagrams are included for measurement signal sensors (such as accelerometers and proximity probes) and speed signal sensors.

Information is also given on attributing specific alarm signals to specific relays on RLC16 cards, and using the Open Collector Bus and the Raw Bus.

9.1 Definition of screw terminals on the IOC4T card

The IOC4T panel (rear of rack) contains three terminal strips, identified as J1, J2 and J3 (see Figure 9-1). Each strip consists of a socket and a mating connector, which contains 16 screw terminals. The screw terminals can accept wires with a cross section of ≤1.5 mm^2.

The mating connectors are labelled “SLOT xx Jn” (where xx is the slot number and Jn = J1, J2 or J3) to enable the connector to be matched to the correct socket of the correct card.

Each socket and mating connector can be equipped with a mechanical key system to prevent incorrect connection.

Further details on these screw terminal contacts can be found in Table 9-1.

Table 9-1: Definition of terminals for J1, J2 and J3 on the IOC4T card

Terminal	Name	Definition
Connector J1		
1	PS	Measurement channel 1, power supply contact
2	HI	Measurement channel 1, differential signal input (high)
3	LO	Measurement channel 1, differential signal input (low)
4	SHIELD	Measurement channel 1, shield contact
5	PS	Measurement channel 2, power supply contact
6	HI	Measurement channel 2, differential signal input (high)
7	LO	Measurement channel 2, differential signal input (low)
8	SHIELD	Measurement channel 2, shield contact
9	PS	Measurement channel 3, power supply contact
10	HI	Measurement channel 3, differential signal input (high)
11	LO	Measurement channel 3, differential signal input (low)
12	SHIELD	Measurement channel 3, shield contact
13	PS	Measurement channel 4, power supply contact
14	HI	Measurement channel 4, differential signal input (high)
15	LO	Measurement channel 4, differential signal input (low)
16	SHIELD	Measurement channel 4, shield contact

Table 9-1: Definition of terminals for J1, J2 and J3 on the IOC4T card (continued)

Terminal	Name	Definition
Connector J2		
1	PS	Tacho channel 1, power supply contact
2	HI	Tacho channel 1, differential signal input (high)
3	LO	Tacho channel 1, differential signal input (low)
4	SHIELD	Tacho channel 1, shield contact
5	PS	Tacho channel 2, power supply contact
6	HI	Tacho channel 2, differential signal input (high)
7	LO	Tacho channel 2, differential signal input (low)
8	SHIELD	Tacho channel 2, shield contact
9	RL1	Contact of relay RL1
10	RL1	Contact of relay RL1
11	RL2	Contact of relay RL2
12	RL2	Contact of relay RL2
13	RL3	Contact of relay RL3
14	RL3	Contact of relay RL3
15	RL4	Contact of relay RL4
16	RL4	Contact of relay RL4
Connector J3		
1	DC OUT 1	Processed DC output for measurement channel 1 (0 to 10 V or 4 to 20 mA)
2	DC OUT 2	Processed DC output for measurement channel 2 (0 to 10 V or 4 to 20 mA)
3	DC OUT 3	Processed DC output for measurement channel 3 (0 to 10 V or 4 to 20 mA)
4	DC OUT 4	Processed DC output for measurement channel 4 (0 to 10 V or 4 to 20 mA)
5	TM	Trip Multiply input (control line)
6	DB	Danger Bypass input (control line)
7	AR	Alarm Reset input (control line)
8	RET	Return line for TM, DB, AR and DC OUT n

Table 9-1: Definition of terminals for J1, J2 and J3 on the IOC4T card (continued)

Terminal	Name	Definition
9	RAW 1H	High line of differential output corresponding to the raw signal for measurement channel 1
10	RAW 1L	Low line of differential output corresponding to the raw signal for measurement channel 1
11	RAW 2H	High line of differential output corresponding to the raw signal for measurement channel 2
12	RAW 2L	Low line of differential output corresponding to the raw signal for measurement channel 2
13	RAW 3H	High line of differential output corresponding to the raw signal for measurement channel 3
14	RAW 3L	Low line of differential output corresponding to the raw signal for measurement channel 3
15	RAW 4H	High line of differential output corresponding to the raw signal for measurement channel 4
16	RAW 4L	Low line of differential output corresponding to the raw signal for measurement channel 4

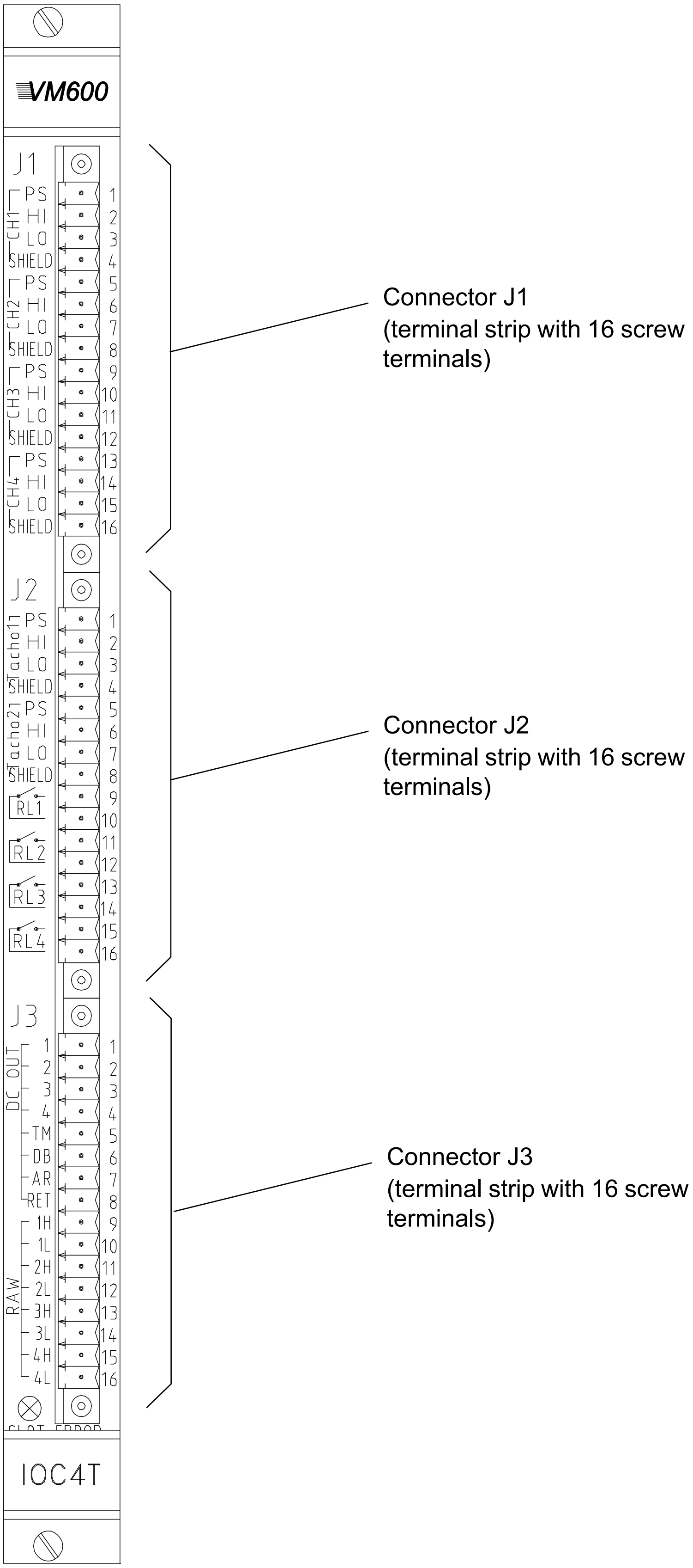


Figure 9-1: View of IOC4T card showing definition of terminals

9.2 Connecting vibration and pressure sensors

The IOC4T panel has four screw terminals for each of the four measurement channels. These terminals are as follows:

PS	Power supply for transducer or signal conditioner.
HI LO	Differential input for the signal.
SHIELD	Terminal for connecting the shield of the transmission cable.

This section contains a description of the measurement channel inputs and includes typical connection diagrams.

The MPC4 / IOC4T card pair can be used to power sensors having built-in or integrally attached signal conditioners, providing the current requirement is ≤25 mA. In cases where this built-in power supply capability is insufficient, an external power supply must be used. Table 9-2 shows when this is necessary.

Table 9-2: Use of an internal (MPC4) or external power supply for various types of sensors

Transducer or transducer and signal conditioner	Output signal	Rating	Supplied by	Connection diagram
Accelerometers and velocity transducers				
2-wire constant current power supply (CE680 or competitor product)	1 V to 20 V	2 to 20 mA (18 to 30 V_{DC})	MPC4 / IOC4T	Figure 9-6
CE1xx and CE3xx	5 mA ±2 mA	12 to 18 V_{DC}	MPC4 / IOC4T	Figure 9-5
SE120	12 mA ±8 mA	+15 to +36 V_{DC}	MPC4 / IOC4T	Figure 9-5
CAxxx + IPC704 (2-wire, current mode)	12 mA_{DC} / 5 mA_{AC}	+18 to 30 V_{DC}, 25 mA	MPC4 / IOC4T	Figure 9-5
CAxxx + IPC704 (3-wire, voltage mode)	+7.5 V_{DC} / 5 V_{AC}	+18 to 30 V_{DC}, 25 mA	MPC4 / IOC4T	Figure 9-4
CV210 + IVC632	Current modulation: 12 mA ±5 mA	−15 to −30 V_{DC} I_{max} ≤17 mA	MPC4 / IOC4T	Figure 9-5
	Voltage modulation: −7.5 V_{DC} ±5 V_{AC}	I_{max} ≤6 mA	MPC4 / IOC4T	Figure 9-4
Velocity transducers such as CV210 or competitor product	AC only	N/A	N/A	Figure 9-7
CAxxx + IPCxxx with GSI127	7 V_{DC} ±5 V_{AC}	+24 V_{DC} ±10%, 100 mA	External supply	Figure 9-8
CAxxx + IPCxxx with GSI124	7 V_{DC} ±5 V_{AC}	+24 V_{DC} ±10%, 60 mA	External supply	Figure 9-9
CExxx with GSI124	7 V_{DC} ±2 V_{AC}	+24 V_{DC} ±10%, 60 mA	External supply	Figure 9-9
Displacement probes				
TQ4xx + IQS45x	Voltage output: 0 to −20 V	−20 to −32 V	MPC4 / IOC4T	Figure 9-4
	Current output: 15 to 20 mA	25 mA max.	MPC4 / IOC4T	Figure 9-5
TQxxx + IQSxxx with GSI127	Voltage output: 0 to −20 V	−24 V_{DC} ±10%, 125 mA	External supply	Figure 9-8
TQxxx + IQSxxx with GSI124	Voltage output: 0 to −20 V	−24 V_{DC} ±10%, 85 mA	External supply	Figure 9-9

Table 9-2: Use of an internal (MPC4) or external power supply for various types of sensors (continued)

Transducer or transducer and signal conditioner	Output signal	Rating	Supplied by	Connection diagram
LS12x + ILS73x	Voltage output: 0 to 10 V	18 to 30 V_{DC}	External supply	Figure 9-11
	Current output: 4 to 20 mA	170 mA (600 mA start-up current)	External supply	Figure 9-12
Displacement transducers				
AE119	4 to 12 mA for 50 mm. 4 to 20 mA full scale.	+20 to +30 V_{DC} max. 60 mA	External supply	Figure 9-12
Pressure sensors				
CP1xx + IPC704	12 mA ±5 mA	+18 V_{DC} ±10%, I_{max} ≤17 mA	External supply	Figure 9-5

9.2.1 General considerations

The IOC4T circuitry associated with the PS, HI, LO and SHIELD terminals (see Figure 9-3) is configurable using the VM600 MPS software. More specifically, the fields in the property sheets for the **Measurement Channels** node (a child of the **Inputs** node) in the tree structure (left) are used to configure switches Sw1 and Sw2 automatically and appropriately for a variety of applications and different types of transducer and/or signal conditioner (see Figure 9-2).

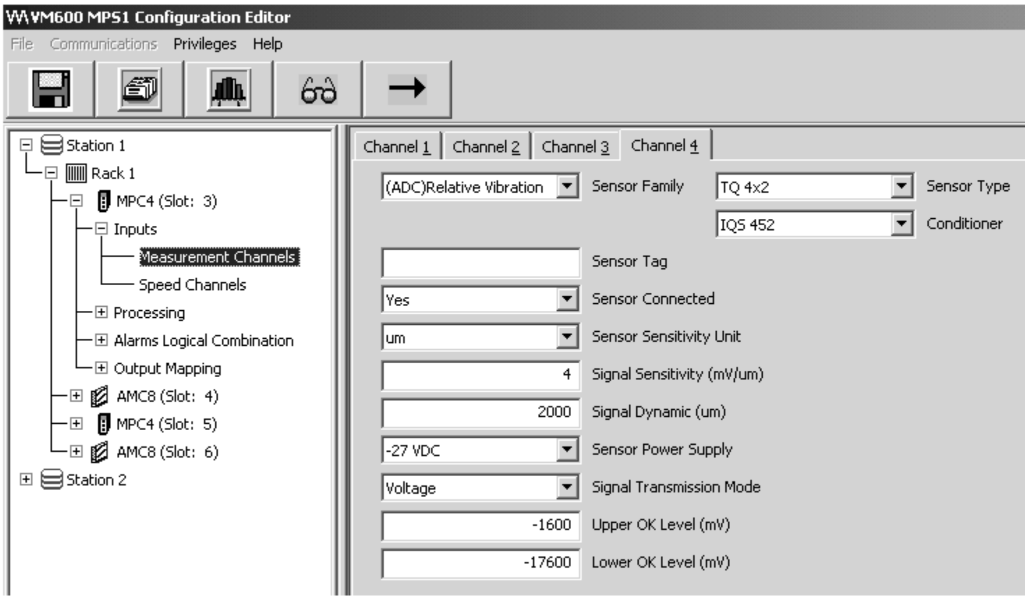


Figure 9-2: The Inputs (parent) and Measurement Channels (child) nodes in the MPS1 software

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Switch Sw1 is set according to whether a voltage-modulated or a current-modulated signal is provided by the transducer or transducer and signal conditioner system:

- Voltage-modulated signal: Sw1 open.
- Current-modulated signal: Sw1 closed.

The position of Sw1 is determined by the setting of the **Signal Transmission Mode** field (see Figure 9-2). The correct setting (current or voltage) is chosen automatically by the program when standard transducers and signal conditioners from Meggitt Sensing Systems' Vibro-Meter product line are selected (using the **Sensor Type** and **Conditioner** fields). For non-Vibro-Meter devices, the operator must enter the appropriate setting (current or voltage) in the **Signal Transmission Mode** field.

Switch Sw2 is used to connect the IOC4T card's sensor power supply to either the PS or the HI terminal.

The position of Sw2 is determined by the setting of the **Sensor Power Supply** field (see Figure 9-2). The correct setting is chosen automatically when standard transducers and signal conditioners from Meggitt Sensing Systems' Vibro-Meter product line are selected (using the **Sensor Type** and **Conditioner** fields). For non-Vibro-Meter devices, the operator must enter the appropriate setting in the **Sensor Power Supply** field. The option **No Supply** sets Sw2 to position 2. Any other option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**) sets Sw2 to position 1.

The **Sensor Connected** field has no direct influence on the setting of Sw1 and Sw2. The field can be considered as a comment for the user. When it is set to "No", the other fields in this VM600 MPS software window will be unavailable (that is, appear greyed out), but the values and settings will still be effective.

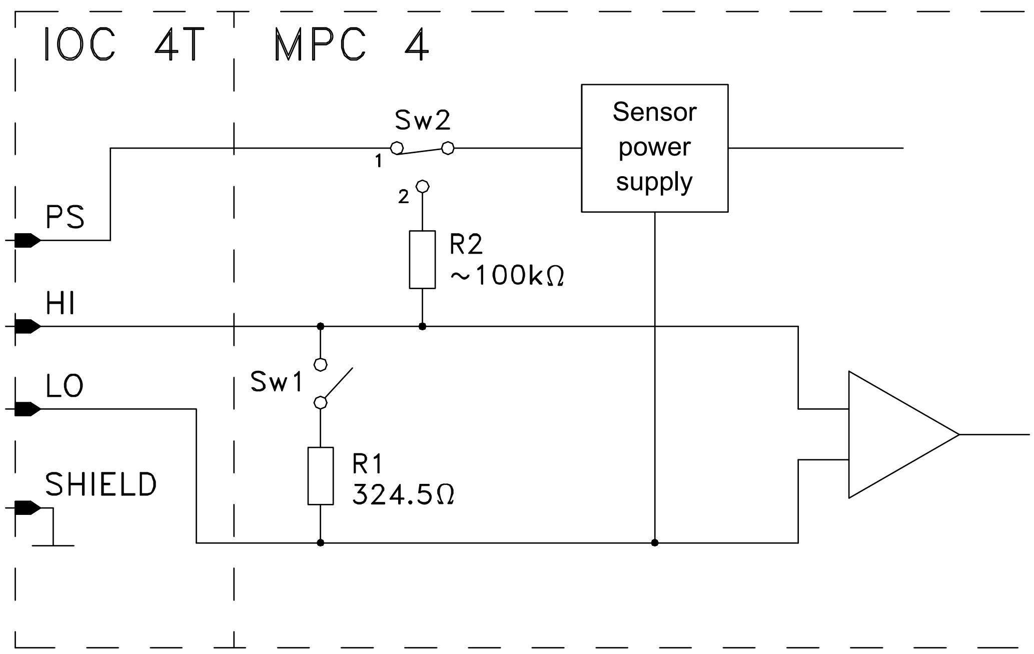


Figure 9-3: Circuitry associated with measurement channel inputs

NOTE: For all devices (Meggitt Sensing Systems' Vibro-Meter products and competitor products), the **Sensor Power Supply** field has to be set to one of the voltage values (**No Supply**, **+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**). Any one of these settings can be chosen.

9.2.2 Connection diagrams for hardware powered by IOC4T / MPC4

9.2.2.1 Voltage-modulated signal

Applies to the following transducers or transducer and signal conditioner systems:

- CV210 + IVC632
- TQ4xx + IQS45x
- CAxxx + IPC704 (3-wire, voltage modulation).

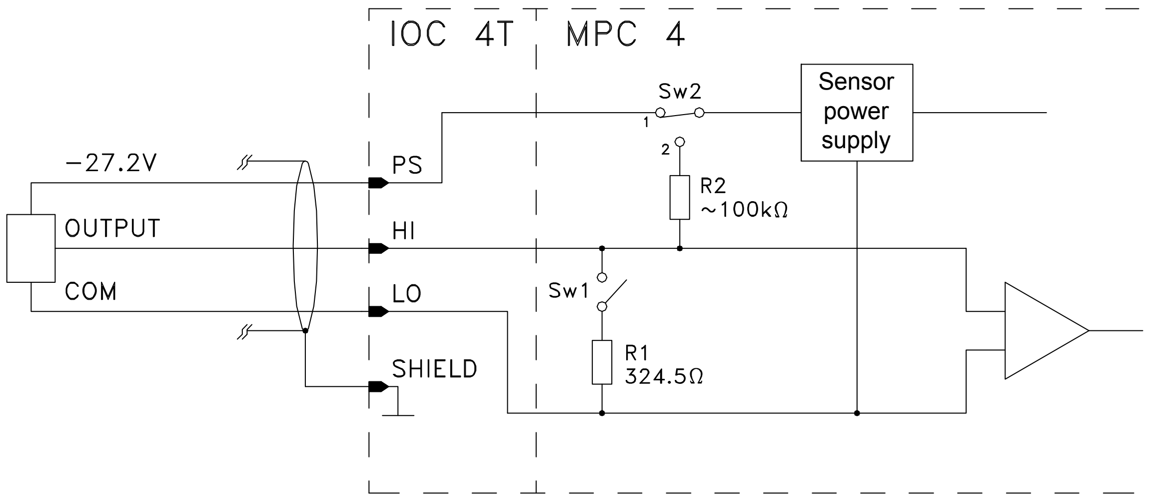


Figure 9-4: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 is set to position 1 to connect the IOC4T card's sensor power supply to the PS terminal.
For non-Vibro-Meter devices, the **Sensor Power Supply** field has to be set to the appropriate voltage powered option (**+27 VDC**, **−27 VDC** or **+15 VDC**).

3- The required power supply for the IPC704 is +27.2 V.

9.2.2.2 Current-modulated signal

Applies to the following transducers or transducer and signal conditioner systems:

- CAxxx + IPC704 (2-wire, current modulation)
- CE1xx
- CE3xx
- CPxxx + IPC704 (2-wire, current modulation, Note: This setup is not recommended)
- CV210 + IVC632 (PS = −27.2 V, HI = COM)
- SE120
- TQ4xx + IQS45x (PS = −27.2 V, HI = COM).

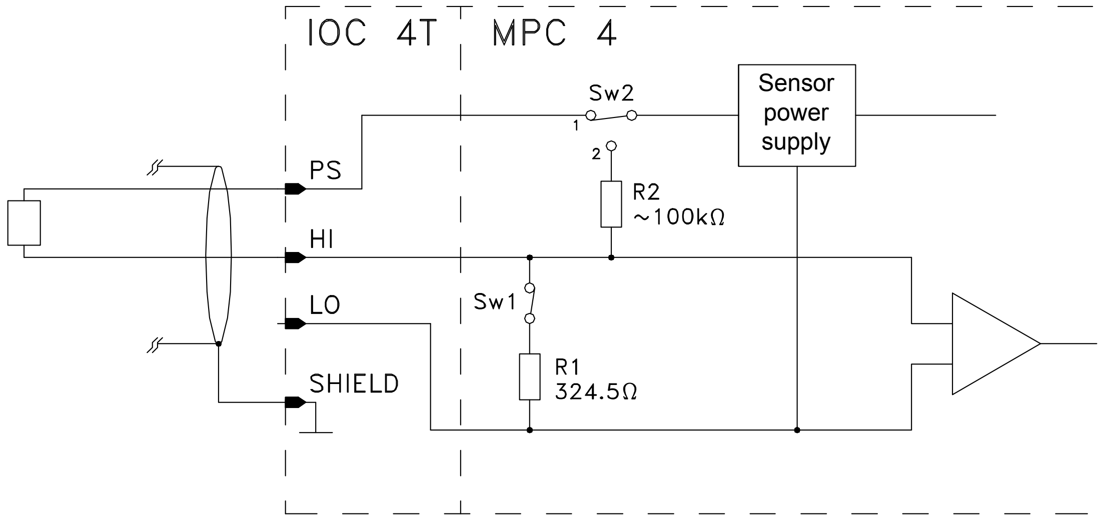


Figure 9-5: Connection diagram

Notes

1- Switch Sw1 is closed to allow current-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Current option.

2- Switch Sw2 is set to position 1 to connect the IOC4T card's sensor power supply to the PS terminal.
For non-Vibro-Meter devices, the **Sensor Power Supply** field has to be set to the appropriate voltage (**+27 VDC**, **−27 VDC** or **+15 VDC**).

9.2.2.3 Constant current power supply and voltage-modulated signal

Applies to the following transducers:

- CE6xx.

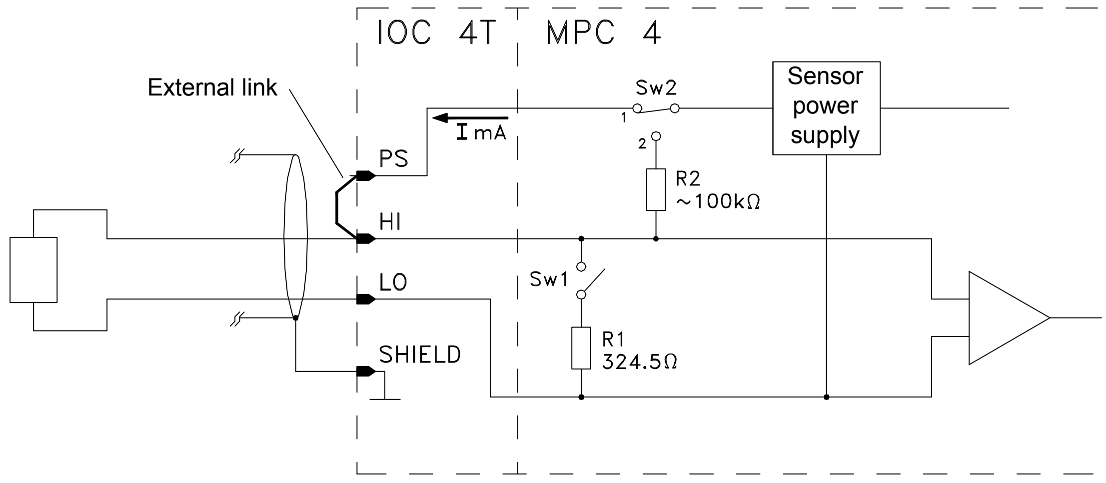


Figure 9-6: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 is set to position 1 to connect the IOC4T card's sensor power supply to the PS terminal.
For non-Vibro-Meter devices, the **Sensor Power Supply** field has to be set to a current option.

3- An external link must be made between the PS and HI terminals.

4- The standing current value is 6.16 mA.

9.2.3 Connection diagrams for unpowered hardware

9.2.3.1 Voltage-based signal

Applies to the following transducers:

- CV213 and CV214 velocity transducers.

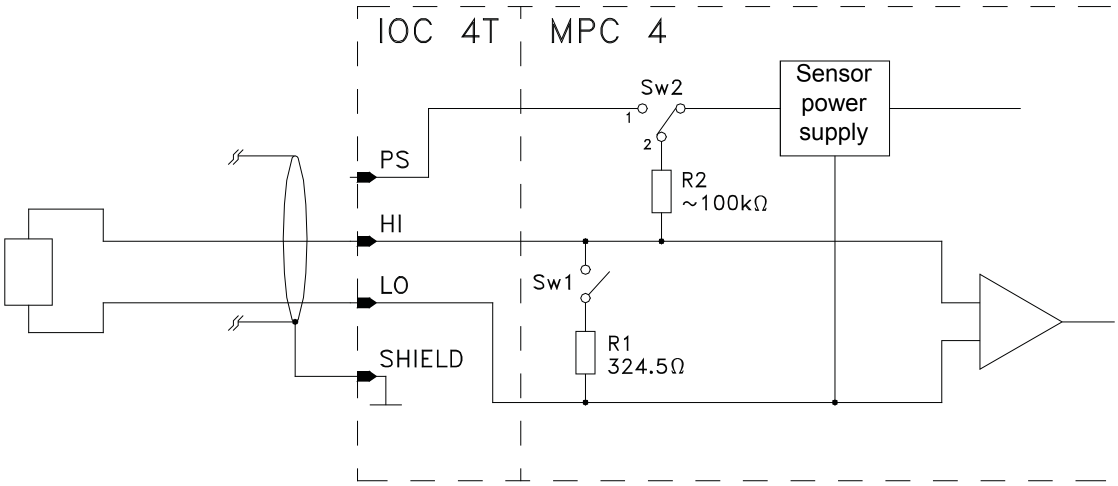


Figure 9-7: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-based signals to be processed.

For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 can be set to position 1 or position 2 depending on the application:

- When switch Sw2 is set to position 1, the OK system check will not detect an open circuit condition at the input to the card due to a faulty sensor or cabling (see 4.7.1 OK system checking).
- When switch Sw2 is set to position 2, the OK system check will work normally. However, the accuracy of the measurement on the channel will be affected as the current flowing through the resistor R2 (100 kΩ) will introduce an error.

See 9.2.1 General considerations for information on how the set the position of Sw2.

9.2.4 Connection diagrams for externally powered hardware

9.2.4.1 Voltage-modulated signal with GSI127 galvanic separation unit

Applies to the later versions of the following transducers or transducer and signal conditioner systems:

- CAxxx + IPC704 + GSI127 galvanic separation unit
- CE1xx + GSI127 galvanic separation unit
- CE3xx + GSI127 galvanic separation unit
- CPxxx + IPC704 + GSI127 galvanic separation unit
- TQ4xx + IQS45x + GSI127 galvanic separation unit.

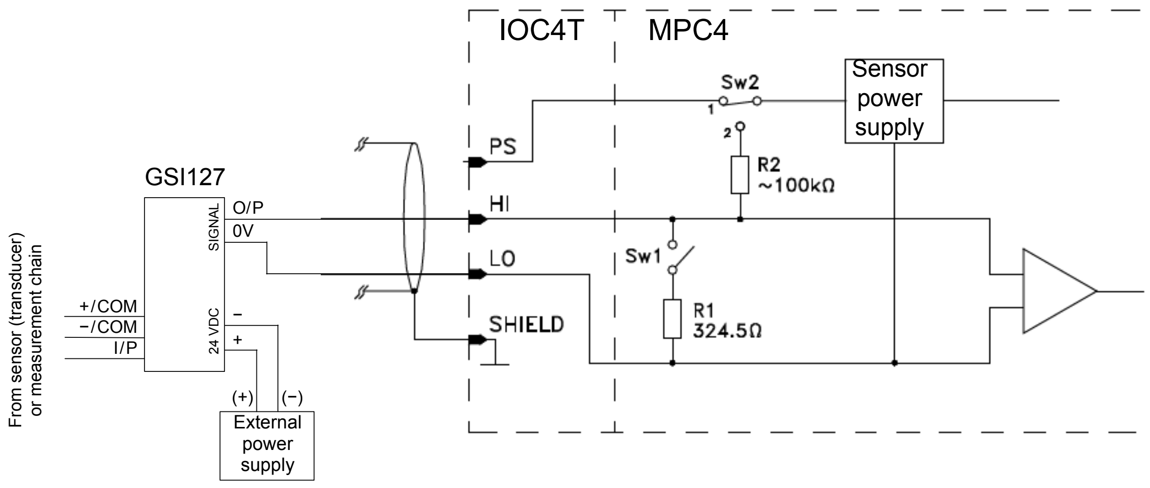


Figure 9-8: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the **Voltage** option.

2- Switch Sw2 must be set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.
The **Sensor Power Supply** field can be set to any option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**).

NOTE: Do not set the **Sensor Power Supply** field to **No Supply**. This option is reserved for unpowered sensors and will cause Sw2 to go to position 2, thus putting 27.2 V on the HI terminal.

3- The operator must connect an external power supply to terminals "24 VDC +" and "24 VDC −" of the GSI127 galvanic separation unit.

NOTE: More detailed information on connecting equipment to an electronic monitoring system can be found in the project-specific wiring diagram delivered with the system or by referring to the electrical connections (wiring diagrams) section of the appropriate sensors and signal conditioners installation manual.

9.2.4.2 Voltage-modulated signal with GSIxxx galvanic separation unit

Applies to the earlier versions of the following transducers or transducer and signal conditioner systems:

- CAxxx + IPC704 + GSIxxx galvanic separation unit
- CE1xx + GSIxxx galvanic separation unit
- CE3xx + GSIxxx galvanic separation unit
- CPxxx + IPC704 + GSIxxx galvanic separation unit
- TQ4xx + IQS45x + GSIxxx galvanic separation unit.

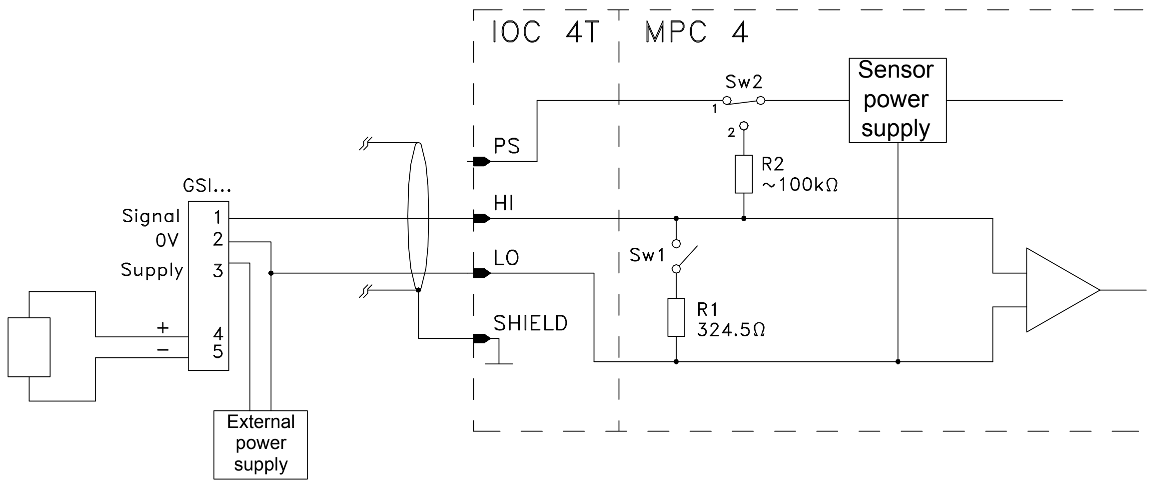


Figure 9-9: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.

The **Signal Transmission Mode** field has to be set to the **Voltage** option.

2- Switch Sw2 must be set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.

The **Sensor Power Supply** field can be set to any option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**).

NOTE: Do not set the **Sensor Power Supply** field to **No Supply**. This option is reserved for unpowered sensors and will cause Sw2 to go to position 2, thus putting 27.2 V on the HI terminal.

3- The operator must connect an external power supply to terminals 2 and 3 of the GSIxxx galvanic separation unit.

9.2.4.3 Voltage-modulated signal with power supply and safety barrier unit

Applies to the following transducers or transducer and signal conditioner systems:

TQ4xx + IQS45x + GSVxxx power supply and safety barrier unit.

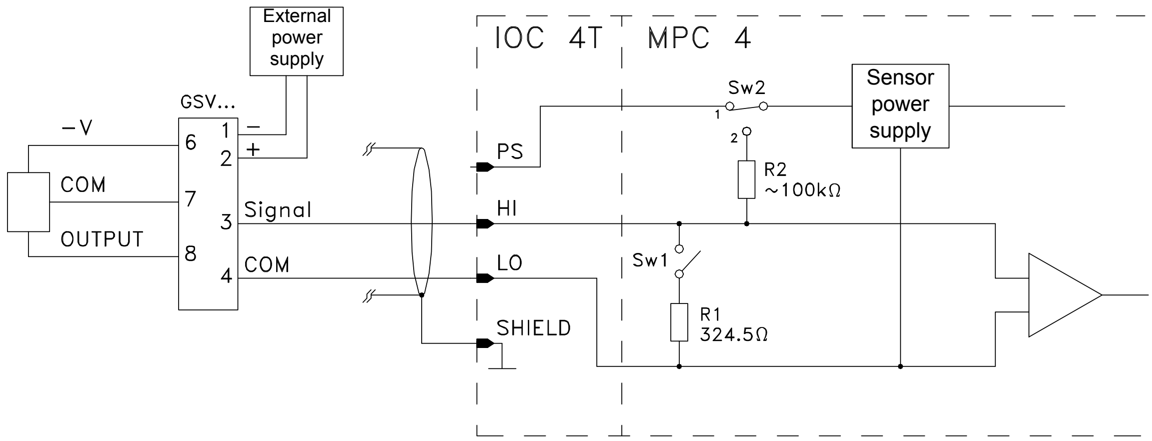


Figure 9-10: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 is set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.
The **Sensor Power Supply** field can be set to any powered option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**) but should preferably be set to **+6.16 mA**.

3- The operator must connect an external power supply to terminals 1 and 2 of the GSVxxx power supply and safety barrier unit.

9.2.4.4 Voltage-modulated signal without galvanic separation unit

Applies to the following transducers or transducer and signal conditioner systems:

- LS12x + ILS73x (HI => MIN. GAP 0 to 10 V, LO => COM).

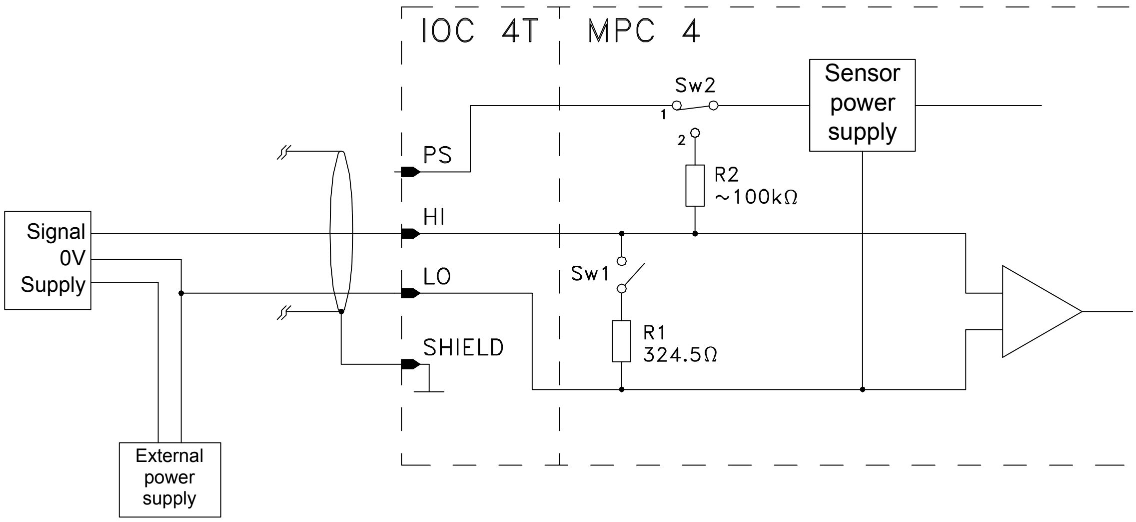


Figure 9-11: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 is set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.
The **Sensor Power Supply** field can be set to any powered option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**) but should preferably be set to **+6.16 mA**.

3- The operator must connect an external power supply to the transducer or transducer and signal conditioner.

9.2.4.5 Current-modulated signal

Applies to the following transducers or transducer and signal conditioner systems:

- AE119
- LS12x + ILS73x (HI => MIN. GAP 4 to 20 mA, LO => COM).

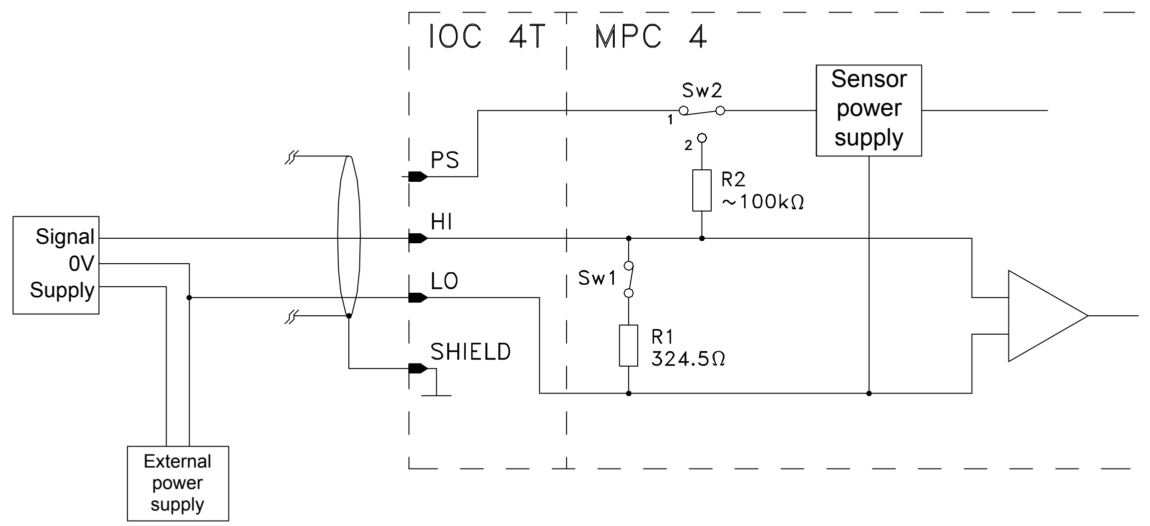


Figure 9-12: Connection diagram

Notes

1- Switch Sw1 is closed to allow current-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Current option.

2- Switch Sw2 is set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.
the **Sensor Power Supply** field can be set to any powered option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**) but should preferably be set to **+6.16 mA**.

3- The operator must connect an external power supply to the transducer or transducer and signal conditioner.

9.2.5 Connection diagram for frequency generator

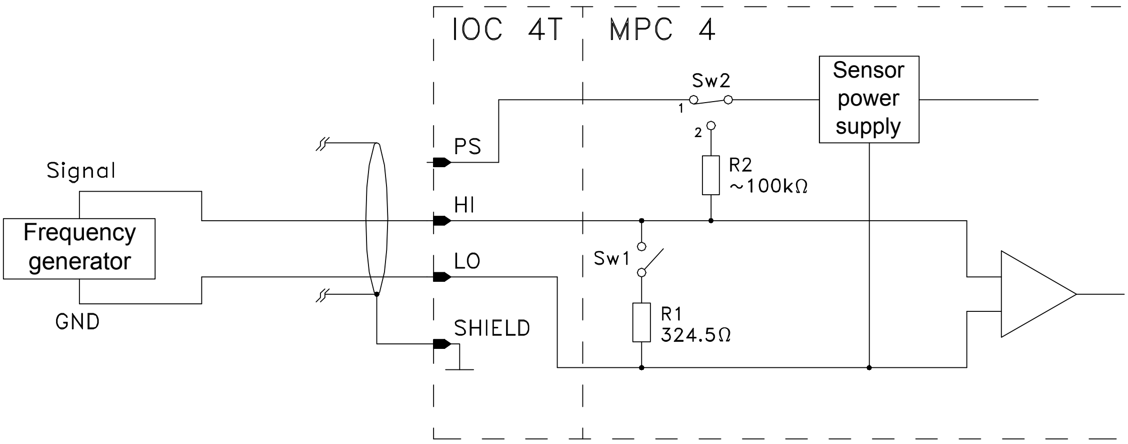


Figure 9-13: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.

The **Signal Transmission Mode** field has to be set to the Voltage option.

2- Switch Sw2 is set to position 1. This connects the IOC4T card's sensor power supply to the PS terminal, though in fact this terminal is not used.

the **Sensor Power Supply** field can be set to any powered option (**+27 VDC**, **−27 VDC**, **+15 VDC** or **+6.16 mA**) but should preferably be set to **+6.16 mA**.

9.3 Connecting speed sensors

The IOC4T panel has four screw terminals for each of the two speed channels. These terminals are as follows:

PS — Power supply for transducer or signal conditioner.

HI, LO — Differential input for the signal.

SHIELD — Terminal for connecting the shield of the transmission cable.

The MPC4 / IOC4T card pair can be used to power sensors having built-in or integrally attached signal conditioners, providing the current requirement is ≤25 mA. In cases where this built-in power supply capability is insufficient, an external power supply must be used. Table 9-3 shows when this is necessary.

Table 9-3: Use of an internal (MPC4) or external power supply for various types of speed sensors

Transducer and signal conditioner	Output signal	Rating	Supplied by	Connection diagram
Displacement probes used as speed sensors				
TQ4xx + IQS45x	0 to −20 V	−20 to −32 V	MPC4 / IOC4T	Figure 9-16
	15 to 20 mA	25 mA max.	MPC4 / IOC4T	Figure 9-17
TQxxx + IQSxxx with GSI127	0 to −20 V	$-24\ V_{DC}$ ±10%, 125 mA	External supply	Figure 9-19
TQxxx + IQSxxx with GSI124	0 to −20 V	$-24\ V_{DC}$ ±10%, 85 mA	External supply	Figure 9-20

Note: According to API 670, the normal range is 0 to −22 V.

9.3.1 General considerations

The IOC4T circuitry associated with the PS, HI, LO and SHIELD terminals (see Figure 9-15) is configurable using the VM600 MPS software. More specifically, the fields found on the property sheets for the **Speed Channels** node (a child of the **Inputs** node) in the tree structure (left) are used to configure switch Sw1 automatically and appropriately for a variety of applications and different types of transducer and/or signal conditioner (see Figure 9-14).

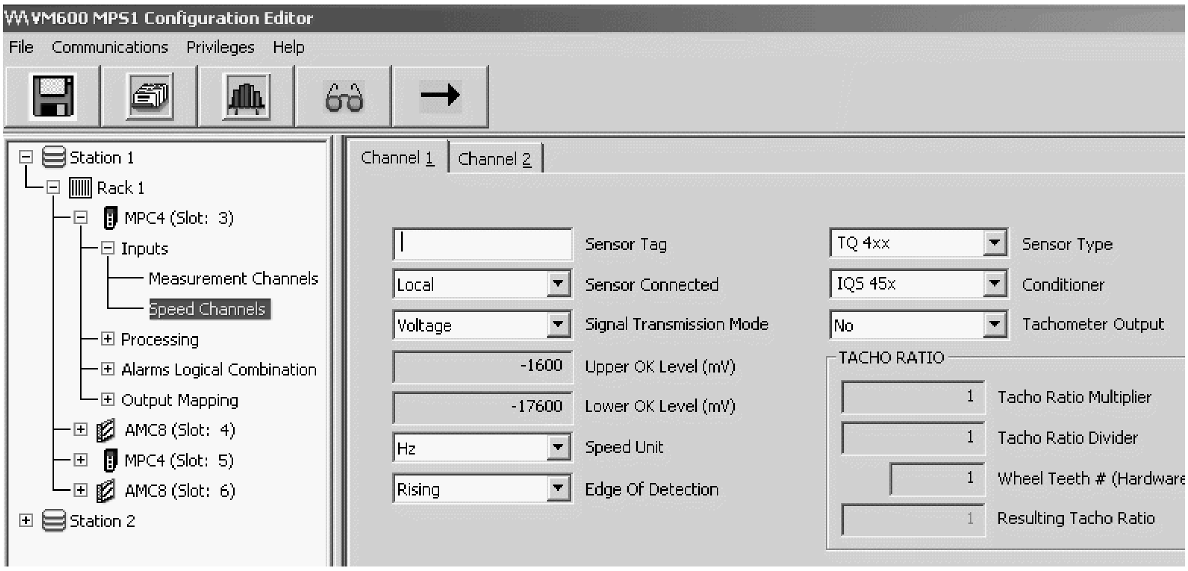


Figure 9-14: VM600 MPS software Speed Channels inputs window

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Switch Sw1 is set according to whether a voltage-modulated or a current-modulated signal is provided by the transducer or transducer and signal conditioner system:

- Voltage-modulated signal: Sw1 open.
- Current-modulated signal: Sw1 closed.

The position of Sw1 is determined by the setting of the **Signal Transmission Mode** field (see Figure 9-14). The correct setting (current or voltage) is chosen automatically by the program when standard transducers and signal conditioners from Meggitt Sensing Systems' Vibro-Meter product line are selected (using the **Sensor Type** and **Conditioner** fields). For non-Vibro-Meter devices, the operator must enter the appropriate setting (current or voltage) in the **Signal Transmission Mode** field.

Unlike the **Measurement channels** inputs, the speed channel inputs do not have switch Sw2, so the corresponding **Speed Channels** inputs windows (under the parent **Inputs** node) do not have a **Sensor Power Supply** field. (The sensor power supply is always −27.2 V.)

The **Sensor Connected** field has no direct influence on the setting of Sw1. The field can be considered as a comment for the user. When it is set to "No", the other fields in this VM600 MPS software window will be unavailable (that is, appear greyed out), but the values and settings are still effective.

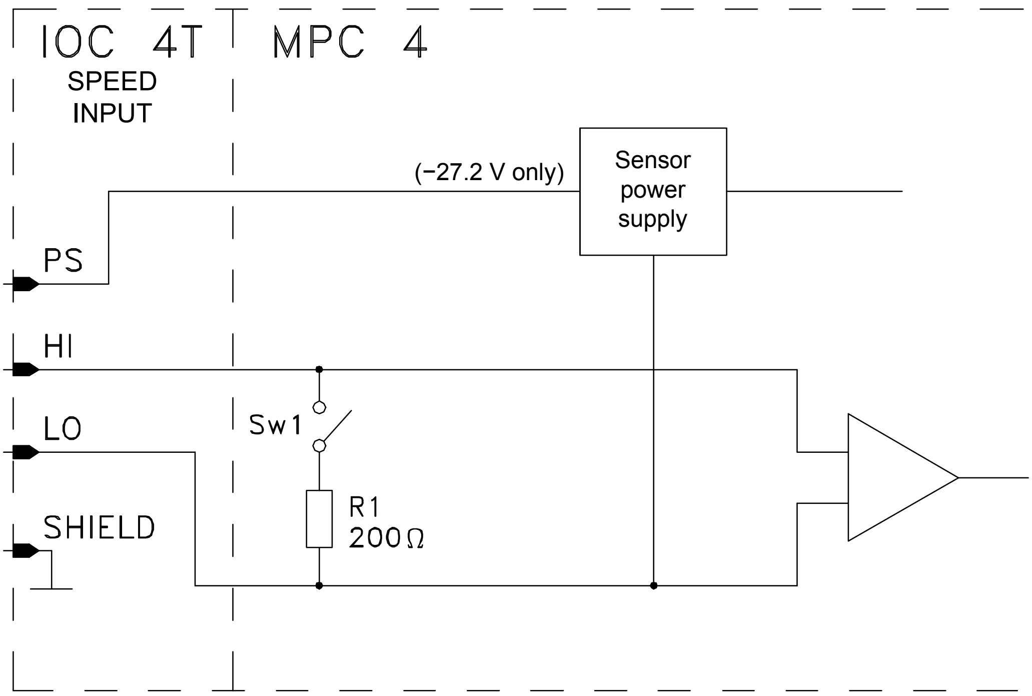


Figure 9-15: Circuitry associated with speed channel inputs

9.3.2 Connection diagrams for hardware powered by IOC4T / MPC4

9.3.2.1 Voltage-modulated signal

Applies to the following transducers or transducer and signal conditioner systems:

- TQ4xx + IQS45x.

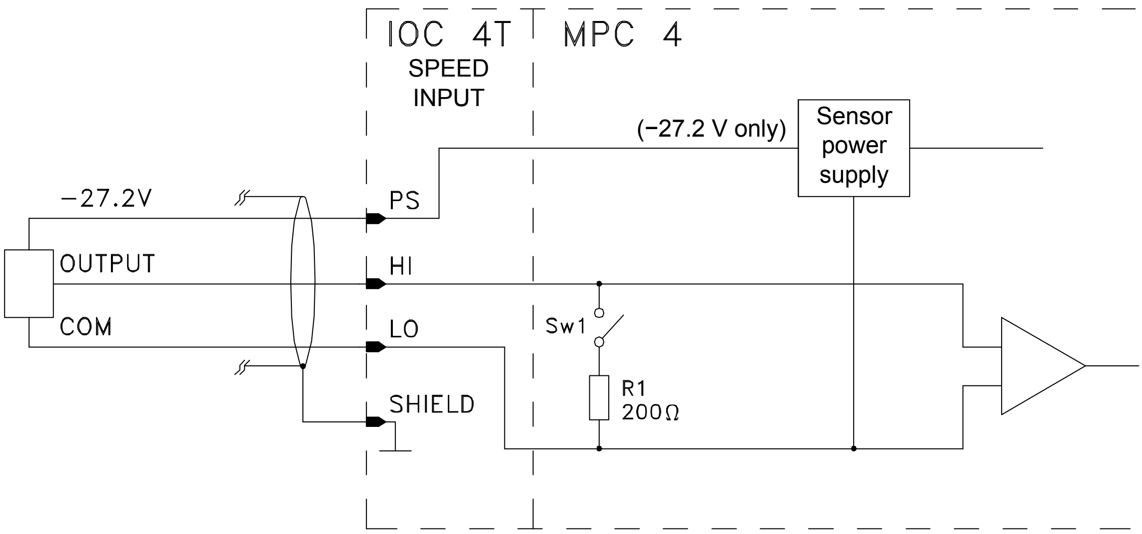


Figure 9-16: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Voltage option.

2- The sensor power supply is always set to −27.2 V.

9.3.2.2 Current-modulated signal

Applies to the following transducers or transducer and signal conditioner systems:

- TQ4xx + IQS45x.

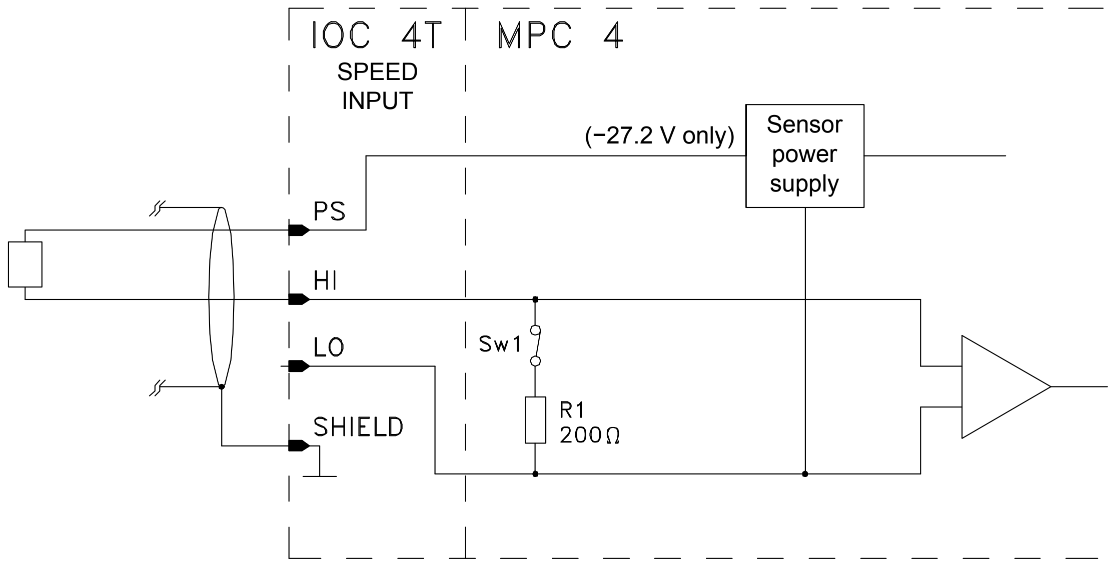


Figure 9-17: Connection diagram

Notes

1- Switch Sw1 is closed to allow current-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Current option.

2- The sensor power supply is always set to −27.2 V.

NOTE: For speed/phase reference input channels, it can be more difficult to achieve the minimum input voltage required when current is selected as the signal transmission mode. Therefore, the 200 Ω current-to-voltage conversion resistor used by the MPC4 card for current-modulated input signals should be used in any system design calculations in order to ensure reliable detection.

9.3.3 Connection diagrams for unpowered hardware

9.3.3.1 Voltage-modulated signal

Applies to generic sensors.

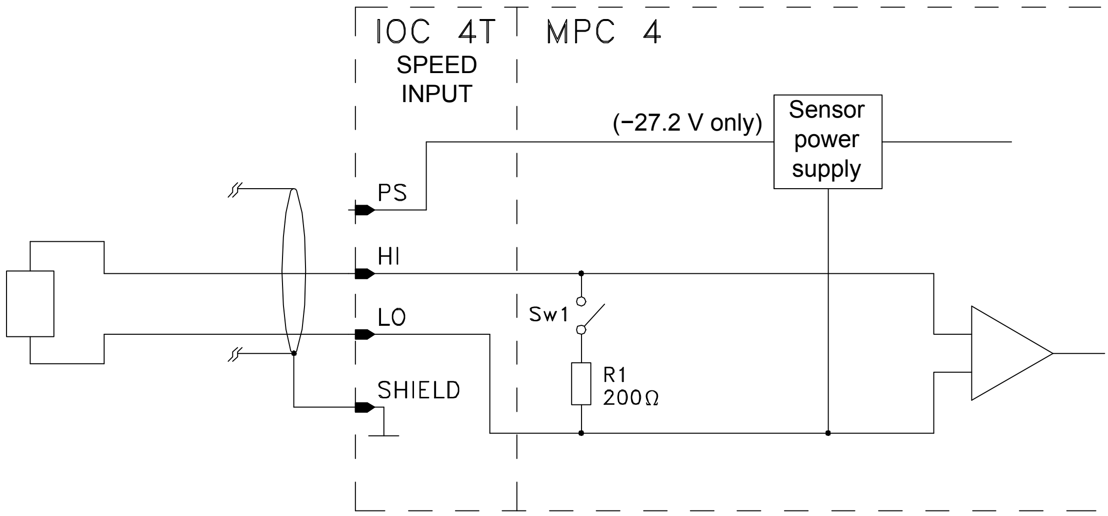


Figure 9-18: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
For non-Vibro-Meter devices, the **Signal Transmission Mode** field has to be set to the Voltage option.

2- The sensor power supply is always set to −27.2 V.

9.3.4 Connection diagrams for externally powered hardware

9.3.4.1 Voltage-modulated signal with GSI127 galvanic separation unit

Applies to the later versions of the following transducers or transducer and signal conditioner systems:

- TQ4xx + IQS45x + GSI127 galvanic separation unit.

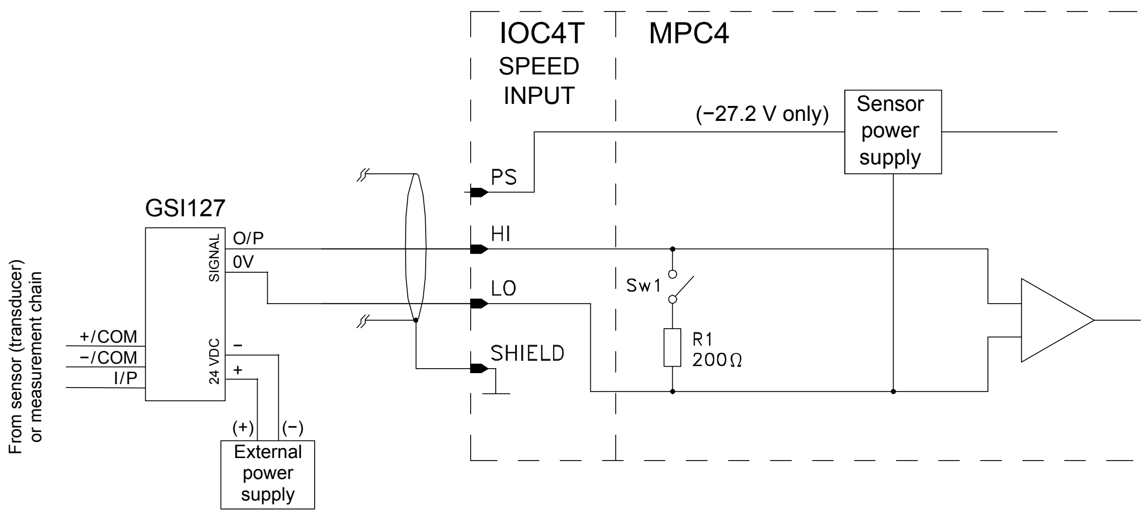


Figure 9-19: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Voltage option.

2- The operator must connect an external power supply to terminals “24 VDC +” and “24 VDC −” of the GSI127 galvanic separation unit.

3- The sensor power supply is always set to −27.2 V.

NOTE: More detailed information on connecting equipment to an electronic monitoring system can be found in the project-specific wiring diagram delivered with the system or by referring to the electrical connections (wiring diagrams) section of the appropriate sensors and signal conditioners installation manual.

9.3.4.2 Voltage-modulated signal with GSIxxx galvanic separation unit

Applies to the earlier versions of the following transducers or transducer and signal conditioner systems:

- TQ4xx + IQS45x + GSIxxx galvanic separation unit.

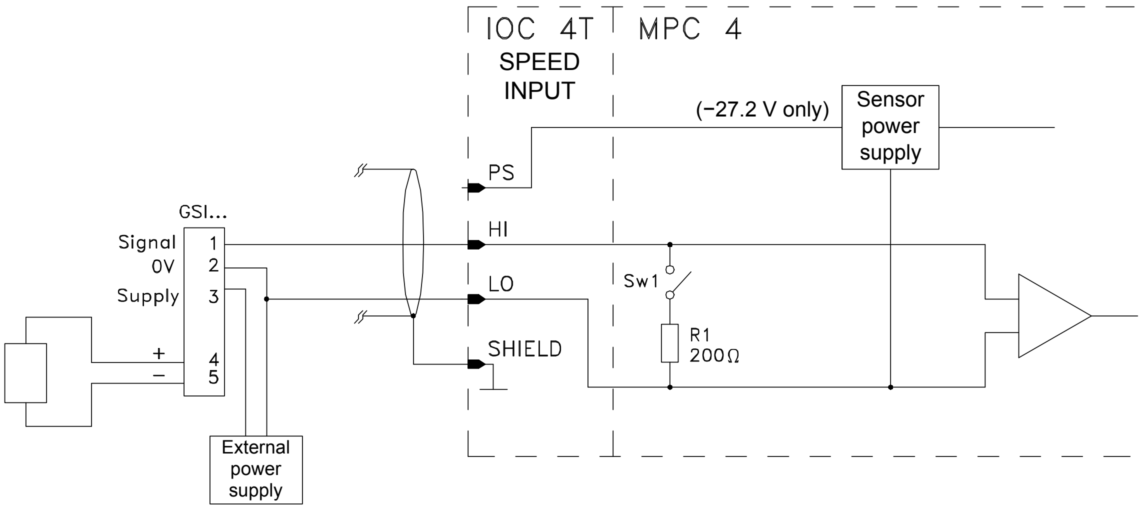


Figure 9-20: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Voltage option.

2- The operator must connect an external power supply to terminals 2 and 3 of the GSIxxx galvanic separation unit.

3- The sensor power supply is always set to −27.2 V.

9.3.4.3 Voltage-modulated signal with power supply and safety barrier unit

Applies to the following transducers or transducer and signal conditioner systems:

- TQ4xx + IQS45x + GSVxxx power supply and safety barrier unit.

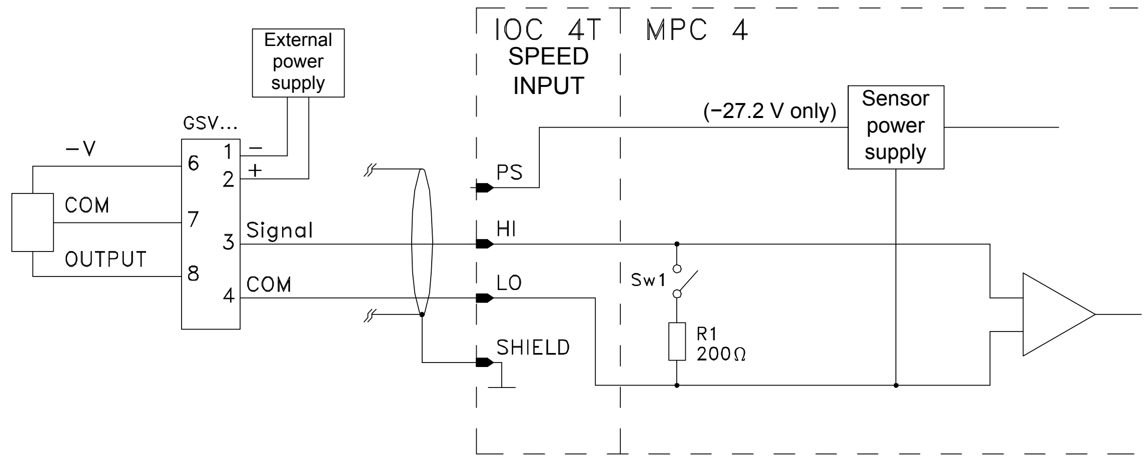


Figure 9-21: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed.
The **Signal Transmission Mode** field has to be set to the Voltage option.

2- The operator must connect an external power supply to terminals 1 and 2 of the GSVxxx power supply and safety barrier unit.

3- The sensor power supply is always set to −27.2 V.

9.3.5 Connection diagram for frequency generator

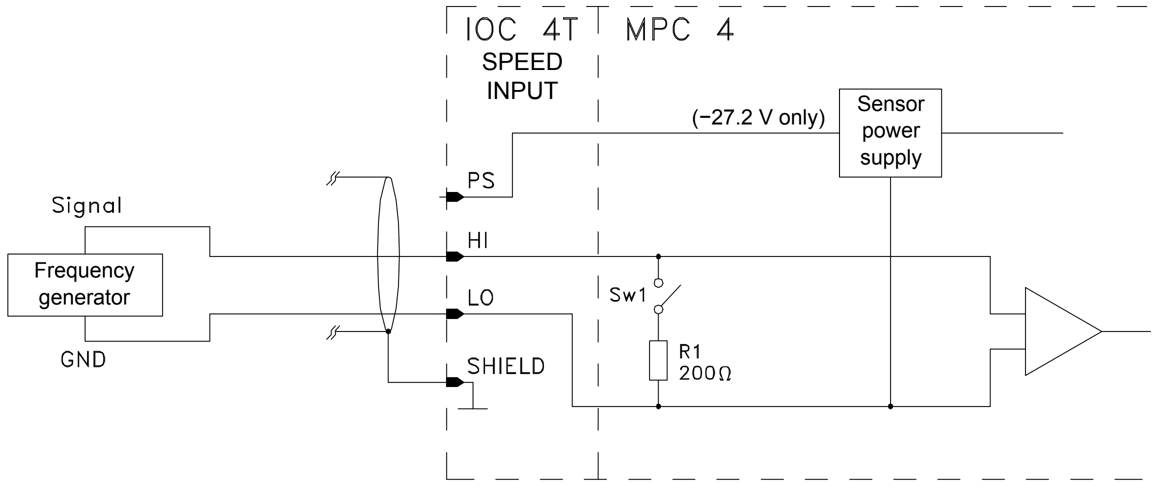


Figure 9-22: Connection diagram

Notes

1- Switch Sw1 is open to allow voltage-modulated signals to be processed. The **Signal Transmission Mode** field has to be set to the Voltage option.

2- The sensor power supply is always set to −27.2 V.

9.4 Configuring the four local relays on the IOC4T

Connector J2 of the IOC4T card has terminals for the following four relay outputs:

- RL1 – Pins 9 and 10 on connector J2
- RL2 – Pins 11 and 12 on connector J2
- RL3 – Pins 13 and 14 on connector J2
- RL4 – Pins 15 and 16 on connector J2.

Specific alarms can be attributed to these relays using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Specific alarms (A+, D− and so on) generated by an MPC4 card can be selected as control signals for these local relays using the VM600 MPS software. The control signals are generally low in the absence of an alarm, that is, in a “normal” state (which means that the control signal is high-impedance), although there are exceptions to this rule as shown in Table 9-4.

In the event of an alarm, the appropriate control signal changes state (which generally means that the control signal is pulled low to ground).

Table 9-4: Normal state of “control signals” (in absence of alarm condition)

Parameter	Normal state	Parameter	Normal state
Common OK (Common OK alarm level)	0	DSP Saturation Error	0
Individual OK	1	Status Latched (Error Log)	0
Common Alert (Common Alert alarm level)	0	Input Signal Error	0
Individual Alert	0	Input Saturation Error	0
Common Danger (Common Danger alarm level)	0	Common Mode Range Overflow	0
Individual Danger	0	Invalid Output	0
TM, DB, AR	0	Speed Out Of Limit	0
MPC Card Running	1	Track Lost	0
Common Monitoring Failure	0	Track Out Of Range	0
Processing Error	0	PGA Saturation Error	0

Key: 0 = control signal in low state, 1 = control signal in high state.

As explained in 9.4.2 Operation of relays, jumpers must be set on the IOC4T card to configure each relay as normally energised (NE) or normally de-energised (NDE), and as normally open (NO) or normally closed (NC).

Table 9-5 shows the required jumper settings for IOC4T cards. See Figure 9-23 for an electrical diagram showing the jumpers and Figure 9-24 for the position of the jumpers on the IOC4T card.

Table 9-5: Jumper settings to configure relays as NE/NDE and NO/NC

Normal state of control signal	Jumper J100x	Jumper J70x	Relay coil	Relay contact
1	1-2	1-2	NDE	NO
1	1-2	1-3	NDE	NC
1	1-3	1-2	NE	NC
1	1-3	1-3	NE	NO
0	1-2	1-2	NE	NC
0	1-2	1-3	NE	NO
0	1-3	1-2	NDE	NO
0	1-3	1-3	NDE	NC

9.4.1 Relay terminology

By convention, the normally closed (NC) and normally open (NO) relay terminology refers to the state of the relay contacts when the relay's coil is de-energised. This use of the word "normally" is not directly related to the "normal" operation/state of the machinery being monitored, as explained below.

When the power supply to a device is turned off:

- There is a closed circuit between the normally closed (NC) and common (COM) contacts.
- There is an open circuit between the normally open (NO) and common (COM) contacts.

When the power supply to a device is turned on, the state of the relay contacts depends on whether the relay's coil is energised or de-energised.

When the relay's coil is energised:

- There is an open circuit between the normally closed (NC) and common (COM) contacts.
- There is a closed circuit between the normally open (NO) and common (COM) contacts.

Whether a relay's coil is energised or de-energised depends on how the relay has been configured, for example, as normally de-energised (NDE) or normally energised (NE) and as latched or not latched. It also depends on the control signal that is used to drive the relay. For example, specific alarms (A+, D− and so on) generated by an MPC4 card (see Table 9-4).

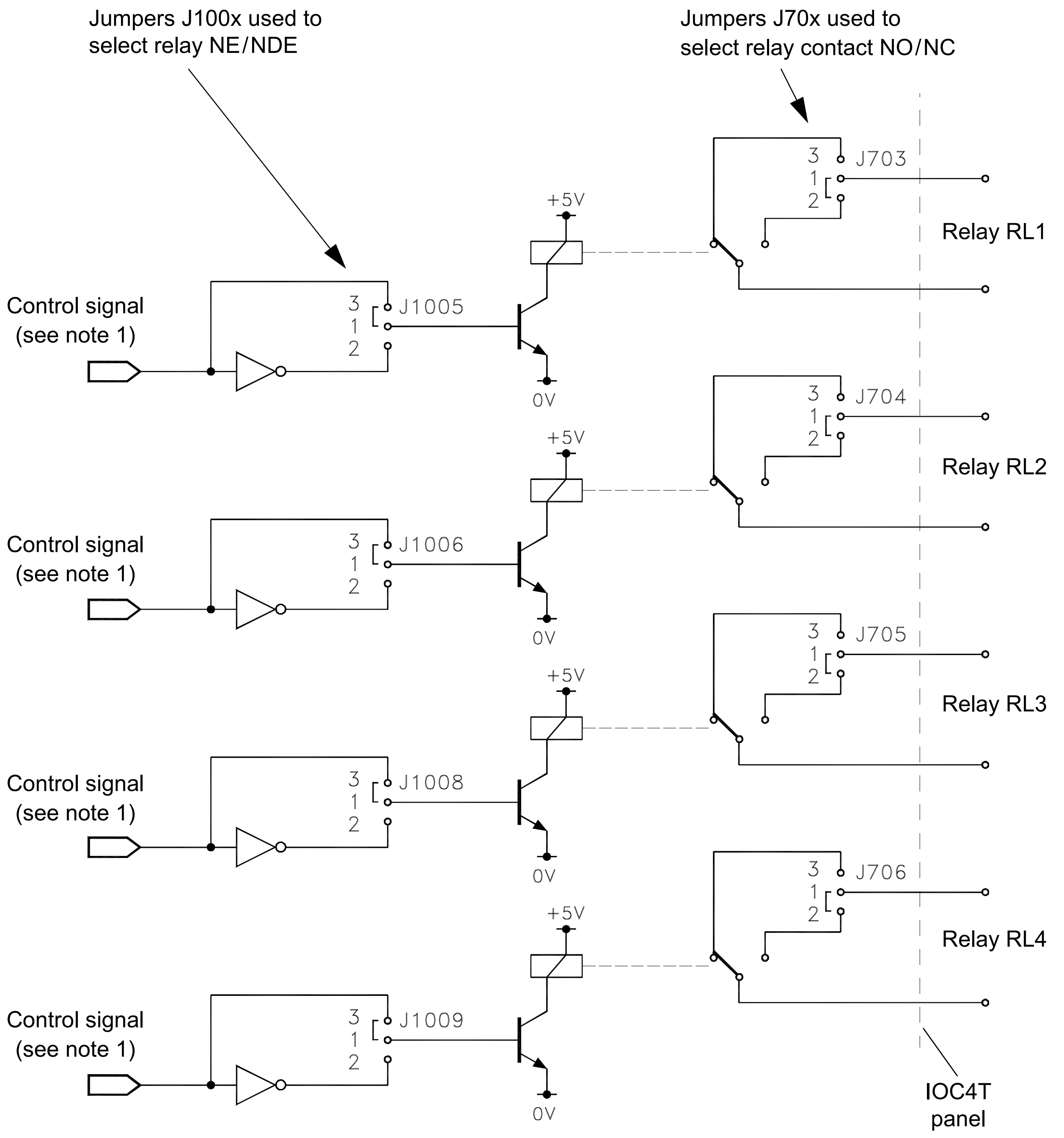
9.4.2 Operation of relays

A relay can be configured to be either normally de-energised (NDE) or normally energised (NE).

Normally de-energised (NDE) and normally energised (NE) refer to the relay coil state (that is, the relay switching circuit) when the hardware is powered and the signal driving the relay's control circuit is in a normal (non-alarm) state.

- For relays configured as normally de-energised (NDE), the control input to the relay's coil is off by default so there is a closed circuit between the NC and COM contacts (and an open circuit between the NO and COM contacts) for a normal state.
- For relays configured as normally energised (NE), the control input to the relay's coil is on by default so there is an open circuit between the NC and COM contacts (and a closed circuit between the NO and COM contacts) for a normal state.

NOTE: An advantage of normally energised (NE) relays is that the "de-energise to trip principle" allows problems with hardware to be detected (for example, due to power supply or wiring failures).



Notes
1. Specific alarms (A+, D− and so on) generated by the corresponding MPC4 card can be selected as the control signal using the VM600 MPSx software. The normal state of the control signal is shown in Table 9-4.
2. See Table 9-5 for information on how to set the jumpers to obtain the desired operation.

Figure 9-23: Electrical diagram showing jumpers used to configure relays as NE/NDE and NO/NC

Configuration examples for relay RL1 using a a control signal with a normal state of 1 (see Table 9-4):

a. To configure RL1 to act as a normally energised (NE) relay with normally closed (NC) contacts (see Table 9-5):

- Jumper J1005 has contacts 1-3 closed.
- Jumper J703 has contacts 1-2 closed.

In this case, RL1 provides a closed circuit when there is no alarm. It provides an open circuit in the event of an alarm or power supply failure.

b. To configure RL1 to act as a normally de-energised (NDE) relay with normally closed (NC) contacts (see Table 9-5):

- Jumper J1005 has contacts 1-2 closed.
- Jumper J703 has contacts 1-3 closed.

In this case, RL1 provides a closed circuit when there is no alarm or when there is a power supply failure. It provides an open circuit in the event of an alarm.

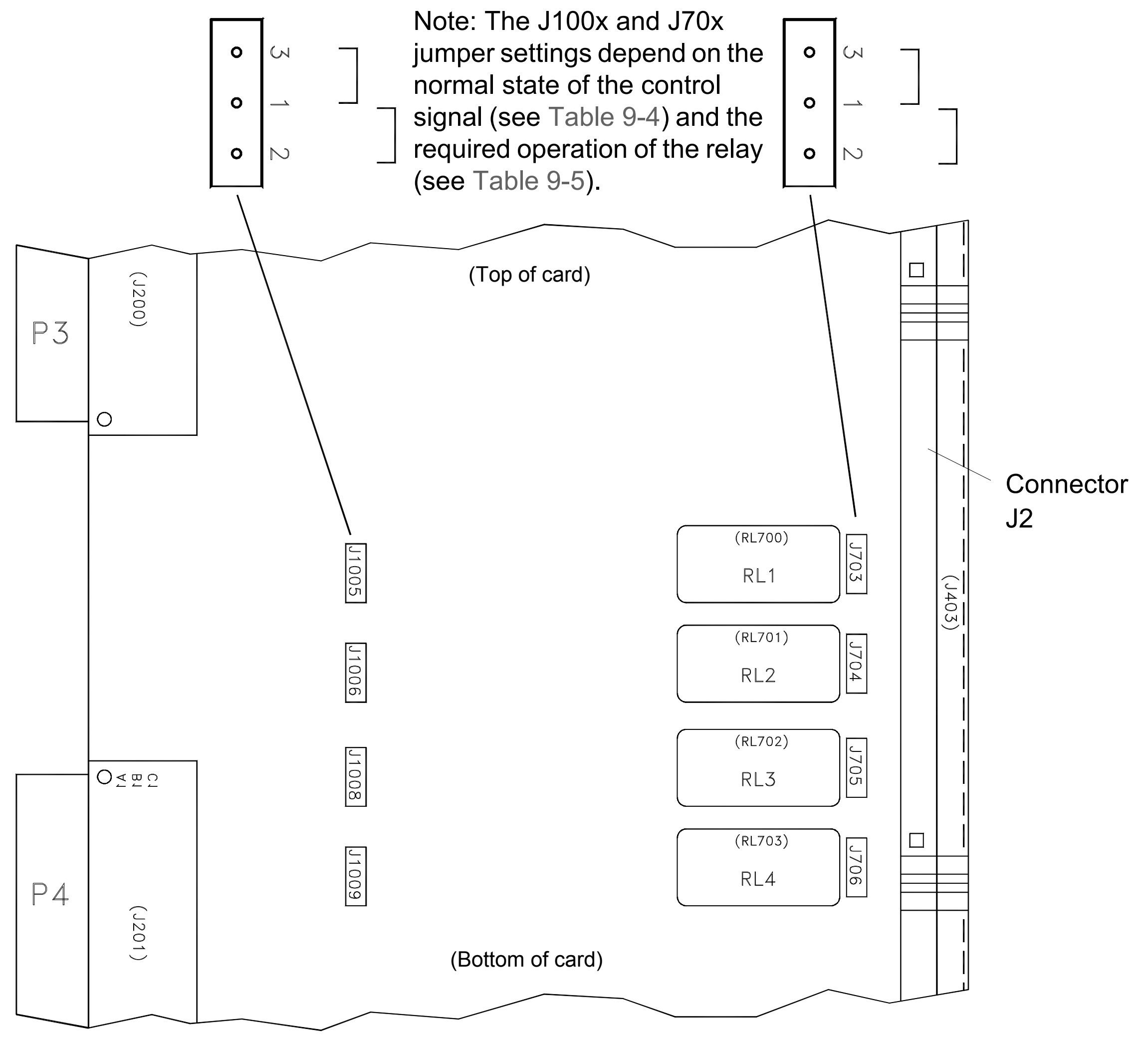


Figure 9-24: Position of jumpers used to configure the IOC4T local relays as NE or NDE

9.5 Configuring the four DC outputs

The four DC outputs (DC OUT 1, DC OUT 2, DC OUT 3, DC OUT 4) on connector J3 of the IOC4T card can be individually configured to provide either:

- A current-based signal in the range 4 to 20 mA
- A voltage-based signal in the range 0 to 10 V.

This is achieved by setting jumpers J1242, J1243, J1244, J1245 on the IOC4T card (see Figure 9-26 and Figure 9-25):

- For a 4 to 20 mA output, place the jumper between contacts 1-2
- For a 0 to 10 V output, place the jumper between contacts 1-3.

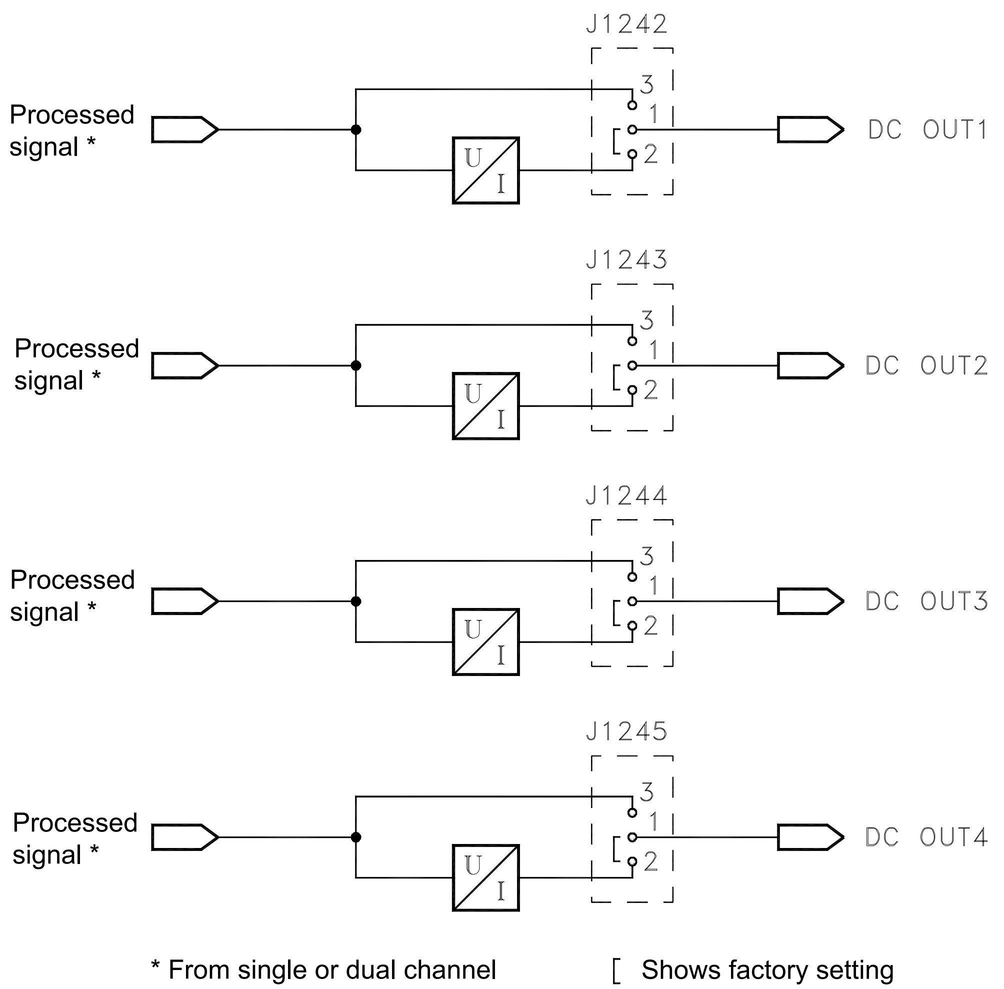


Figure 9-25: Jumpers to select type of DC output (voltage-based or current-based)

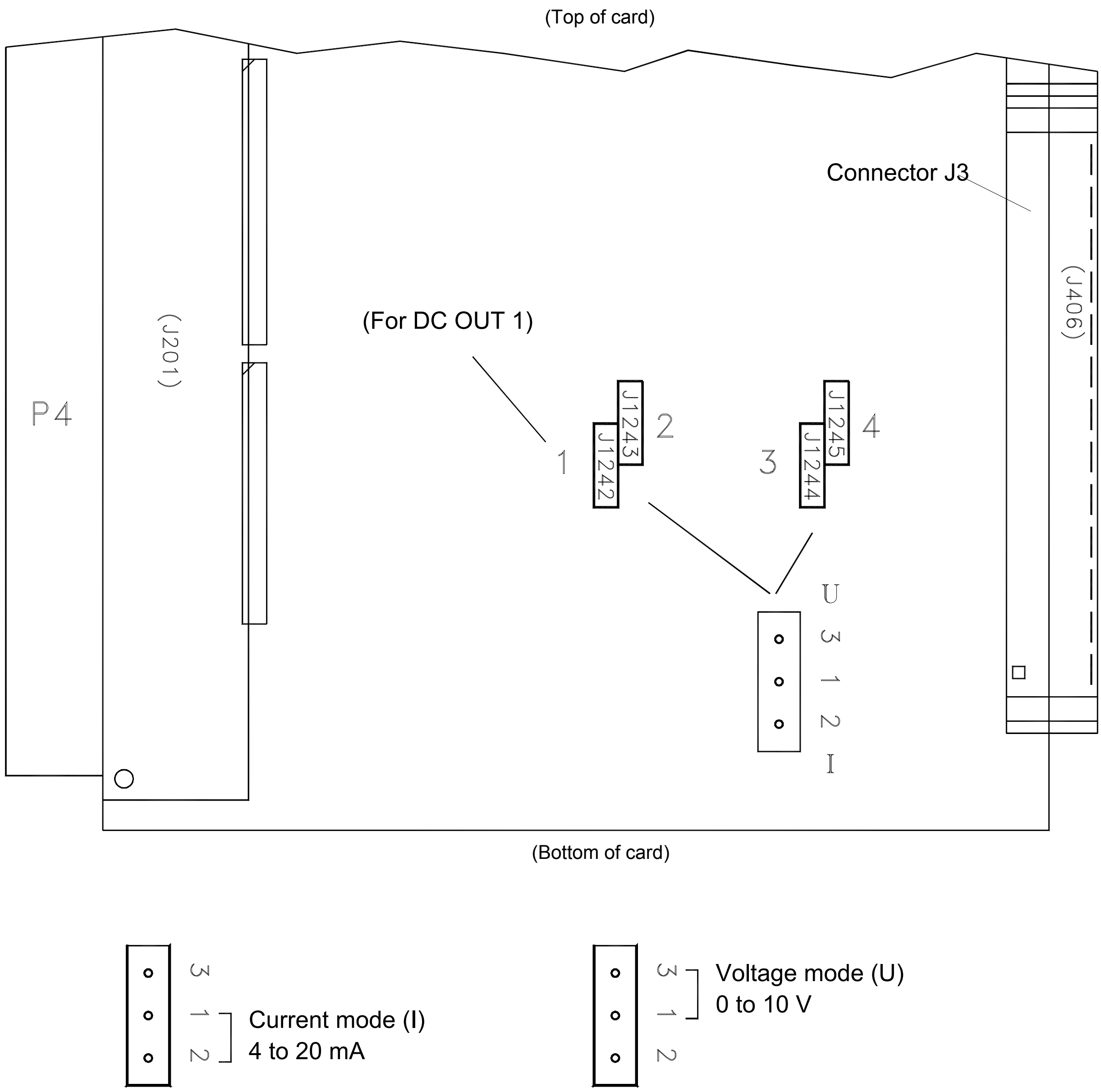


Figure 9-26: Position of jumpers on the IOC4T card related to the DC outputs

The DC outputs (DC OUT 1, DC OUT 2, DC OUT 3 and DC OUT 4) share a common reference/return with the discrete signal interface (DSI) inputs (DB, TM and AR). This common reference/return is known as RET and is available on Connector J3, Terminal 8 (see 9.1 Definition of screw terminals on the IOC4T card).

NOTE: The common reference/return (RET) signal has a voltage limit of ±2 V and a current limit of 100 mA.
Accordingly, it is recommended to use galvanic separation between the RET on the IOC4T card and any circuitry connected to the DC outputs if the potential difference between RET and the external circuitry could be greater than 2 V.

9.6 Buffered (raw) outputs

The IOC4T has four differential outputs providing buffered raw signals. These outputs are:

- RAW 1H (high line) Connector J3, Terminal 9
- RAW 1L (low line) Connector J3, Terminal 10
- RAW 2H (high line) Connector J3, Terminal 11
- RAW 2L (low line) Connector J3, Terminal 12
- RAW 3H (high line) Connector J3, Terminal 13
- RAW 3L (low line) Connector J3, Terminal 14
- RAW 4H (high line) Connector J3, Terminal 15
- RAW 4L (low line) Connector J3, Terminal 16.

The raw signals are derived from the signals coming from the sensors connected to measurement channels 1 to 4 (connector J1 of the IOC4T card). These buffered signals are identical to those available on the BNC connectors on the panel of the corresponding MPC4 card.

Refer to the *MPC4 machinery protection card data sheet* for further specifications.

9.7 DSI control inputs (DB, TM, AR)

These DSI control inputs are normally floating (open circuit).

To activate an input, connect it to the RET terminal (Connector J3, Terminal 8). This closes the contact.

The inputs function as follows:

- Danger Bypass (DB) – A closed contact between the DB and RET terminals allows the operator to inhibit the danger relay outputs.
- Trip Multiply (TM) – When there is a closed contact between the TM and RET terminals, alarm levels are multiplied by a scale factor (software defined).
  When TM is open, the scale factor is not taken into account.
- Alarm Reset (AR) – A closed contact between AR and RET inputs resets (clears) any latched alarms.

NOTE: An externally generated Alarm Reset (AR) should be an aperiodic pulse-type signal, that is, it should not be activated continuously.

The discrete signal interface (DSI) inputs (DB, TM and AR) share a common reference/return with the DC outputs (DC OUT 1, DC OUT 2, DC OUT 3 and DC OUT 4). This common reference/return is known as RET and is available on Connector J3, Terminal 8 (see 9.1 Definition of screw terminals on the IOC4T card).

NOTE: The common reference/return (RET) signal has a voltage limit of ±2 V and a current limit of 100 mA.
Accordingly, it is recommended to use galvanic separation between the RET on the IOC4T card and any circuitry connected to the discrete signal interface (DSI) inputs if the potential difference between RET and the external circuitry could be greater than 2 V.

For further information on the Danger Bypass function, see 4.6.5 Danger Bypass function and for further information on the Direct Trip Multiply function, see 4.6.4 Direct Trip Multiply.

9.8 Channel inhibit function

The channel inhibit function can only be activated using software, that is, there is no equivalent DSI input.

The channel inhibit function is activated when one of the VM600 MPS software packages (MPS1 or MPS2) is used to send channel inhibit commands to individual MPC4 channels (**Communications > To MPC > Channel Inhibits**).

Alternatively, Modbus can be used to control the channel inhibit function for a networked VM600 machinery protection system (containing a CPUM card).

For further information on the channel inhibit function, see 4.6.6 Channel inhibit function.

9.9 Slot number coding for IOC4T cards

IOC4T cards use an electronic keying mechanism to help prevent them from being installed in the wrong slot of a VM600 rack. Each IOC4T card has a bank of micro-switches that are used to assign a slot number to the card, stored in the slot number (address) assignation register.

The IOC4T card compares its slot number with the rack's slot number (see Figure 2-2). The result of the comparison is displayed on the SLOT ERROR LED on the cards panel:

- If the codes are identical, the LED is green.
- If the codes are not identical, the LED is red.

9.9.1 VM600 system rack

When an IOC4T card is installed in a VM600 system rack, the micro-switches on the card must be configured to match the rack slot (slot number) being used (see 2.1.2 Slot number coding for cards in the rear of a rack).

The example in Figure 9-27 shows the micro-switch settings required for an IOC4T card installed in slot 11 of an ABE04x rack.

IOC4T card micro-switch settings for installation in slot 11

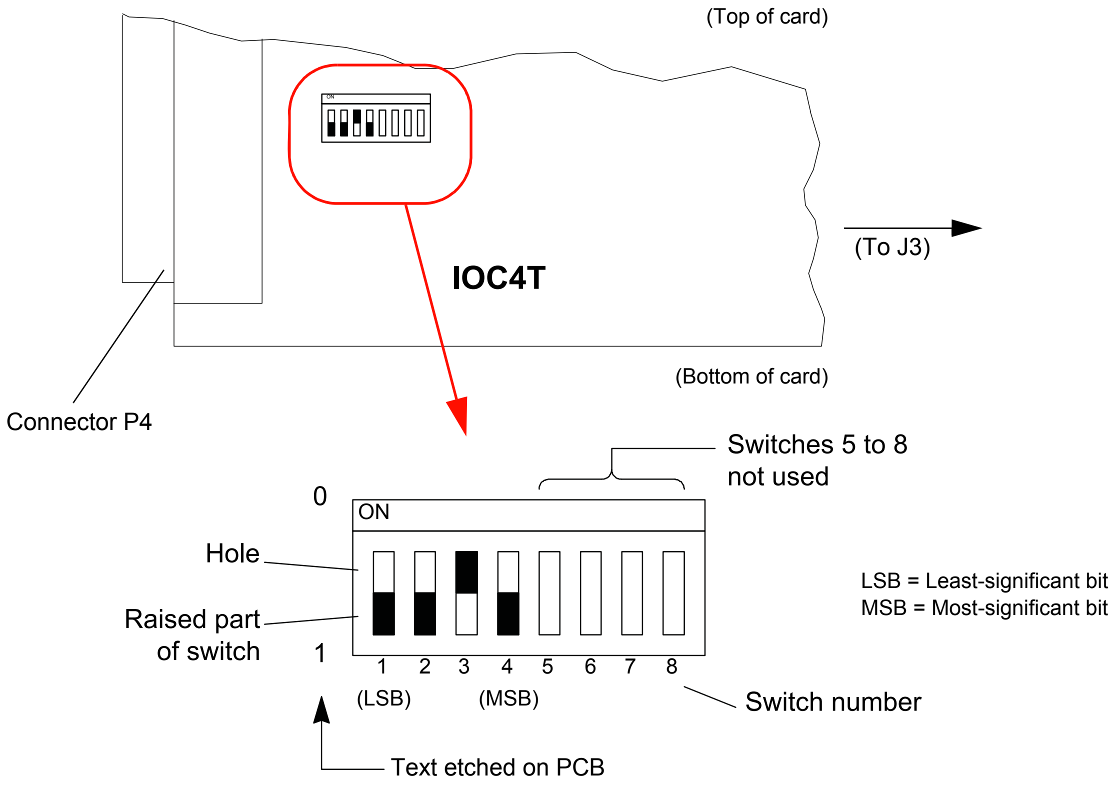
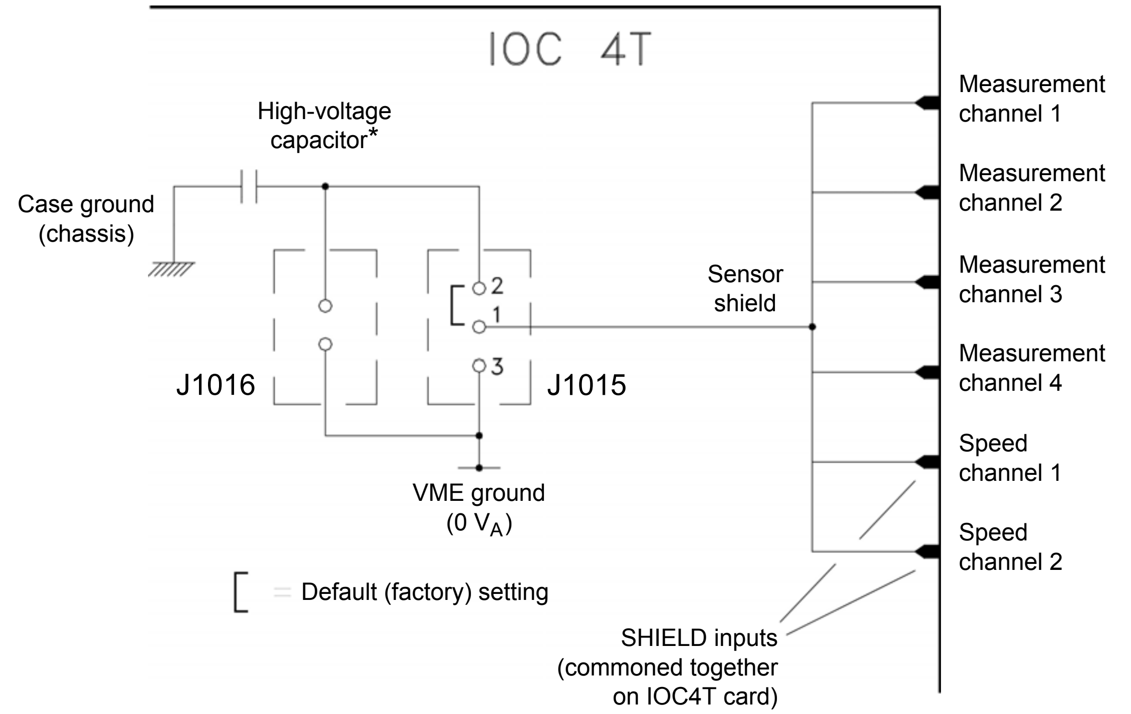


Figure 9-27: Micro-switches to assign the IOC4T slot number

9.10 Grounding options

Jumper J1015 on the IOC4T card (see Figure 9-28) allows the commoned (that is, connected together) sensor shields to be connected to either:

- The case ground (chassis)
  In this case, contacts 2-1 of J1015 must be shorted.
- The VME ground (0 V_A)
  In this case, contacts 1-3 of J1015 must be shorted.



Notes
*The standard version of the IOC4T card has a short-circuit between J1015 contact 2 and case ground.
*The separate circuits version of the IOC4T card has a high-voltage capacitor between J1015 contact 2 and case ground.
The J1016 jumper on the IOC4T card is reserved for system test and should not be changed by the user.

Figure 9-28: Jumper to configure grounding option

The location of the J1015 jumper on the IOC4T card can be found using Figure 9-29.

NOTE: For the standard version of an ABE04x rack with the standard version of an MPC4 card installed, the case ground (rack chassis) is connected to the VME ground (0 V_A) by jumper J701 on the MPC4.

9.11 Using the Raw Bus to share measurement channel inputs

The Raw Bus consists of 64 parallel bus lines, arranged as 32 differential line pairs. It allows the raw analog signals coming from measurement transducers and devices connected to the dynamic signal inputs of an IOC4T card (via the CH1, CH2, CH3 and CH4, accessible at the rear of the ABE04x rack) to be placed on a Raw bus line pair. The dynamic signal input (measurement channel) is subsequently available throughout the VM600 rack to be used as an input by any other IOC card in the rack.

This feature is typically used to reduce external wiring requirements. For example, in a VM600 rack featuring both MPS and CMS hardware, signals wired to the MPS cards (externally) can be shared with the CMS cards over the Raw bus (internally).

The allocation of a specific Raw Bus line pair to a measurement channel is done by setting jumpers on the IOC4T card (and on the IOC16T card – refer to the *VM600 condition monitoring system (CMS) hardware manual* (MACMS-HW/E)). The mapping of the measurement channels to the Raw Bus line pairs is summarised in Table 9-6, together with the required jumper settings. The position of the relevant jumpers on the IOC4T card is shown in Figure 9-29 with an explanation of which jumpers correspond to which Raw Bus lines (see “measurement channel selection” on the right of the figure).

For information on the allocation of a specific Raw Bus line pair to a control signal line, see 9.12.2 Using the Raw Bus to switch relays.

Table 9-6: Raw bus lines and jumpers associated with measurement channels for the MPC4 card

MPC4 measurement channel (raw analog signal)	Raw Bus line pair	IOC4T jumper settings (contacts 1-3 closed)
Measurement channel 1	0	J300 and J301
Measurement channel 2	1	J302 and J303
Measurement channel 3	2	J304 and J305
Measurement channel 4	3	J306 and J307
Measurement channel 1	4	J308 and J309
Measurement channel 2	5	J310 and J311
Measurement channel 3	6	J312 and J313
Measurement channel 4	7	J314 and J315
Measurement channel 1	8	J316 and J317
Measurement channel 2	9	J318 and J319
Measurement channel 3	10	J320 and J321
Measurement channel 4	11	J322 and J323
Measurement channel 1	12	J324 and J325
Measurement channel 2	13	J326 and J327
Measurement channel 3	14	J328 and J329

Table 9-6: Raw bus lines and jumpers associated with measurement channels for the MPC4 card (continued)

MPC4 measurement channel (raw analog signal)	Raw Bus line pair	IOC4T jumper settings (contacts 1-3 closed)
Measurement channel 4	15	J330 and J331
Measurement channel 1	16	J332 and J333
Measurement channel 2	17	J334 and J335
Measurement channel 3	18	J336 and J337
Measurement channel 4	19	J338 and J339
Measurement channel 1	20	J340 and J341
Measurement channel 2	21	J342 and J343
Measurement channel 3	22	J344 and J345
Measurement channel 4	23	J346 and J347
Measurement channel 1	24	J348 and J349
Measurement channel 2	25	J350 and J351
Measurement channel 3	26	J352 and J353
Measurement channel 4	27	J354 and J355
Measurement channel 1	28	J356 and J357
Measurement channel 2	29	J358 and J359
Measurement channel 3	30	J360 and J361
Measurement channel 4	31	J362 and J363

For example, to allocate Raw Bus line pair 7 for use with measurement channel 4 (that is, its corresponding measurement channel), jumpers J314 and J315 should have contacts 1-3 closed.

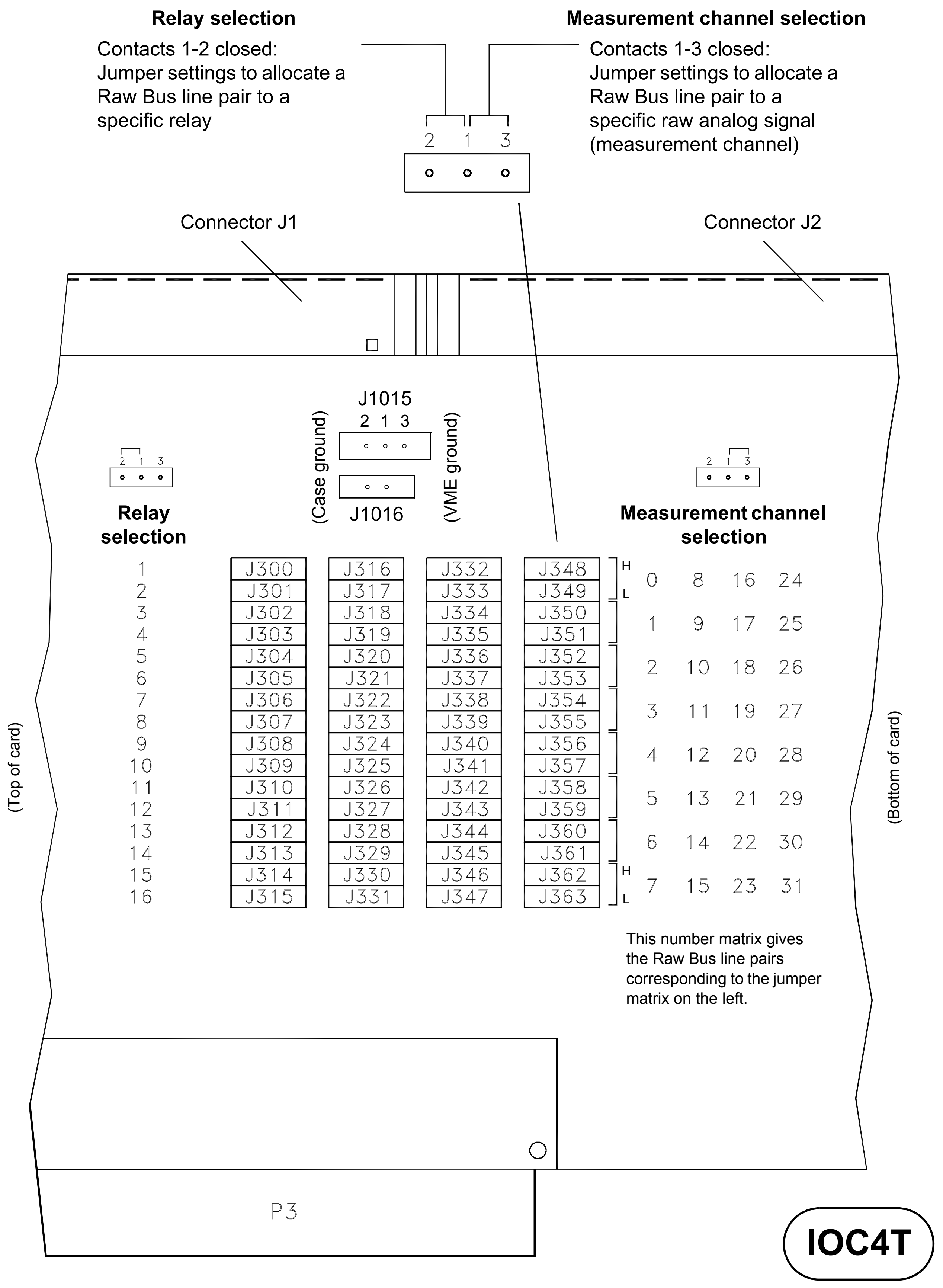


Figure 9-29: Position of jumpers related to the Raw Bus on the IOC4T card

9.12 Assigning alarm signals to relays on the RLC16 card

The IOC4T card contains the following four local relays for signalling alarms: RL1, RL2, RL3 and RL4.

Specific alarms can be attributed to these relays using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

A large number of alarm signals can be processed by the MPS. The possible alarms are summarised in the table below:

Figure 9-30: Available alarm signals (MPC4 / IOC4T card pair)

	Channel 1		Channel 2		Channel 3		Channel 4		Dual	Dual	Speed	Speed
	O/P 1	O/P 2	O/P 1	O/P 2	O/P 1	O/P 2	O/P 1	O/P 2	O/P 1&2	O/P 3&4	O/P 1	O/P 2
Alert+												
Alert−												
Danger+											N/A	N/A
Danger−											N/A	N/A
OK level												
Channel Status *												

Basic logical combinations of alarms	Up to 8 possibilities
Advanced logical combinations of alarms	Up to 4 possibilities

Key:

(green)	=	Alarm available
N/A	=	Alarm not available

* Channel Status = Processing Error, Track Lost and so on

Any of these alarm signals can be sent to the RLC16 card to switch relays. This is achieved by either of the following two means:

1- Using the Open Collector Bus (OC Bus)

This is the normal method of switching relays. Hardware settings required for this method are described in Section 9.12.1.

Refer also to 3.4.3 Open Collector Bus for a description of the OC Bus.

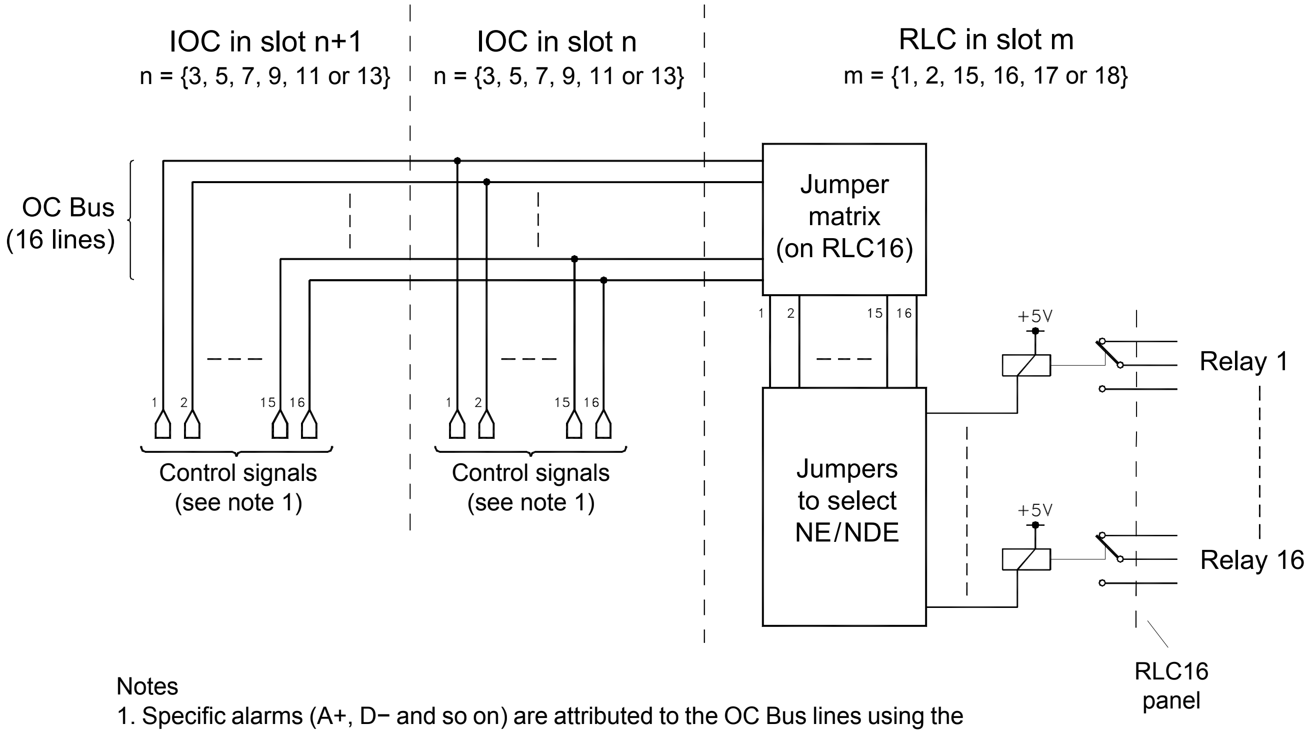
2- Using the Raw Bus

This method can be used if the 16 lines provided by the OC Bus are insufficient, or if only a few relays are required for more than two MPC cards. This method is described in 9.12.2 Using the Raw Bus to switch relays.

Refer also to 3.4.4 Raw Bus for a description of the Raw Bus.

9.12.1 Using the Open Collector Bus (OC Bus) to switch relays

Figure 9-31 shows the operating principle when the OC Bus is used to switch relays.



Notes
1. Specific alarms (A+, D− and so on) are attributed to the OC Bus lines using the VM600 MPSx software. See Table 9-4 for information on the normal state of the control signal.

Figure 9-31: Using the Open Collector Bus (OC Bus) to switch relays

The attribution of a specific alarm signal (generated by the MPC4 / IOC4T cards) to a control signal line (and therefore to an OC Bus line) is done using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

The attribution of a specific line on the OC Bus to a specific relay on the RLC16 is done by setting a jumper on the RLC16 card. Additional jumpers allow the selection of relay normally energised (NE) or normally de-energised (NDE). The jumper settings are summarised in Table 9-7 and the position of the relevant jumpers on the RLC16 card is shown in Figure 9-33.

NOTE: See 3.4.3 Open Collector Bus for further information on the OC Bus.

9.12.1.1 Configuration procedure (OC Bus)

To configure a particular relay on the RLC16 card using the OC Bus, proceed as follows:

1- Consult Table 9-7 (this lists the jumpers associated with each relay).

2- For the relay in question, set the appropriate jumper on the RLC16 card.

3- Set the appropriate jumper to configure the relay as normally energised (NE) or normally de-energised (NDE).

NOTE: Make sure that either the NE or the NDE jumper is set. You cannot set both of them together.

4- Using the VM600 MPS software, select the **Discrete Outputs** node (a child of the **Output Mapping** node) in the tree structure (left). Then expand the **RLC/OC bus** node in the main window (right) and select the relay in question (between 1 and 16). See Figure 9-32.

5- Configure the **Channel**, **Output** and **Status** fields of this window.

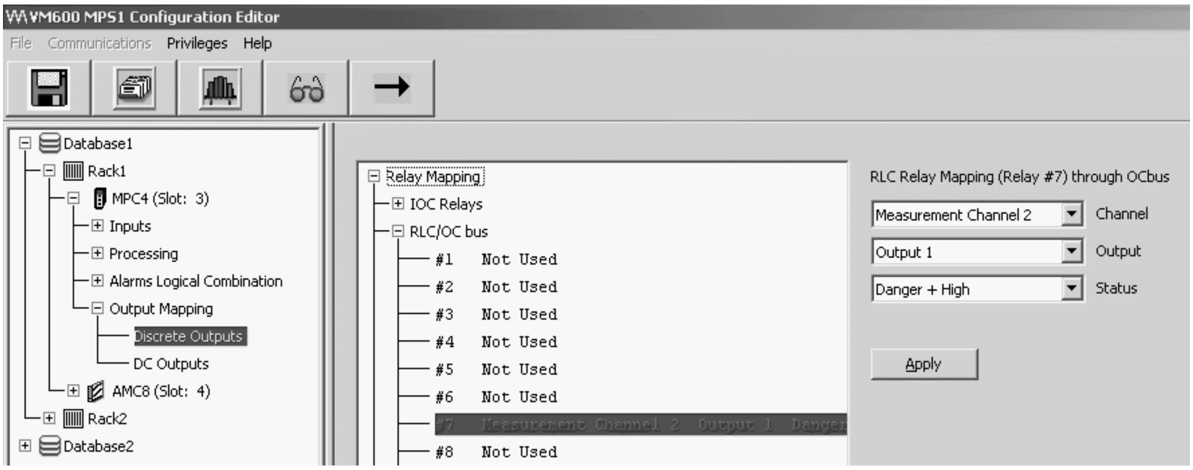


Figure 9-32: VM600 MPS software window to configure the OC Bus

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Configuration example

A user wants to assign the alarm signal “Danger+" generated on Output 1 of Channel 2 of a given MPC4 card to Relay 7 on the RLC16 card. In addition, the user wants Relay 7 to be in a normally energised (NE) state.

Relay 7 is selected by placing jumper J31 on the RLC16 card (see Table 9-7).

(Note that this operation actually selects OC Bus Line 6. This information, however, does not normally concern the user, as the VM600 MPS software takes it into account.)

Placing jumper J88 ensures that Relay 7 is normally energised (see Table 9-7).

The user must then use the VM600 MPSx software to select Relay 7 from the 16 relays available in the **RLC/OC bus** node. Then, the Danger+ alarm for Output 1 of Channel 2 can be assigned to this relay (see Figure 9-32).

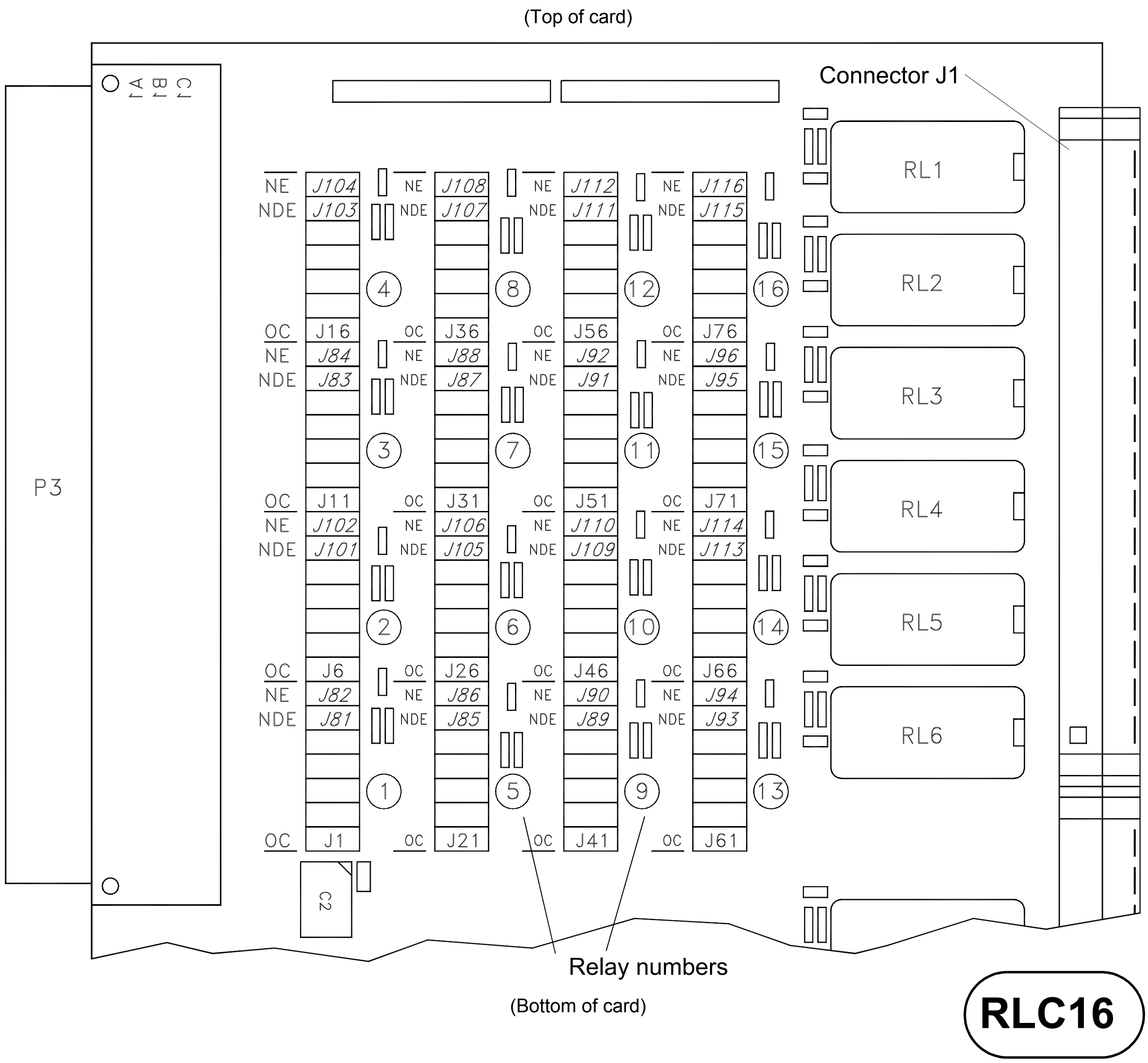


Figure 9-33: Position of jumpers on the RLC16 card related to the OC Bus

9.12.2 Using the Raw Bus to switch relays

The Raw Bus can be used to supplement the OC Bus by allowing additional alarm signals to be routed to the relays on the RLC16 card. (The Raw Bus is common to all IOC4T and RLC16 cards.)

MPS configuration example

An example illustrating the use of the Raw Bus is shown in Figure 9-34. In this example, four MPC cards and their corresponding IOC cards are mounted in a rack. It is assumed that the Open Collector Bus is used to convey alarm signals to relay cards RLC #1 to RLC #4. The OC Bus lines are not shown on this drawing for the sake of clarity, but they affect the following links (see 3.4.3 Open Collector Bus):

- IOC #1 in slot 3 connects to RLC #1 in slot 1
- IOC #2 in slot 5 connects to RLC #2 in slot 2
- IOC #3 in slot 7 connects to RLC #3 in slot 15
- IOC #4 in slot 9 connects to RLC #4 in slot 16.

The Raw Bus in this example is used to allow each IOC card to access half an RLC16 card:

- IOC #1 and IOC #2 can access RLC #5 via Raw Bus lines 31 to 16
- IOC #3 and IOC #4 can access RLC #6 via Raw Bus lines 47 to 32.

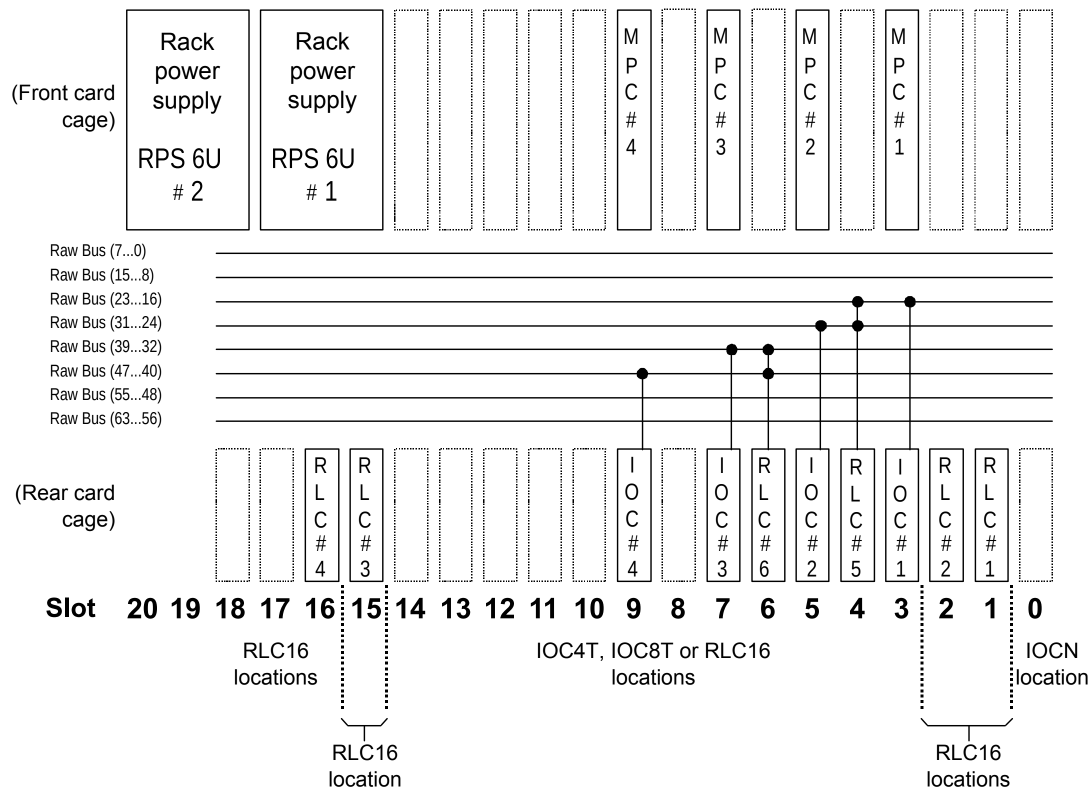
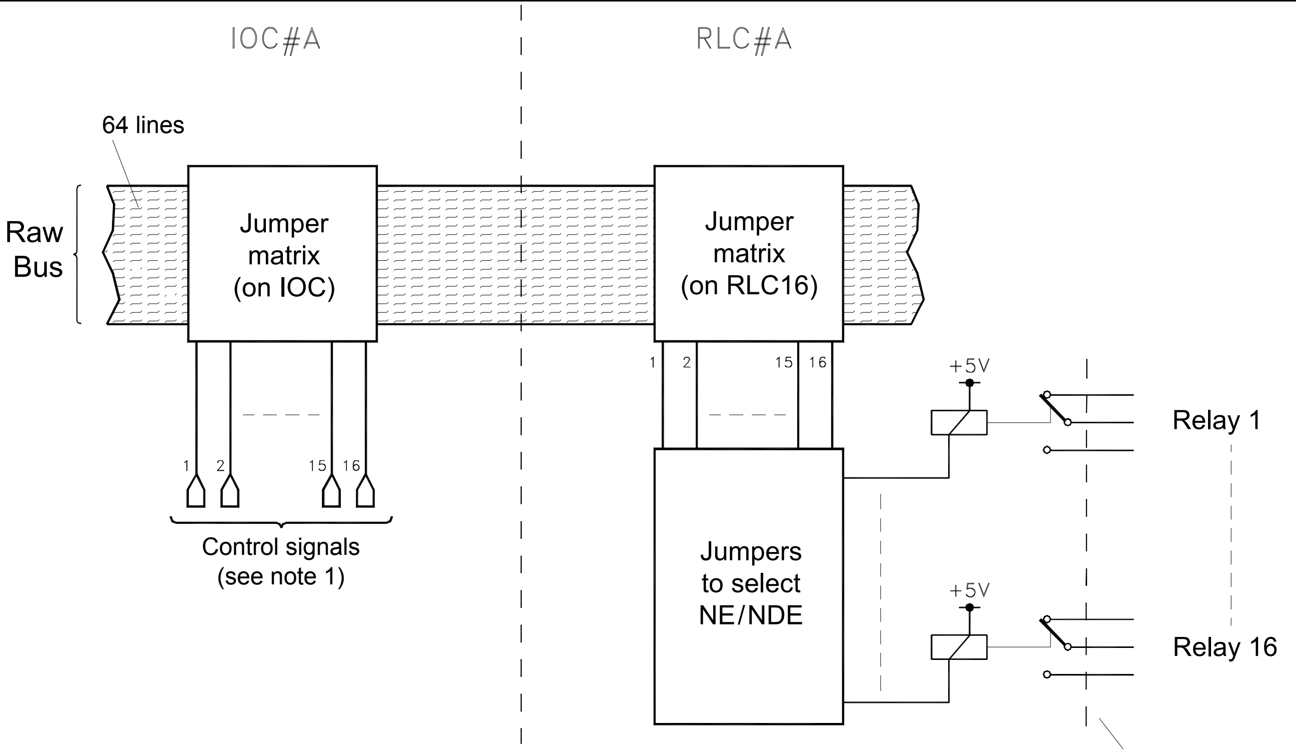


Figure 9-34: MPS configuration example showing use of the Raw Bus

Figure 9-35 shows the operating principle when the Raw Bus is used to switch relays.



Notes
1. Specific alarms (A+, D− and so on) generated by the corresponding MPC4 card are attributed to the control lines using the VM600 MPSx software. See Table 9-4 for information on the normal state of the control signal.

Figure 9-35: Using the Raw Bus to switch relays

The allocation of a specific alarm signal (generated by the MPC4 / IOC4T cards) to a control signal line is done using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

The allocation of a specific Raw Bus line pair to a specific control signal line is done by setting jumpers on the IOC4T card. The jumper settings are summarised in Table 9-7 and the position of the relevant jumpers on the IOC4T card is shown in Figure 9-29 with an explanation of which jumpers correspond to which Raw Bus lines (see “relay selection” on the left of the figure).

For information on the allocation of a specific Raw Bus line pair to a measurement channel, see 9.11 Using the Raw Bus to share measurement channel inputs.

The control signal is subsequently routed towards a specific relay on the RLC16 card by setting a jumper on the RLC16. Additional jumpers on the RLC16 allow the selection of relay normally energised (NE) or normally de-energised (NDE). The jumper settings are summarised in Table 9-7 and the position of the relevant jumpers on the RLC16 card is shown in Figure 9-29.

The IOC4T card drives the Raw Bus lines using open collector driver circuitry. These bus lines do not have line terminations. (The principle is the same as for the Open Collector Bus, see Figure 3-7.)

9.12.2.1 Configuration procedure (Raw Bus)

To configure a particular relay on the RLC16 card using the Raw Bus, proceed as follows:

1- Consult Table 9-7 (this lists the Raw Bus lines and jumpers associated with each relay).

2- Choose a free Raw Bus line from the four that are associated with that relay.

3- For the relay and Raw Bus line, set the appropriate jumper on the RLC16 card.

4- Set the appropriate jumper on the RLC16 card to configure the relay as normally energised (NE) or normally de-energised (NDE).

NOTE: Make sure that either the NE or the NDE jumper is set. You cannot set both of them together.

5- For the relay and Raw Bus line in question, set the appropriate jumper on the IOC4T card.

6- Using the VM600 MPSx software, select the **Discrete Outputs** node (a child of the **Output Mapping** node) in the tree structure (left). Then expand the **RLC/Raw bus** node in the main window (right) and select the relay in question (between 1 and 16). See Figure 9-36.

7- Configure the **Channel**, **Output** and **Status** fields of this window.

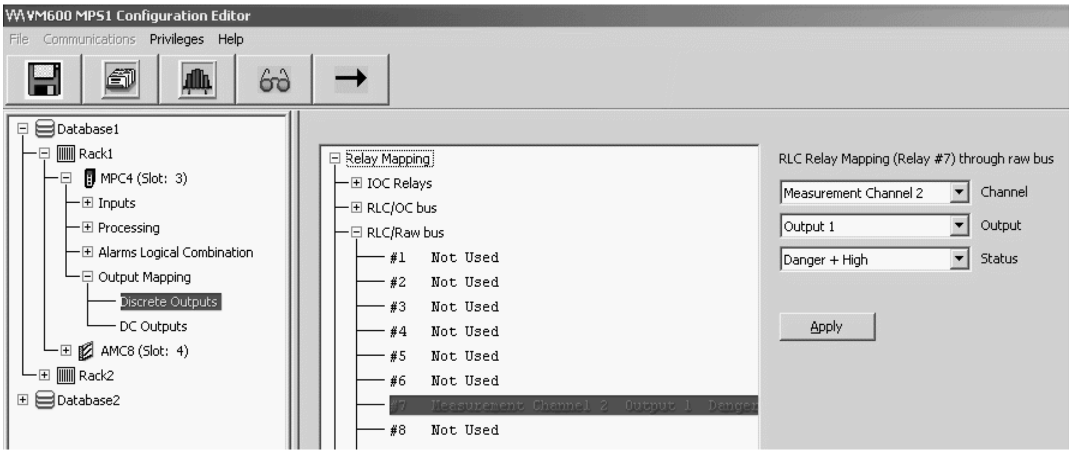


Figure 9-36: VM600 MPS software window to configure the Raw Bus

Configuration example

A user wants to assign the alarm signal "Danger+" generated on Output 1 of Channel 2 of a given MPC4 card to Relay 7 on the RLC16 card. In addition, the user wants Relay 7 to be in a normally energised (NE) state.

Table 9-7 shows that Raw Bus lines 35, 43, 51 and 59 are associated with Relay 7.

The choice of one of these four lines will be dictated by the hardware configuration of the overall MPS, as certain bus lines may already be reserved for other functions. The desired bus line is then selected by placing the appropriate jumper on the RLC16 card (J32, J33, J34 or J35 in the case of Relay 7).

For the sake of this example, we will assume that Raw Bus line 51 is chosen. Jumper J34 therefore has to be set on the RLC16 card.

Placing jumper J88 will ensure that Relay 7 is normally energised (see Table 9-7).

Jumper J338 now has to be set on the IOC4T card.

The user must then use the VM600 MPSx software to select Relay 7 from the 16 relays available in the **RLC/Raw bus** node. Then, the Danger+ alarm for Output 1 of Channel 2 can be assigned to this relay (see Figure 9-36).

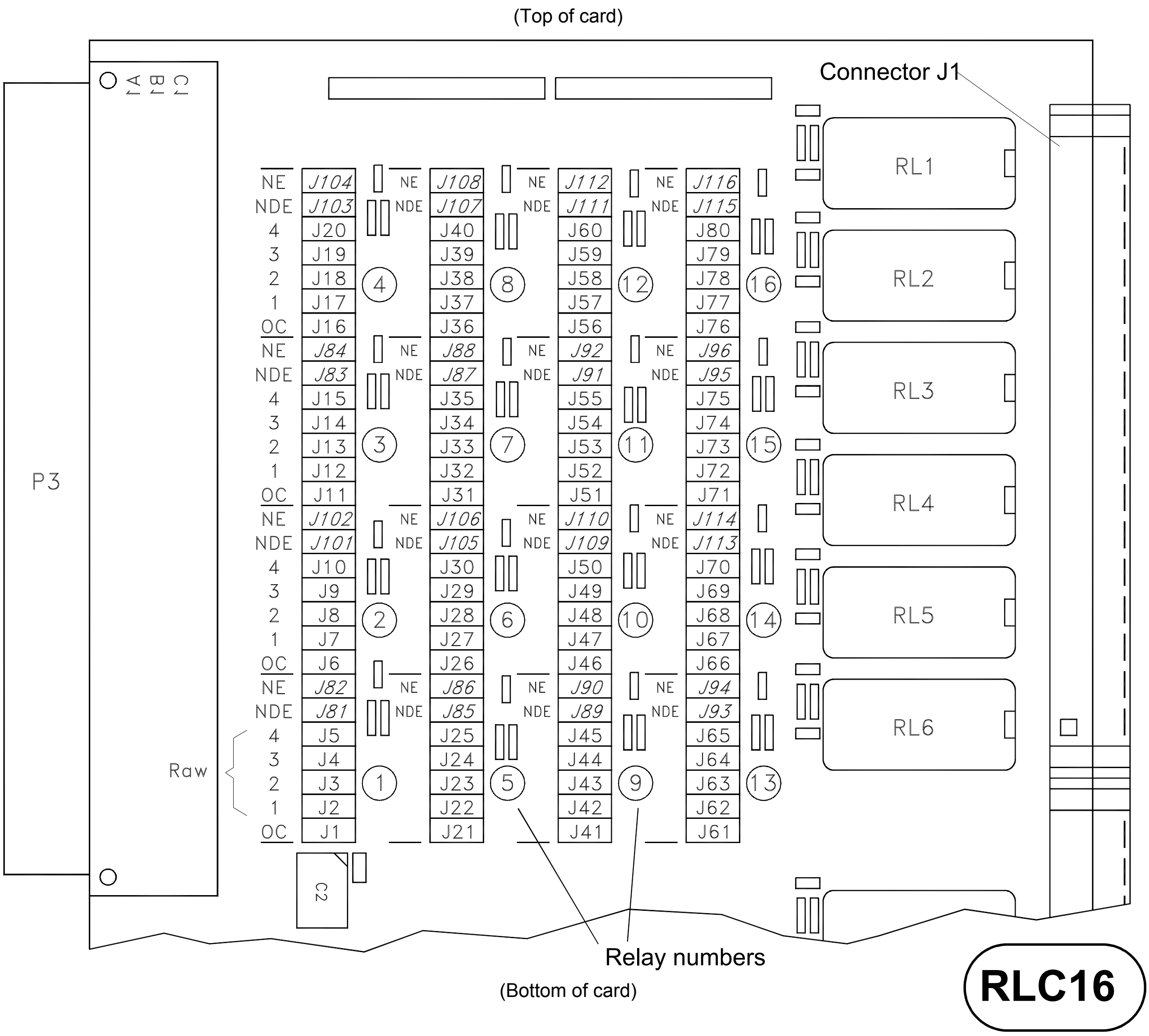


Figure 9-37: Position of jumpers on the RLC16 card related to the OC Bus and the Raw Bus

Table 9-7: Jumpers and bus lines associated with relays on the RLC16 card

	Line number		Jumper settings				
Relay number (on RLC16)	OC Bus	Raw Bus	On IOC4T (see note 1 and note 2)	On RLC16: To select the relay	On RLC16: To set the relay as NE	On RLC16: To set the relay as NDE	Raw Bus signal line used (see note 2)
1	0	- - -	- - -	J1	J82	J81	- - -
	- - -	32	J300	J2	J82	J81	0 High
	- - -	40	J316	J3	J82	J81	8 High
	- - -	48	J332	J4	J82	J81	16 High
	- - -	56	J348	J5	J82	J81	24 High
2	1	- - -	- - -	J6	J102	J101	- - -
	- - -	0	J301	J7	J102	J101	0 Low
	- - -	8	J317	J8	J102	J101	8 Low
	- - -	16	J333	J9	J102	J101	16 Low
	- - -	24	J349	J10	J102	J101	24 Low
3	2	- - -	- - -	J11	J84	J83	- - -
	- - -	33	J302	J12	J84	J83	1 High
	- - -	41	J318	J13	J84	J83	9 High
	- - -	49	J334	J14	J84	J83	17 High
	- - -	57	J350	J15	J84	J83	25 High
4	3	- - -	- - -	J16	J104	J103	- - -
	- - -	1	J303	J17	J104	J103	1 Low
	- - -	9	J319	J18	J104	J103	9 Low
	- - -	17	J335	J19	J104	J103	17 Low
	- - -	25	J351	J20	J104	J103	25 Low
5	4	- - -	- - -	J21	J86	J85	- - -
	- - -	34	J304	J22	J86	J85	2 High
	- - -	42	J320	J23	J86	J85	10 High
	- - -	50	J336	J24	J86	J85	18 High
	- - -	58	J352	J25	J86	J85	26 High

Table 9-7: Jumpers and bus lines associated with relays on the RLC16 card (continued)

Relay number (on RLC16)	Line number: OC Bus	Line number: Raw Bus	Jumper settings: On IOC4T (see note 1 and note 2)	Jumper settings: On RLC16: To select the relay	Jumper settings: On RLC16: To set the relay as NE	Jumper settings: On RLC16: To set the relay as NDE	Raw Bus signal line used (see note 2)
6	5	- - -	- - -	J26	J106	J105	- - -
	- - -	2	J305	J27	J106	J105	2 Low
	- - -	10	J321	J28	J106	J105	10 Low
	- - -	18	J337	J29	J106	J105	18 Low
	- - -	26	J353	J30	J106	J105	26 Low
7	6	- - -	- - -	J31	J88	J87	- - -
	- - -	35	J306	J32	J88	J87	3 High
	- - -	43	J322	J33	J88	J87	11 High
	- - -	51	J338	J34	J88	J87	19 High
	- - -	59	J354	J35	J88	J87	27 High
8	7	- - -	- - -	J36	J108	J107	- - -
	- - -	3	J307	J37	J108	J107	3 Low
	- - -	11	J323	J38	J108	J107	11 Low
	- - -	19	J339	J39	J108	J107	19 Low
	- - -	27	J355	J40	J108	J107	27 Low
9	8	- - -	- - -	J41	J90	J89	- - -
	- - -	36	J308	J42	J90	J89	4 High
	- - -	44	J324	J43	J90	J89	12 High
	- - -	52	J340	J44	J90	J89	20 High
	- - -	60	J356	J45	J90	J89	28 High
10	9	- - -	- - -	J46	J110	J109	- - -
	- - -	4	J309	J47	J110	J109	4 Low
	- - -	12	J325	J48	J110	J109	12 Low
	- - -	20	J341	J49	J110	J109	20 Low
	- - -	28	J357	J50	J110	J109	28 Low
11	10	- - -	- - -	J51	J92	J91	- - -
	- - -	37	J310	J52	J92	J91	5 High
	- - -	45	J326	J53	J92	J91	13 High
	- - -	53	J342	J54	J92	J91	21 High
	- - -	61	J358	J55	J92	J91	29 High

Table 9-7: Jumpers and bus lines associated with relays on the RLC16 card (continued)

Relay number (on RLC16)	Line number: OC Bus	Line number: Raw Bus	Jumper settings: On IOC4T (see note 1 and note 2)	Jumper settings: On RLC16: To select the relay	Jumper settings: On RLC16: To set the relay as NE	Jumper settings: On RLC16: To set the relay as NDE	Raw Bus signal line used (see note 2)
12	11	- - -	- - -	J56	J112	J111	- - -
	- - -	5	J311	J57	J112	J111	5 Low
	- - -	13	J327	J58	J112	J111	13 Low
	- - -	21	J343	J59	J112	J111	21 Low
	- - -	29	J359	J60	J112	J111	29 Low
13	12	- - -	- - -	J61	J94	J93	- - -
	- - -	38	J312	J62	J94	J93	6 High
	- - -	46	J328	J63	J94	J93	14 High
	- - -	54	J344	J64	J94	J93	22 High
	- - -	62	J360	J65	J94	J93	30 High
14	13	- - -	- - -	J66	J114	J113	- - -
	- - -	6	J313	J67	J114	J113	6 Low
	- - -	14	J329	J68	J114	J113	14 Low
	- - -	22	J345	J69	J114	J113	22 Low
	- - -	30	J361	J70	J114	J113	30 Low
15	14	- - -	- - -	J71	J96	J95	- - -
	- - -	39	J314	J72	J96	J95	7 High
	- - -	47	J330	J73	J96	J95	15 High
	- - -	55	J346	J74	J96	J95	23 High
	- - -	63	J362	J75	J96	J95	31 High
16	15	- - -	- - -	J76	J116	J115	- - -
	- - -	7	J315	J77	J116	J115	7 Low
	- - -	15	J331	J78	J116	J115	15 Low
	- - -	23	J347	J79	J116	J115	23 Low
	- - -	31	J363	J80	J116	J115	31 Low

Notes

1. To attribute a Raw Bus line to a relay, the appropriate jumper must have contacts 1-2 closed.
2. To obtain a raw signal on a Raw Bus line, the appropriate jumper(s) must have contacts 1-3 closed. For differential signals, two jumpers must be set. For example, for Raw Bus line 16, set J332 and J333 as they correspond to 16 High and 16 Low respectively.

10 CONFIGURATION OF AMC8 / IOC8T CARDS

This chapter describes the connectors on the IOC8T card. These are accessed from the rear of a VM600 MPS rack.

Typical sensor connection diagrams are included for thermocouples, RTD devices as well as other sensors providing a voltage-based or current-based signal.

Information is also given on attributing specific alarm signals to specific relays on RLC16 cards using the Open Collector Bus and the Raw Bus.

10.1 Definition of screw terminals on the IOC8T card

The IOC8T panel (rear of rack) contains four contact strips, identified as J1 to J4.

Strips J1 to J3 consist of a socket and a mating connector, which contains either 24 or 20 cage clamp terminals (see Figure 10-1). The terminals can accept wires with a cross section of between 0.08 and 1.0 mm^2. Strip J4 consists of a socket and a mating connector, which contains 12 screw terminals. The terminals can accept wires with a cross section of $\leq$1.5 mm^2.

The mating connectors are labelled “SLOT xx Jn” (where xx is the slot number and Jn = J1, J2, J3 or J4) to enable the connector to be matched to the correct socket of the correct card. Each socket and mating connector can be equipped with a mechanical key system to prevent incorrect connection.

Further details on these screw terminal contacts can be found in Table 10-1.

Table 10-1: Definition of terminals for connectors J1 to J4 on the IOC8T card

Terminal	Definition	Terminal	Definition
Connector J1: Connection of sensors 1 to 4			
1	Channel 1 – Current Source Output (I)	2	Channel 1 – Input (H)
3	Channel 1 – Input (R)	4	Channel 1 – Common Input (C)
5	Channel 1 – Shield (S)	6	Channel 1 – Chassis Ground
7	Channel 2 – Current Source Output (I)	8	Channel 2 – Input (H)
9	Channel 2 – Input (R)	10	Channel 2 – Common Input (C)
11	Channel 2 – Shield (S)	12	Channel 2 – Chassis Ground
13	Channel 3 – Current Source Output (I)	14	Channel 3 – Input (H)
15	Channel 3 – Input (R)	16	Channel 3 – Common Input (C)
17	Channel 3 – Shield (S)	18	Channel 3 – Chassis Ground
19	Channel 4 – Current Source Output (I)	20	Channel 4 – Input (H)
21	Channel 4 – Input (R)	22	Channel 4 – Common Input (C)
23	Channel 4 – Shield (S)	24	Channel 4 – Chassis Ground

Table 10-1: Definition of terminals for connectors J1 to J4 on the IOC8T card (continued)

Terminal	Definition	Terminal	Definition
Connector J2: Connection of sensors 5 to 8			
1	Channel 5 – Current Source Output (I)	2	Channel 5 – Input (H)
3	Channel 5 – Input (R)	4	Channel 5 – Common Input (C)
5	Channel 5 – Shield (S)	6	Channel 5 – Chassis Ground
7	Channel 6 – Current Source Output (I)	8	Channel 6 – Input (H)
9	Channel 6 – Input (R)	10	Channel 6 – Common Input (C)
11	Channel 6 – Shield (S)	12	Channel 6 – Chassis Ground
13	Channel 7 – Current Source Output (I)	14	Channel 7 – Input (H)
15	Channel 7 – Input (R)	16	Channel 7 – Common Input (C)
17	Channel 7 – Shield (S)	18	Channel 7 – Chassis Ground
19	Channel 8 – Current Source Output (I)	20	Channel 8 – Input (H)
21	Channel 8 – Input (R)	22	Channel 8 – Common Input (C)
23	Channel 8 – Shield (S)	24	Channel 8 – Chassis Ground
Connector J3: DC Outputs (DC OUT n) and DSI control inputs (AR and DB)			
1	DC Output 1 (DC OUT 1) – Signal	2	DC Output 1 (DC OUT 1) – Return
3	DC Output 2 (DC OUT 2) – Signal	4	DC Output 2 (DC OUT 2) – Return
5	DC Output 3 (DC OUT 3) – Signal	6	DC Output 3 (DC OUT 3) – Return
7	DC Output 4 (DC OUT 4) – Signal	8	DC Output 4 (DC OUT 4) – Return
9	DC Output 5 (DC OUT 5) – Signal	10	DC Output 5 (DC OUT 5) – Return
11	DC Output 6 (DC OUT 6) – Signal	12	DC Output 6 (DC OUT 6) – Return
13	DC Output 7 (DC OUT 7) – Signal	14	DC Output 7 (DC OUT 7) – Return
15	DC Output 8 (DC OUT 8) – Signal	16	DC Output 8 (DC OUT 8) – Return
17	Alarm Reset (AR) – Input	18	Alarm Reset (AR) – Return (0 V digital)
19	Danger Bypass (DB) – Input	20	Danger Bypass (DB) – Return (0 V digital)

Table 10-1: Definition of terminals for connectors J1 to J4 on the IOC8T card (continued)

Terminal	Definition	Terminal	Definition
Connector J4: Relay contacts			
1	Relay RL1 – NC contact (normally closed)		
2	Relay RL1 – NO contact (normally open)		
3	Relay RL1 – COM contact (common)		
4	Relay RL2 – NC contact		
5	Relay RL2 – NO contact		
6	Relay RL2 – COM contact		
7	Relay RL3 – NC contact		
8	Relay RL3 – NO contact		
9	Relay RL3 – COM contact		
10	Relay RL4 – NC contact		
11	Relay RL4 – NO contact		
12	Relay RL4 – COM contact		

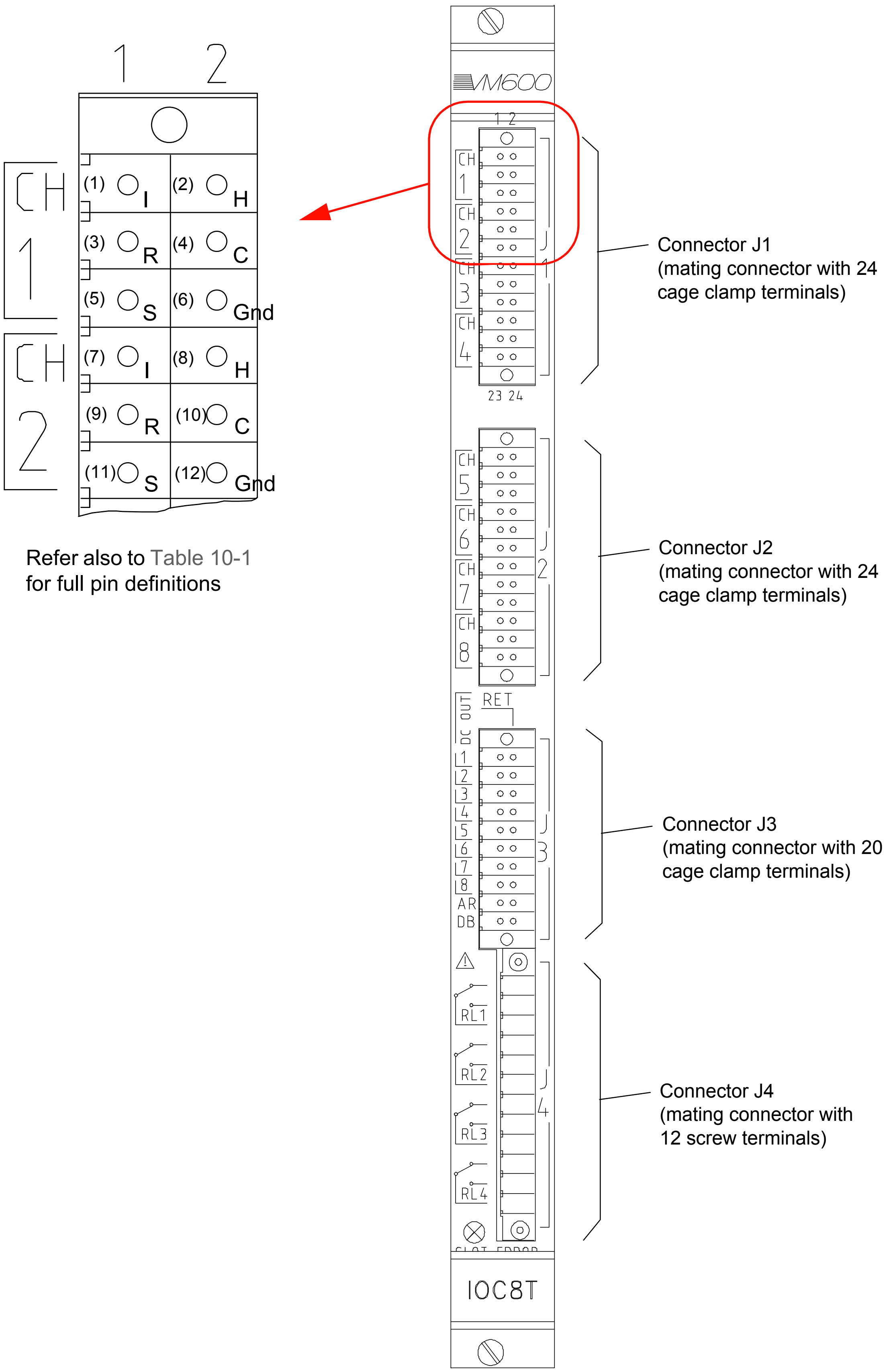


Figure 10-1: View of IOC8T card showing definition of terminals (without mating connectors)

10.2 Connecting sensors to the IOC8T

The IOC8T panel has six terminals for each of the 8 measurement channels. These terminals are as follows:

- I — Current source output
- H — Positive signal input
- R — Measuring resistor input for current-based signals (4 to 20 mA)
- C — Common input
- S — Shield
- (Unnamed) — A terminal for chassis ground.

Typical connection diagrams are shown below.

10.2.1 Setting of jumper J805

A measuring resistor (Rm) for current-based signals can be switched in across terminals R and C by jumper J805. The setting of this jumper is not important for most connection cases, apart from the following exceptions:

- The jumper must be removed for 4-wire RTD connection using the “true 4-wire arrangement”. See Figure 10-7 (b).
- The jumper must be placed for measuring current-based signals. See Figure 10-8.

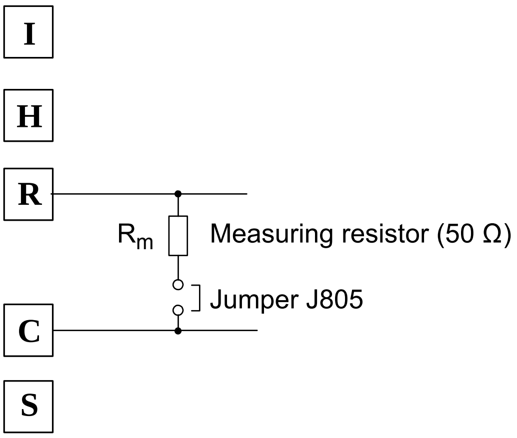


Figure 10-2: Measuring resistor and jumper J805

Each channel has its own jumper J805. These are identified by a suffix (A to H) as follows:

Channel 1: Jumper J805_A	Channel 5: Jumper J805_E
Channel 2: Jumper J805_B	Channel 6: Jumper J805_F
Channel 3: Jumper J805_C	Channel 7: Jumper J805_G
Channel 4: Jumper J805_D	Channel 8: Jumper J805_H.

The position of these jumpers on the IOC8T is shown in Figure 10-3.

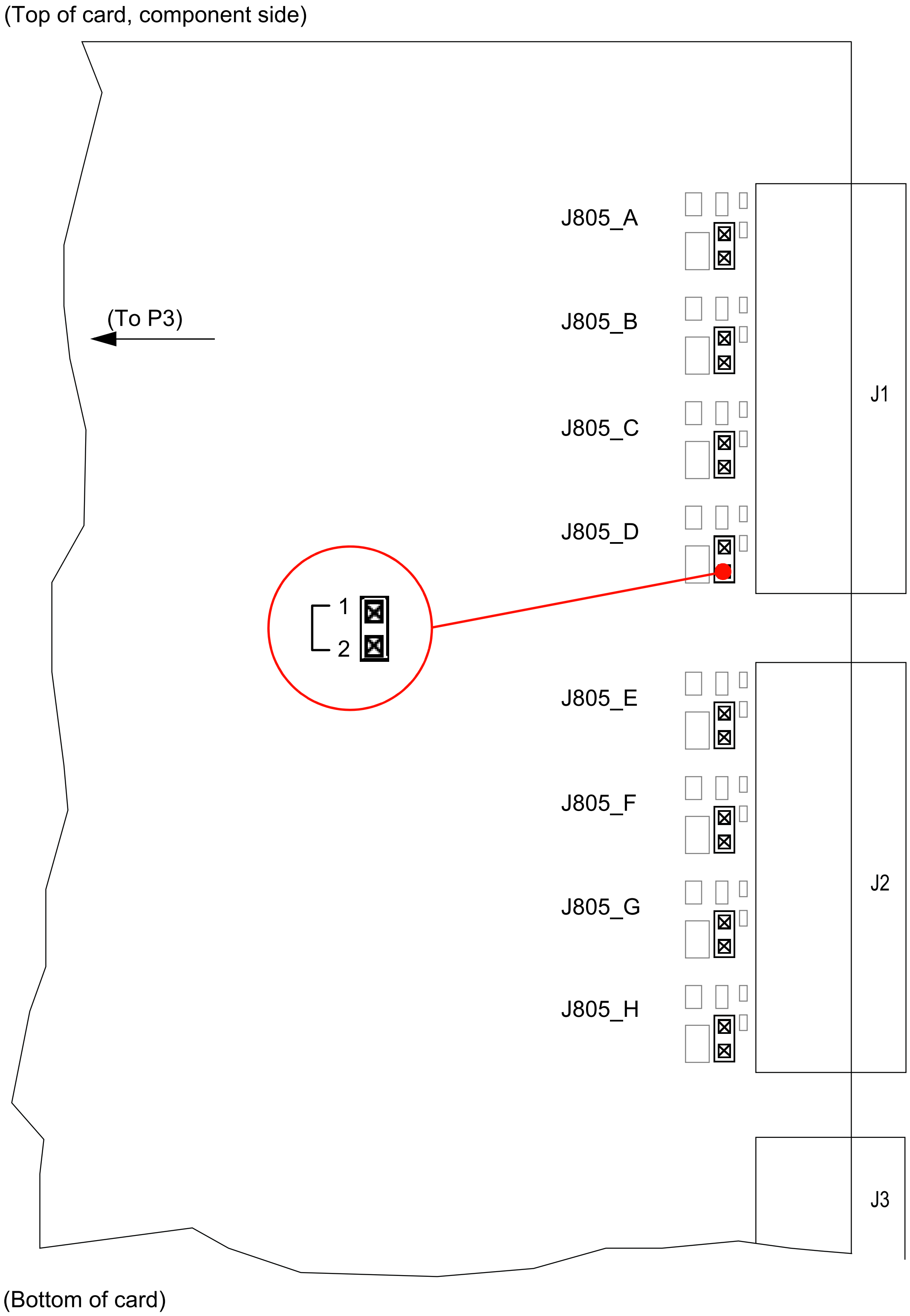


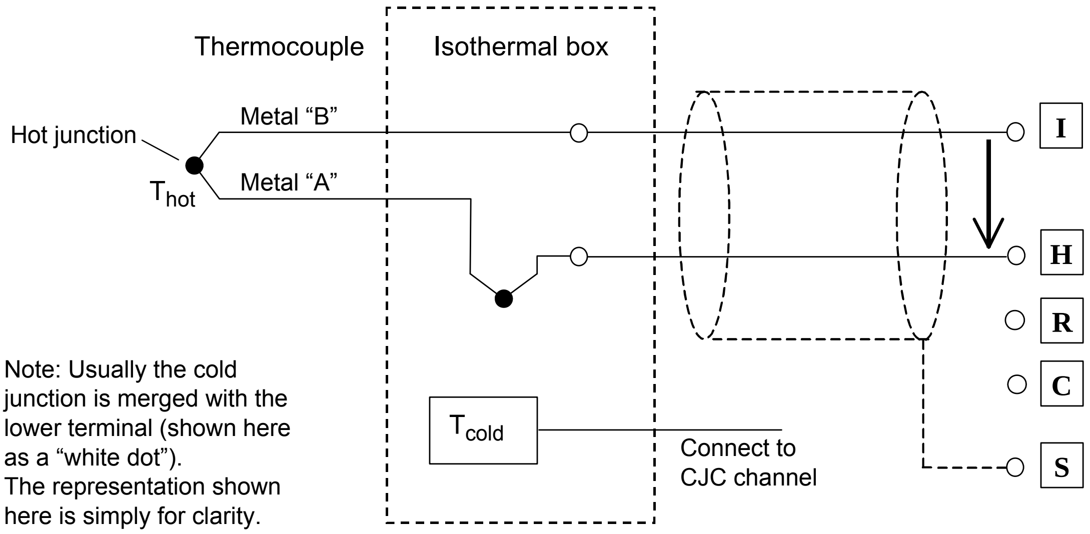
Figure 10-3: Position of jumpers J805_x on IOC8T card

10.2.2 Connecting thermocouples

The operating principle of a thermocouple (TC) is based on the Seebeck effect. If two dissimilar metal wires are soldered together at one end (the “hot” junction), a voltage in the mV range will be generated across the free ends (the “cold” junction). This voltage is proportional to the difference in temperature between the hot and cold junctions. The temperature of the cold junction should be measured by another sensor (preferably a RTD device) and this signal is then used for compensation purposes. This technique is known as cold junction compensation (CJC).

The hot junction is placed at the measuring point. The cold junction should ideally be on a terminal strip placed in an isothermal box, that is, one in which there is a negligible temperature difference between the junctions on the terminal pins, creating a negligible voltage error.

Another temperature sensor measures the internal temperature of the box, near the terminal strip. This is processed by another channel on the AMC8 card and used for cold junction compensation (2 out of the 8 channels on the AMC8 can be configured for CJC purposes using the VM600 MPS software).



NOTE: The setting of jumper J805 is unimportant.

Figure 10-4: Wiring for thermocouple with CJC

10.2.3 Connecting RTD devices

An RTD (resistance temperature detector) is a metal wire resistor whose resistance varies with temperature in a precisely known manner. A known current is injected into the device and the resulting voltage across the resistor is measured.

Several connection possibilities exist:

1- 3-wire connection (see Figure 10-5)

This is the most common arrangement and takes the form of a bridge connection. It requires a shielded, 3-core cable. It uses two equal injection currents (i1 and i2) which allow compensation of the opposing voltages on RL1 and RL2. It is insensitive to line resistance provided that RL1 = RL2 and i1 = i2.
A disadvantage of the technique is that corroded contacts can make RL1 and RL2 different, thereby inducing measurement errors.

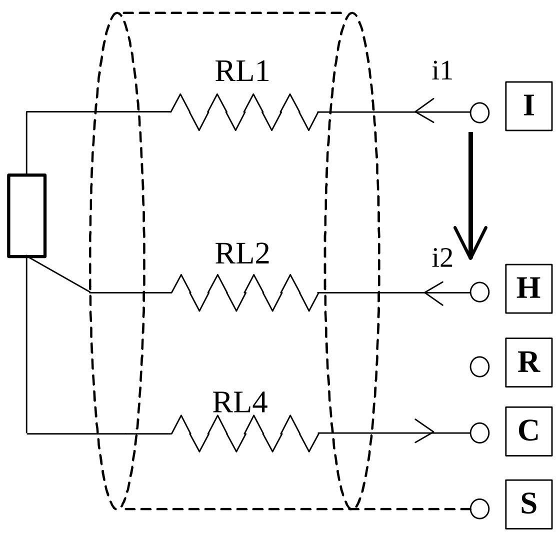
2- 2-wire connection (see Figure 10-6)

This is the worst arrangement as it is very sensitive to line resistance. Despite this, it is quite commonly used with RTDs having a low resistance value (for example, Cu10). It is often built into the stator of old hydro alternators. The 2-wire technique demands high performance on the part of the measuring chain.

3- 4-wire connections (see Figure 10-7)

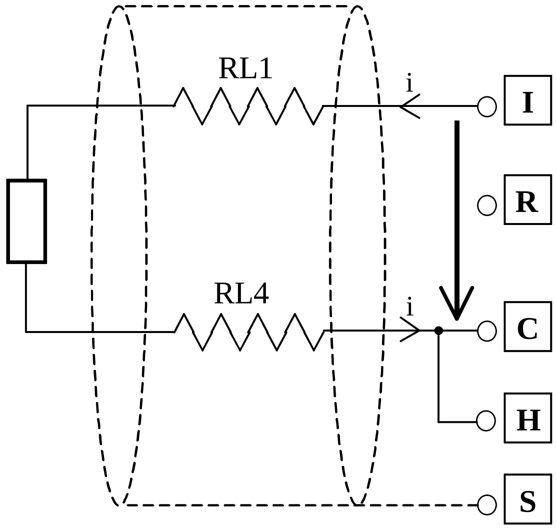
This arrangement (also known as “Kelvin connection”) is the best and the least sensitive to disturbances. The current path and voltage path are well separated. The arrangement is insensitive to corroded contacts.

In the 3-wire plus shield arrangement (case (a) of Figure 10-7), the measuring current return flows through the shield. In terms of EMC, this is less favourable than the true 4-wire arrangement (case (b) of Figure 10-7).



NOTE: The setting of jumper J805 is unimportant.

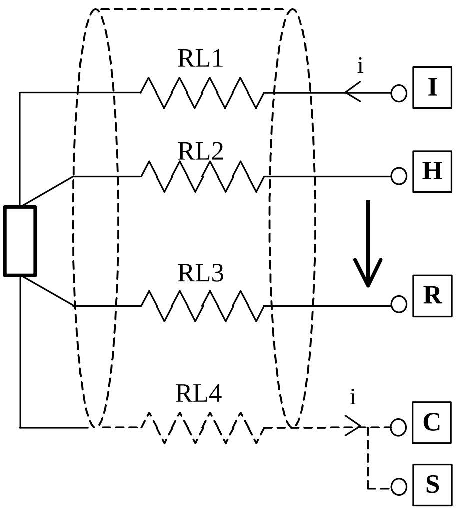
Figure 10-5: 3-wire RTD connection



NOTE: The setting of jumper J805 is unimportant.

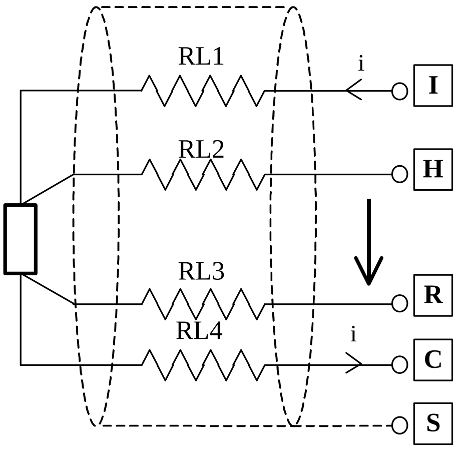
Figure 10-6: 2-wire RTD connection

(a) 3-wire plus shield arrangement



NOTE: The setting of jumper J805 is unimportant.

(b) True 4-wire arrangement



NOTE: Jumper J805 must be removed.

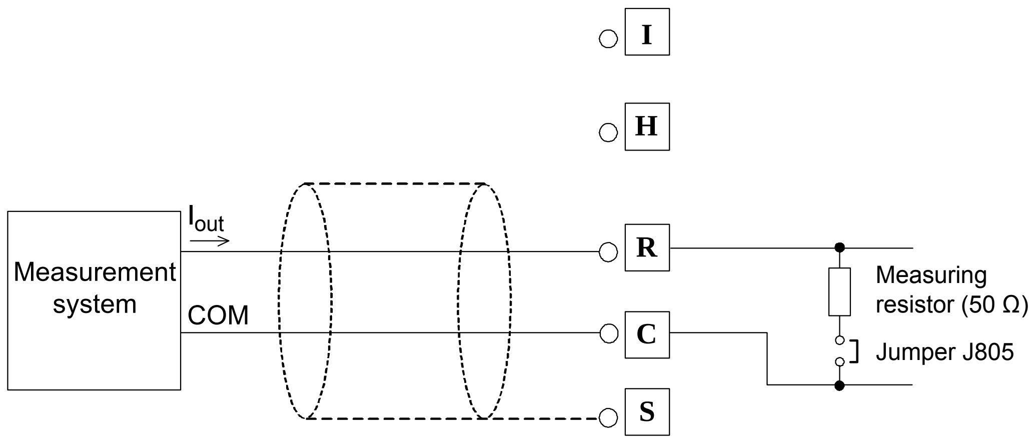
Figure 10-7: 4-wire RTD connections

10.2.4 Connecting other sensors (process values)

The AMC8 / IOC8T card pair can process signals coming from a variety of other devices such as flow rate detectors, fluid level detectors and so on. The pair can process current-based and voltage-based signals.

10.2.4.1 Current-based signal

Devices that output a current-based signal (4 to 20 mA) should be connected to the IOC8T as shown in Figure 10-8.

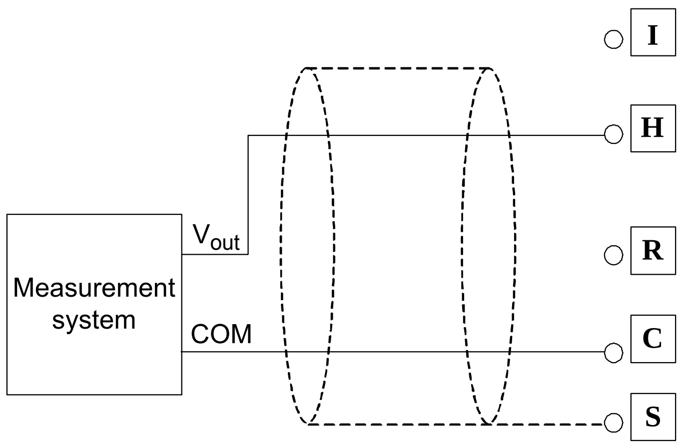


NOTE: Jumper J805 must be placed to switch in the measuring resistor.

Figure 10-8: Connection of systems that output a current-based signal

10.2.4.2 Voltage-based signal

Devices that output a voltage-based signal (0 to 10 V) should be connected to the IOC8T as shown in Figure 10-9.



NOTE: The setting of jumper J805 is unimportant.

Figure 10-9: Connection of systems that output a voltage-based signal

10.3 Configuring the four local relays on the IOC8T

Connector J4 of the IOC8T card has terminals for the following four relay outputs:

- RL1 – Pins 1, 2 and 3 on connector J4
- RL2 – Pins 4, 5 and 6 on connector J4
- RL3 – Pins 7, 8 and 9 on connector J4
- RL4 – Pins 10, 11 and 12 on connector J4.

Specific alarms can be attributed to these relays using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

As explained in 9.4.2 Operation of relays, micro-switches must be set on the IOC8T card to configure each relay as normally energised (NE) or normally de-energised (NDE). See Figure 10-10 for the position of the micro-switches on the IOC8T card.

10.3.1 Relay terminology

See 9.4.1 Relay terminology.

10.3.2 Operation of relays

See 9.4.2 Operation of relays.

10.4 Configuring the eight DC outputs

The eight DC outputs (DC OUT 1 to DC OUT 8) on connector J3 of the IOC8T card are factory configured to provide a current-based output (4 to 20 mA).

Optionally, all eight can be configured as voltage-based outputs (0 to 10 V). This requires the setting of a solder bridge on the IOC8T card.

Note that it is not possible to have a mixture of current-based and voltage-based outputs.

NOTE: Contact your nearest Meggitt Sensing Systems representative for further information.

10.5 DSI control inputs (DB, AR)

These DSI control inputs are normally floating (open circuit).

To activate a function, connect the appropriate “Input” and “Return” terminals together to close the contact.

The inputs function as follows:

- Danger Bypass (DB): A closed contact between the DB Input and DB Return terminals allows the operator to inhibit the danger relay outputs.
  DB Input = Connector J3, Terminal 19
  DB Return = Connector J3, Terminal 20.
- Alarm Reset (AR): A closed contact between the AR Input and AR Return terminals resets any latched alarms.
  AR Input = Connector J3, Terminal 17
  AR Return = Connector J3, Terminal 18.

NOTE: An externally generated Alarm Reset (AR) should be an aperiodic pulse-type signal, that is, it should not be activated continuously.

For further information on the Danger Bypass function, see 4.6.5 Danger Bypass function.

10.6 Channel inhibit function

The channel inhibit function can only be activated using software, that is, there is no equivalent DSI input.

The channel inhibit function is activated when one of the VM600 MPS software packages (MPS1 or MPS2) is used to send channel inhibit commands to individual AMC8 channels (**Communications > To AMC > Channel Inhibits**).

Alternatively, Modbus can be used to control the channel inhibit function for a networked VM600 machinery protection system (containing a CPUM card).

For further information on the channel inhibit function, see 5.7.4 Channel inhibit function.

10.7 Slot number coding for IOC8T cards

IOC8T cards use an electronic keying mechanism to help prevent them from being installed in the wrong slot of a VM600 rack. Each IOC8T card has a bank of micro-switches that are used to assign a slot number to the card, stored in the slot number (address) assignation register.

The IOC8T card compares its slot number with the rack’s slot number (see Figure 2-2). The result of the comparison is displayed on the SLOT ERROR LED on the cards panel:

- If the codes are identical, the LED is green.
- If the codes are not identical, the LED is red.

10.7.1 VM600 system rack

When an IOC8T card is installed in a VM600 system rack, the micro-switches on the card must be configured to match the rack slot (slot number) being used (see 2.1.2 Slot number coding for cards in the rear of a rack).

The example in Figure 10-10 shows the micro-switch settings required for an IOC8T card installed in slot 11 of a rack.

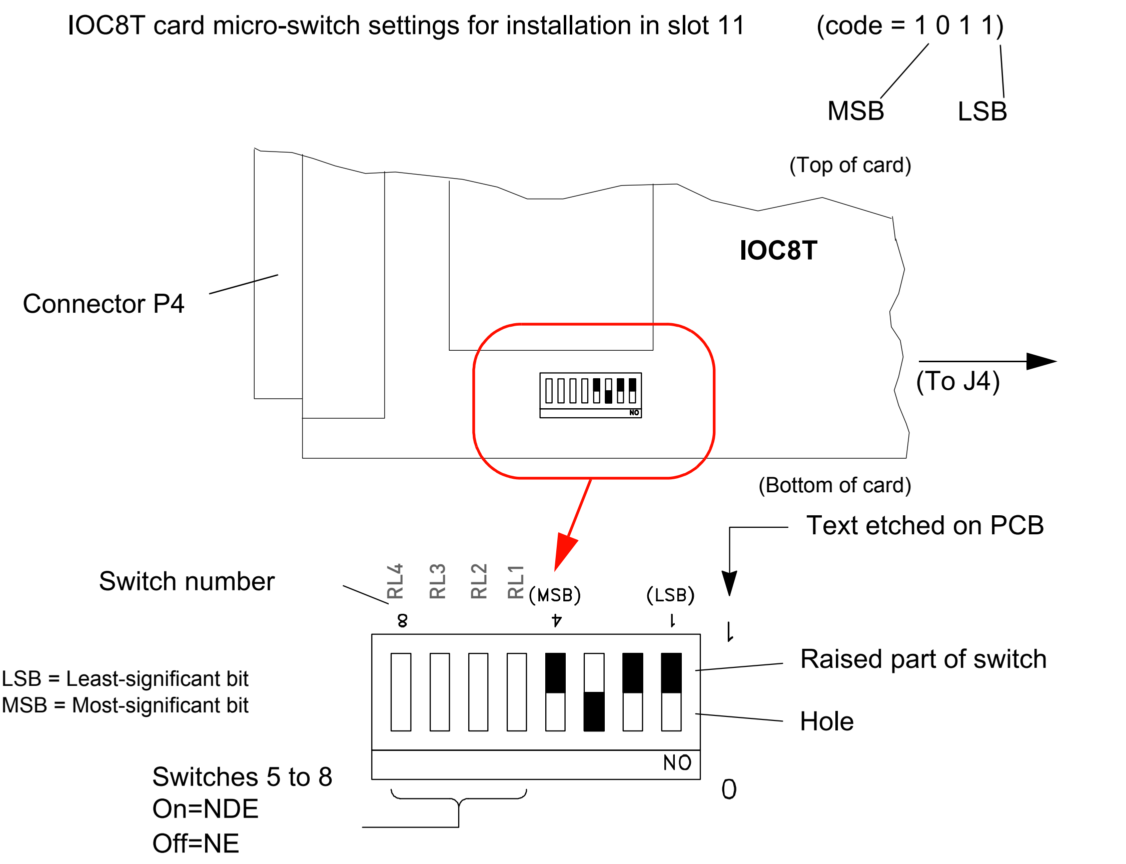


Figure 10-10: Position of micro-switches to assign the IOC8T slot number and configure relays as NE/NDE

NOTE: Pay attention to the polarity of the micro-switches!
Note that “0" corresponds to ON.

10.8 Assigning alarm signals to relays on the RLC16 card

The IOC8T card contains the following four local relays for signalling alarms: RL1, RL2, RL3 and RL4.

Specific alarms can be attributed to these relays using the VM600 MPSx software.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

A large number of alarm signals can be processed by the MPS. The possible alarms are summarised in the table below:

Figure 10-11: Available alarm signals (AMC8 / IOC8T card pair)

	Individual channels								Multi-channels			
	1	2	3	4	5	6	7	8	1	2	3	4
Alert+												
Alert−												
Danger+												
Danger−												
Global Channel OK												
Channel Status *												

Basic logical combinations of alarms	Up to 16 possibilities
Advanced logical combinations of alarms	Up to 8 possibilities

Key:

(green)	=	Alarm available
N/A	=	Alarm not available

* Channel Status = AMC Configuration Not Running, Alarm Reset and so on.

Any of these alarm signals can be sent to the RLC16 card to switch relays. This is achieved by either of the following two means:

1- Using the Open Collector Bus (OC Bus)

This is the normal method of switching relays. Hardware settings required for this method are described in 10.8.1 Using the Open Collector Bus (OC Bus) to switch relays.

Refer also to 3.4.3 Open Collector Bus for a description of the OC Bus.

2- Using the Raw Bus

This method can be used if the 16 lines provided by the OC Bus are insufficient, or if only a few relays are required for more than two MPC cards. This method is described in 10.8.2 Using the Raw Bus to switch relays.

Refer also to 3.4.4 Raw Bus for a description of the Raw Bus.

10.8.1 Using the Open Collector Bus (OC Bus) to switch relays

Figure 10-12 shows the operating principle when the OC Bus is used to switch relays.

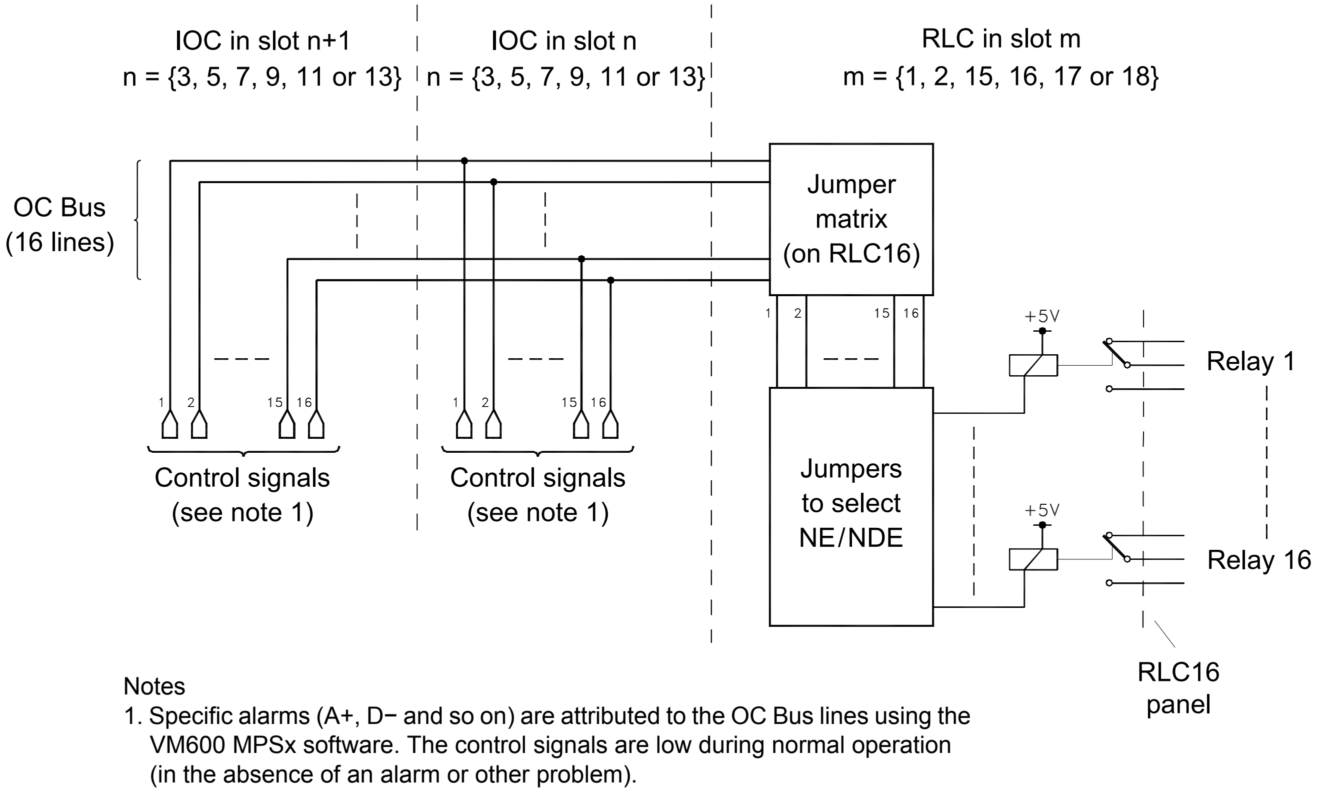


Figure 10-12: Using the Open Collector Bus (OC Bus) to switch relays

The attribution of a specific alarm signal (generated by the AMC8 / IOC8T cards) to a control signal line (and therefore to an OC Bus line) is done using the VM600 MPSx software.

These alarm signals include Alert, Danger, Global Channel OK Fail, AMC Configuration Not Running, Status Latched. During normal operation (that is, when no alarms/problems present) the corresponding control signals are low. They become high when an alarm or other problem is detected.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

The attribution of a specific line on the OC Bus to a specific relay on the RLC16 is done by setting a jumper on the RLC16 card. Additional jumpers allow the selection of relay normally energised (NE) or normally de-energised (NDE). The jumper settings are summarised in Table 10-2 and the position of the relevant jumpers on the RLC16 card is shown in Figure 10-14.

NOTE: See 3.4.3 Open Collector Bus for further information on the OC Bus.

10.8.1.1 Configuration procedure (OC Bus)

To configure a particular relay on the RLC16 card using the OC Bus, proceed as follows:

1- Consult Table 10-2 (this lists the jumpers associated with each relay).

2- For the relay in question, set the appropriate jumper on the RLC16 card.

3- Set the appropriate jumper to configure the relay as normally energised (NE) or normally de-energised (NDE).

NOTE: Make sure that either the NE or the NDE jumper is set. You cannot set both of them together.

4- Using the VM600 MPSx software, select the **Discrete Outputs** node (a child of the **Output Mapping** node) in the tree structure (left). Then expand the **RLC/OC bus** node in the main window (right) and select the relay in question (between 1 and 16). See Figure 10-13.

5- Configure the **Source** and **Type** fields of this window.

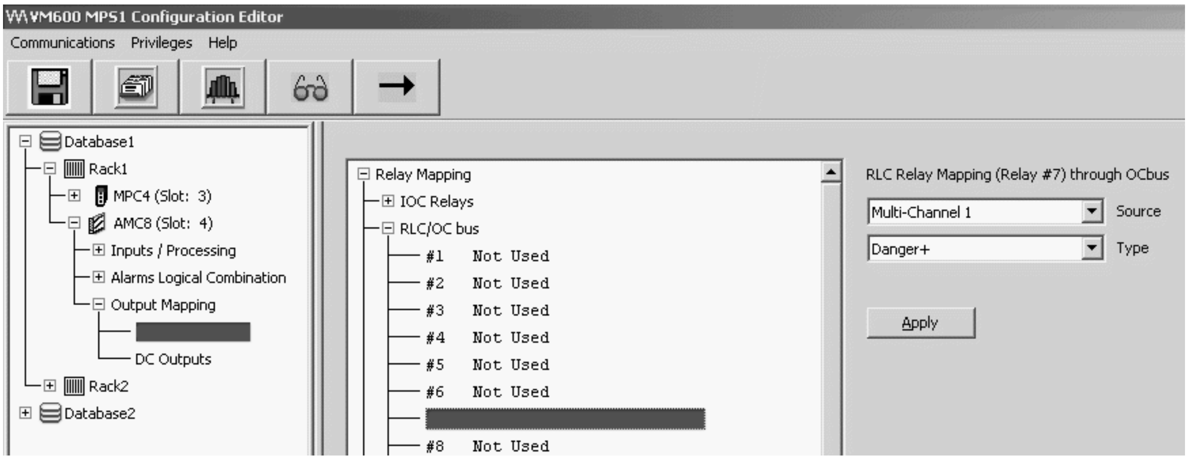


Figure 10-13: VM600 MPS software window to configure the OC Bus

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NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

Configuration example

A user wants to assign the alarm signal “Danger+" generated on Multi-Channel 1 of a given AMC8 card to Relay 7 on the RLC16 card. In addition, the user wants Relay 7 to be in a normally energised (NE) state.

Relay 7 is selected by placing jumper J31 on the RLC16 card (see Table 10-2).

(Note that this operation actually selects OC Bus Line 6. This information, however, does not normally concern the user, as the VM600 MPS software takes it into account.)

Placing jumper J88 will ensure that Relay 7 is normally energised (see Table 10-2).

The user must then use the VM600 MPSx software to select Relay 7 from the 16 relays available in the **RLC/OC bus** node. Then, the Danger+ alarm for Multi-Channel 1 can be assigned to this relay (see Figure 10-13).

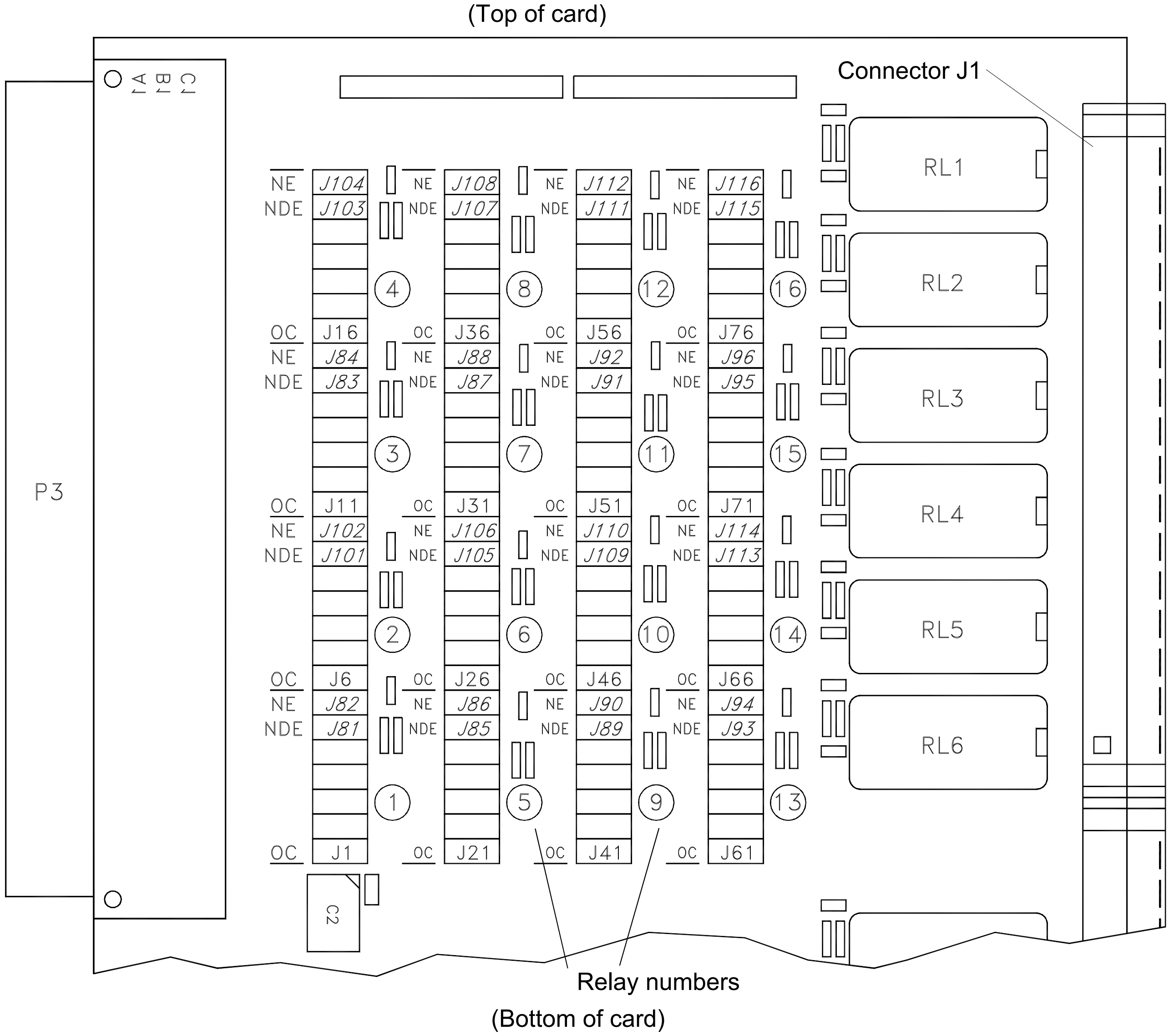


Figure 10-14: Position of jumpers on the RLC16 card related to the OC Bus

10.8.2 Using the Raw Bus to switch relays

The Raw Bus can be used to supplement the OC Bus by allowing additional alarm signals to be routed to the relays on the RLC16 card. (The Raw Bus is common to all IOC8T and RLC16 cards.)

MPS configuration example

An example illustrating the use of the Raw Bus is shown in Figure 10-15. In this example, four AMC8 cards and their corresponding IOC8T cards are mounted in a rack. It is assumed that the Open Collector Bus is used to convey alarm signals to relay cards RLC #1 to RLC #4. The OC Bus lines are not shown on this drawing for the sake of clarity, but they effect the following links (see 3.4.3 Open Collector Bus):

- IOC #1 in slot 3 connects to RLC #1 in slot 1
- IOC #2 in slot 5 connects to RLC #2 in slot 2
- IOC #3 in slot 7 connects to RLC #3 in slot 15
- IOC #4 in slot 9 connects to RLC #4 in slot 16.

The Raw Bus in this example is used to allow each IOC card to access half an RLC card:

- IOC #1 and IOC #2 can access RLC #5 via Raw Bus lines 31 to 16
- IOC #3 and IOC #4 can access RLC #6 via Raw Bus lines 47 to 32.

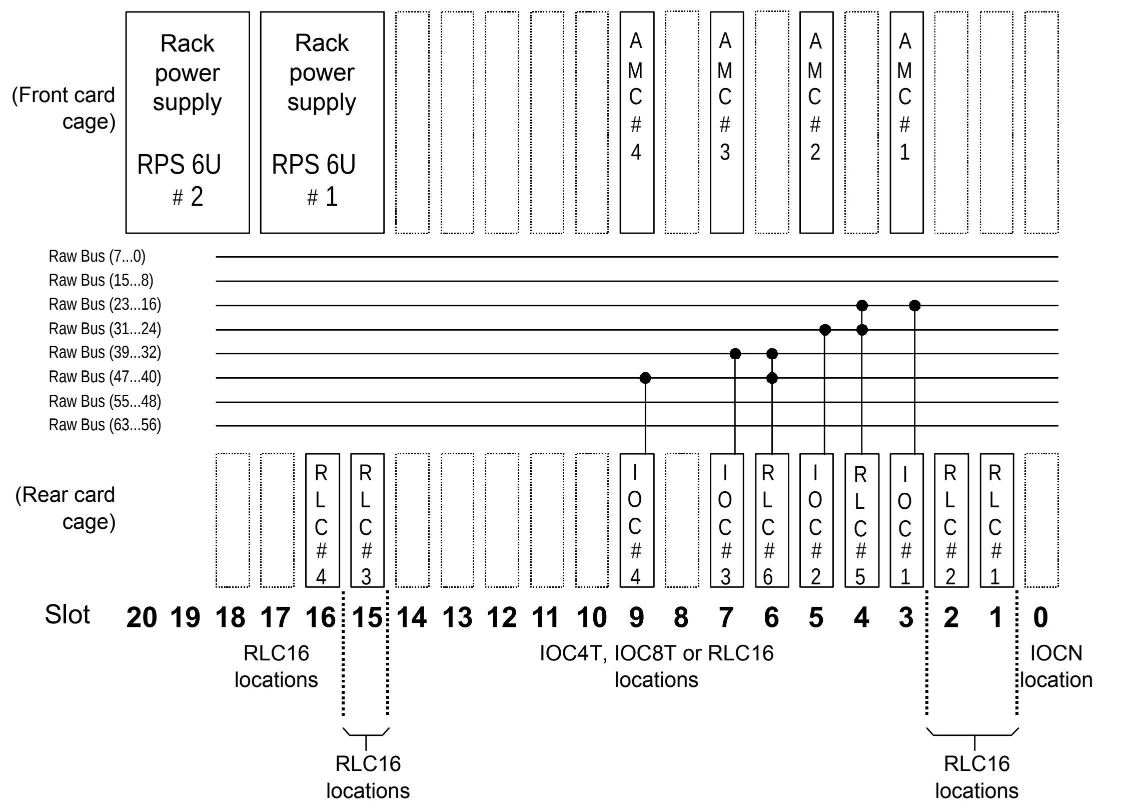
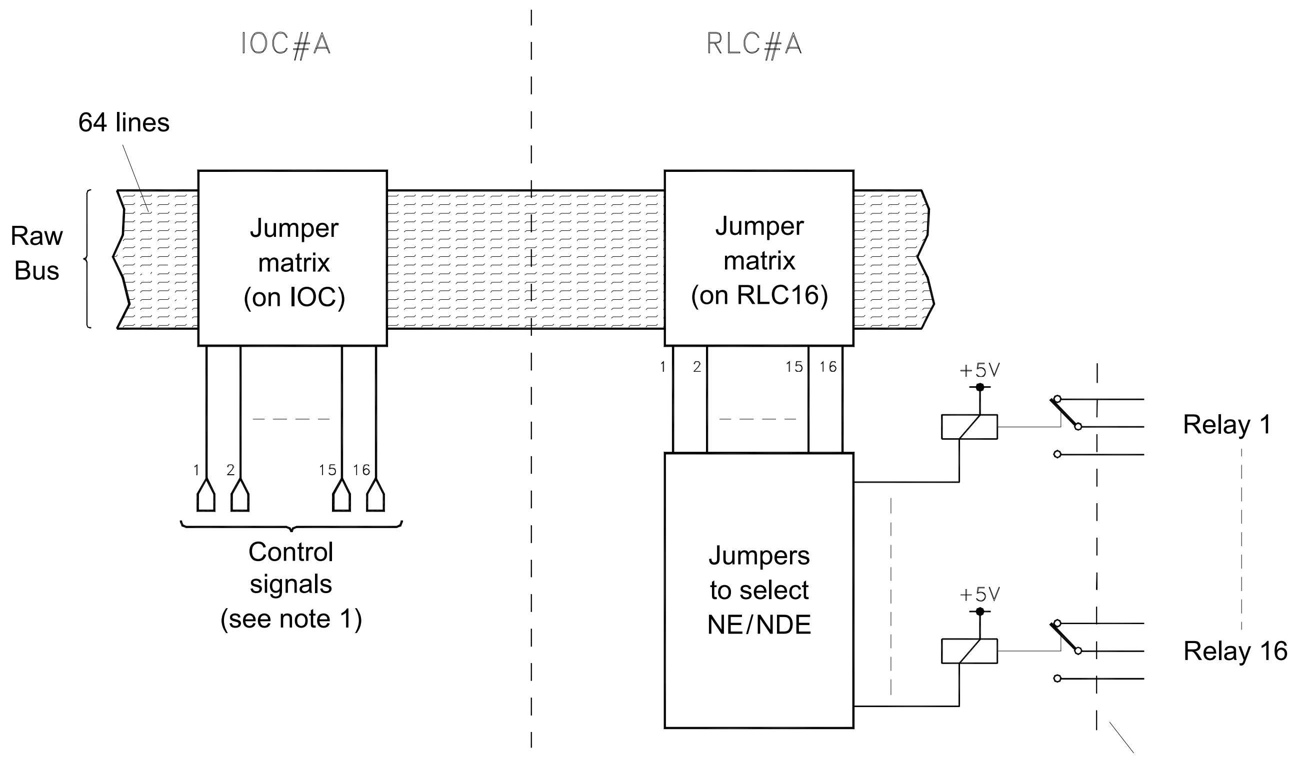


Figure 10-15: MPS configuration example showing use of the Raw Bus

Figure 10-16 shows the operating principle when the Raw Bus is used to switch relays.



Notes
1. Specific alarms (A+, D− and so on) generated by the corresponding AMC8 card are attributed to the control lines using the VM600 MPSx software. The control signals are low during normal operation (in the absence of an alarm or other problem).

Figure 10-16: Using the Raw Bus to switch relays

The attribution of a specific alarm signal (generated by the AMC8 / IOC8T cards) to a control signal line is done using the VM600 MPSx software.

These alarm signals include Alert, Danger, Global Channel OK Fail, AMC Configuration Not Running, Status Latched. During normal operation (that is, when no alarms/problems present) the corresponding control signals are low. They become high when an alarm or other problem is detected.

NOTE: Refer to the relevant manual for further information: *VM600 MPS1 software manual* or *VM600 MPS2 software manual*.

The attribution of a specific control signal line to a specific Raw Bus line is done by setting a jumper on the IOC8T card. The jumper settings are summarised in Table 10-2 and the position of the relevant jumpers on the IOC8T card is shown in Figure 10-18.

The control signal is subsequently routed towards a specific relay on the RLC16 card by setting a jumper on the RLC16. Additional jumpers on the RLC16 allow the selection of relay normally energised (NE) or normally de-energised (NDE). The jumper settings are summarised in Table 10-2 and the position of the relevant jumpers on the RLC16 card is shown in Figure 10-19.

The IOC8T card drives the Raw Bus lines using open collector driver circuitry. These bus lines do not have line terminations. (The principle is the same as for the Open Collector Bus, see Figure 3-7.)

10.8.2.1 Configuration procedure (Raw Bus)

To configure a particular relay on the RLC16 card using the Raw Bus, proceed as follows:

1- Consult Table 10-2 (this lists the Raw Bus lines and jumpers associated with each relay).

2- Choose a free Raw Bus line from the four that are associated with that relay.

3- For the relay and Raw Bus line in question, set the appropriate jumper on the RLC16 card.

4- Set the appropriate jumper on the RLC16 card to configure the relay as normally energised (NE) or normally de-energised (NDE).

NOTE: Make sure that either the NE or the NDE jumper is set. You cannot set both of them together.

5- For the relay and Raw Bus line in question, set the appropriate jumper on the IOC8T card.

6- Using the VM600 MPSx software, select the **Discrete Outputs** node (a child of the **Output Mapping** node) in the tree structure (left). Then expand the **RLC/Raw bus** node in the main window (right) and select the relay in question (between 1 and 16). See Figure 10-17.

7- Configure the **Source** and **Type** fields of this window.

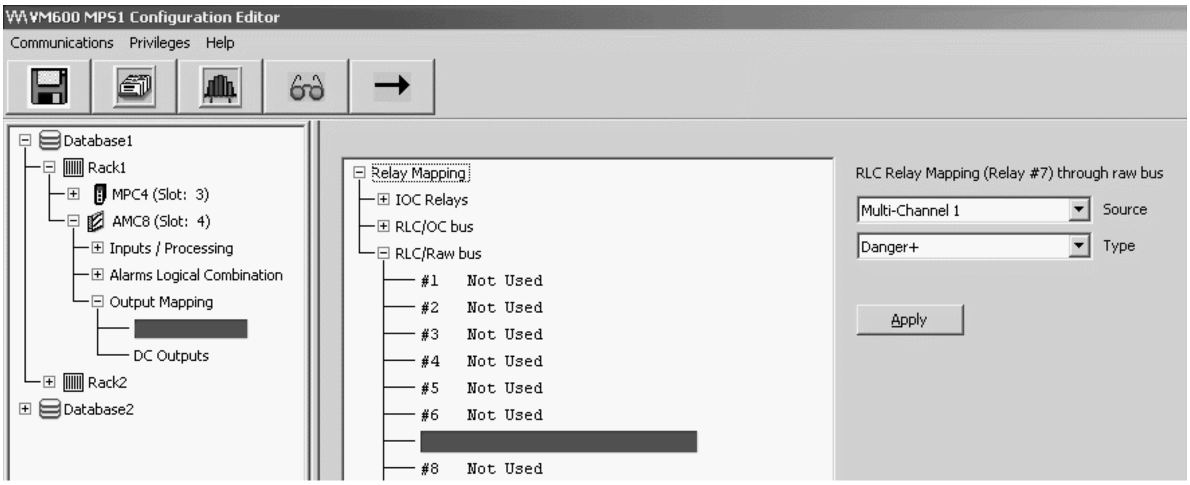


Figure 10-17: VM600 MPS software window to configure the Raw Bus

Configuration example

A user wants to assign the alarm signal "Danger+" generated on Multi-Channel 1 of a given AMC8 card to Relay 7 on the RLC16 card. In addition, the user wants Relay 7 to be in a normally-energised (NE) state.

Table 10-2 shows that Raw Bus lines 35, 43, 51 and 59 are associated with Relay 7.

The choice of one of these four lines will be dictated by the hardware configuration of the overall MPS, as certain bus lines may already be reserved for other functions. The desired bus line is then selected by placing the appropriate jumper on the RLC16 card (J32, J33, J34 or J35 in the case of Relay 7).

For the sake of this example, we will assume that Raw Bus line 51 is chosen. Jumper J34 therefore has to be set on the RLC16 card.

Placing jumper J88 will ensure that Relay 7 is normally energised (see Table 10-2).

Jumper J138 now has to be set on the IOC8T card.

The user must then use the VM600 MPSx software to select Relay 7 from the 16 relays available in the **RLC/Raw bus** node. Then, the Danger+ alarm for Multi-Channel 1 can be assigned to this relay (see Figure 10-17).

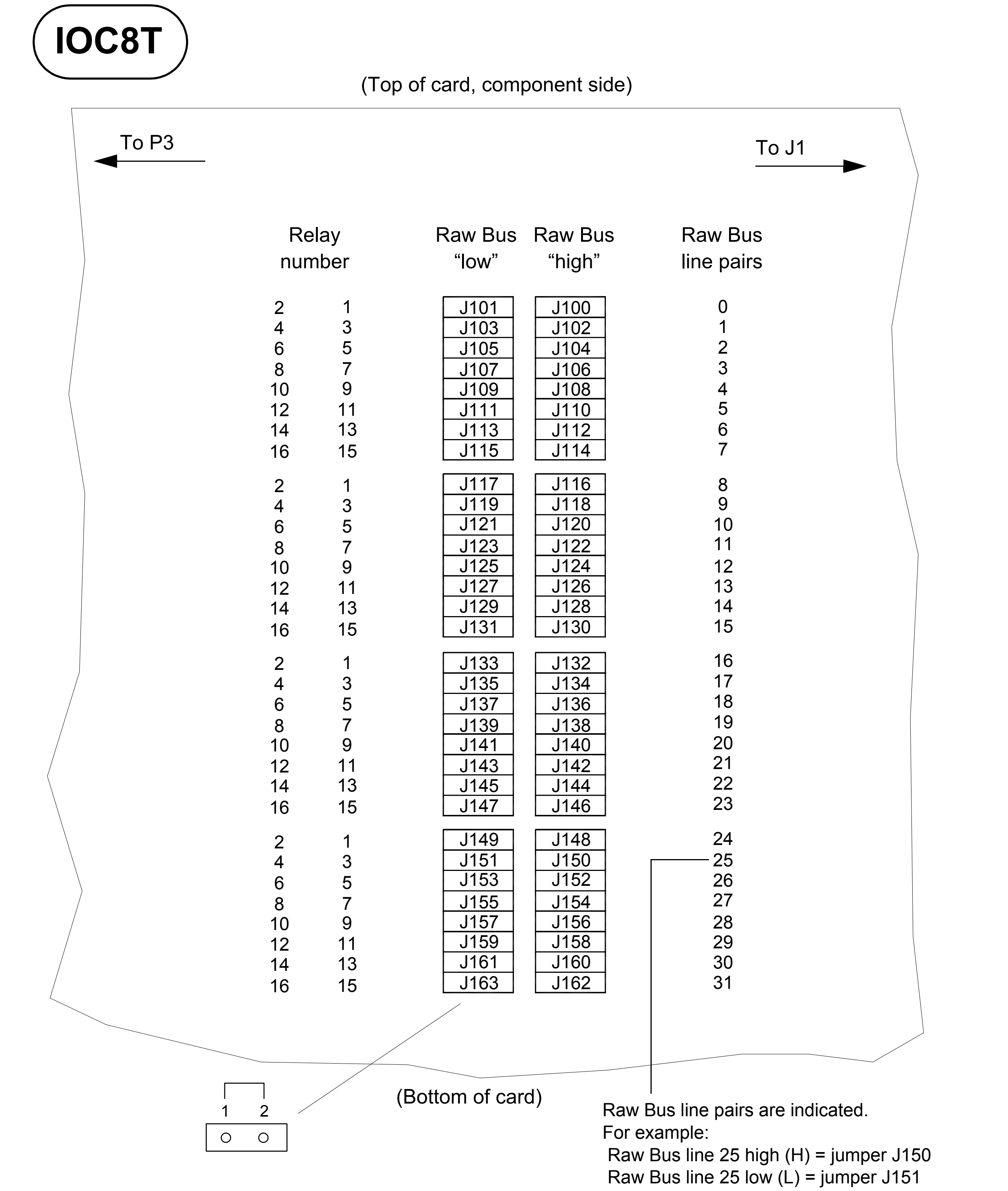


Figure 10-18: Position of jumpers on the IOC8T card related to the Raw Bus lines

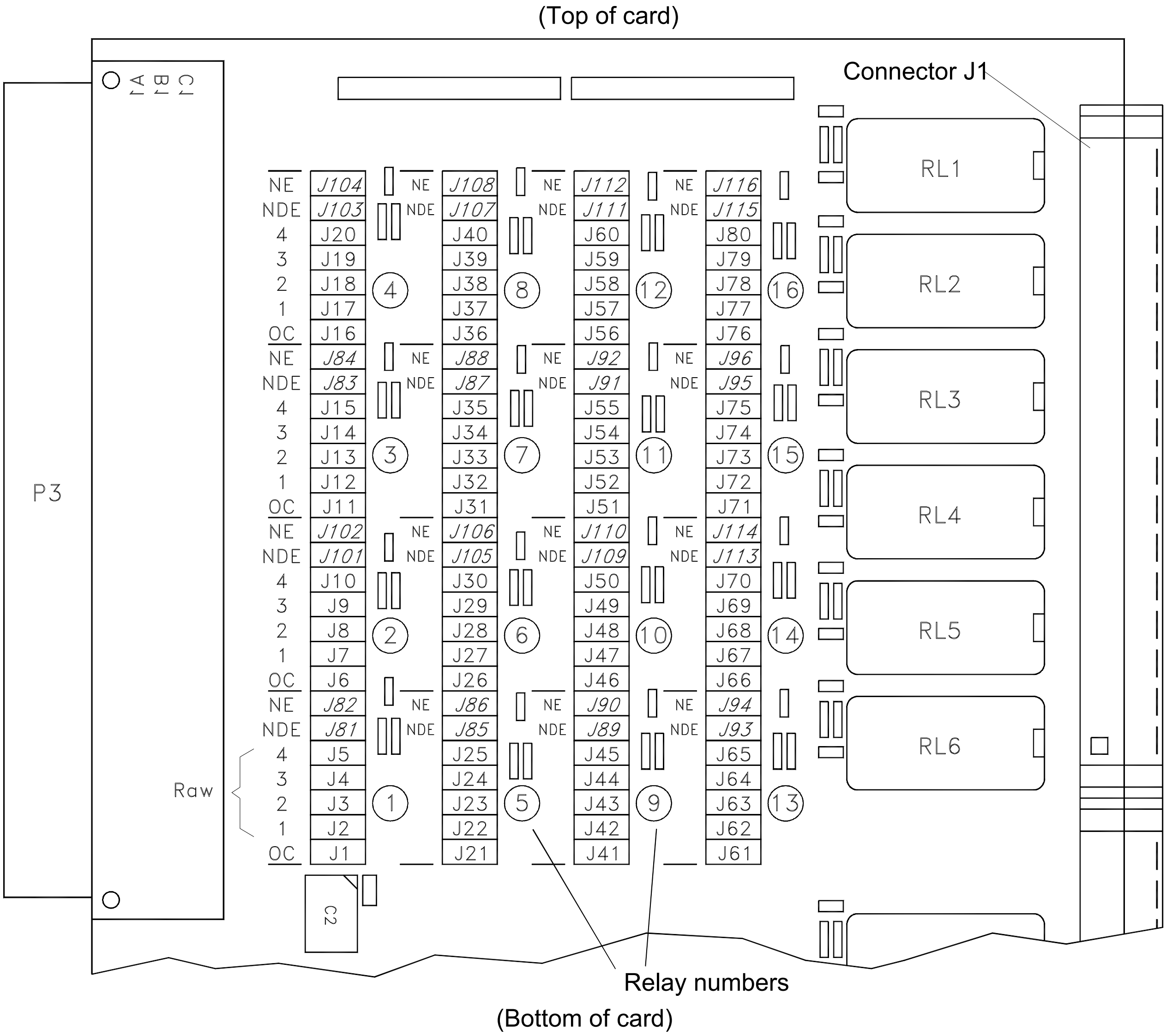


Figure 10-19: Position of jumpers on the RLC16 card related to the OC Bus and the Raw Bus

Table 10-2: Jumpers and bus lines associated with relays on RLC16 card

Relay number (on RLC16)	Line number		Jumper settings				Raw Bus signal line used
	OC Bus	Raw Bus	On IOC8T (see note 1)	On RLC16			
				To select the relay	To set the relay NE	To set the relay NDE	
1	0	- - -	- - -	J1	J82	J81	- - -
	- - -	32	J100	J2	J82	J81	0 High
	- - -	40	J116	J3	J82	J81	8 High
	- - -	48	J132	J4	J82	J81	16 High
	- - -	56	J148	J5	J82	J81	24 High
2	1	- - -	- - -	J6	J102	J101	- - -
	- - -	0	J101	J7	J102	J101	0 Low
	- - -	8	J117	J8	J102	J101	8 Low
	- - -	16	J133	J9	J102	J101	16 Low
	- - -	24	J149	J10	J102	J101	24 Low
3	2	- - -	- - -	J11	J84	J83	- - -
	- - -	33	J102	J12	J84	J83	1 High
	- - -	41	J118	J13	J84	J83	9 High
	- - -	49	J134	J14	J84	J83	17 High
	- - -	57	J150	J15	J84	J83	25 High
4	3	- - -	- - -	J16	J104	J103	- - -
	- - -	1	J103	J17	J104	J103	1 Low
	- - -	9	J119	J18	J104	J103	9 Low
	- - -	17	J135	J19	J104	J103	17 Low
	- - -	25	J151	J20	J104	J103	25 Low
5	4	- - -	- - -	J21	J86	J85	- - -
	- - -	34	J104	J22	J86	J85	2 High
	- - -	42	J120	J23	J86	J85	10 High
	- - -	50	J136	J24	J86	J85	18 High
	- - -	58	J152	J25	J86	J85	26 High
6	5	- - -	- - -	J26	J106	J105	- - -
	- - -	2	J105	J27	J106	J105	2 Low
	- - -	10	J121	J28	J106	J105	10 Low
	- - -	18	J137	J29	J106	J105	18 Low
	- - -	26	J153	J30	J106	J105	26 Low

Table 10-2: Jumpers and bus lines associated with relays on RLC16 card (continued)

	Line number		Jumper settings				
Relay number (on RLC16)	**OC Bus**	**Raw Bus**	**On IOC8T (see note 1)**	**On RLC16: To select the relay**	**On RLC16: To set the relay NE**	**On RLC16: To set the relay NDE**	**Raw Bus signal line used**
7	6	- - -	- - -	J31	J88	J87	- - -
	- - -	35	J106	J32	J88	J87	3 High
	- - -	43	J122	J33	J88	J87	11 High
	- - -	51	J138	J34	J88	J87	19 High
	- - -	59	J154	J35	J88	J87	27 High
8	7	- - -	- - -	J36	J108	J107	- - -
	- - -	3	J107	J37	J108	J107	3 Low
	- - -	11	J123	J38	J108	J107	11 Low
	- - -	19	J139	J39	J108	J107	19 Low
	- - -	27	J155	J40	J108	J107	27 Low
9	8	- - -	- - -	J41	J90	J89	- - -
	- - -	36	J108	J42	J90	J89	4 High
	- - -	44	J124	J43	J90	J89	12 High
	- - -	52	J140	J44	J90	J89	20 High
	- - -	60	J156	J45	J90	J89	28 High
10	9	- - -	- - -	J46	J110	J109	- - -
	- - -	4	J109	J47	J110	J109	4 Low
	- - -	12	J125	J48	J110	J109	12 Low
	- - -	20	J141	J49	J110	J109	20 Low
	- - -	28	J157	J50	J110	J109	28 Low
11	10	- - -	- - -	J51	J92	J91	- - -
	- - -	37	J110	J52	J92	J91	5 High
	- - -	45	J126	J53	J92	J91	13 High
	- - -	53	J142	J54	J92	J91	21 High
	- - -	61	J158	J55	J92	J91	29 High
12	11	- - -	- - -	J56	J112	J111	- - -
	- - -	5	J111	J57	J112	J111	5 Low
	- - -	13	J127	J58	J112	J111	13 Low
	- - -	21	J143	J59	J112	J111	21 Low
	- - -	29	J159	J60	J112	J111	29 Low

Table 10-2: Jumpers and bus lines associated with relays on RLC16 card (continued)

Relay number (on RLC16)	Line number		Jumper settings				Raw Bus signal line used
	OC Bus	Raw Bus	On IOC8T (see note 1)	On RLC16			
				To select the relay	To set the relay NE	To set the relay NDE	
13	12	- - -	- - -	J61	J94	J93	- - -
	- - -	38	J112	J62	J94	J93	6 High
	- - -	46	J128	J63	J94	J93	14 High
	- - -	54	J144	J64	J94	J93	22 High
	- - -	62	J160	J65	J94	J93	30 High
14	13	- - -	- - -	J66	J114	J113	- - -
	- - -	6	J113	J67	J114	J113	6 Low
	- - -	14	J129	J68	J114	J113	14 Low
	- - -	22	J145	J69	J114	J113	22 Low
	- - -	30	J161	J70	J114	J113	30 Low
15	14	- - -	- - -	J71	J96	J95	- - -
	- - -	39	J114	J72	J96	J95	7 High
	- - -	47	J130	J73	J96	J95	15 High
	- - -	55	J146	J74	J96	J95	23 High
	- - -	63	J162	J75	J96	J95	31 High
16	15	- - -	- - -	J76	J116	J115	- - -
	- - -	7	J115	J77	J116	J115	7 Low
	- - -	15	J131	J78	J116	J115	15 Low
	- - -	23	J147	J79	J116	J115	23 Low
	- - -	31	J163	J80	J116	J115	31 Low

Notes
1. To attribute a Raw Bus line to a relay, the appropriate jumper must have contacts 1-2 closed.

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11 USING THE RLC16 CARD

This chapter describes the connectors on the RLC16 card. These are accessed from the rear of a VM600 MPS rack.

11.1 Definition of screw terminals on the RLC16 card

The RLC16 panel (rear of rack) contains three terminal strips, identified as J1, J2 and J3 (see Figure 11-1). Each strip consists of a socket and a mating connector, which contains 16 screw terminals. The screw terminals can accept wires with a cross section of ≤1.5 mm^2.

Each socket and mating connector can be equipped with a mechanical key system to prevent incorrect connection.

Further details on these screw terminal contacts can be found in Table 11-1.

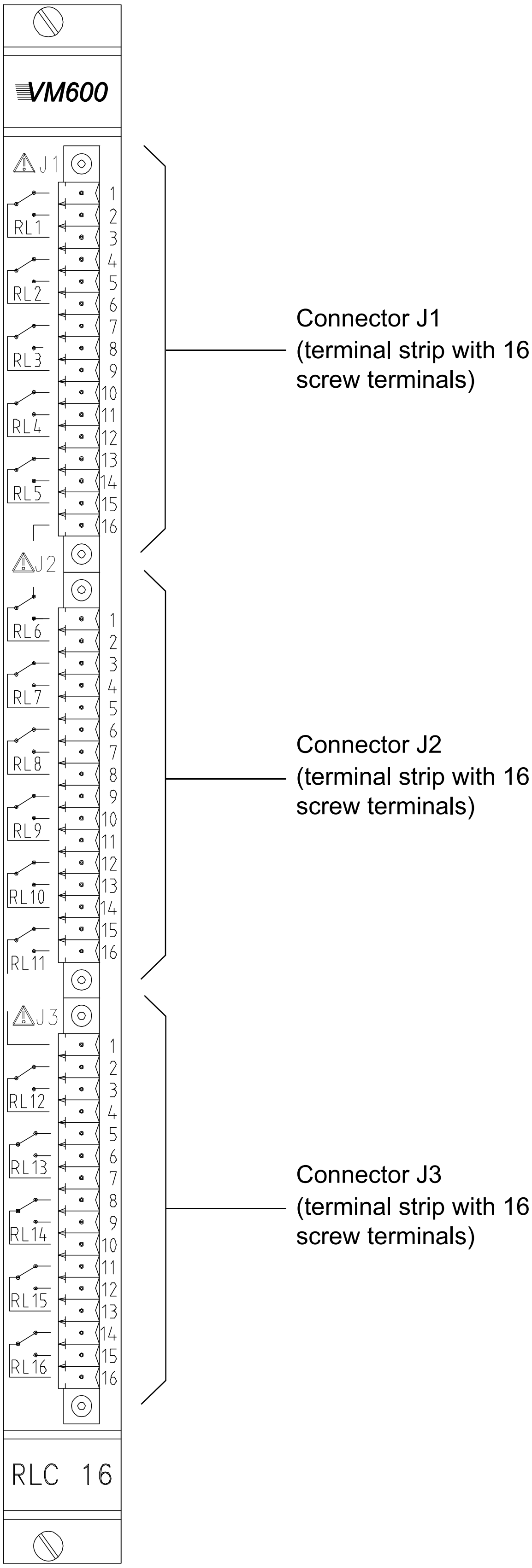

Figure 11-1: View of RLC16 card showing definition of terminals

Table 11-1: Definition of terminals for J1, J2 and J3 on the RLC16 card

Terminal	Name	Definition
Connector J1		
1	RL1	Relay 1 NC (normally closed) contact
2	RL1	Relay 1 NO (normally open) contact
3	RL1	Relay 1 COM (common) contact
4	RL2	Relay 2 NC
5	RL2	Relay 2 NO
6	RL2	Relay 2 COM
7	RL3	Relay 3 NC
8	RL3	Relay 3 NO
9	RL3	Relay 3 COM
10	RL4	Relay 4 NC
11	RL4	Relay 4 NO
12	RL4	Relay 4 COM
13	RL5	Relay 5 NC
14	RL5	Relay 5 NO
15	RL5	Relay 5 COM
16	RL6	Relay 6 NC
Connector J2		
1	RL6	Relay 6 NO
2	RL6	Relay 6 COM
3	RL7	Relay 7 NC
4	RL7	Relay 7 NO
5	RL7	Relay 7 COM
6	RL8	Relay 8 NC
7	RL8	Relay 8 NO
8	RL8	Relay 8 COM
9	RL9	Relay 9 NC
10	RL9	Relay 9 NO
11	RL9	Relay 9 COM
12	RL10	Relay 10 NC
13	RL10	Relay 10 NO
14	RL10	Relay 10 COM

Table 11-1: Definition of terminals for J1, J2 and J3 on the RLC16 card (continued)

Terminal	Name	Definition
15	RL11	Relay 11 NC
16	RL11	Relay 11 NO
Connector J3		
1	RL11	Relay 11 COM
2	RL12	Relay 12 NC
3	RL12	Relay 12 NO
4	RL12	Relay 12 COM
5	RL13	Relay 13 NC
6	RL13	Relay 13 NO
7	RL13	Relay 13 COM
8	RL14	Relay 14 NC
9	RL14	Relay 14 NO
10	RL14	Relay 14 COM
11	RL15	Relay 15 NC
12	RL15	Relay 15 NO
13	RL15	Relay 15 COM
14	RL16	Relay 16 NC
15	RL16	Relay 16 NO
16	RL16	Relay 16 COM

11.2 Connecting the RLC16 relays

The RLC16 panel has three screw terminals for each of its 16 relays. These terminals are as follows:

- NC – The normally closed relay contact
- NO – The normally open relay contact
- COM – The common relay contact.

The actual behaviour of each individual relay depends on the jumpers on the RLC16 card. For example, a relay can be configured to be normally energised (NE) or normally de-energised (NDE).

11.2.1 Relay terminology

See 9.4.1 Relay terminology.

11.2.2 Operation of relays

See 9.4.2 Operation of relays.

11.3 Configuring the RLC16 card

The RLC16 is used to supplement the on-board (local) relays on IOC4T and IOC8T cards. The jumpers on the RLC16 must be set up at the same time as these cards are configured.

For this reason, the configuration of the RLC16 card is described in the chapters concerning the MPC4 / IOC4T and AMC8 / IOC8T card pairs.

NOTE: See 9.12 Assigning alarm signals to relays on the RLC16 card and 10.8 Assigning alarm signals to relays on the RLC16 card for further information.

11.4 Slot number coding for RLC16 cards

The RLC16 card does not contain any electronic keying mechanism to prevent it being installed in the wrong slot of a VM600 rack. This is because the RLC16 does not contain any intelligence (that is, it is not programmed with a configuration) and does not function as a card pair (such as the MPC4 / IOC4T or AMC8 / IOC8T).

Although RLC16 cards can be installed in almost every slot of a rack (see 8.2 Attribution of slots in the rack), the actual slot location of an RLC16 card in a configured system is dictated by the Open Collector (OC) Bus (see 3.4.3 Open Collector Bus) and other details of the VM600 MPS system configuration.

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12 CONFIGURATION OF CPUM / IOCN CARDS

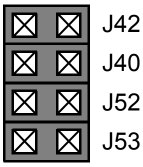
Jumpers on the CPUM and IOCN cards are used to configure the external communications interfaces. Refer also to the block diagrams in 6 CPUM / IOCN card pair.

12.1 Configuring Ethernet communications

Primary Ethernet communications can be routed via either the ‘**NET**’ connector on the CPUM card’s panel *or* the ‘**1**’ connector on the IOCN card’s panel.

The choice is made using jumpers J42, J40, J52 and J53 on the CPUM card.

The location of the jumpers on the CPUM card can be found using Figure 12-13 or Figure 12-14.



(a) The **NET** Ethernet connector on panel of CPUM is selected

(b) The **1** Ethernet connector on panel of IOCN is selected

NOTE: This is the default factory setting.

Figure 12-1: CPUM card jumper settings to select the Ethernet connector

12.2 Configuring RS serial communications

Secondary serial communications (RS-232 or RS-485) via the '**RS**' connector on the IOCN card's panel is configured using jumpers on the CPUM card.

12.2.1 RS-232 selection

This is the simplest configuration as the lines coming from the PC/104 CPU module are routed directly to the P2 connector.

RS-232 communication is configured by bypassing the RS-232 to RS-485 converter on the CPUM card. The converter is switched out using jumpers J43, J45 and J41 (see Figure 12-2).

The location of the jumpers on the CPUM card can be found using Figure 12-13 or Figure 12-14.

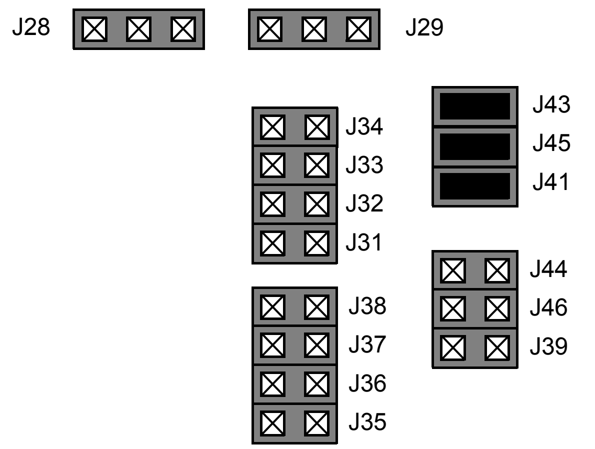


Figure 12-2: CPUM card jumper settings to select RS-232 (**RS** connector)

12.2.2 RS-485 selection, half-duplex (2-wire) configuration

Half-duplex (2-wire) RS-485 communications is configured by using the RS-232 to RS-485 converter on the CPUM card. The converter is switched in using jumpers J28, J29, J44, J46 and J39 (see Figure 12-3).

Jumpers J31 to J34 can also be set if terminations are needed (see Figure 12-9).

The location of the jumpers on the CPUM card can be found using Figure 12-13 or Figure 12-14.

NOTE: In the Meggitt Sensing Systems' factory, the default configuration for CPUM/IOCN card pairs is full-duplex RS-485, with each differential pair terminated with a 120 Ω resistor (see case (b) of Figure 12-9).
CPUM and IOCN card pairs will be delivered with the default configuration, unless a different one is specified by the customer.

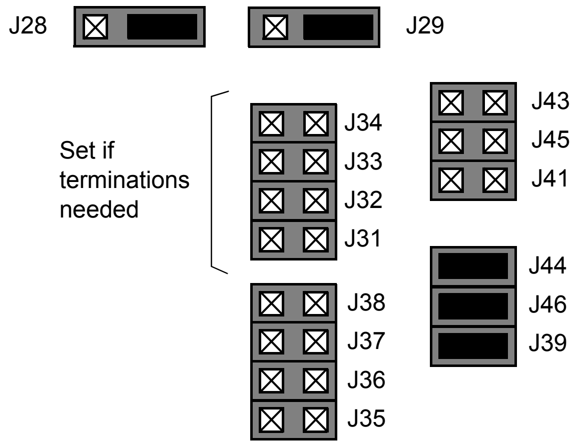


Figure 12-3: CPUM card jumper settings to select half-duplex RS-485 (**RS** connector)

12.2.3 RS-485 selection, full-duplex (4-wire) configuration

The jumper settings for full-duplex (4-wire) RS-485 communications are similar to those for half-duplex except for the position of jumper J29 (see Figure 12-3 and Figure 12-4).

If terminations are needed, jumper groups J31 to J34 and J35 to J38 should have the same configuration, that is, J31 should be set like J35, J32 like J36, J33 like J37 and J34 like J38.

The location of the jumpers on the CPUM card can be found using Figure 12-13 or Figure 12-14.

NOTE: In the Meggitt Sensing Systems' factory, the default configuration for CPUM/IOCN card pairs is full-duplex RS-485, with each differential pair terminated with a 120 Ω resistor (see case (b) of Figure 12-9).
CPUM and IOCN card pairs will be delivered with the default configuration, unless a different one is specified by the customer.

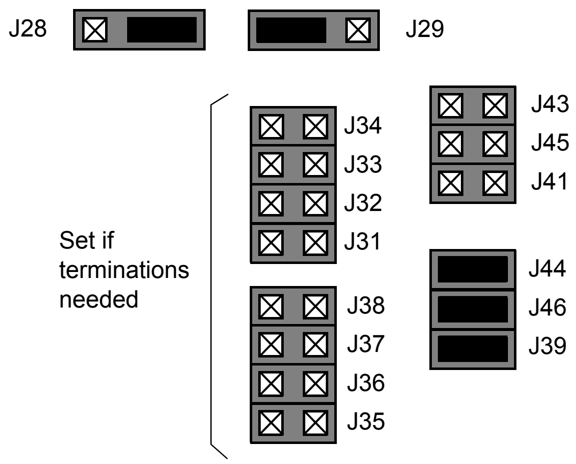


Figure 12-4: CPUM card jumper settings to select full-duplex RS-485 (**RS** connector)

12.3 Configuring A and B serial communications

An optional serial communications module (AIM104-COM4 or equivalent) can be fitted to the CPUM card in order to support additional serial connections that can be used to configure multi-drop RS-485 networks of VM600 racks.

Additional serial communications (RS-485) via the group ‘**A**’ (two connectors) and group ‘**B**’ (two connectors) on the IOCN card’s panel can be configured as either half-duplex (2-wire) or full-duplex (4-wire) using jumpers on the serial communications module itself.

As shown in Figure 12-5, Figure 12-6, Figure 12-7 and Figure 12-8, jumper groups LK1, LK2, LK3, LK4, LK5, LK6, LK7 and LK8 are used to configure factory settings and do not need to be changed by the user.

Jumper group LK6 is used to configure the serial communications module (AIM104-COM4 or equivalent) for operation with different versions of the CPUM card. LK6 (AB0) must be removed for later versions of the CPUM card fitted with the PFM-541I or equivalent CPU module, or LK6 (AB0) must be inserted for earlier versions of the CPUM card fitted with the MSM586EN or equivalent CPU module.

Jumper groups LK9 and LK11 are used to configure RS-485 communications for connector group A and jumper goups LK10 and LK12 are used to configure RS-485 communications for connector group B.

Jumper groups LK13 and LK15 are used to configure the terminations for connector group A and jumper goups LK14 and LK16 are used for connector group B.

NOTE: The configuration of each communication port (connector groups A and B) can be set independently. For example, connector group A can be configured as half-duplex and connector group B configured as full-duplex (or vice versa) at the same time.

The jumper settings for half-duplex or full-duplex RS-485 communications are very similar. The only difference is that in full-duplex mode, jumpers LK9 and LK10 must be changed.

12.3.1 RS-485 selection, half-duplex (2-wire) configuration

The serial communications module (AIM104-COM4 or equivalent) jumper settings to select half-duplex RS-485 communications for the A and B connectors depends on the version of the CPUM card being used:

- For later versions of the CPUM card fitted with the PFM-541I or equivalent CPU module, the jumpers and terminations should be set as shown in Figure 12-5.
- For earlier versions of the CPUM card fitted with the MSM586EN or equivalent CPU module, the jumpers and terminations should be set as shown in Figure 12-6.

12.3.2 RS-485 selection, full-duplex (4-wire) configuration

The serial communications module (AIM104-COM4 or equivalent) jumper settings to select full-duplex RS-485 communications for the A and B connectors depends on the version of the CPUM card being used:

- For later versions of the CPUM card fitted with the PFM-541I or equivalent CPU module, the jumpers and terminations should be set as shown in Figure 12-7.
- For earlier versions of the CPUM card fitted with the MSM586EN or equivalent CPU module, the jumpers and terminations should be set as shown in Figure 12-8.

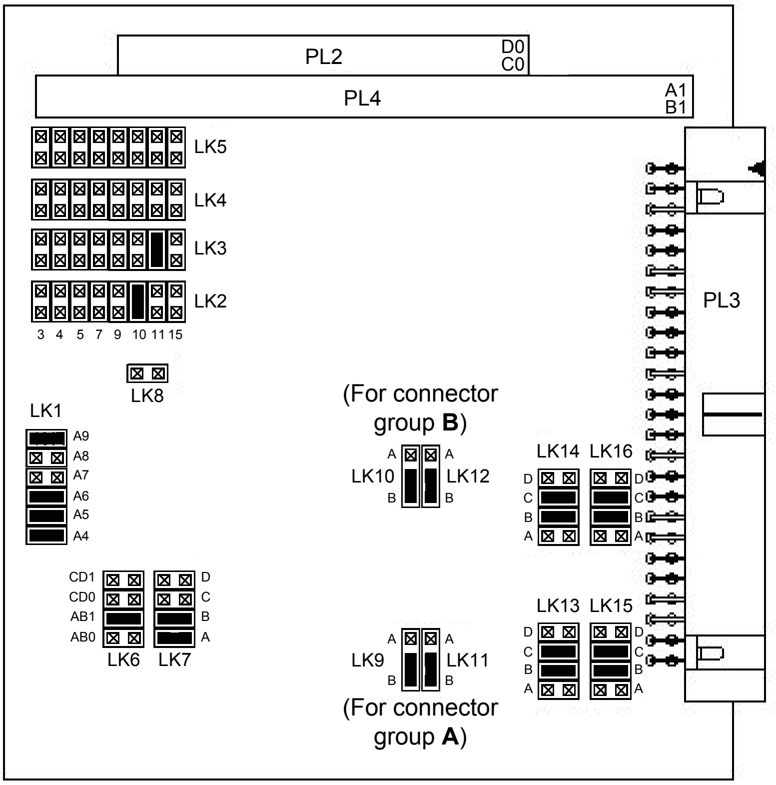


Figure 12-5: Serial communications module jumper settings to select half-duplex RS-485 communications for later versions of the CPUM card (PFM-541I or equivalent)

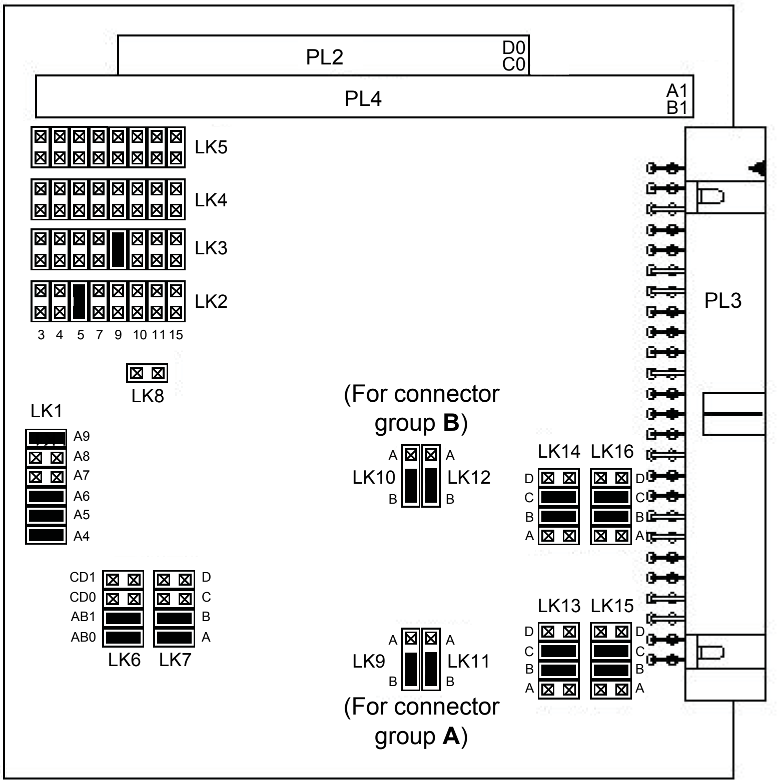


Figure 12-6: Serial communications module jumper settings to select half-duplex RS-485 communications for earlier versions of the CPUM card (MSM586EN or equivalent)

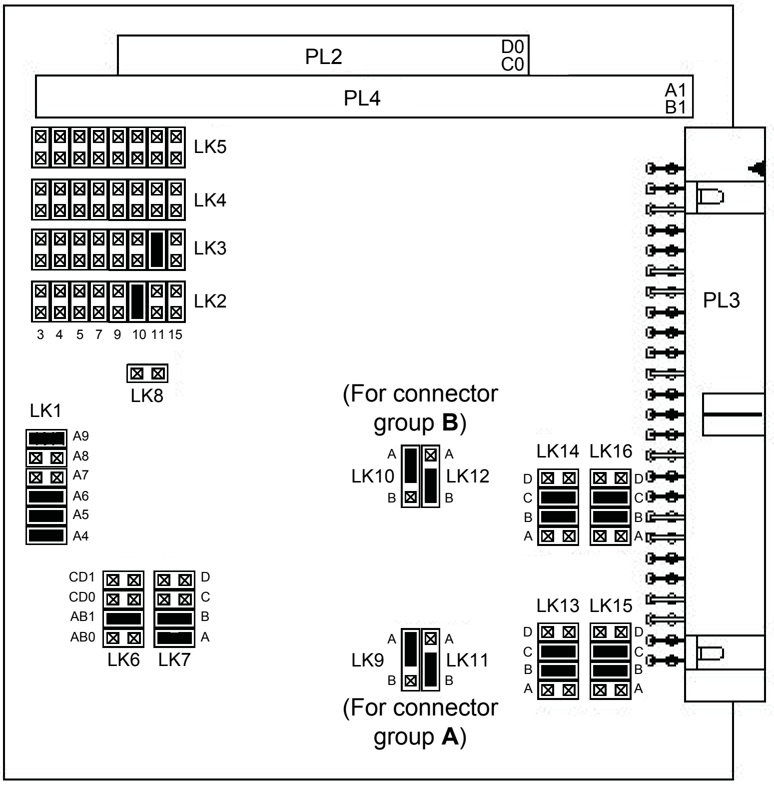


Figure 12-7: Serial communications module jumper settings to select full-duplex RS-485 communications for later versions of the CPUM card (PFM-541I or equivalent)

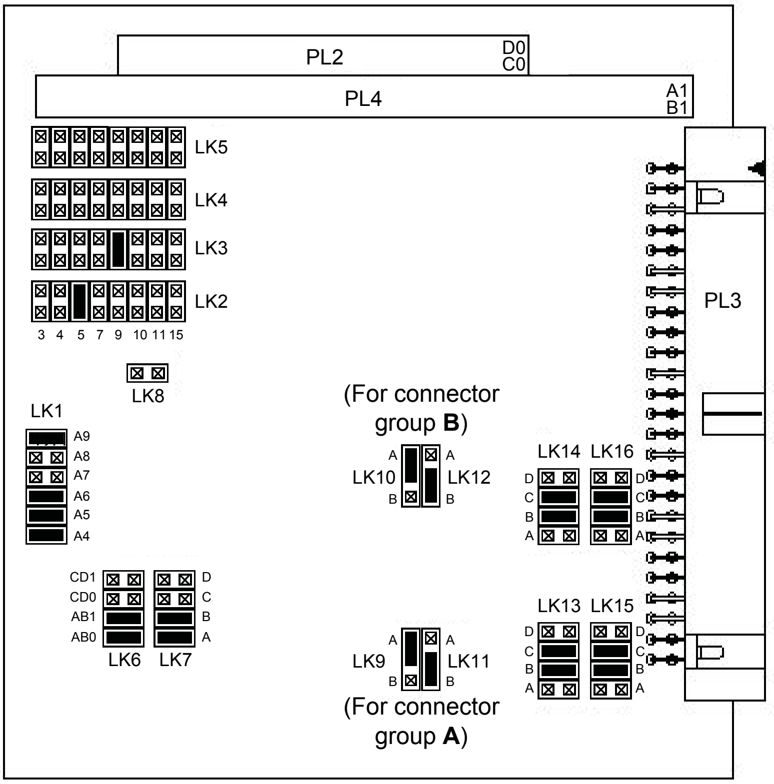
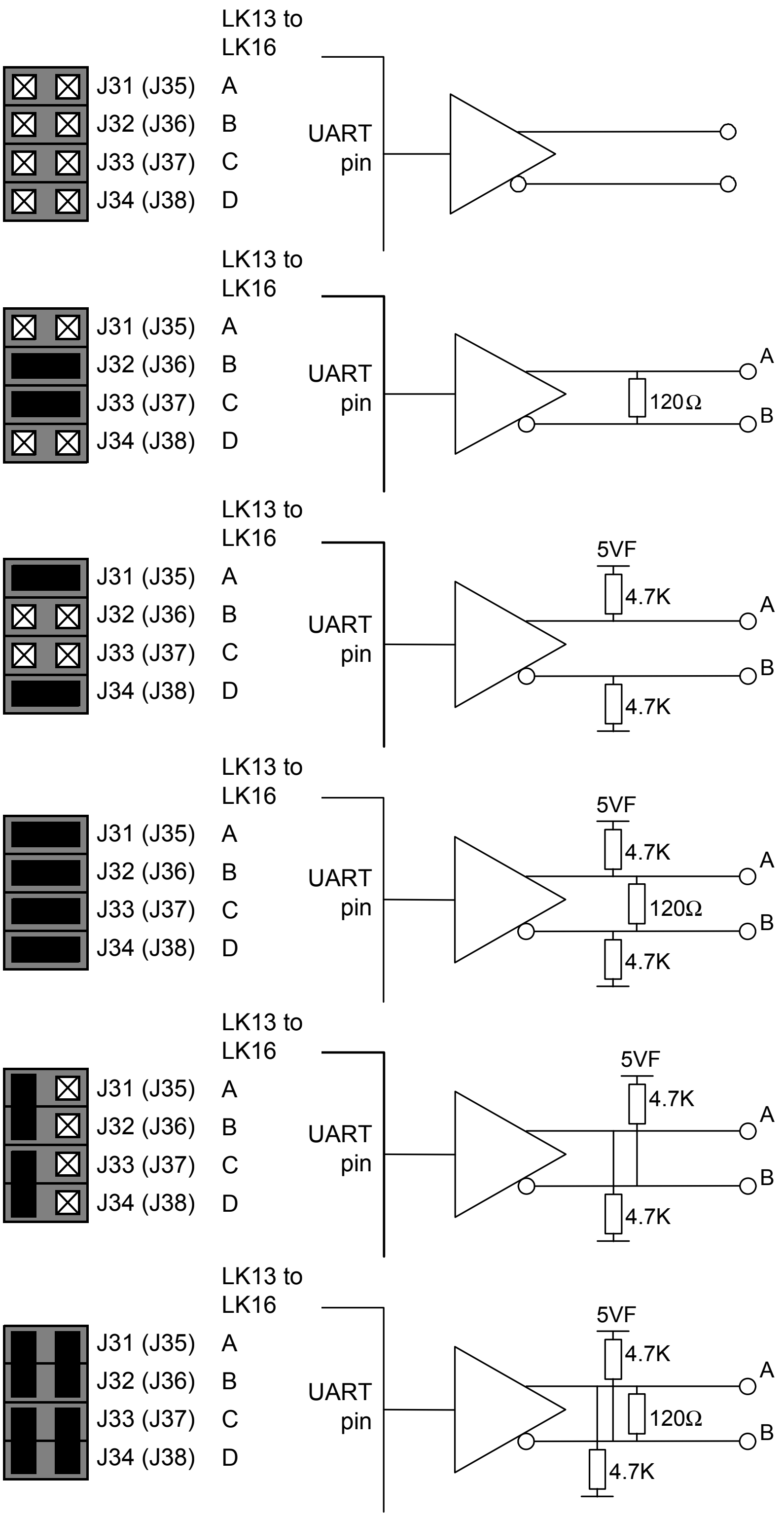


Figure 12-8: Serial communications module jumper settings to select full-duplex RS-485 communications for earlier versions of the CPUM card (MSM586EN or equivalent)

12.4 Configuring RS-485 terminations for RS, A and B serial communications

For RS serial communications (RS-485 only), and A and B serial communications, jumpers on the CPUM card are used to configure terminations.

Each RS-485 differential pair can be terminated in one of six ways, as shown in Figure 12-9.



(a) Not terminated
Line driver connects directly to the differential pair.

(b) Terminated
Differential pair is terminated with 120 Ω resistance between the signal lines.

NOTE: This is the default factory setting.

(c) Pulled inactive
Differential pair is pulled apart to mimic no character being transmitted from UART.

(d) Pulled inactive and terminated
Differential pair is terminated with 120 Ω and is pulled apart to mimic no character being transmitted.

(e) Pulled active
Differential pair is pulled apart to mimic UART sending a break condition.

(f) Pulled active and terminated
Differential pair is terminated with 120 Ω and is pulled apart to mimic a break condition.

Figure 12-9: CPUM card jumper settings for various types of RS-485 terminations

12.4.1 CPUM card (carrier board)

For half-duplex RS-485 (2-wire), only jumpers J31 to J34 need to be configured.

For full-duplex RS-485 (4-wire), jumper groups J31 to J34 and J35 to J38 and must be configured identically.

Further details on RS-485 terminations can be found in Table 12-1.

12.4.2 Optional serial communications module (AIM104-COM4 or equivalent)

For half-duplex RS-485 (2-wire), only jumpers LK15 and LK16 need to be configured. These groups should be configured identically

For full-duplex RS-485 (4-wire), jumper groups LK13 and LK15, and LK14 and LK16 must be configured identically.

Further details on RS-485 terminations can be found in Table 12-1.

Table 12-1: RS-485 terminations

Type of RS-485	Serial communications (connector)	Jumper location	Jumpers
Half-duplex (2-wire)	**RS**	CPUM card (carrier board)	J31 to J34
Half-duplex (2-wire)	**A**	Optional serial communications module (AIM104-COM4 or equivalent)	LK15
Half-duplex (2-wire)	**B**	Optional serial communications module (AIM104-COM4 or equivalent)	LK16
Full-duplex (4-wire)	**RS**	CPUM card (carrier board)	J31 to J34 and J35 to J38
Full-duplex (4-wire)	**A**	Optional serial communications module (AIM104-COM4 or equivalent)	LK13 and LK15
Full-duplex (4-wire)	**B**	Optional serial communications module (AIM104-COM4 or equivalent)	LK14 and LK16

12.5 Additional jumpers on the IOCN card

12.5.1 Linking the RS and A serial communications connectors

On the IOCN card, the **RS** connector used for secondary serial communications (RS-232 or RS-485) can be linked pin-by-pin to the two group **A** connectors.

NOTE: Linking the **RS** and **A** serial communications connectors requires that the optional serial communications module (AIM104-COM4 or equivalent) is not fitted to the CPUM card so that two group **A** connectors are available.
Linking the **RS** and **A** serial communications connectors in this way is the only way that RS-232 signals can be used with the group **A** connectors.

The **RS** and **A** serial communications connectors are linked using jumpers J20 to J24 on the IOCN card, as shown in Figure 12-10.

The location of the jumpers on the IOCN card can be found using Figure 12-15.

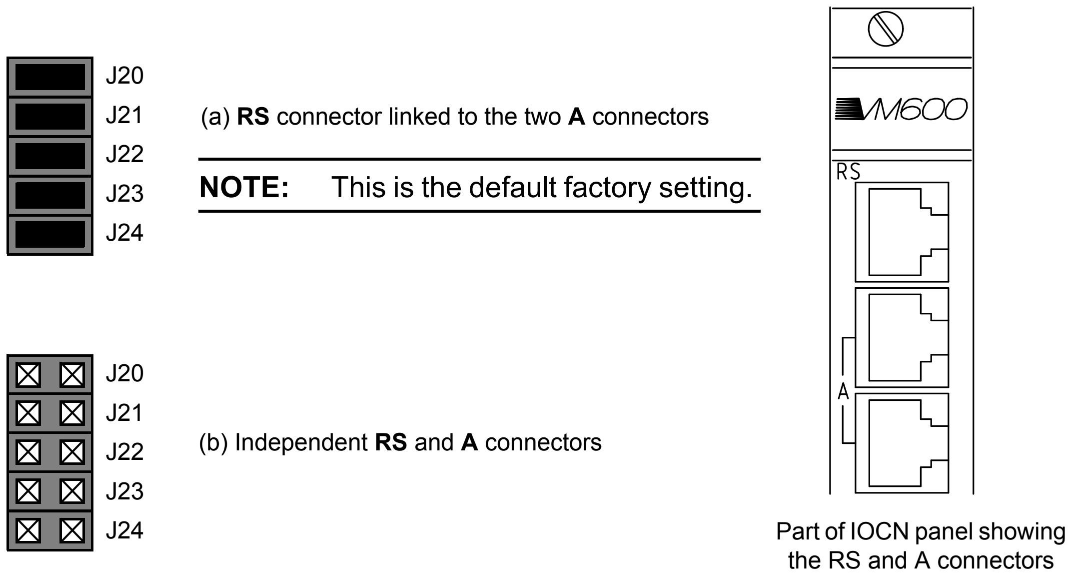


Figure 12-10: IOCN card jumpers to link the **RS** and **A** connectors

12.6 Connectors on the IOCN card

NOTE: The pin definitions shown in Figure 12-11 and Figure 12-12 are for the connectors (female) on the IOCN card's panel, such as the 8P8C (RJ45) and the 6P6C (RJ11/RJ25).

12.6.1 Modular connector pinouts

For modular connectors such as 6P6C (RJ11/RJ25) or 8P8C (RJ45) used by the IOCN card (and MPC4 card), the pin definitions of the connectors (male) on the cables that will mate with the connectors (female) on an IOCN card are established as follows:

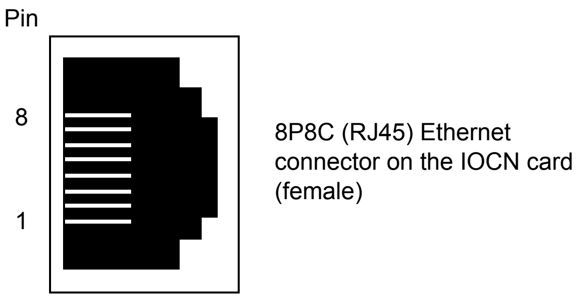
1- Hold the cable connector (male) in your hand with the tab side down and with the cable opening facing towards you.

2- Reading from left to right, the pins are numbered 1 to n, that is, 1 to 6 for an 6P6C (RJ11/RJ25) connector.

12.6.2 Ethernet connectors

These 8-pin 8P8C (RJ45) connectors allow the connection of a standard Ethernet 10BASE-TX or 100BASEX-T link.

The pin connections (pinouts) for the 8-pin 8P8C (RJ45) connectors are shown in Figure 12-11.



Pin	Signal
1	Tx+
2	Tx−
3	Rx+
4	Not connected
5	Not connected
6	Rx−
7	Not connected
8	Not connected

Figure 12-11: Pin definitions for the Ethernet connectors on the IOCN card (**1** and **2** connectors)

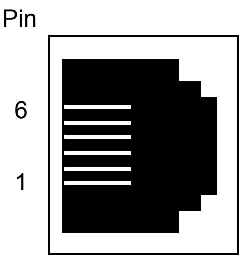
12.6.3 RS, A and B connectors

The 6-pin 6P6C (RJ11/RJ25) **RS** connector supports RS-232 or RS-485 communication with the rack.

The 6-pin 6P6C (RJ11/RJ25) group **A** and group **B** connectors support RS-485 communication with the rack. (Alternatively, the group **A** connectors only can be used to support RS-232 communication with the rack (see 12.5.1 Linking the RS and A serial communications connectors)).

The pin connections (pinouts) for the 6-pin 6P6C (RJ11/RJ25) connectors are shown in Figure 12-12.

The pin connections (pinouts) depend on how the serial communications are configured: RS-232, half-duplex RS-485 or full-duplex RS-485 (see 12.2 Configuring RS serial communications and 12.3 Configuring A and B serial communications).



6P6C (RJ11/RJ25) connector on the IOCN card (female)

Pin	Signal
1	Not connected
2	Not connected
3	Rx
4	Tx
5	Not connected
6	0VD

(a) RS-232 configured

Pin	Signal
1	A
2	B
3	Not connected
4	Not connected
5	RGND
6	Not connected

(b) Half-duplex RS-485 configured

Pin	Signal
1	TxA
2	TxB
3	RxA
4	RxB
5	RGND
6	Not connected

(c) Full-duplex RS-485 configured

Figure 12-12: Pin definitions for the serial communications connectors on the IOCN card (**RS**, **A** and **B** connectors)

12.7 Location of components on the CPUM card (later PFM-541I version)

Figure 12-13 shows the position of jumpers and large components on later versions of the CPUM card (PNR 200-595-076-HHh or later) designed to be fitted with the PFM-541I or equivalent CPU module (see 6.1 Different versions of the CPUM card).

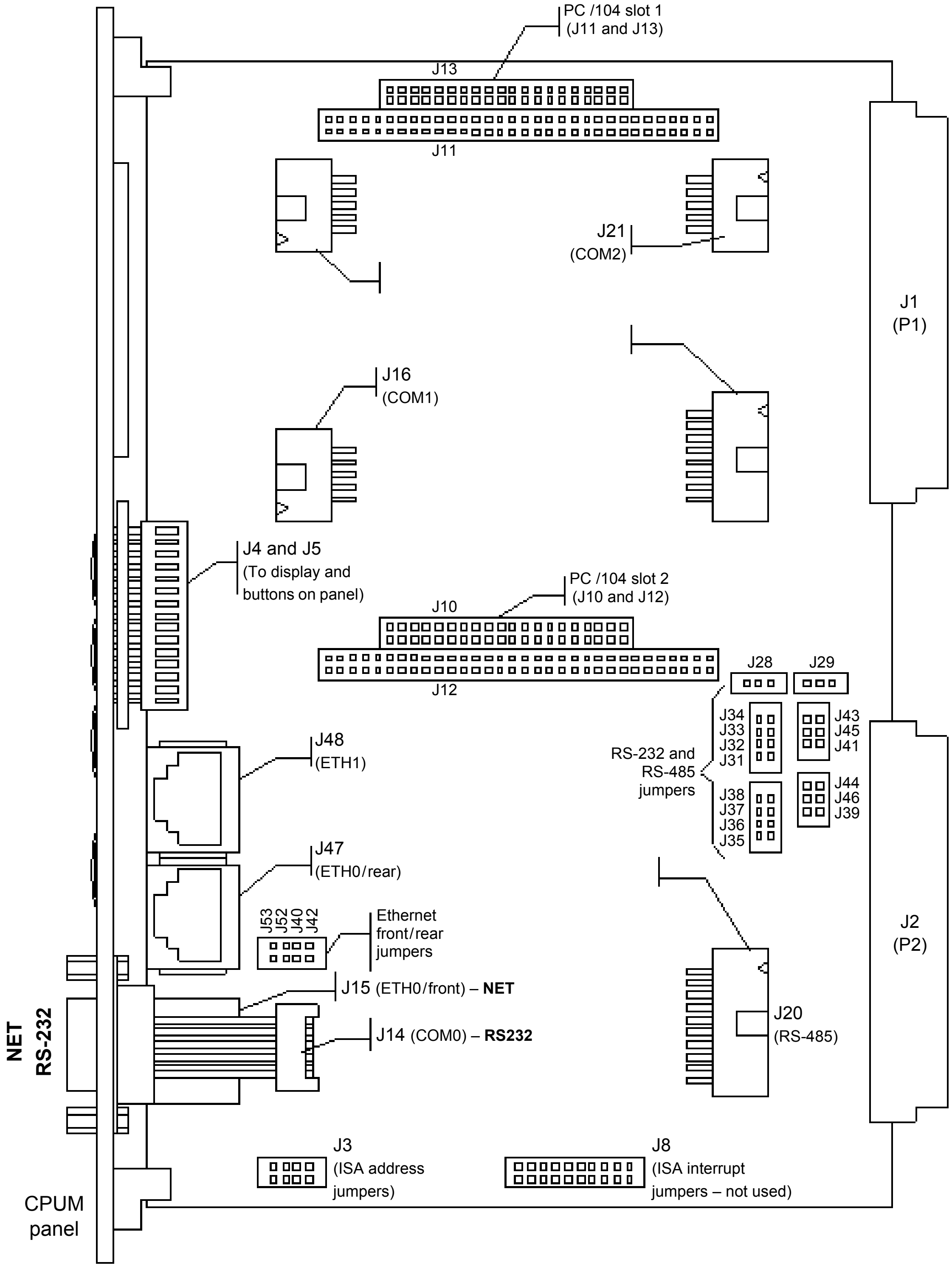


Figure 12-13: Location of jumpers on the CPUM card (later PFM-541I version)

12.8 Location of components on the CPUM card (earlier MSM586EN version)

Figure 12-14 shows the position of jumpers and large components on earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier) designed to be fitted with the MSM586EN or equivalent CPU module (see 6.1 Different versions of the CPUM card).

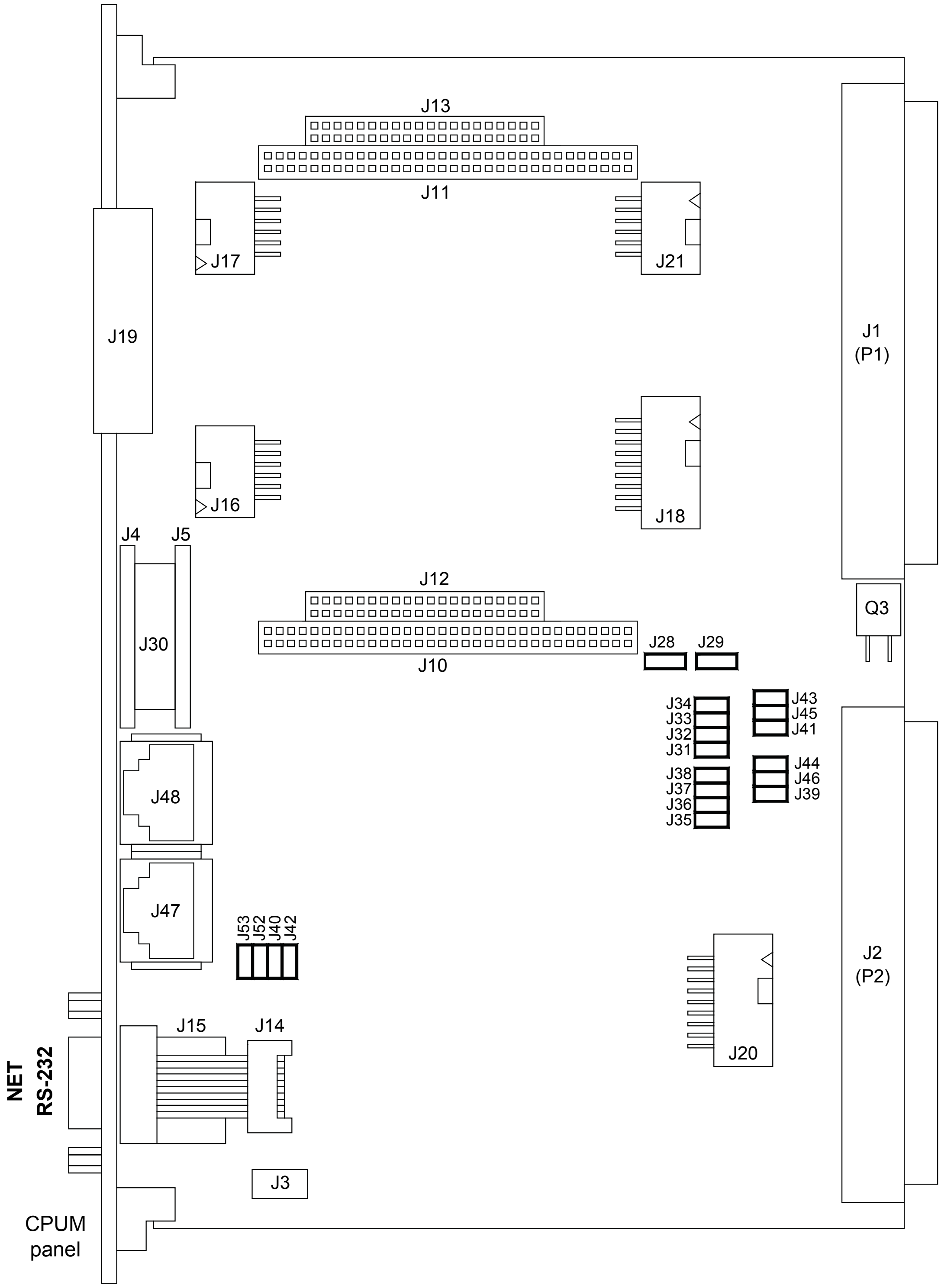


Figure 12-14: Location of jumpers on the CPUM card (earlier MSM586EN version)

12.9 Location of components on the IOCN card

Figure 12-15 shows the position of jumpers and large components on the IOCN card.

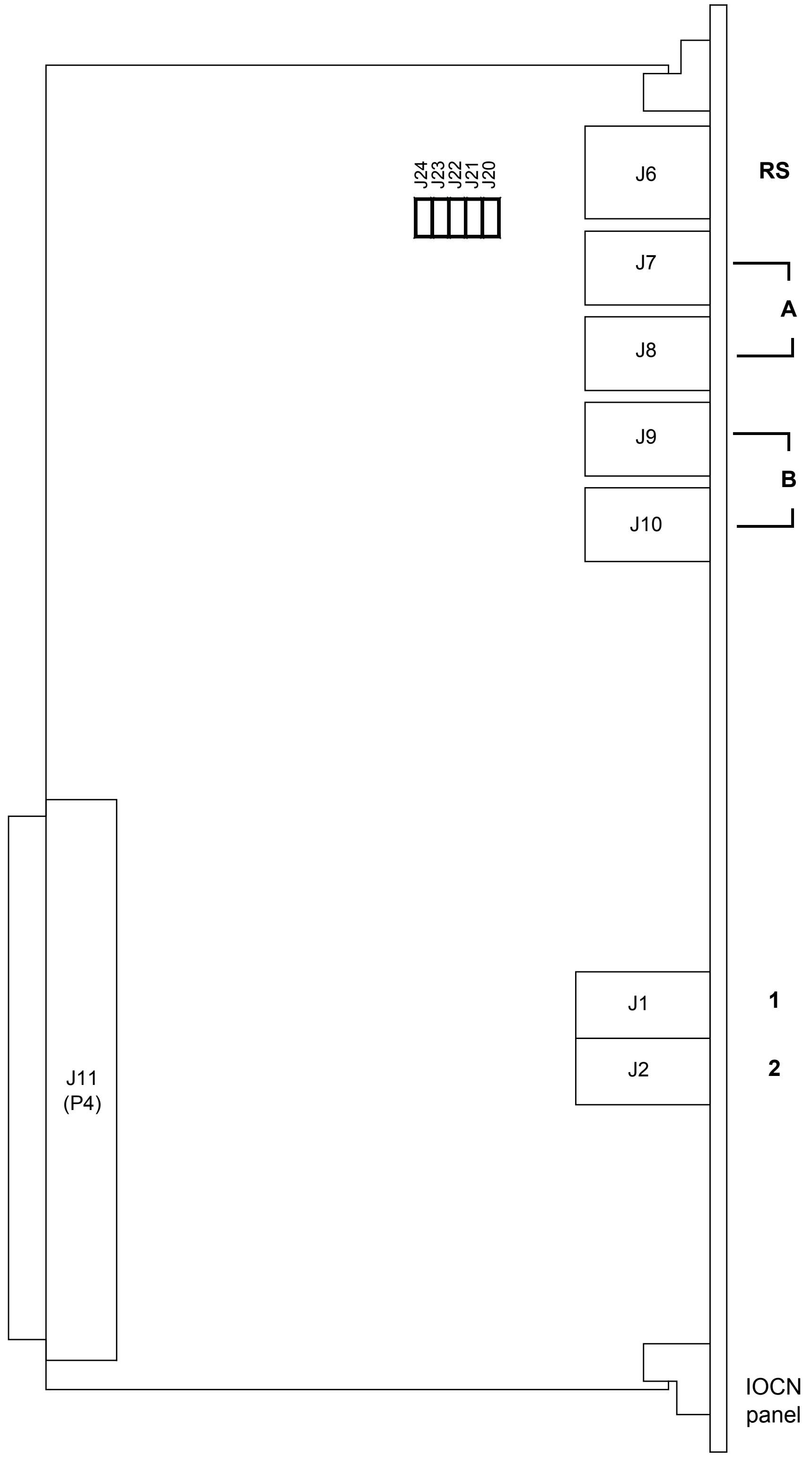


Figure 12-15: Location of jumpers on the IOCN card

12.10 Upgrading the version of firmware running on a CPUM card

Earlier versions of the CPUM card use a DiskOnChip DIP memory module for the storage of the firmware (FW) and user-editable configuration files used by the CPUM. As DiskOnChip memory modules are no longer produced (end-of-life), these CPUM cards need to be upgraded to use a CompactFlash memory card instead of the DiskOnChip memory in order to allow the CPUM to run more up-to-date versions of firmware.

Refer to the *CPUM upgrade kit instruction sheet* (Meggitt Sensing Systems document reference 268-037) for further information on replacing a CPUM card's existing memory with a newer CompactFlash memory in order to upgrade the CPUM card to run a different version of firmware.

NOTE: The CPUM upgrade kit instructions are equally applicable to versions of the CPUM card already using a CompactFlash memory card, except that the new CompactFlash included in the upgrade kit replaces the existing CompactFlash on the CPUM (rather than replaces the DiskOnChip).

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Part III: Maintenance and technical support

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13 MAINTENANCE AND TROUBLESHOOTING

Before maintaining or otherwise working with a VM600 rack, it is important to refer to the information given in the Safety section of the manual, including:

- Electrical safety and installation on page xiv
- Hazardous voltages and the risk of electric shock on page xv
- Hot surfaces and the risk of burning on page xv
- Heavy objects and the risk of injury on page xv
- Replacement parts and accessories on page xvi

13.1 Long-term storage of racks

The specifications given below cover the preparation and storage of VM600 racks in defined areas for a maximum of 3 years without intermediate checks.

13.1.1 Preparation

- Store the racks fully wired.
- Remove any batteries used in the rack and store them separately.

NOTE: The CPUM is the only card in a VM600 rack that uses a battery.

- Allow time for the racks to acclimatise to the storage conditions before covering them.
- Cover the racks with polyethylene sheeting having very good resistance to tearing or perforating.
- Provide suitable ventilation to avoid condensation.

13.1.2 Storage

Temperature	:	See Appendix A - Environmental specifications
Humidity	:	Between 50 and 70%

NOTE: Maintain a certain distance from pipes carrying water or other liquids that could cause condensation.

Dust	:	Dust-free environment
Air quality	:	No smoke particles, no salt or oil mists, no halogens or solvents, ambient pressure equal to atmospheric pressure, no permanent draughts
Sunlight	:	Direct sunlight to be avoided
Mechanical protection	:	Protect the racks in an appropriate manner if there is a risk of mechanical damage occurring
Shock	:	To be avoided
Vibrations	:	Not exceeding levels found in inhabited buildings

Electromagnetic interference	:	Avoid storage near high-voltage lines or strong magnetic fields
Radiation	:	Not exceeding levels found in inhabited buildings

13.2 Modifications and repairs

No adjustments or calibration are required for the individual cards or system components in a VM600 rack. In addition, there is no maintenance that the customer can perform on this equipment.

Only Meggitt Sensing Systems personnel, or persons authorised by Meggitt Sensing Systems, should attempt to modify or repair MPS hardware.

NOTE: Any attempt by unauthorised personnel to modify or repair equipment still under guarantee will invalidate the warranty.

See 15 Service and support for contact details for repairing defective hardware.

13.3 Cleaning

It is not required to clean a VM600 rack.

However, if cleaning does become necessary:

- Clean with a damp cloth, then wipe with a dry cloth if required.
- Keep away from live electrical parts.
- Do not use any solvents or cleaning agents. Never pour or spray any cleaner or liquid on the rack. Keep all liquids away from the rack.

  Liquids entering the housing of the rack can cause short-circuits and damage electronic components.

STOP

HAZARDOUS VOLTAGES EXIST WITHIN VM600 RACKS.

IF CLEANING BECOMES NECESSARY, USE A DAMP CLOTH ONLY AND KEEP AWAY FROM LIVE ELECTRICAL PARTS.

SEE ALSO HAZARDOUS VOLTAGES AND THE RISK OF ELECTRIC SHOCK ON PAGE XV.

13.4 General remarks on fault-finding

The following sections contain information needed to localise a failure, whether this is due to an internal MPS problem (that is, within the rack) or to an external problem.

The complete measurement system is composed of the following elements (arranged in the order of the signal processing):

- The transducers and signal conditioners } Front-end components
- The cabling between the transducers and signal conditioners, and the IOC4T / IOC8T cards } Front-end components
- The MPS rack, including the IOC, MPC4, AMC8 and/or CPUM cards.

The diagnostics of a system failure can be separated into these parts.

NOTE: Before troubleshooting the MPS, it is worthwhile checking that the overall measuring system (transducer, signal conditioner, and cabling) is correctly installed.

13.5 Detecting problems due to front-end components and cabling

A front-end problem may be due to:

1- A defective transducer and signal conditioner.

2- Incorrect cabling of the transducer.

3- Cabling between the transducer and the signal conditioner and the MPS becoming damaged (for example, open-circuit or short-circuit).

4- Incorrect configuration of the input transducer using the VM600 MPS software.

5- A problem with an external power supply (if used), leading to incorrect powering of the transducer, signal conditioner and/or galvanic separation unit.

Any of the above faults will be signalled on the panel of the MPC4 or AMC8 card by one of the following:

- The card's DIAG/STATUS indicator (a multi-function, multi-colour LED).
- The status indicator(s) for the individual channel(s) in question (also multi-function, multi-colour LEDs).

See Figure 2-5 and 4.9 Operation of LEDs on MPC4 panel for further information.

See Figure 2-7 and 5.10 Operation of LEDs on AMC8 panel for further information.

Cabling problems

Two categories can be observed:

1- The corresponding status indicator on the panel of the MPC4 or AMC8 card blinks green *continuously*.
This indicates a continuous problem, for example, incorrect cabling.

2- The corresponding status indicator on the panel of the MPC4 or AMC8 card blinks green *intermittently*.
This indicates an intermittent problem, for example, poor electrical contact.
Spikes may be observed on the signal output (for example, by studying the signal on the corresponding BNC connector on the panel of MPC4 card).

NOTE: The risk of having cabling problems will be reduced if good wiring practice is observed when installing the hardware.

External power supply failures

Replace the suspect external power supply by one from your spare parts stock. If this solves the problem, the original power supply can be considered defective.

13.5.1 Replacing a suspect front-end component or cable

If a front-end problem has been traced to a particular measurement channel, then the channel inhibit function can be used to temporarily bypass the sensor (that is, temporarily inhibit the protection offered by any associated relays) while the other machinery monitoring channels and functions continue to operate as normal.

This allows components in a particular measurement channel front-end (such as a sensor/transducer, signal conditioner and/or cable) to be replaced while the machinery being monitored continues to operate (if the protection offered by the other machinery monitoring channels and functions is adequate). It also allows any control system using the relays to avoid false trips during such maintenance activity.

To use channel inhibit on an MPC4 card, see 4.6.6 Channel inhibit function and 9.8 Channel inhibit function.

To use channel inhibit on an AMC8 card, see 5.7.4 Channel inhibit function and 10.6 Channel inhibit function.

13.6 Detecting problems in the VM600 MPS rack

13.6.1 General checks for racks

The following basic checks should be carried out if a problem is suspected at rack level:

- Check that the four LEDs on a RPS6U rack power supply are on (see Figure 2-12). An LED that remains off indicates a power supply problem.
- Check the MPS rack's mains fuses are intact and change them if necessary.
  - Racks running on an AC supply are fitted with two fuses having the following specifications:

    Rated voltage = 250 V_{AC}
    Rated current = 8 A
    Type = 5 x 20 mm cartridge fuse with time-lag / delay (T).
    For example, Schurter FST 5x20 8A 250VAC (order number 0034.3126).
  - Racks running on a DC supply do not have any fuses.
- If a CPUM card is installed, check that the green DIAG LED on its panel is on (see Figure 2-9). An LED that remains off indicates a problem with this card.
- If a CPUM card is installed, use the SLOT+, SLOT−, OUT+ and OUT− keys on its panel to check that the built-in display shows the values processed by the various cards in the rack (MPC4 and AMC8, as applicable).
- If installed, check the state of the DIAG/STATUS indicator on each MPC4 card (see Figure 2-5). It should normally be green, although it can also be yellow or red, depending on the activation of the Trip Multiply and Danger Bypass functions. A problem is indicated by the LED blinking yellow or blinking red.
- If installed, check the state of the DIAG/STATUS indicator on each AMC8 card (see Figure 2-7). It should normally be green, although it can also be red, depending on the activation of the Danger Bypass function. A problem is indicated by the LED blinking yellow or blinking red.
- Check that the SLOT ERROR indicator on each IOC4T or IOC8T card is green (see Figure 2-6 and Figure 2-8). These LEDs are visible from the rear of the rack. A red LED indicates that the IOC card is installed in the wrong slot of a VM600 rack.
- Visually check that the connectors at the rear of the rack are correctly installed.

If one of the checks described above reveals that a card may have a problem, you should try replacing the card in question as described below. If the replacement card functions correctly, the original card can be considered defective.

NOTE: In all cases, defective cards should be returned to Meggitt Sensing Systems for repair. See 15 Service and support for further information.

13.6.2 Replacing a suspect card

Certain precautions must be observed when replacing suspect cards. These are described below.

Hazardous voltages exist within VM600 system racks (ABE04x).

When an RPS6U rack power supply, associated rear panel or card is removed from a VM600 system rack (ABE04x), the rack backplane – containing hazardous voltages – is exposed and there is the risk of electric shock, as indicated by the use of the following warning label on the equipment:

See also Hazardous voltages and the risk of electric shock on page xiii.

Hazardous temperatures can exist within and on VM600 system racks (ABE04x).

Depending on the ambient operating temperature, number of cards and power supplies installed (and their configuration and operation), the installation and cooling (forced or natural ventilation), the top of a VM600 rack can become hot and there is the risk of burning handling the rack, as indicated by the use of the following warning label on the equipment:

See also Hot surfaces and the risk of burning on page xiii.

When handling cards, the necessary precautions should be taken to prevent damage due to electrostatic discharges.
See Handling precautions for electrostatic sensitive devices on page xiv for further information.

Before "hot swapping" any card in the rear of a VM600 rack, any associated processing card in the corresponding slots in the front of the rack must be disconnected from the rack's backplane.

See 8.4.2 Subsequent installation of cards ("hot-swapping" capability).

13.6.2.1 General precautions for removing cards

The AMC8, MPC4, IOC4T, IOC8T and RLC16 cards all feature a lever mechanism to help the user to easily remove the card. Follow the procedure below and see Figure 13-1:

1- Disconnect all external cables connected to the card, for example, the communication cable (RS-232) for an MPC4 card or front-end cables (J1, J2 and J3) for an IOC4T card.

2- Unfasten the two captive fixing screws. These are found at the top and at the bottom of the card's panel.

3- With your thumbs, **simultaneously** push the upper handle upwards and the lower handle downwards. These combined actions will cause the card to move forwards by 1 to 2 mm.

4- Pull on both handles together (with equal force) to extract the card from the rack.

NOTE: Remember to reconnect all of the cables after the card is replaced in the rack.

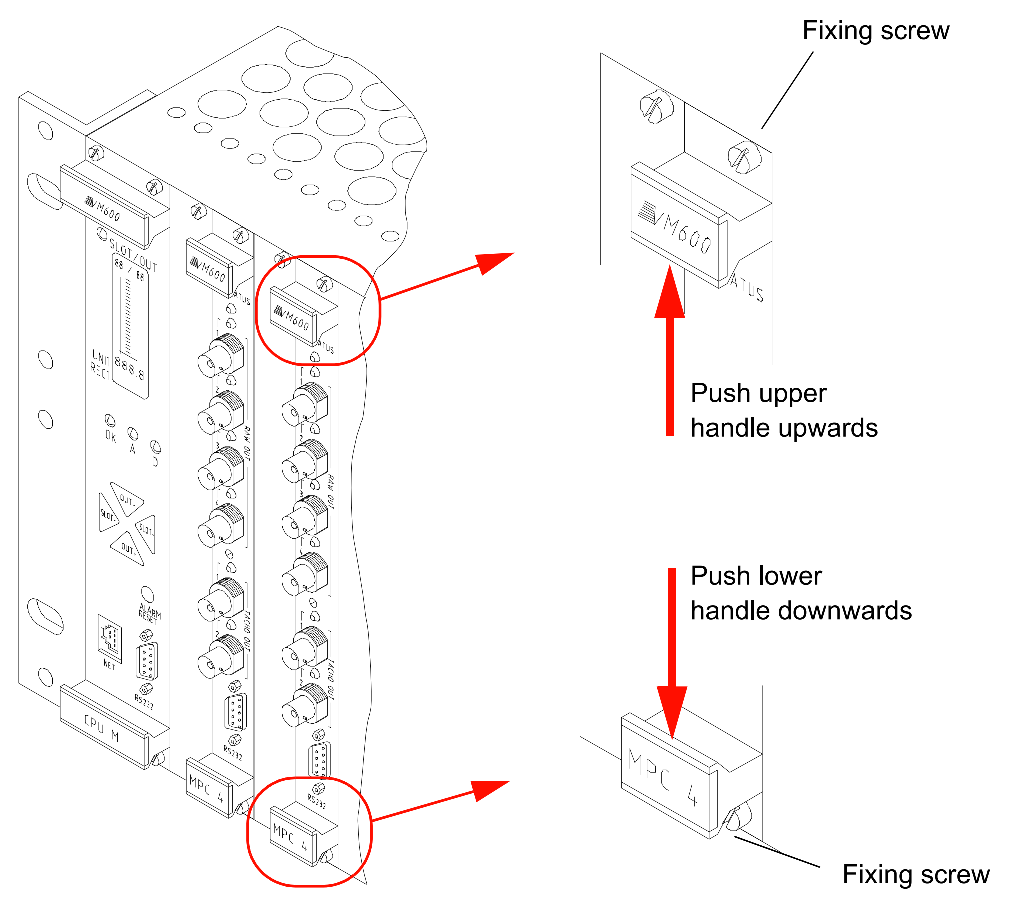

Figure 13-1: Removing a card from the rack

13.6.2.2 CPUM card

The CPUM cannot be hot swapped, that is, it is necessary to switch off (or disconnect) the rack power before replacing this type of card.

NOTE: The removal of a CPUM card requires both strength and care!
Note that this card does not employ the lever mechanism described in 13.6.2.1 General precautions for removing cards.

The replacement CPUM card must have exactly the same hardware configuration (jumper settings) as the original (suspect) CPUM card.

The replacement CPUM card must also have the same sub-modules installed as the original card. This will allow the same communications possibilities.

Once the replacement CPUM card has been installed, the entire MPS rack configuration must be downloaded using the VM600 MPSx software.

13.6.2.3 IOCN card

The IOCN can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

The replacement IOCN card must have exactly the same hardware configuration (jumper settings) as the original (suspect) IOCN card.

13.6.2.4 RPS6U rack power supply

In a VM600 rack containing only one RPS6U rack power supply (that is, a configuration without rack power supply redundancy), it is obviously necessary to interrupt the rack power while the rack power supply is being replaced. The power should be switched off (or disconnected) before the suspect rack power supply is removed and only switched on (or reconnected) once the new rack power supply is installed.

In a VM600 rack employing two RPS6U rack power supplies to support rack power supply redundancy, the rack and cards can continue to be powered while one of the rack power supplies is being replaced (see 2.9.5 Racks with two RPS6U rack power supplies in order to support rack power supply redundancy).

13.6.2.5 MPC4 card

(1) Before replacing a card

Where possible, various MPS system parameters and other information should be read before replacing the MPC4 card. We recommend sending the following information to your Meggitt Sensing Systems representative in order to help the diagnosis of any problems:

- Output states
- The system status
- The system identification
- Status of latched data.

This should be done using the VM600 MPSx software (MPS1 is shown in Figure 13-2). Select the card in question (for example, slot 3) and use the following menu bar commands to capture the information:

Communications > From MPC > Read Outputs

Communications > From MPC > Read System Status

Communications > From MPC > Read System Identification

Communications > From MPC > Read Status Latch Data.

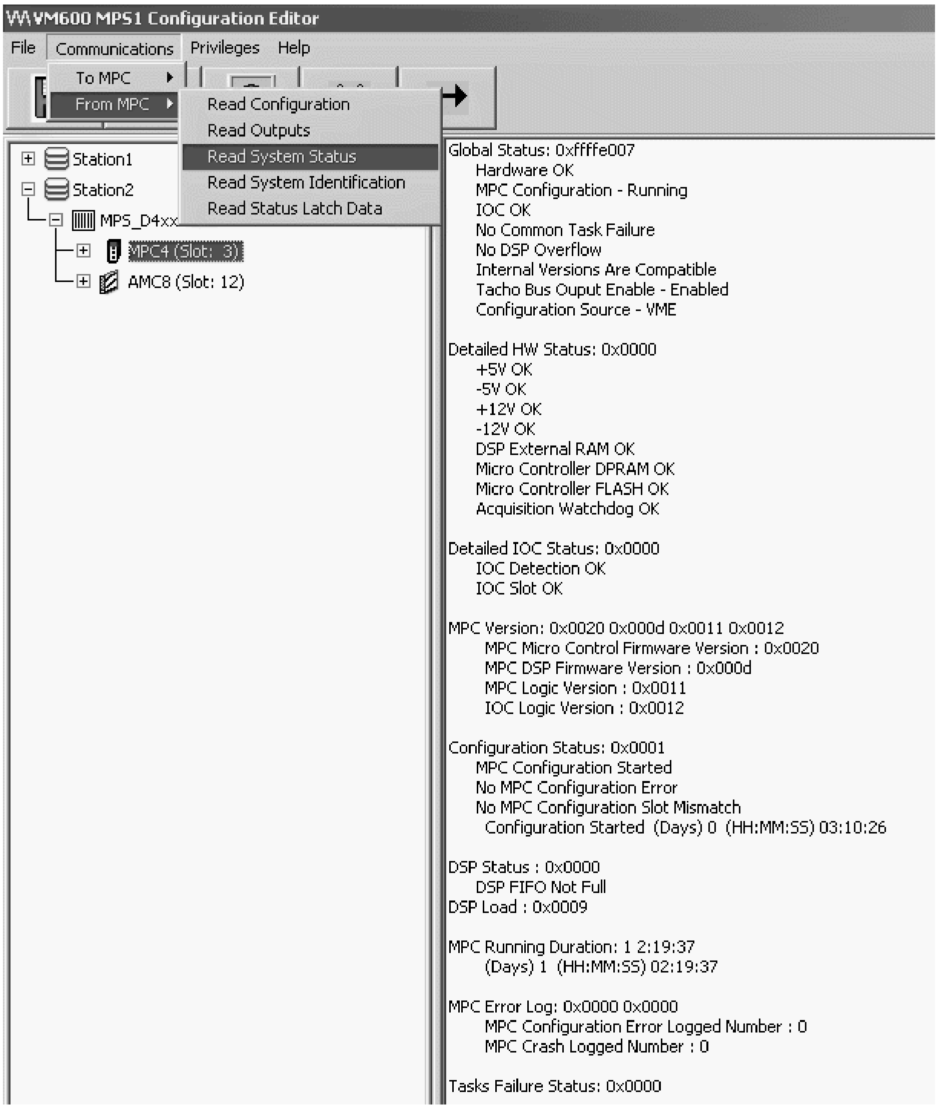

Figure 13-2: VM600 MPS software menu bar commands used to obtain MPC4 card information

It is important to capture all of this information, because some of it can disappear once the MPC4 card has been removed from the rack. Note that some information found in **Read System Status** is coded in hexadecimal and should be recorded as such.

If an intermittent problem is seen, it is recommended to:

1- Read the registers using the **Communications > From MPC > Read Status Latch Data** command and record the values

2- Clear the registers using the **Communications > To MPC > Clear Status Latch Data** command

3- Leave the system running for some time.

4- Read the registers using the **Communications > From MPC > Read Status Latch Data** command and compare the values obtained with the values recorded in step 1.

The same values and errors should be found if the problem is reproducible.

(2) Replacing the card

The MPC4 can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

If the MPS rack contains a CPUM card, the configuration for slot *nn* will be downloaded from the CPUM to the new MPC4 card once it has been installed in slot *nn*.

While the configuration is being downloaded into the new MPC4, the card's DIAG/STATUS indicator will blink green. It will become green (continuous) once the configuration process has been completed.

(3) Checking the card after replacement

Once the new card has been configured, it is advisable to check its status using the VM600 MPSx software. Follow the same steps as described above in "Before replacing a Card".

13.6.2.6 AMC8 card

(1) Before replacing a card

Where possible, various MPS system parameters and other information should be read before replacing the AMC8 card. We recommend sending the following information to your Meggitt Sensing Systems representative in order to help the diagnosis of any problems:

- Output states
- The system status
- The system identification
- Status of latched data.

This should be done using the VM600 MPSx software (MPS1 is shown in Figure 13-3). Select the card in question (for example, slot 12) and use the following menu bar commands to capture the information:

Communications > From AMC > Read Outputs

Communications > From AMC > Read System Status

Communications > From AMC > Read System Identification

Communications > From AMC > Read Status Latch Data.

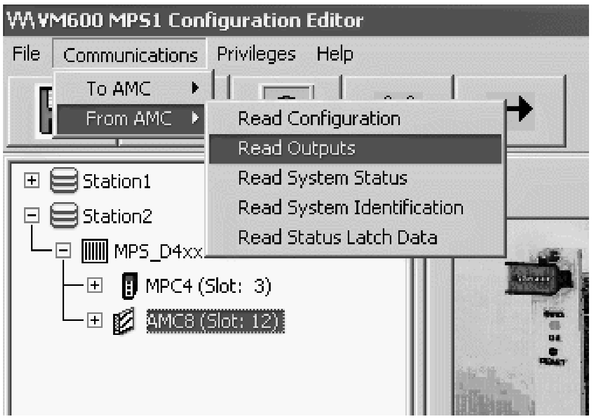

Figure 13-3: VM600 MPS software menu bar commands used to obtain AMC8 card information

It is important to capture all of this information, because some of it can disappear once the AMC8 card has been removed from the rack. Note that some information found in **Read System Status** is coded in hexadecimal and should be recorded as such.

If an intermittent problem is seen, it is recommended to:

1- Read the registers using the **Communications > From AMC > Read Status Latch Data** command and record the values

2- Clear the registers using the **Communications > To AMC > Clear Status Latch Data** command

3- Leave the system running for some time.

4- Read the registers using the **Communications > From AMC > Read Status Latch Data** command and compare the values obtained with the values recorded in step 1.

The same values and errors should be found if the problem is reproducible.

(2) Replacing the card

The AMC8 can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

If the MPS rack contains a CPUM card, the configuration for slot *nn* will be downloaded from the CPUM to the new AMC8 card once it has been installed in slot *nn*.

While the configuration is being downloaded into the new AMC8, the card's DIAG/STATUS indicator will blink green. It will become green (continuous) once the configuration process has been completed.

(3) Checking the card after replacement

Once the new card has been configured, it is advisable to check its status using the VM600 MPSx software. Follow the same steps as described above in "Before Replacing a Card".

13.6.2.7 IOC4T card

The IOC4T card can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

Before "hot swapping" an IOC4T card, the associated MPC4 card in the corresponding slots in the front of the rack must be disconnected from the rack's backplane.

The replacement IOC4T card must have exactly the same hardware configuration (jumper settings) as the original (suspect) IOC4T card.

13.6.2.8 IOC8T card

The IOC8T card can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

Before "hot swapping" an IOC8T card, the associated AMC8 card in the corresponding slots in the front of the rack must be disconnected from the rack's backplane.

The replacement IOC8T card must have exactly the same hardware configuration (jumper settings) as the original (suspect) IOC8T card.

13.6.2.9 RLC16 card

The RLC16 card can be hot swapped, therefore it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

The replacement RLC16 card must have exactly the same hardware configuration (jumper settings) as the original (suspect) RLC16 card.

13.7 Checking the MPC4 for processing overload

In certain circumstances, the MPC4 card's digital signal processor (DSP) will overload if the processing requirements are too demanding on all four measurement channels at once. This will be indicated by the DIAG/STATUS LED on the MPC4 blinking yellow (see Table 4-1).

This situation can occur when broad-band processing is being performed on all four channels. Possible solutions are to:

- Reduce the LP/HP filter frequency ratio
- Reduce the cut-off slope of the filters (for example, from 60 to 48 dB/octave).

The DSP loading can be examined by reading the MPC4 card's system status as described in 13.6.2.5 MPC4 card. Click the following menu bar command:

Communications > From MPC > Read System Status.

The DSP loading (**DSP Load**) is displayed as a percentage of full load in the VM600 MPS software listing (see Figure 13-4). The value is expressed in hexadecimal, so that:

- Full loading (100%) is shown as 0x0064
- 99% loading is shown as 0x0063
- 96% loading is shown as 0x0060 and so on.

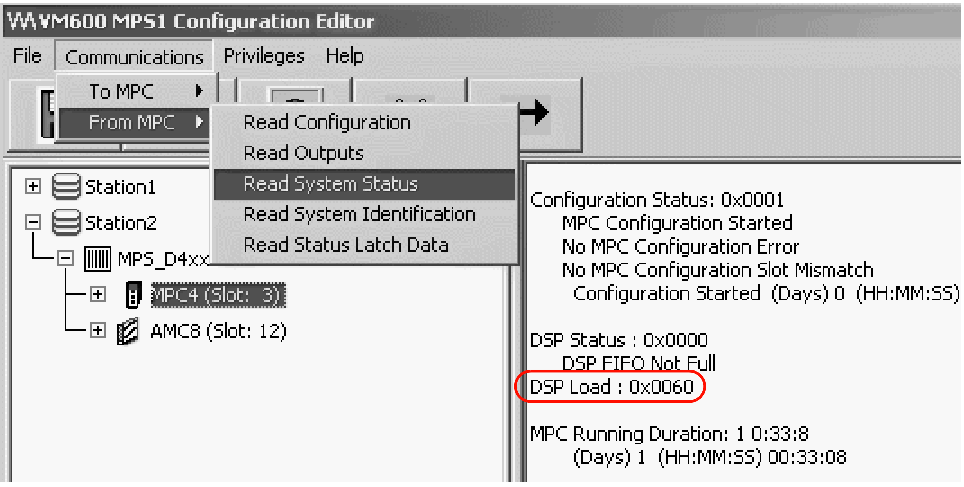

Figure 13-4: Examining the DSP for processing overload

14 END-OF-LIFE PRODUCT DISPOSAL

A VM600-rack based monitoring system is an electrical/electronic product, therefore, it must be disposed of in a acceptable manner at the end of its useful life. This is important in order to reduce pollution and improve resource efficiency.

NOTE: For environmental and economic reasons, end-of-life electrical and electronic equipment must be collected and treated separately from other waste: it must not go into landfill (or tip, dump, rubbish dump, garbage dump or dumping ground).

In Europe (the European Union), end-of-life electrical/electronic products are classed as waste electrical and electronic equipment (WEEE), and are subject to the requirements of the European Union (EU) directive 2012/19/EU on waste electrical and electronic equipment (commonly referred to as the WEEE directive).

According to the WEEE regulations, all waste electrical and electronic equipment should be collected separately and then treated and disposed of in accordance with the best available and environmentally friendly techniques. This is because electronic waste (or e-waste) may contain substances harmful to the environment and/or to human health. In addition, electronic waste is also a valuable source of raw materials that can contribute to a circular economy.

The WEEE symbol (a “crossed-out wheeled bin”) is used on product labelling to indicate equipment that must be properly treated and disposed of at the end of its life (see Figure 14-1).

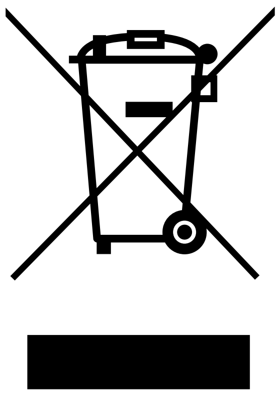

Figure 14-1: WEEE symbol

Although a number of non-EU countries have enacted WEEE regulations, different end-of-life product disposal laws and regulations apply in other countries and regions of the world. Accordingly, please consult your local authorities to obtain the information and guidance relevant to your country and region.

NOTE: At the end of its useful life, a VM600-rack based monitoring system must be disposed of in an environmentally friendly manner.
In European Union Member States, the WEEE directive is applicable.
In other countries and regions of the world, different laws and regulations may be applicable, so please consult your local authorities.

For additional end-of-life product disposal information and guidance, contact your local Meggitt Sensing Systems representative. Alternatively, contact our main office:

Meggitt SA
Environment, health and safety department
Route de Moncor 4
PO Box 1616
1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: ehs@ch.meggitt.com
Website: www.meggittsensing.com/energy

15 SERVICE AND SUPPORT

15.1 Contacting us

Meggitt Sensing Systems' worldwide customer support network offers a range of support, including 15.2 Technical support and 15.3 Sales and repairs support. For customer support, contact your local Meggitt Sensing Systems representative. Alternatively, contact our main office:

Meggitt SA
Customer support department
Route de Moncor 4
PO Box 1616
1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: energysupport@ch.meggitt.com
Website: www.meggittsensing.com/energy

15.2 Technical support

Meggitt Sensing Systems' technical support team provide both pre-sales and post-sales technical support, including:

1- General advice

2- Technical advice

3- Troubleshooting

4- Site visits.

NOTE: For further information, contact Meggitt Sensing Systems (see 15.1 Contacting us).

15.3 Sales and repairs support

Meggitt Sensing Systems' sales team provide both pre-sales and post-sales support, including advice on:

1- New products

2- Spare parts

3- Repairs.

NOTE: If a product has to be returned for repairs, then it should be accompanied by a completed Energy product return form, included on page 15-4.

15.4 Customer feedback

As part of our continuing commitment to improving customer service, we warmly welcome your opinions. To provide feedback, complete the Energy customer feedback form on page 15-7 and return it Meggitt Sensing Systems' main office (see 15.1 Contacting us).

REPAIRS AND RETURNS

Energy product return procedure

If a Meggitt Vibro-Meter® Energy product needs to be returned to Meggitt Switzerland, please use the online product return procedure on the Meggitt Vibro-Meter® website at www.meggittsensing.com/energy/service-and-support/repair

As described on the website, the product return procedure is as follows:

1- Complete and submit online the **Energy product return form** that is available on the website (note: * indicates a required field).

For each Energy product to be returned, a separate Energy product return form must be completed and submitted online.
When an Energy product return form is submitted online, an acknowledgement email including an Energy product return reference number, will be sent by return to confirm that the product return form was received by Meggitt Switzerland.
Please use the Energy product return reference number in all future communications regarding your product return.

2- Complete and include an end-user certificate.

For each Energy product to be returned, an associated end-user certificate is also required.
The single-use end-user certificate is recommended for smaller organisations that handle few products and the annual end-user certificate is recommended for larger organisations that handle many products.
Either end-user certificate can be used to cover multiple products.

NOTE: Visit the website or contact our Customer support department (see 15.1 Contacting us) to obtain the appropriate end-user certificate form.

3- Send the Energy product together with printed copies of the acknowledgement email (or emails) and the end-user certificate (or certificates) to Meggitt Switzerland at

Meggitt SA, Repairs department, Route de Moncor 4, PO Box 1616, 1701 Fribourg, Switzerland.

A separate acknowledgement email (printed copy) is required for each product to be returned, although a single end-user certificate (printed copy) can be used for multiple products.

4- In addition, a purchase order (PO) with a value of CHF 0.00 must also be sent to Meggitt Switzerland, in order to support the initial problem diagnosis.

NOTE: The **Energy product return form** reproduced below is included to support the gathering of information required for completion and submission online.

Energy product return form

Contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

Product information

Product type:*

Part number (PNR):*

Serial number (SER):

Note: Enter “Unknown” if the serial number (SER) is not known.

Ex product:

☐ Yes

☐ No

SIL product:*

☐ Yes

☐ No

Meggitt SA purchase order number:

Date of purchase (dd.mm.yyyy):

Product under warranty:

☐ Yes

☐ No

☐ Don’t know

Site where installed:

End user:

Return information

Reason for return:*

☐ Repair

☐ Out-of-box failure

If the reason for return is "Repair", please answer the following questions:*

Type of failure:

☐ Continuous

☐ Intermittent

☐ Temperature dependent

How long was the operating time before failure?

Description of failure:

Please provide a detailed description in order to help with problem diagnosis.

If the reason for return is "Out-of-box failure", please answer the following questions:*

Type of out-of-box failure:

☐ Product damaged

☐ Incorrect product configuration

☐ Incorrect product delivered

☐ Problem with documentation / labelling

☐ Product dead-on-arrival

Additional information:

Please provide as much information as possible in order to help with problem diagnosis.

Ex product information – additional information required for Ex products only

Is the product installed in a hazardous area (potentially explosive atmosphere)?:

☐ Yes

☐ No

If the product is installed in a hazardous area, please answer the following questions:

How long was the operating time before failure?:

Additional information:

SIL product information – additional information required for SIL products only*

Note: For SIL products used in functional safety contexts/systems, this **SIL product information** section must be completed.

Is the product installed in a safety-related system?:*

☐ Yes

☐ No

If the product is installed in a safety-related system, please answer the following questions:*

Did the system fail** in a safe mode?:* (That is, the safety relay operated but the trip was spurious.)

☐ Yes

☐ No

☐ Not applicable

Did the system fail** in a dangerous state?:* (That is, the failure did not result in the safe state.)

☐ Yes

☐ No

☐ Not applicable

How long was the operating time before failure (in hours)?:*

Additional information:

** A faulty indicator LED is considered as a cosmetic failure.

FEEDBACK

Energy customer feedback form

Manual information

Title of manual:

VM600 machinery protection system (MPS) hardware manual (CSA version)

Reference:	MAMPS-HW/E-CSA	Version:	Edition 17
Date of issue:	February 2018		

Customer contact information

First name:*	Last name:*
Job title:	Company:*

Address:*

Country:*	Email:*
Telephone:*	Fax:

Feedback – general

Please answer the following questions:

Is the document well organised?	☐ Yes	☐ No
Is the information technically accurate?	☐ Yes	☐ No
Is more technical detail required?	☐ Yes	☐ No
Are the instructions clear and complete?	☐ Yes	☐ No
Are the descriptions easy to understand?	☐ Yes	☐ No
Are the examples and diagrams/photos helpful?	☐ Yes	☐ No
Are there enough examples and diagrams/photos?	☐ Yes	☐ No
Is the style/wording easy to read?	☐ Yes	☐ No
Is any information not included?	☐ Yes	☐ No

Please include any additional information in the "Feedback – additional" section below.

Feedback – additional

Additional information:

Please provide as much feedback as possible in order to help us improve our product documentation.
Continue on a separate sheet if necessary …

Part IV: Appendices

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A ENVIRONMENTAL SPECIFICATIONS

A.1 Overall

The following specifications apply to the entire VM600 machinery protection system (MPS).

NOTE: Operating and storage temperatures for individual components are included at the end of this appendix. For further information on individual components, please refer to the specific data sheets listed in Appendix B.

Operating temperature:

- Minimum: −13, -4 *or* 32 °F (−25, −20 *or* 0 °C), depending on the VM600 system components used
- Maximum: *118°F* (*48°C*)
  With forced ventilation and all slots used.
  This value can be increased or decreased according to:
  - *The ventilation mode used (natural or forced)*
  - *The number of used slots.*

  To determine the maximum operating temperature in your application, first calculate the power consumption by referring to the following table, depending on your particular configuration:

	INDIVIDUAL POWER CONSUMPTION (W)	QTY	POWER CONSUMPTION (W)	MAX QTY	MAX POWER CONSUMPTION (W)
BACKPLANE + POWER SUPPLY (1 OR 2)	21.0	1	21.0	1	21.0
AMC8 + IOC8T	8.0			12	
CPUM + I0CN	10.5			1	10.5
RLC16	4.0			6	24.0
CMC16 + IOC16T	14.0			12	0.0
MPC4 + IOC4T	26.5			12	318.0
VM600					373.5

Using this power consumption figure, you can determine the maximum operating temperature from the following graph (Figure A-1), according to your particular ventilation mode:

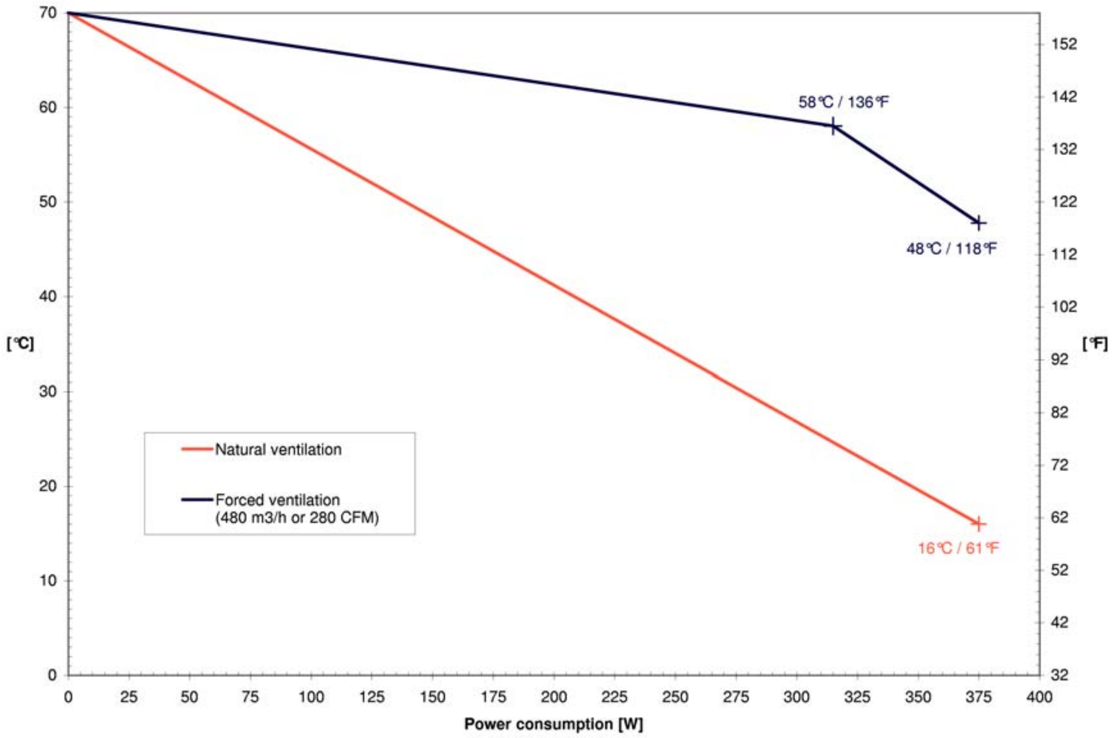

Figure A-1: Maximum operating temperature vs. power consumption for 158°F (70°C) temperature case

With the power and the ventilation mode information, you can also determine the maximum case temperature increase from the following graph (Figure A-2):

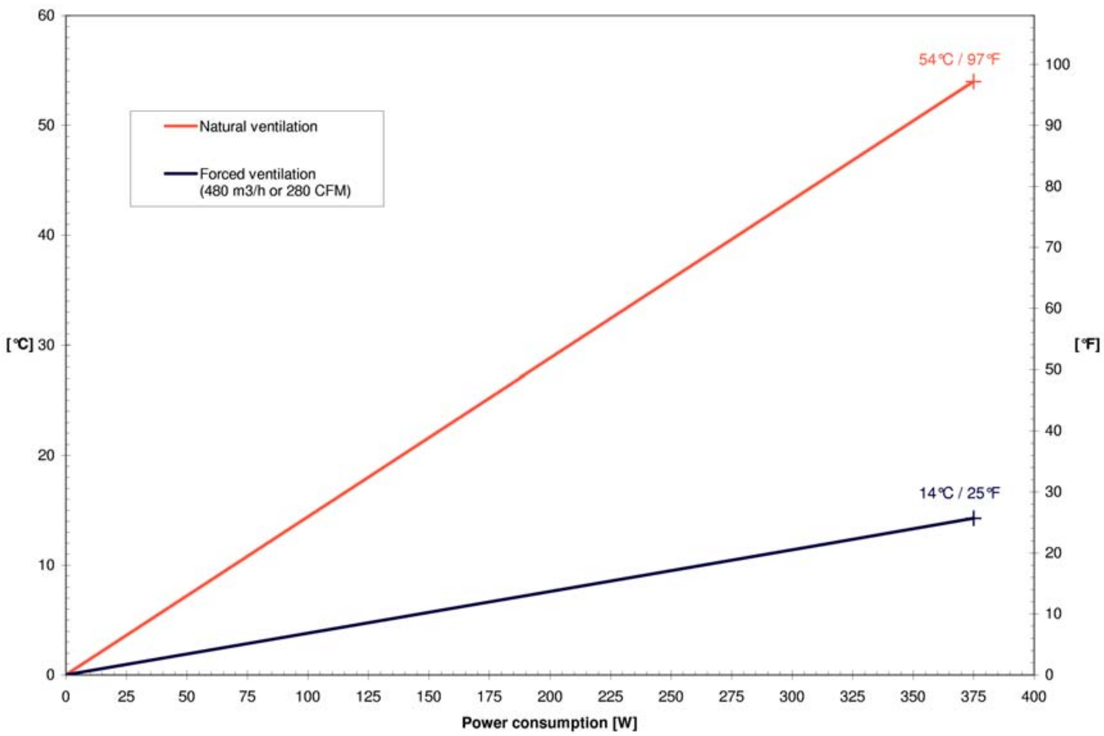

Figure A-2: Maximum case temperature vs. power consumption

Storage temperature:	According to IEC 60068-1
• Short-term (<3 years)	−40 *or* −13 to 176 *or* 185 °F (−40 *or* −25 to 80 *or* 85 °C) for an unpowered system, depending on the VM600 system components used
• Long-term (≥3 years)	50 to 86 °F (10 to 30 °C) for long-term storage rehabilitated (installed) without requiring any condition assessment
Humidity:	According to IEC 60068-2-30
• Operating	0 to 90 %, non-condensing
• Storage	0 to 95 %, non-condensing
Vibration	5 to 35 Hz, 90 minutes/axis, 0.15 mm pk below resonance, 1 g pk above, according to IEC 60068-2-6
Shock	Half-sine, 6 g pk, 11 ms, 3 shocks/axis, according to IEC 60068-2-27
Drop test	30° drop angle, according to IEC 60068-2-31
Power supply perturbations:	
• AC line voltages (AC-input version of the RPS6U)	115 V_{AC} ±20 %. 230 V_{AC} +15 %, −20 %.
• AC line frequencies	50 / 60 Hz
• AC line harmonics	2^{nd} = 4.5 %, 3^{rd} = 4.5 %, 4^{th} = 3.0 %, 5^{th} = 1.5 %, 6^{th} = 1.5 %, 7^{th} = 3.0 %
• DC line voltage variations (DC-input versions of the RPS6U)	+30 %, −25 %
Electromagnetic compatibility (EMC):	
• Emission	According to IEC / EN 61000-6-4
• Immunity	According to IEC / EN 61000-6-2
Safety:	
Electrical safety	Conforms to the following electrical safety standards: IEC / EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
Installation category	CAT I
Pollution degree	2
Other:	
Altitude	Max. 2000 m (6560 ft). Note: Reduced air density affects cooling ability.

MEGGiTT

A.2 Operating temperatures for individual VM600 system components

The operating temperatures for individual VM600 system components are given in Table A-1.

Table A-1: Operating temperatures for individual VM600 system components

	−13 to 149°F (−25 to 65°C)	−4 to 149°F (−20 to 65°C)	32 to 149°F (0 to 65°C)	32 to 158°F (0 to 70°C)
ABE040 and ABE042	√			
AMC8 and IOC8T	√			
CMC16	√			
CPUM and IOCN	√ See note 1	√ See note 2		
IOC4T	√			
IOC4T adaptors	√			
IOC16T			√	
MPC1	√			
MPC4	√			
RLC16	√			
RPS6U	√ See note 3			√ See note 4
XMx16 and XIO16T			√	

Notes

In 2015, the CPUM card was updated to use a new CPU module (PC/104) that supports two Ethernet interfaces by default. However, this change resulted in different temperature specifications for the CPUM/IOCN card pair.

1. Earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier) fitted with the MSM586EN or equivalent CPU module have an operating temperature range of −13 to 149°F (−25 to 65°C).
2. Later versions of the CPUM card (PNR 200-595-076-HHh or later) fitted with the PFM-541I or equivalent CPU module have an operating temperature range of −4 to 149°F (−20 to 65°C).

In 2016, the RPS6U rack power supply was updated to provide a higher output power of 330 W. However, this change resulted in different temperature specifications for the power supply.

3. Earlier versions of the RPS6U rack power supply (PNR 200-582-x00-01h or earlier) that define the power as a rated power of 300 W have an operating temperature range of −13 to 149°F (−25 to 65°C).
4. Later versions of the RPS6U rack power supply (PNR 200-582-x00-02h or later) that define the power as a total maximum output power of 330 W have an operating temperature range of 32 to 158°F (0 to 70°C).

A.3 Storage temperatures for individual VM600 system components

The storage temperatures for individual VM600 system components are given in Table A-2.

Table A-2: Storage temperatures for individual VM600 system components

	−40 to 185°F (−40 to 85°C)	−13 to 185°F (−25 to 85°C)	−13 to 176°F (−25 to 80°C)
ABE040 and ABE042	√		
AMC8 and IOC8T	√		
CMC16	√		
CPUM and IOCN		√ See note 1	√ See note 2
IOC4T	√		
IOC4T adaptors	√		
IOC16T	√		
MPC1	√		
MPC4	√		
RLC16	√		
RPS6U	√		
XMx16 and XIO16T	√		

Notes
In 2015, the CPUM card was updated to use a new CPU module (PC/104) that supports two Ethernet interfaces by default. However, this change resulted in different temperature specifications for the CPUM/IOCN card pair.

1. Earlier versions of the CPUM card (PNR 200-595-075-HHh or earlier) fitted with the MSM586EN or equivalent CPU module have a storage temperature range of −13 to 185°F (−25 to 85°C).
2. Later versions of the CPUM card (PNR 200-595-076-HHh or later) fitted with the PFM-541I or equivalent CPU module have a storage temperature range of −13 to 176°F (−25 to 80°C).

A.4 Temperature derating for the power entry module of a VM600 rack

The AC-input rear panels with mains sockets used by ABE04x racks have a compact filtered power entry module with an IEC type C14 connector (IEC 60320).

As shown in Figure A-3, this power entry module requires temperature derating when the VM600 rack operates in environments with temperatures greater than 122 °F (50 °C).

Basically, the power entry module (and VM600 rack) can operate at 100 % power for temperatures up to 122 °F (50 °C), but for temperatures greater than 122 °F (50 °C) it must be derated linearly to 50 % power at 158 °F (70 °C).

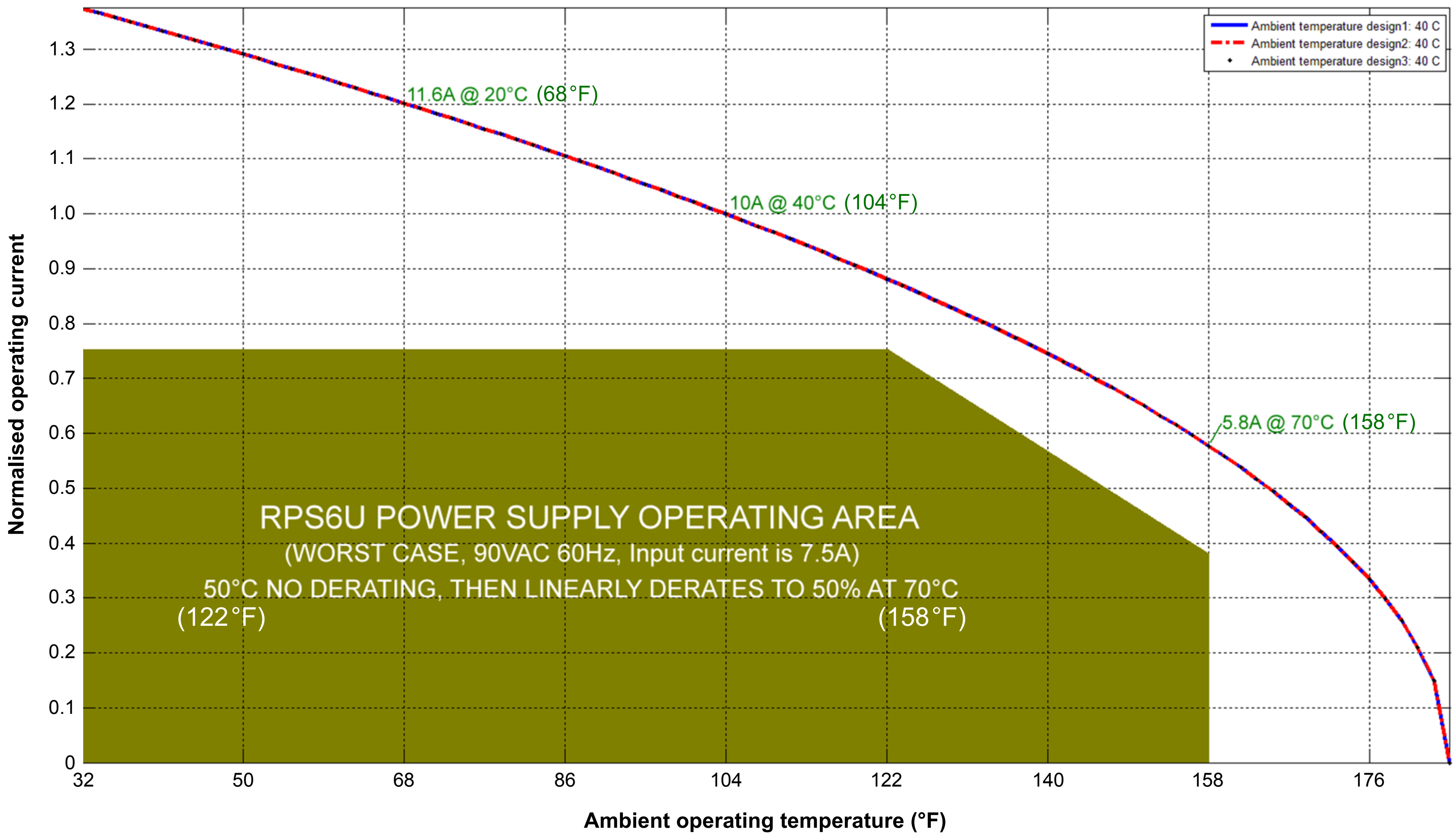

Figure A-3: Temperature derating for the power entry module (AC input) of a VM600 rack

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B DATA SHEETS

Data sheets exist for the following Meggitt Sensing Systems' products:

Type	Designation	Document reference
ABE040 and ABE042	VM600 system rack	268-001
AMC8 and IOC8T	Analog monitoring card and input/output card	268-041
CPUM and IOCN	Modular CPU card and input/output card	268-031
IOC4T	Input/output card for MPC4	268-071
IOC4T adaptors	Capacitive-coupling adaptor	268-078
	Voltage-drop adaptor	268-077
MPC1	Machinery pulsation card	268-025
MPC4	Machinery protection card	268-021
RLC16	Relay card	268-081
RPS6U	VM600 rack power supply	268-011
XMx16 and XIO16T	Extended condition monitoring cards	660-020-010-208A

Visit the Meggitt Vibro-Meter® website to obtain the latest version of a data sheet and other product information:

- www.meggittsensing.com/energy

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C DEFINITION OF BACKPLANE CONNECTOR PINS

This appendix defines the pins on backplane connectors P1, P2, P3 and P4.

The definition of pins on each connector depends on the position of the connector on the rack backplane (that is, in which slot it is used). The information is presented in tabular form for the following groups of slots:

- Slot 0 (see Figure C-1)
- Slots 1 and 2 (see Figure C-2)
- Slots 3 to 14 (see Figure C-3)
- Slots 15 and 18 (see Figure C-4).

	SLOT 0		
	CONNECTOR P1		
PIN No.	ROW A	ROW B	ROW C
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL*	D10
4	D03	BG0IN*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1*	BR0*	SYSRESET*
13	DS0*	BR1*	LWORD*
14	WRITE*	BR2*	AM5
15	GND	BR3*	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN*	Not connected	A17
22	IACKOUT*	Not connected	A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A9
30	A01	IRQ1*	A8
31	-12 V	+5 V STDBY	+12 V
32	+5 V	+5 V	+5 V

	SLOT 0		
	CONNECTOR P3		
PIN No.	ROW A	ROW B	ROW C
1	Conn. P1, Z1	Not connected	Conn. P1, D1
2	Conn. P1, Z2	Not connected	Conn. P1, D2
3	Conn. P1, Z3	Not connected	Conn. P1, D3
4	Conn. P1, Z4	Not connected	Conn. P1, D4
5	Conn. P1, Z5	Not connected	Conn. P1, D5
6	Conn. P1, Z6	Not connected	Conn. P1, D6
7	Conn. P1, Z7	Not connected	Conn. P1, D7
8	Conn. P1, Z8	Not connected	Conn. P1, D8
9	Conn. P1, Z9	Not connected	Conn. P1, D9
10	Conn. P1, Z10	Not connected	Conn. P1, D10
11	Conn. P1, Z11	Not connected	Conn. P1, D11
12	Conn. P1, Z12	Not connected	Conn. P1, D12
13	Conn. P1, Z13	Not connected	Conn. P1, D13
14	Conn. P1, Z14	Not connected	Conn. P1, D14
15	Conn. P1, Z15	Not connected	Conn. P1, D15
16	Conn. P1, Z16	Not connected	Conn. P1, D16
17	Conn. P1, Z17	Not connected	Conn. P1, D17
18	Conn. P1, Z18	Not connected	Conn. P1, D18
19	Conn. P1, Z19	Not connected	Conn. P1, D19
20	Conn. P1, Z20	Not connected	Conn. P1, D20
21	Conn. P1, Z21	Not connected	Conn. P1, D21
22	Conn. P1, Z22	Not connected	Conn. P1, D22
23	Conn. P1, Z23	Not connected	Conn. P1, D23
24	Conn. P1, Z24	Not connected	Conn. P1, D24
25	Conn. P1, Z25	Not connected	Conn. P1, D25
26	Conn. P1, Z26	Not connected	Conn. P1, D26
27	Conn. P1, Z27	Not connected	Conn. P1, D27
28	Conn. P1, Z28	Not connected	Conn. P1, D28
29	Conn. P1, Z29	Not connected	Conn. P1, D29
30	Conn. P1, Z30	Not connected	Conn. P1, D30
31	Conn. P1, Z31	Not connected	Conn. P1, D31
32	Conn. P1, Z32	Not connected	Conn. P1, D32

	SLOT 0		
	CONNECTOR P2		
PIN No.	ROW A	ROW B	ROW C
1	Not connected	+5 V	Not connected
2	Not connected	GND	Not connected
3	Not connected	RESERVED	Not connected
4	Not connected	A24	Not connected
5	Not connected	A25	Not connected
6	Not connected	A26	Not connected
7	Not connected	A27	Not connected
8	Not connected	A28	Not connected
9	Not connected	A29	Not connected
10	Not connected	A30	Not connected
11	Not connected	A31	Not connected
12	Not connected	GND	Not connected
13	Not connected	+5 V	Not connected
14	Not connected	D16	Not connected
15	Not connected	D17	Not connected
16	Not connected	D18	Not connected
17	Not connected	D19	Not connected
18	Not connected	D20	Not connected
19	Not connected	D21	Not connected
20	Not connected	D22	Not connected
21	Not connected	D23	Not connected
22	Not connected	GND	Not connected
23	Not connected	D24	Not connected
24	Not connected	D25	Not connected
25	Not connected	D26	Not connected
26	Not connected	D27	Not connected
27	Not connected	D28	Not connected
28	Not connected	D29	Not connected
29	Not connected	D30	Not connected
30	Not connected	D31	Not connected
31	Not connected	GND	Not connected
32	Not connected	+5 V	Not connected

	SLOT 0		
	CONNECTOR P4		
PIN No.	ROW A	ROW B	ROW C
1	Conn.. P2, Z1	Not connected	Conn. P2, D1
2	Conn. P2, Z2	Not connected	Conn. P2, D2
3	Conn. P2, Z3	Not connected	Conn. P2, D3
4	Conn. P2, Z4	Not connected	Conn. P2, D4
5	Conn. P2, Z5	Not connected	Conn. P2, D5
6	Conn. P2, Z6	Not connected	Conn. P2, D6
7	Conn. P2, Z7	Not connected	Conn. P2, D7
8	Conn. P2, Z8	Not connected	Conn. P2, D8
9	Conn. P2, Z9	Not connected	Conn. P2, D9
10	Conn. P2, Z10	Not connected	Conn. P2, D10
11	Conn. P2, Z11	Not connected	Conn. P2, D11
12	Conn. P2, Z12	Not connected	Conn. P2, D12
13	Conn. P2, Z13	Not connected	Conn. P2, D13
14	Conn. P2, Z14	Not connected	Conn. P2, D14
15	Conn. P2, Z15	Not connected	Conn. P2, D15
16	Conn. P2, Z16	Not connected	Conn. P2, D16
17	Conn. P2, Z17	Not connected	Conn. P2, D17
18	Conn. P2, Z18	Not connected	Conn. P2, D18
19	Conn. P2, Z19	Not connected	Conn. P2, D19
20	Conn. P2, Z20	Not connected	Conn. P2, D20
21	Conn. P2, Z21	Not connected	Conn. P2, D21
22	Conn. P2, Z22	Not connected	Conn. P2, D22
23	Conn. P2, Z23	Not connected	Conn. P2, D23
24	Conn. P2, Z24	Not connected	Conn. P2, D24
25	Conn. P2, Z25	Not connected	Conn. P2, D25
26	Conn. P2, Z26	Not connected	Conn. P2, D26
27	Conn. P2, Z27	Not connected	Conn. P2, D27
28	Conn. P2, Z28	Not connected	Conn. P2, D28
29	Conn. P2, Z29	Not connected	Conn. P2, D29
30	Conn. P2, Z30	Not connected	Conn. P2, D30
31	Conn. P2, Z31	Not connected	Conn. P2, D31
32	Conn. P2, Z32	Not connected	Conn. P2, D32

Figure C-1: Pin definitions for slot 0

	SLOTS 1-2		
	CONNECTOR P1		
PIN No.	ROW A	ROW B	ROW C
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL*	D10
4	D03	BG0IN*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1*	BR0*	SYSRESET*
13	DS0*	BR1*	LWORD*
14	WRITE*	BR2*	AM5
15	GND	BR3*	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN*	Not connected	A17
22	IACKOUT*	Not connected	A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A9
30	A01	IRQ1*	A8
31	-12 V	+5 V STDBY	+12 V
32	+5 V	+5 V	+5 V

	SLOTS 1-2		
	CONNECTOR P3		
PIN No.	ROW A	ROW B	ROW C
1	OC 0	TACHO 0	OC 8
2	OC 1	TACHO 1	OC 9
3	OC 2	TACHO 2	OC 10
4	OC 3	TACHO 3	OC 11
5	OC 4	TACHO 4	OC 12
6	OC 5	TACHO 5	OC 13
7	OC 6	TACHO 6	OC 14
8	OC 7	TACHO 7	OC 15
9	GND	TACHO GND	RAW_H 2
10	RAW_H 0	RAW_H 1	RAW_L 2
11	RAW_L 0	RAW_L 1	RAW_H 5
12	RAW_H 3	RAW_H 4	RAW_L 5
13	RAW_L 3	RAW_L 4	RAW_H 8
14	RAW_H 6	RAW_H 7	RAW_L 8
15	RAW_L 6	RAW_L 7	RAW_H 11
16	RAW_H 9	RAW_H 10	RAW_L 11
17	RAW_L 9	RAW_L 10	RAW_H 14
18	RAW_H 12	RAW_H 13	RAW_L 14
19	RAW_L 12	RAW_L 13	RAW_H 17
20	RAW_H 15	RAW_H 16	RAW_L 17
21	RAW_L 15	RAW_L 16	RAW_H 20
22	RAW_H 18	RAW_H 19	RAW_L 20
23	RAW_L 18	RAW_L 19	RAW_H 23
24	RAW_H 21	RAW_H 22	RAW_L 23
25	RAW_L 21	RAW_L 22	RAW_H 26
26	RAW_H 24	RAW_H 25	RAW_L 26
27	RAW_L 24	RAW_L 25	RAW_H 29
28	RAW_H 27	RAW_H 28	RAW_L 29
29	RAW_L 27	RAW_L 28	RAW_H 31
30	GND	RAW_H 30	RAW_L 31
31	-12 V	RAW_L 30	+12 V
32	+5 V	+5 V	+5 V

	SLOTS 1-2		
	CONNECTOR P2		
PIN No.	ROW A	ROW B	ROW C
1	Not connected	+5 V	Not connected
2	Not connected	GND	Not connected
3	Not connected	RESERVED	Not connected
4	Not connected	A24	Not connected
5	Not connected	A25	Not connected
6	Not connected	A26	Not connected
7	Not connected	A27	Not connected
8	Not connected	A28	Not connected
9	Not connected	A29	Not connected
10	Not connected	A30	Not connected
11	Not connected	A31	Not connected
12	Not connected	GND	Not connected
13	Not connected	+5 V	Not connected
14	Not connected	D16	Not connected
15	Not connected	D17	Not connected
16	Not connected	D18	Not connected
17	Not connected	D19	Not connected
18	Not connected	D20	Not connected
19	Not connected	D21	Not connected
20	Not connected	D22	Not connected
21	Not connected	D23	Not connected
22	Not connected	GND	Not connected
23	Not connected	D24	Not connected
24	Not connected	D25	Not connected
25	Not connected	D26	Not connected
26	Not connected	D27	Not connected
27	Not connected	D28	Not connected
28	Not connected	D29	Not connected
29	Not connected	D30	Not connected
30	Not connected	D31	Not connected
31	Not connected	GND	Not connected
32	Not connected	+5 V	Not connected

	SLOTS 1-2		
	CONNECTOR P4		
PIN No.	ROW A	ROW B	ROW C
1	Not connected	Not connected	Not connected
2	Not connected	Not connected	Not connected
3	Not connected	Not connected	Not connected
4	Not connected	Not connected	Not connected
5	Not connected	Not connected	Not connected
6	Not connected	Not connected	Not connected
7	Not connected	Not connected	Not connected
8	Not connected	Not connected	Not connected
9	Not connected	Not connected	Not connected
10	Not connected	Not connected	Not connected
11	Not connected	Not connected	Not connected
12	Not connected	Not connected	Not connected
13	Not connected	Not connected	Not connected
14	Not connected	Not connected	Not connected
15	Not connected	Not connected	Not connected
16	Not connected	Not connected	Not connected
17	Not connected	Not connected	Not connected
18	Not connected	Not connected	Not connected
19	Not connected	Not connected	Not connected
20	Not connected	Not connected	Not connected
21	Not connected	Not connected	Not connected
22	Not connected	Not connected	Not connected
23	Not connected	Not connected	Not connected
24	Not connected	Not connected	Not connected
25	Not connected	Not connected	Not connected
26	Not connected	Not connected	Not connected
27	Not connected	Not connected	Not connected
28	Not connected	Not connected	Not connected
29	Not connected	Not connected	Not connected
30	Not connected	Not connected	Not connected
31	Not connected	Not connected	Not connected
32	Not connected	Not connected	Not connected

Figure C-2: Pin definitions for slots 1 and 2

	SLOTS 3-14		
	CONNECTOR P1		
PIN No.	ROW A	ROW B	ROW C
1	D00	BBSY*	D08
2	D01	BCLR*	D09
3	D02	ACFAIL*	D10
4	D03	BG0IN*	D11
5	D04	BG0OUT*	D12
6	D05	BG1IN*	D13
7	D06	BG1OUT*	D14
8	D07	BG2IN*	D15
9	GND	BG2OUT*	GND
10	SYSCLK	BG3IN*	SYSFAIL*
11	GND	BG3OUT*	BERR*
12	DS1*	BR0*	SYSRESET*
13	DS0*	BR1*	LWORD*
14	WRITE*	BR2*	AM5
15	GND	BR3*	A23
16	DTACK*	AM0	A22
17	GND	AM1	A21
18	AS*	AM2	A20
19	GND	AM3	A19
20	IACK*	GND	A18
21	IACKIN*	Not connected	A17
22	IACKOUT*	Not connected	A16
23	AM4	GND	A15
24	A07	IRQ7*	A14
25	A06	IRQ6*	A13
26	A05	IRQ5*	A12
27	A04	IRQ4*	A11
28	A03	IRQ3*	A10
29	A02	IRQ2*	A9
30	A01	IRQ1*	A8
31	-12 V	+5 V STDBY	+12 V
32	+5 V	+5 V	+5 V

	SLOTS 3-14		
	CONNECTOR P3		
PIN No.	ROW A	ROW B	ROW C
1	OCx 0	TACHO 0	OCx 8
2	OCx 1	TACHO 1	OCx 9
3	OCx 2	TACHO 2	OCx 10
4	OCx 3	TACHO 3	OCx 11
5	OCx 4	TACHO 4	OCx 12
6	OCx 5	TACHO 5	OCx 13
7	OCx 6	TACHO 6	OCx 14
8	OCx 7	TACHO 7	OCx 15
9	GND	TACHO GND	RAW_H 2
10	RAW_H 0	RAW_H 1	RAW_L 2
11	RAW_L 0	RAW_L 1	RAW_H 5
12	RAW_H 3	RAW_H 4	RAW_L 5
13	RAW_L 3	RAW_L 4	RAW_H 8
14	RAW_H 6	RAW_H 7	RAW_L 8
15	RAW_L 6	RAW_L 7	RAW_H 11
16	RAW_H 9	RAW_H 10	RAW_L 11
17	RAW_L 9	RAW_L 10	RAW_H 14
18	RAW_H 12	RAW_H 13	RAW_L 14
19	RAW_L 12	RAW_L 13	RAW_H 17
20	RAW_H 15	RAW_H 16	RAW_L 17
21	RAW_L 15	RAW_L 16	RAW_H 20
22	RAW_H 18	RAW_H 19	RAW_L 20
23	RAW_L 18	RAW_L 19	RAW_H 23
24	RAW_H 21	RAW_H 22	RAW_L 23
25	RAW_L 21	RAW_L 22	RAW_H 26
26	RAW_H 24	RAW_H 25	RAW_L 26
27	RAW_L 24	RAW_L 25	RAW_H 29
28	RAW_H 27	RAW_H 28	RAW_L 29
29	RAW_L 27	RAW_L 28	RAW_H 31
30	GND	RAW_H 30	RAW_L 31
31	-12 V	RAW_L 30	+12 V
32	+5 V	+5 V	+5 V

	SLOTS 3-14		
	CONNECTOR P2		
PIN No.	ROW A	ROW B	ROW C
1	Conn. P4, A1	Conn. P4, B1	Conn. P4, C1
2	Conn. P4, A2	Conn. P4, B2	Conn. P4, C2
3	Conn. P4, A3	Conn. P4, B3	Conn. P4, C3
4	Conn. P4, A4	Conn. P4, B4	Conn. P4, C4
5	Conn. P4, A5	Conn. P4, B5	Conn. P4, C5
6	Conn. P4, A6	Conn. P4, B6	Conn. P4, C6
7	Conn. P4, A7	Conn. P4, B7	Conn. P4, C7
8	Conn. P4, A8	Conn. P4, B8	Conn. P4, C8
9	Conn. P4, A9	Conn. P4, B9	Conn. P4, C9
10	Conn. P4, A10	Conn. P4, B10	Conn. P4, C10
11	Conn. P4, A11	Conn. P4, B11	Conn. P4, C11
12	Conn. P4, A12	Conn. P4, B12	Conn. P4, C12
13	Conn. P4, A13	Conn. P4, B13	Conn. P4, C13
14	Conn. P4, A14	Conn. P4, B14	Conn. P4, C14
15	Conn. P4, A15	Conn. P4, B15	Conn. P4, C15
16	Conn. P4, A16	Conn. P4, B16	Conn. P4, C16
17	Conn. P4, A17	Conn. P4, B17	Conn. P4, C17
18	Conn. P4, A18	Conn. P4, B18	Conn. P4, C18
19	Conn. P4, A19	Conn. P4, B19	Conn. P4, C19
20	Conn. P4, A20	Conn. P4, B20	Conn. P4, C20
21	Conn. P4, A21	Conn. P4, B21	Conn. P4, C21
22	Conn. P4, A22	Conn. P4, B22	Conn. P4, C22
23	Conn. P4, A23	Conn. P4, B23	Conn. P4, C23
24	Conn. P4, A24	Conn. P4, B24	Conn. P4, C24
25	Conn. P4, A25	Conn. P4, B25	Conn. P4, C25
26	Conn. P4, A26	Conn. P4, B26	Conn. P4, C26
27	Conn. P4, A27	Conn. P4, B27	Conn. P4, C27
28	Conn. P4, A28	Conn. P4, B28	Conn. P4, C28
29	Conn. P4, A29	Conn. P4, B29	Conn. P4, C29
30	Conn. P4, A30	Conn. P4, B30	Conn. P4, C30
31	Conn. P4, A31	Conn. P4, B31	Conn. P4, C31
32	Conn. P4, A32	Conn. P4, B32	Conn. P4, C32

	SLOTS 3-14		
	CONNECTOR P4		
PIN No.	ROW A	ROW B	ROW C
1	Conn. P2, A1	Conn. P2, B1	Conn. P2, C1
2	Conn. P2, A2	Conn. P2, B2	Conn. P2, C2
3	Conn. P2, A3	Conn. P2, B3	Conn. P2, C3
4	Conn. P2, A4	Conn. P2, B4	Conn. P2, C4
5	Conn. P2, A5	Conn. P2, B5	Conn. P2, C5
6	Conn. P2, A6	Conn. P2, B6	Conn. P2, C6
7	Conn. P2, A7	Conn. P2, B7	Conn. P2, C7
8	Conn. P2, A8	Conn. P2, B8	Conn. P2, C8
9	Conn. P2, A9	Conn. P2, B9	Conn. P2, C9
10	Conn. P2, A10	Conn. P2, B10	Conn. P2, C10
11	Conn. P2, A11	Conn. P2, B11	Conn. P2, C11
12	Conn. P2, A12	Conn. P2, B12	Conn. P2, C12
13	Conn. P2, A13	Conn. P2, B13	Conn. P2, C13
14	Conn. P2, A14	Conn. P2, B14	Conn. P2, C14
15	Conn. P2, A15	Conn. P2, B15	Conn. P2, C15
16	Conn. P2, A16	Conn. P2, B16	Conn. P2, C16
17	Conn. P2, A17	Conn. P2, B17	Conn. P2, C17
18	Conn. P2, A18	Conn. P2, B18	Conn. P2, C18
19	Conn. P2, A19	Conn. P2, B19	Conn. P2, C19
20	Conn. P2, A20	Conn. P2, B20	Conn. P2, C20
21	Conn. P2, A21	Conn. P2, B21	Conn. P2, C21
22	Conn. P2, A22	Conn. P2, B22	Conn. P2, C22
23	Conn. P2, A23	Conn. P2, B23	Conn. P2, C23
24	Conn. P2, A24	Conn. P2, B24	Conn. P2, C24
25	Conn. P2, A25	Conn. P2, B25	Conn. P2, C25
26	Conn. P2, A26	Conn. P2, B26	Conn. P2, C26
27	Conn. P2, A27	Conn. P2, B27	Conn. P2, C27
28	Conn. P2, A28	Conn. P2, B28	Conn. P2, C28
29	Conn. P2, A29	Conn. P2, B29	Conn. P2, C29
30	Conn. P2, A30	Conn. P2, B30	Conn. P2, C30
31	Conn. P2, A31	Conn. P2, B31	Conn. P2, C31
32	Conn. P2, A32	Conn. P2, B32	Conn. P2, C32

Figure C-3: Pin definitions for slots 3 to 14

SLOTS 15 & 18	
CONNECTOR P1	
PIN NUMBER	DESIGNATION
D4	+5 V
Z6	+5 V
D8	+5 V
Z10	+5 V
D12	+5 V
Z14	+5 V SENSE
D16	-12 V
Z18	GND
D20	GND
Z22	GND
D24	GND
Z26	GND
D28	+12 V
Z30	+12 V
D32	GND SENSE

	SLOTS 15-18		
	CONNECTOR P3		
PIN No.	ROW A	ROW B	ROW C
1	OC 0	TACHO 0	OC 8
2	OC 1	TACHO 1	OC 9
3	OC 2	TACHO 2	OC 10
4	OC 3	TACHO 3	OC 11
5	OC 4	TACHO 4	OC 12
6	OC 5	TACHO 5	OC 13
7	OC 6	TACHO 6	OC 14
8	OC 7	TACHO 7	OC 15
9	GND	TACHO GND	RAW_H 2
10	RAW_H 0	RAW_H 1	RAW_L 2
11	RAW_L 0	RAW_L 1	RAW_H 5
12	RAW_H 3	RAW_H 4	RAW_L 5
13	RAW_L 3	RAW_L 4	RAW_H 8
14	RAW_H 6	RAW_H 7	RAW_L 8
15	RAW_L 6	RAW_L 7	RAW_H 11
16	RAW_H 9	RAW_H 10	RAW_L 11
17	RAW_L 9	RAW_L 10	RAW_H 14
18	RAW_H 12	RAW_H 13	RAW_L 14
19	RAW_L 12	RAW_L 13	RAW_H 17
20	RAW_H 15	RAW_H 16	RAW_L 17
21	RAW_L 15	RAW_L 16	RAW_H 20
22	RAW_H 18	RAW_H 19	RAW_L 20
23	RAW_L 18	RAW_L 19	RAW_H 23
24	RAW_H 21	RAW_H 22	RAW_L 23
25	RAW_L 21	RAW_L 22	RAW_H 26
26	RAW_H 24	RAW_H 25	RAW_L 26
27	RAW_L 24	RAW_L 25	RAW_H 29
28	RAW_H 27	RAW_H 28	RAW_L 29
29	RAW_L 27	RAW_L 28	RAW_H 31
30	GND	RAW_H 30	RAW_L 31
31	-12 V	RAW_L 30	+12 V
32	+5 V	+5 V	+5 V

SLOTS 15 & 18	
CONNECTOR P2	
PIN NUMBER	DESIGNATION
D4	AC_FAIL*
Z6	SYSRESET*
D8	Not used
Z10	Not used
D12	Not used
Z14	Not used
D16	Not used
Z18	Not used
D20	DC_VOLT+
Z22	DC_VOLT+
D24	DC_GND
Z26	DC_GND
D28	AC_LINE
Z30	AC_NEUTRAL
D32	AC_PE

	SLOTS 15-18		
	CONNECTOR P4		
PIN No.	ROW A	ROW B	ROW C
1	Not connected	Not connected	Not connected
2	Not connected	Not connected	Not connected
3	Not connected	Not connected	Not connected
4	Not connected	Not connected	Not connected
5	Not connected	Not connected	Not connected
6	Not connected	Not connected	Not connected
7	Not connected	Not connected	Not connected
8	Not connected	Not connected	Not connected
9	Not connected	Not connected	Not connected
10	Not connected	Not connected	Not connected
11	Not connected	Not connected	Not connected
12	Not connected	Not connected	Not connected
13	Not connected	Not connected	Not connected
14	Not connected	Not connected	Not connected
15	Not connected	Not connected	Not connected
16	Not connected	Not connected	Not connected
17	Not connected	Not connected	Not connected
18	Not connected	Not connected	Not connected
19	Not connected	Not connected	Not connected
20	Not connected	Not connected	Not connected
21	Not connected	Not connected	Not connected
22	Not connected	Not connected	Not connected
23	Not connected	Not connected	Not connected
24	Not connected	Not connected	Not connected
25	Not connected	Not connected	Not connected
26	Not connected	Not connected	Not connected
27	Not connected	Not connected	Not connected
28	Not connected	Not connected	Not connected
29	Not connected	Not connected	Not connected
30	Not connected	Not connected	Not connected
31	Not connected	Not connected	Not connected
32	Not connected	Not connected	Not connected

Figure C-4: Pin definitions for slots 15 to 18

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D ABBREVIATIONS AND SYMBOLS

This appendix defines the abbreviations and symbols used in this manual as well as in associated Meggitt Sensing Systems documentation.

Only the basic measurement unit symbols are listed here (for example, Hz, V, W). Units combined with metric prefixes (such as micro-, milli- and kilo-) have not been included.

Table D-1: Abbreviations and symbols

Abbreviation	Definition
A	Ampere (unit of electric current)
AB	Absolute bearing vibration (= MPS processing function)
ABE04x	VM600 system rack (19" racks, including the ABE040 and ABE042, from Meggitt Sensing Systems' Vibro-Meter® product line)
AC	Alternating current
ADC	Analog-to-digital converter
AMC	Analog monitoring card (AMC8)
ANSI	American national standards institute
API	American petroleum institute (standards organisation)
AR	Alarm Reset
AS	Absolute shaft / shaft absolute vibration (= MPS processing function)
ASPS	Auxiliary sensor power supply
ATEX	ATEX Directive (94/9/EC) concerning the use of equipment in potentially explosive atmospheres (from the French term **AT**mosphères **EX**plosibles)
AVG	Average
BBAB	Broad-band absolute bearing vibration* (= MPS processing function)
BBP	Broad-band pressure (= MPS processing function)
BIST	Built-in self test
BIT	Built-in test
BITE	Built-in test equipment
BP	Band pass (filter)
BW	Bandwidth
C	Coulomb (unit of electric charge)
CJ	Cold junction
CJC	Cold-junction compensation
CMC	Condition monitoring card (CMC16). See also XMC and XMV.

Table D-1: Abbreviations and symbols (continued)

Abbreviation	Definition
CMRR	Common-mode rejection ratio
CMS	Condition monitoring system
CMV	Common-mode voltage
COM	Common
CPU	Central processing unit
CSA	Canadian standards association
DAC	Digital-to-analog converter
dB	Decibel
DB	Danger Bypass
DC	Direct current
DCS	Distributed control system
DFT	Discrete fourier transform
DHE	Differential housing expansion (= MPS processing function)
DMF	Dual mathematical function (= MPS processing function)
DPDT	Double-pole double-throw (type of relay)
DQSP	Delta (or differential) quasi-static pressure (= MPS processing function)
DQST	Delta (or differential) quasi-static temperature (= MPS processing function)
DSI	Discrete signal interface
DSP	Digital signal processor
EC	Eccentricity (= MPS processing function)
EEPROM	Electrically erasable programmable read-only memory
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EN	European standard
EPROM	Erasable programmable read-only memory
F	Farad (unit of electric capacitance)
FLASH	Type of memory (sometimes called flash EEPROM)
FFT	Fast fourier transform
FW	Firmware (embedded software)
g	Gram (unit of mass)
g	Grav (unit of acceleration, approximately equal to 9.81 m/s^2)

Table D-1: Abbreviations and symbols (continued)

Abbreviation	Definition
GND	Ground
HE	(Absolute) housing expansion (= MPS processing function)
HP	(i) High-pass (filter) (ii) High-pressure (turbine)
HW	Hardware
Hz	Hertz (unit of frequency)
IEC	International electrotechnical commission
IOC	Input/output cards (IOC4T, IOC8T, IOC16T and IOCN)
IP	Industry pack
I/P	Input
ISO	International organisation for standardisation
JS	Jumper selectable
K	Kelvin (unit of temperature)
LCD	Liquid crystal display
LCIE	Laboratoire central des industries électriques (French certifying body used by Meggitt Sensing Systems)
LED	Light emitting diode
LP	(i) Low-pass (filter) (ii) Low-pressure (turbine)
m	Meter (unit of length)
max.	Maximum
min.	Minimum
MPC	Machinery protection card (MPC4 and MPC4SIL)
MPS	Machinery protection system
MTBF	Mean time between failures
MUX	Multiplexer
N	Newton (unit of force)
N/A	Not applicable
NB	Narrow band (= MPS processing function, also known as tracking)
NBFS	Narrow-band fixed frequency (= MPS processing function)
NC	Normally closed
NDE	Normally de-energised

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Table D-1: Abbreviations and symbols (continued)

Abbreviation	Definition
NE	Normally energised
NO	Normally open
OC	Open collector
O/P	Output
Pa	Pascal (unit of pressure, equivalent to N/m^2)
PCB	Printed circuit board
PCS	Process control system
PLC	Programmable logic controller
pk	Peak
P/N	Part number
pp	Peak-to-peak
PS	Power supply
PS	Position* (= MPS processing function)
PTB	Physikalisch-Technische Bundesanstalt (German certifying body used by Meggitt Sensing Systems)
QSP	Quasi-static pressure (= MPS processing function)
QST	Quasi-static temperature (= MPS processing function)
RAM	Random access memory
RFI	Radio frequency interference
RLC	Relay card (RLC16)
RMS	Root mean square
ROM	Read only memory
RPM	Revolutions per minute
RPS	Rack power supply (RPS6U)
RS	Relative shaft / shaft relative (API: radial shaft)* (= MPS processing function)
RSC	Relative shaft / shaft relative expansion using shaft collar (= MPS processing function)
RST	Relative shaft / shaft relative expansion using shaft taper (= MPS processing function)
RTD	Resistance temperature detector
s	Second (unit of time)

Table D-1: Abbreviations and symbols (continued)

Abbreviation	Definition
SEP	Relative shaft / shaft relative expansion using pendulum (= MPS processing function)
S/H	Sample and hold
S_{max}	Maximum vibratory displacement in the plane of measurement, as defined in ISO 7919-1 (= MPS processing function)
SNR	Signal-to-noise ratio
SPDT	Single-pole double-throw (type of relay)
SW	Software
TC	Thermocouple
TM	Trip Multiply
TTL	Transistor-transistor logic
typ.	typical, typically
U/I	Voltage-to-current (converter)
V	Volt (unit of electric potential)
V_{AC}	Voltage (alternating current)
V_{DC}	Voltage (direct current)
V_{pp}	Voltage (peak-to-peak value)
V_{RMS}	Voltage (root-mean-square value)
VDI	Verein Deutscher Ingenieure
VM600	VM600 series (product range), from Meggitt Sensing Systems' Vibro-Meter® product line
VME	VERSAbus module eurocard
W	Watt (unit of power)
XIO	Extended input/output card (XIO16T) for use with the XMC16 and XMV16
XMC	Extended monitoring card for combustion (XMC16)
XMV	Extended monitoring card for vibration (XMV16) and extended monitoring card for vibration (XMVS16)
−ve	Negative
+ve	Positive
°C	Degree celsius
°F	Degree fahrenheit
Ω	Ohm (unit of electric resistance)

*API 670 terminology:

- (BB/NB) AB is close to casing vibration.
- PS corresponds to axial position.
- RS corresponds to radial shaft vibration.