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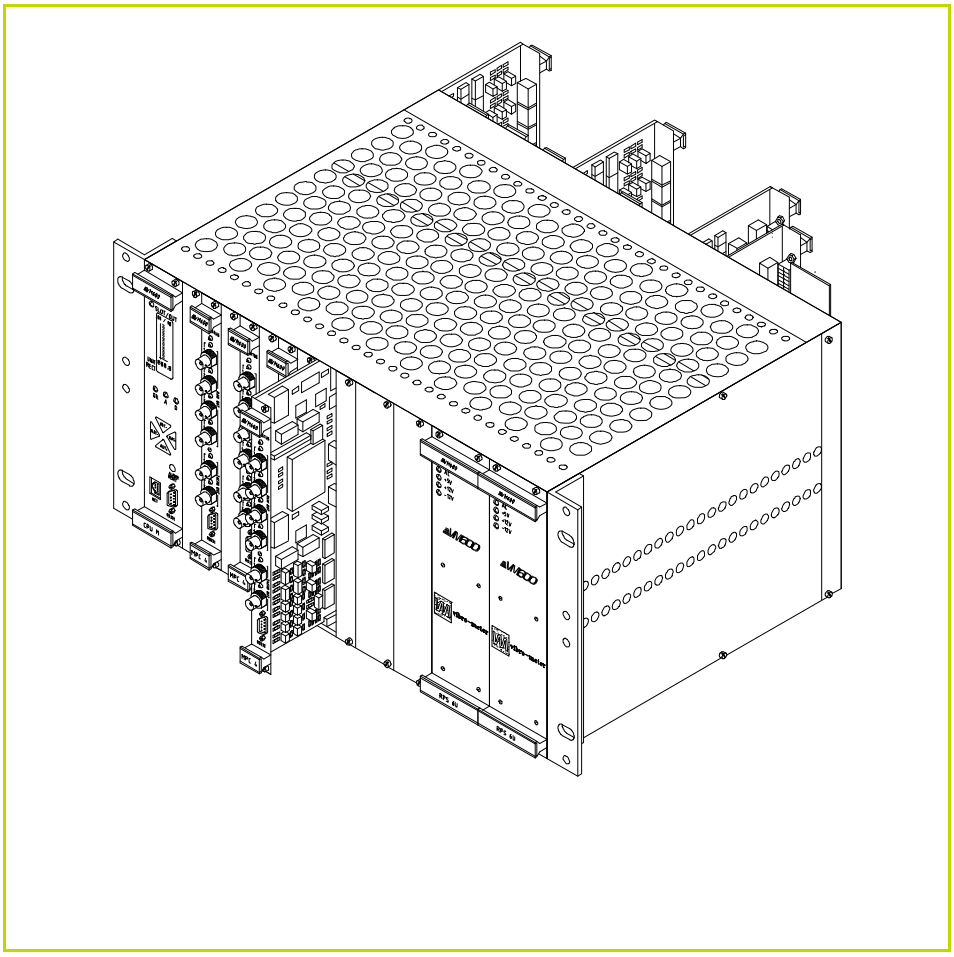
MEGGiTT
Vibro-Meter®

MANUAL

VM600
CPUR and IOCR rack controller and communications interface card pair



Document reference MACPUR/E
Edition 2 – September 2019

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REVISION RECORD SHEET

Edition	Date of issue	Written by / modified by	Description	Signature
1	30.07.2019	Peter Ward	Original edition.	PW
2	09.09.2019	Peter Ward	Updated to use the latest Meggitt brand identity.	PW

	Department	Name	Date	Signature
Technical content approved by	Systems and Safety	Ricardo Madureira		
	Product Line Management	Michaël Hafner	30.07.2019	MH
Document released by	Technical Publications	Peter Ward	09.09.2019	PW

The duly signed master copy of this page is stored by the Technical publications department of Meggitt SA and can be obtained by writing to Technical publications.

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PREFACE

About this manual

This manual provides reference information on the VM600 CPUR and IOCR rack controller and communications interface card pair with support for Modbus RTU/TCP and card pair redundancy that can be used in a VM600 series machinery protection system (MPS), from Meggitt's Vibro-Meter® product line.
It offers information concerning the installation, configuration and general use of such systems.

About Meggitt and Vibro-Meter®

Meggitt PLC is a global engineering group, headquartered in the UK, specialising in the design and manufacture of high-performance components and systems for aerospace and energy markets.

The Meggitt facility in Fribourg, Switzerland, operates as the legal entity Meggitt SA (formerly Vibro-Meter SA). Vibro-Meter® is a product line of Meggitt that applies our core sensing and monitoring technologies to power generation, oil & gas and other industrial markets.

Meggitt SA 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.

Vibro-Meter® products and solutions have been at the forefront of sensing and monitoring for more than 65 years and help keep machinery and equipment working safely, reliably and efficiently. This includes the VM600 CPUR/IOCR card pair produced for the Meggitt Vibro-Meter® product line.

To learn more about Meggitt Switzerland, our proud tradition of innovation and excellence, and our solutions for energy markets and applications, visit the www.meggittsensing.com/energy website.

Who should use this manual?

The manual is intended for personnel such as operators of process monitoring/control systems using a VM600 machinery protection system (MPS) containing a CPUR/IOCR card pair.

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 VM600 rack-based machinery protection systems (MPSs) using a CPUR/IOCR card pair installed in later versions of the VM600 rack (ABE04x) that contain an I^2C interface (part of the VM600 rack's VME utility bus).

NOTE: Only later versions of the VM600 rack (ABE04x) containing the VME utility bus are compatible with the CPUR/IOCR card pair. See 1.3.4 Rack compatibility.

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 minimize 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.

Chapter 1 — *Introduction*: Familiarises the user with the function and features of the CPUR/IOCR card pair.

Chapter 2 — *Hardware overview*: Provides information on the physical aspects of the CPUR/IOCR card pair and other system components making up a CMS or MPS. (Provides a brief overview and describes the elements on the front/rear panels of the CPUR and IOCR cards, including indicators and connectors.)

Chapter 3 — *General system description*: Describes the CPUR/IOCR card pair from a global, rack-level point of view and implications for the VM600 rack and the buses.

Chapter 4 — *CPUR and IOCR card pair*: Contains a block diagram of the CPUR/IOCR card pair and more detail on the functions performed by the cards.

Chapter 5 — *Hardware installation*: Provides information on installing the cards in a VM600 rack. Also includes important rack safety requirements.

Chapter 6 — *Software overview*: Introduces the software and configuration files applicable to the CPUR/IOCR card pair, including information on installing VibroSight System Manager.

Chapter 7 — *Configuring a CPUR / IOCR card pair – hardware configuration*: Contains details on configuring jumpers on the IOCR card.

Chapter 8 — *Configuring a CPUR / IOCR card pair – configuration and management using VibroSight System Manager*: Contains details on configuring and managing a CPUR/IOCR card pair using the VibroSight System Manager software. Operations include configuring IP and time reference settings, uploading/downloading Modbus configurations, updating firmware and downloading events logs and diagnostic information.

Chapter 9	*Modbus configuration file and event log files*: Contains details on the Modbus configuration file (`modbusDefault.cfg`) that is used configure the Modbus functionality of a CPUR/IOCR card pair, and the system events and measurement events log files.
Chapter 10	*Maintenance and troubleshooting*: Contains some basic tips for fault-finding. Also includes information on long-term storage of racks.
Chapter 11	*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 12	*Service and support*: Provides contact details for technical queries and for getting equipment repaired.

Energy product return procedure	Allows the user to indicate problems observed on a module/unit, thus enabling Meggitt customer support to repair the equipment as quickly as possible.
Energy customer feedback form	Allows the user to provide us with valuable feedback on our documentation.

Appendix A – Example Modbus configuration	Illustrates how to detect the removal of machinery monitoring cards and indicate changes using the CPUR/IOCR card pair's relays.

Terminology

VM600 CPUx cards

NOTE: Different versions of VM600 CPUx rack controller and communications interface cards are available, that is, the CPUM, CPUR and CPUR2.
See 4 CPUR and IOCR card pair for additional information.

In general, CPUx is used in this manual to refer to all versions of the card, unless otherwise stated. And where it is necessary to make a distinction, CPUM, CPUR and/or CPUR2 (and/or IOCN, IOCR or IOCR2) is used as appropriate.

Software

VM600 MPSx is proprietary software from the Meggitt Vibro-Meter® product line 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 the Meggitt Vibro-Meter® product line 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 monitoring and/or protection system, refer to the following Meggitt Vibro-Meter® documentation:

- *VM600 machinery protection system (MPS) hardware manual*
  (document reference MAMPS-HW/E)
- *VM600 MPS1 configuration software for machinery protection systems software manual*
  (document reference MAMPS1-SW/E)
- *VM600 MPS2 configuration software for machinery protection systems software manual*
  (document reference MAMPS2-SW/E).

Users of networked systems should also refer to the following document:

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

For information on installing the VibroSight® software, refer to the:

- *Getting started with VibroSight® installation guide*
  (document reference 660-010-006-2xxA).

For information on using the VibroSight® software and/or the related monitoring system hardware (VM600 and VibroSmart®), refer to the:

- *VibroSight help*

NOTE: The *VibroSight help* is copied to the computer by the VibroSight® installer as part of the software installation process.

NOTE: Ensure that the latest version of related documentation is being used by obtaining the documents from the Meggitt Vibro-Meter® website at www.meggittsensing.com/energy or by contacting your local Meggitt representative.

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 xii** **for further information.**

NOTE: This is an example of the NOTE paragraph style. This draws the operator's attention to complementary information or advice relating to the subject being treated.

Important remarks on safety

FAILURE TO FOLLOW THE INSTRUCTIONS AND IMPLEMENT THE RECOMMENDATIONS IN THIS MANUAL MIGHT RESULT IN INJURY TO THE OPERATOR AND/OR THIRD PARTIES, AND/OR RESULT IN DAMAGE TO EQUIPMENT AND WILL INVALIDATE ANY WARRANTY.

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 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.

DEFLECTION PLATES (BARRIERS) MUST BE INSTALLED ABOVE AND BELOW A VM600 RACK IN ORDER TO HELP REDUCE THE RISK OF ELECTRICAL SHOCK AND IN THE CASE OF THE BARRIER INSTALLED BELOW A VM600, IN ORDER TO HELP PREVENT THE SPREAD OF FIRE TOO.

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 FULLY POPULATED VM600 SYSTEM RACK (ABE04X) WITH VM600 CARDS AND RPS6U RACK POWER SUPPLIES INSTALLED IS A HEAVY OBJECT.

DEPENDING ON THE NUMBER OF CARDS AND RACK POWER SUPPLIES INSTALLED, A VM600 SYSTEM RACK CAN BE TOO HEAVY TO HANDLE MANUALLY BY ONE PERSON AND THERE IS THE RISK OF INJURY DURING INSTALLATION OR REMOVAL. ACCORDINGLY, A FULLY POPULATED VM600 SYSTEM RACK SHOULD BE CONSIDERED AS A HEAVY OBJECT THAT REQUIRES TWO PEOPLE TO LIFT, LOWER OR OTHERWISE HANDLE MANUALLY.

ALTERNATIVELY, THE RPS6U RACK POWER SUPPLIES (THE HEAVIEST SYSTEM COMPONENTS AND EASILY REMOVABLE), AND THEN VM600 CARDS AS NECESSARY, CAN BE REMOVED FROM A VM600 SYSTEM RACK IN ORDER TO REDUCE THE WEIGHT AND ALLOW ONE PERSON TO SAFELY HANDLE MANUALLY.

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 Meggitt 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.

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1 INTRODUCTION

1.1 Application

The VM600 CPUR and IOCR rack controller and communications interface card pair consists of a CPUR processing card and a corresponding IOCR input/output card for VM600 machinery protection system (MPS) racks. The CPUR/IOCR card pair acts as a rack controller and provides communication interfaces to other systems via Modbus TRU/TCP.

The CPUR/IOCR card pair has the same features/functionality as the CPUM/IOCN card pair, with the main differences being that the CPUR/IOCR supports “true redundant” operation but does not have a front-panel display (see 4.1 Different versions of the VM600 CPUx card).

NOTE: The CPUR cannot operate on its own in the rack (unlike the CPUM) and is always used with a matching IOCR as a card pair. For example, the simplest rack configuration using the CPUR and IOCR requires a single card pair and a redundant system requires two CPUR and IOCR card pairs.

When two CPUR/IOCR card pairs are installed in a VM600 rack, “true redundant” operation is supported as follows: in the event of a card pair failure, the other card pair will automatically take control (see 4.4.5 Switch over), thereby increasing the availability of a system.

The CPUR and IOCR card pair is intended as a system controller in a VM600 rack-based machinery protection system (MPS) and/or condition monitoring system (CMS). These systems are typically used for vibration monitoring to assure the protection of rotating machinery as used in, for example, the power generation, petrochemical and petroleum industries as well as in marine related applications.

1.2 General overview

The CPUR/IOCR card pair is applicable to MPSs and/or CMSs from Meggitt Vibro-Meter® using a standard VM600 rack, that is, a VM600 system rack (ABE040 - 6U 19" rack).

A VM600 rack can contain various types of cards depending on the application. There are basically three types of system:

- Machinery protection system (MPS) in a VM600 system rack (ABE040 – 6U 19" rack) or VM600 slimline rack (ABE056 – 1U 19" rack).
- Condition monitoring system (CMS) in a VM600 system rack (ABE040 – 6U 19" rack) or VM600 slimline rack (ABE056 – 1U 19" rack).
- Combined MPS and CMS in a VM600 system rack (ABE04x - 6U 19" rack).

NOTE: This manual describes only the CPUR and IOCR rack controller and communications interface card pair with support for Modbus RTU/TCP and card pair redundancy. Further information on MPS and CMS hardware can be found in their corresponding manuals. See Related publications and documentation.

As the CPUR and IOCR redundant card pair includes all of the features of the CPUM and IOCN card pair, a CPUR/IOCR card pair can be used to replace a CPUM and IOCN card pair in any VM600 system that requires non-redundant CPUx operation.

NOTE: The CPUR and IOCR rack controller and communications interface card pair with support for Modbus RTU/TCP and card pair redundancy is only compatible with earlier generation condition monitoring systems (CMSs) using CMC16/IOC16T card pairs. It is not compatible with later generation CMSs using XMx16/XIO16T card pairs.

For example, a networked version of a VM600 rack-based MPS could contain the following hardware:

1- ABE04x system rack (6U 19" rack)

NOTE: Only later versions of the VM600 rack (ABE04x) containing the VME utility bus are compatible with the CPUR/IOCR card pair. See 1.3.4 Rack compatibility.

2- RPS6U rack power supply unit

3- ASPS auxiliary sensor power supply unit (with an AC version of the RPS6U only)

4- MPC4 machinery protection card

5- IOC4T input/output card matching the MPC4

(The MPC4 and IOC4T cards form an inseparable pair and one cannot be used without the other. These cards are used principally for vibration monitoring.)

6- AMC8 analog monitoring card

7- IOC8T input/output card matching the AMC8.

(The AMC8 and IOC8T cards also form an inseparable pair. These cards are used principally for monitoring quasi-static parameters such as temperature, fluid level or flow rate.)

8- RLC16 relay card (16 relays) and IRC4 intelligent relay card (8 relays combined as either 4x DPDT or 8x SPDT)

9- CPUx modular CPU card

10- IOCx input/output card (matching the CPUx).

The CPUx and IOCx card pair are required for the MPS to be compatible with a computer network. A stand-alone (that is, not connected to a network) MPS could be created by removing the CPUx and IOCx and in fact, a more simple rack could contain:

- only MPC4 / IOC4T card pairs
- only AMC8 / IOC8T card pairs
- a combination of MPC4 / IOC4T and AMC8 / IOC8T card pairs

Figure 1-1 shows the front view of a typical combined MPS and CMS rack.

NOTE: Refer to the data sheets for full technical specifications of the MPS hardware (rack, cards and modules).

1.3 CPUR/IOCR card pair

The CPUR is a central processing unit (CPU) card that acts as a system controller in a VM600 rack and provides “true redundant” operation.

The IOCR is a network communications card that acts as a signal and communications interface for the CPUR card. It includes a 8P8C (RJ45) connector for a Gigabit Ethernet connection and a pair of D-sub connectors for configuring multi-drop RS-485 networks of VM600 racks.

The modular, highly versatile design of this card pair supports all rack configuration and communications interfacing from a single point (external interface).

1.3.1 Functions

The main functions of the CPUR and IOCR are:

- Run the software for controlling the processing cards (such as MPC4, AMC8 and CMC16) in a VM600 MPS or CMS:
  - Runs the software for controlling, configuring, diagnosing and monitoring the processing cards
  - Sends configuration and control commands over the control bus to the other cards
  - Receives status, alarm messages and statistics from the other cards
  - Communicates with other nodes in the network
  - Communicates with the other cards in a VM600 rack over the VME bus (internal).
- ‘One-shot’ configuration of all cards in a VM600 rack using an Ethernet connection from an external computer running the appropriate software such as the VibroSight®, VM600 MPSx and/or VM600 CMS software.
- Automatic configuration of a processing card if it is replaced (“hot-swap”).
- Up to two serial connections (RS-232 and RS-485), as well as one Ethernet connection. 'Redundant' communications links can be configured where necessary.
- Redundancy in respect to the automatic configuration of the cards in the rack and in respect to the communication with third party devices (such as a DCS or PCS).

1.3.2 Features

In addition to all of the standard features of the CPUM and IOCN card pair, the main features of the CPUR and IOCR are:

- Multi-master architecture with up to two CPUR/IOCR card pairs per rack.
- Higher VME bus (internal) communication speed.
- Lower power consumption (<15 W).
- Live insertion and removal of cards (“hot-swap”).
- External communication interfaces with third party devices such as DCS/PCS.
- Simultaneous operation of Gigabit Ethernet and serial (RS-232/RS-422/RS-485) for redundant communications.
- Extended operating temperature range of −20 °C to +65 °C (−4 °F to +149 °F).
- Alarm and diagnostic event list, with up to 2000 events available using Modbus.
- Fully software configurable serial interfaces:
  - Half-duplex or full-duplex operation
  - Differential lines held active or inactive
  - Line termination (120 Ω).

1.3.3 Specifications

For full technical specifications of the CPUR and IOCR card pair, refer to the corresponding data sheet available from Meggitt.

1.3.4 Rack compatibility

The CPUR/IOCR card pair requires an I^2C interface (part of the VM600 rack's VME utility bus) to implement the redundancy functionality, so they can only be used with later versions of the VM600 rack (ABE04x) that contain the I^2C interface (VME utility bus).

Accordingly, CPUR/IOCR card pairs can only be used with VM600 racks (ABE04x) listed in Table 1-1.

.

Table 1-1: CPUR/IOCR card pair and VM600 rack (ABE04x) compatibility

VM600 rack (6U 19" rack)	Part number (PNR)
ABE040	204-040-100-013 or later
ABE042	204-042-100-013 or later
ABE040	204-040-100-115 or later
ABE040	204-040-100-212 or later

NOTE: It is important to consider CPUR/IOCR card pair and VM600 rack (ABE04x) compatibility when updating an existing system and replacing a CPUM/IOCN card pair with a CPUR/IOCR.

1.3.5 Limitations

While otherwise compatible with the CPUM and IOCN card pair, the CPUR/IOCR card pair does not support the capability to be configured via a VT100 terminal session or via a PPP connection, as described in the *VM600 networking manual*.

1.4 Terminology

No special terminology is necessary when using a single CPUR/IOCR card pair as a “system controller” in a VM600, for example, as a replacement for a CPUM/IOCN card pair).

However, when two functionally equivalent CPUR/IOCR card pairs are installed in a VM600 rack in order to obtain 'true redundant' operation, it becomes necessary to make a distinction between these different CPUR/IOCR card pairs.

In general:

- The **Master** CPUR is the first CPUR, installed in the left-most position (slot 0) in the rack. Under normal operating conditions, the Master CPUR is the controlling (active) CPUR card in a system.
- The **Inactive** CPUR is the second CPUR, installed in the next available position (slot 1 or slot 2) in the rack. This is the redundant card, that is, the backup CPUR that automatically takes control of a system, if the Master CPUR fails.

During normal operation, the Master CPUR is the ‘active’ card. It processes all external communications and ensures that the Inactive CPUR remains synchronised with it, in case of a failure. At the same time, the Inactive CPUR constantly monitors the status of the Master CPUR card, so that if the Master CPUR fails, the Inactive CPUR will detect this and automatically take control of the system, thereby becoming the Master CPUR (“system controller”). In this way, there is no impact on the system functionality and the availability of the entire system is increased.

Also, in this manual:

- A **redundant system** refers to a VM600 rack with two CPUR/IOCR card pairs installed.

  These systems use two CPUR/IOCR card pairs for redundancy, in order to increase the availability of the system.
- A **non-redundant** (or standard) system refers to a VM600 rack with one CPUR/IOCR card pair installed.

  These systems use a single CPUR/IOCR card pair to replace a CPUM/IOCN card pair), typically for improved system performance. For example, the CPUR/IOCR card pair includes five relays which can be used to indicate the status of the rack/system (unlike the CPUM/IOCN card pair).

If two fully operational CPUR/IOCR card pairs are in a VM600 rack and the Master CPUR fails, the card pairs will swap roles (that is, the Master CPUR card pair becomes the Inactive CPUR card pair and Inactive CPUR becomes the Master CPUR) in a **switch over** operation (see 4.4.5 Switch over).

(a) ABE040 rack configured for a combined MPS and CMS application, using one CPUM, eight MPC4 cards, two CMC16 cards and one RPS6U power supply. The corresponding input/output cards (and any relay cards) are in the rear of the rack (not shown).

(b) ABE040 rack configured for a combined MPS and CMS application, using as two CPURs in slots 0 and 1. The rest of the configuration is as in (a).

Figure 1-1: Front view photograph of a typical combined MPS and CMS system using: (a) one CPUM and (b) two CPURs for redundant operation

1.5 Communicating with a CPUR/IOCR card pair on a network

A VM600 MPS and/or CMS may be configured in several ways, depending on the hardware installed in the ABE040 rack. Figure 1-2 shows the various possibilities for communicating with the system, including using a CPUR/IOCR card pair as the rack controller and communications interface.

In all cases:

- The VM600 MPSx software (MPS1 or MPS2) is required to perform the configuration of MPC4 machinery protection cards and AMC8 analog monitoring cards.
- The VM600 CMS software is required to perform the configuration of the CMC16 condition monitoring cards (using the CPUR/IOCR system controller, over Ethernet).
- The VibroSight System Manager software module is required to perform the configuration and management of CPUR/ IOCR rack controller and communications interface card pairs.

Figure 1-2 (a) shows the simplest configuration. This is a stand-alone rack, that is, it does not contain a system controller (CPUR/ IOCR) card (so no CMC16 condition monitoring cards can be used), thereby limiting the rack to a machinery protection system only. In this scenario, the MPS cards (such as MPC4 or AMC8) must be programmed individually from a computer over an RS-232 link. This is done via a 9-pin D-sub connector on the front panel of each of these card types.

Figure 1-2 (b) shows a rack containing a CPUR/IOCR card pair as the system controller. A Gigabit Ethernet link may be established between the computer and the VM600 rack via this card pair. The connection is made on the front panel of the IOCR, hence at the rear of the rack. Communication between the CPUR and all other cards in the rack takes place over an internal VME bus on the rack backplane.

Figure 1-2 (c) shows a rack containing two CPUR/IOCR card pairs in a redundant configuration (see 4.4 Redundant behaviour).

As before, Gigabit Ethernet link may be established between the computer and the VM600 rack using either of these card pairs. As before, connections are made on the IOCR cards (rear of the rack) and communication between the CPUR cards and all other cards in the rack takes place over the internal VME bus on the rack backplane.

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

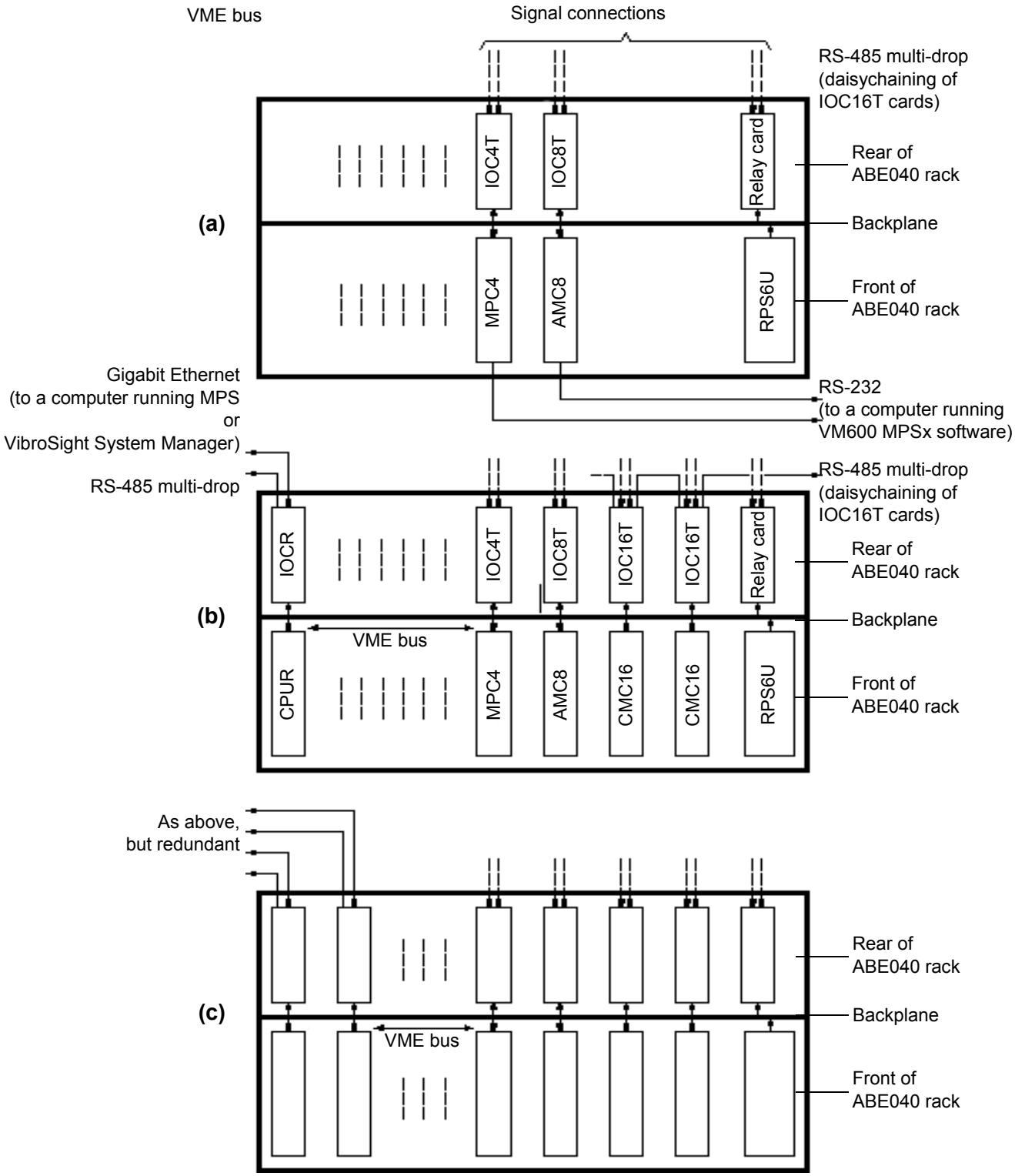

Figure 1-2: Methods of communicating with CPUR/IOCR card pair

NOTE: VibroSight signal processing cards (such as XMV16/XIO16T and XMV16/XIO16T card pairs) can coexist with other cards in a VM600 rack. However, the VibroSight signal processing cards do not utilise the VME bus, so they exist independently of any system controller (CPUR/IOCR or CPUM/IOCN) in a VM600 rack.

2 HARDWARE OVERVIEW

This chapter provides a brief overview of the physical appearance of the CPUR and IOCR hardware. Functional information is also given for certain elements (such as indicators) found on the front panels of the cards.

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

2.1 Racks

2.1.1 19" Rack – 6U (ABE04x)

The CPUR and IOCR card pair is designed for operation in standard VM600 series racks that supports the VME utility bus.

NOTE: The CPUR/IOCR card pair is compatible with the VM600 racks (ABE04x) listed in 1.3.4 Rack compatibility.

An ABE04x contains a front and a rear card cage. The card cages are separated by the rack backplane. The new ABE04x rack is fully backwards compatible with existing ABE04x racks but adds support for a VME utility bus (based on I^2C) that is used to detect CPUR card failure, and therefore enable redundant operation.

An example of an MPS housed in an ABE04x rack is shown in Figure 1-1. The appearance of the front and rear panels of the rack depends entirely on the types of cards installed in the two card cages. Only the CPUR and IOCR cards are presented in this chapter.

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of other VM600 cards including power supplies.

2.1.2 19" Rack – 1U (ABE056)

A slimline 1U 19" rack (ABE056) is also available in the VM600 series but it only contains one processing card slot so it is not used with CPUR and IOCR card pairs.

2.2 CPUR rack controller and communications interface card

The CPUR card's front panel (found on the front of the ABE040 rack) has the following elements (see also Figure 2-1):

- Status LED

  The status LED and the data LED are used to indicate the status of the card. The meaning of the colour (green, orange or red) and state of the LEDs (off, blinking or on) are given in 2.2.1 CPUR front panel LEDs.
- Data LED

  The data LED and the status LED are used to indicate the status of the card. The meaning of the colour and state of the LEDs are given in 2.2.1 CPUR front panel LEDs.
- Maintenance

  Access (recessed) to a reset switch.

- Act LED

  This LED indicates when there is activity on the communications link established on the Ethernet port of the corresponding IOCR card (see 2.2.1.2 Act and link LEDs).

- Link LED

  This LED indicates when there is an active connection on the Ethernet port of the corresponding IOCR card (see 2.2.1.2 Act and link LEDs).

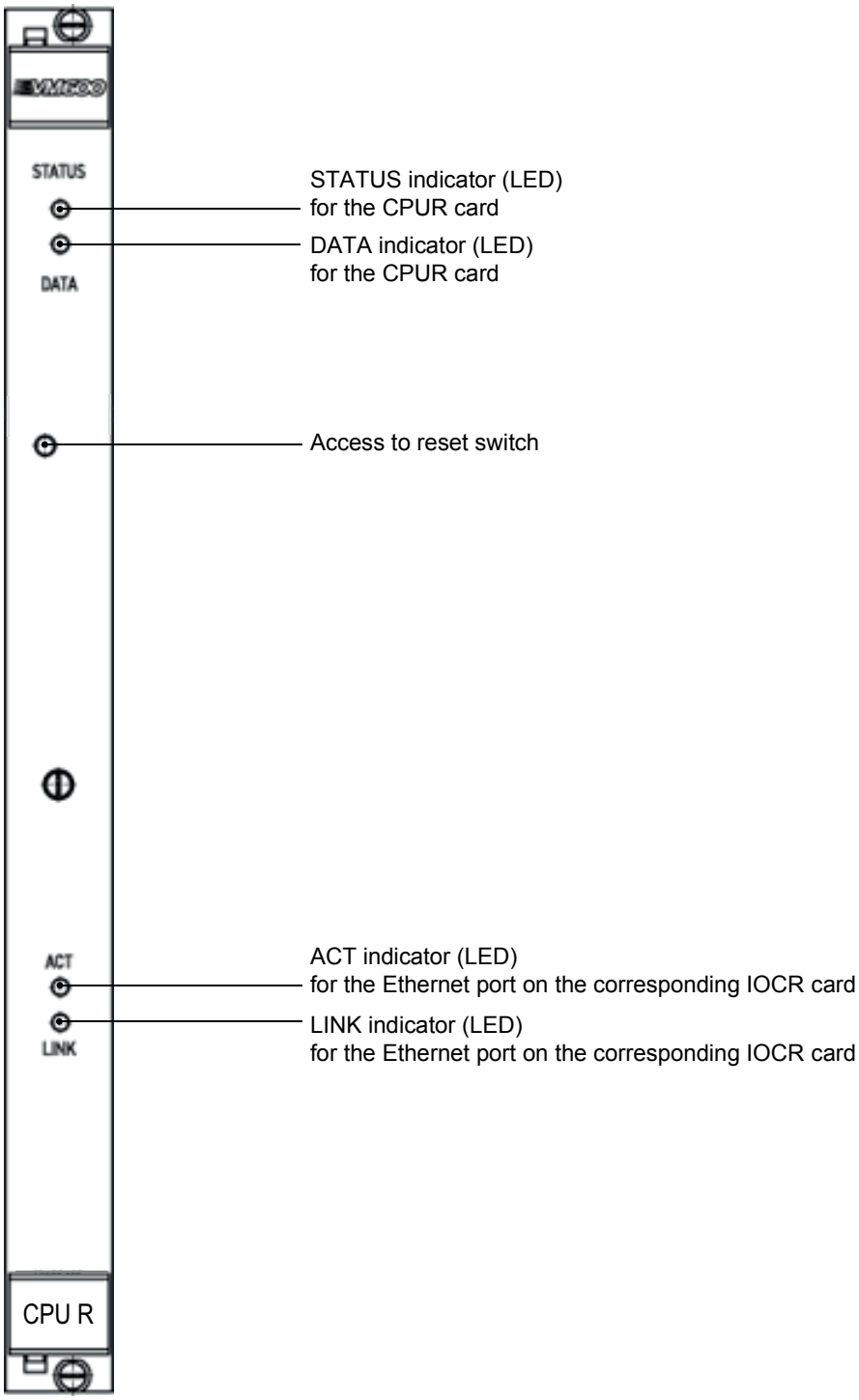

Figure 2-1: Front panel of the CPUR card

2.2.1 CPUR front panel LEDs

2.2.1.1 Status and data LEDs

The CPUR card's status and data LEDs are used to indicate the state of the card. Table 2-1 relates the LED activity to the card state.

Table 2-1: Relationship between the CPUR's status and data LEDs and the state of the card

Status LED	Data LED	Card state
Red blinking	Off	The card power supplies are working properly and the card is in its initial boot up phase. *OR* The card is held in reset.
Red on	Off	One or more of the card power supplies is not working properly.
Orange on	Off	The card is in the second phase of booting. *OR* The card is the Inactive CPUR and its configuration for the cards in the VM600 rack is not synchronised with the Master CPUR's configuration.
Green on	Off	The card is the Master CPUR and does not have a valid configuration* for one or more cards in the VM600 rack.
Orange on	Orange on	The card is the Inactive CPUR and its configuration for the cards in the VM600 rack is synchronised with the Master CPUR's configuration.
Green on	Orange on	The card is the Master CPUR and has a valid configuration* for all the cards in the VM600 rack.

Notes:

*In this context, a valid configuration is a configuration held by the CPUR for a slot in a VM600 rack that matches the type of card that is inserted in that particular slot (for example, CMC16 or MPC4).

2.2.1.2 Act and link LEDs

The CPUR card's act and link LEDs are used to indicate the state of the card's Ethernet communications link. Table 2-2 and Table 2-3 relate the LED activity to the Ethernet communications link state.

Table 2-2: Relationship between the CPUR's act LED and the state of the Ethernet communications link

Act LED	Ethernet communications link state
Green (on *OR* blinking)	The Ethernet communications link is active

Table 2-3: Relationship between the CPUR's link LEDs and the state of the Ethernet communications link

Link LED	Ethernet communications link state
Green (on *OR* blinking)	The Ethernet communications link is at 1000 Mbps (1 Gbps)
Yellow (on *OR* blinking)	The Ethernet communications link is at 100 Mbps
Red (on *OR* blinking)	The Ethernet communications link is at 10 Mbps

2.3 IOCR input/output card for CPUR

The IOCR card's front panel (found on the rear of the ABE040 rack) has the following elements (see also Figure 2-1):

- Terminal strip connector

  This is a terminal strip socket and a mating connector, which contains 16 screw terminals that supports five output relays.

  The screw terminals can accept wires with a cross section of ≤ 1.5 mm^2. Figure 2-2(a) shows the appearance of the IOC4T panel without the mating connector and Figure 2-2(b) shows the appearance of the panel when the screw terminal mating connector is inserted.
- D-sub connector

  This is a DCE 9-pin (female) connector terminal strip socket that supports serial communications (RS-232, half-duplex RS-485 and full-duplex RS-485).
- D-sub connector (DCE 9-pin D-sub connector, female)

  This is a DCE 9-pin (female) connector terminal strip socket that supports serial communications (RS-232, half-duplex RS-485 and full-duplex RS-485).
- Ethernet connector

  This is a 8P8C (RJ45) modular jack (female) connector that supports a Gigabit Ethernet interface (1000BASE-T).

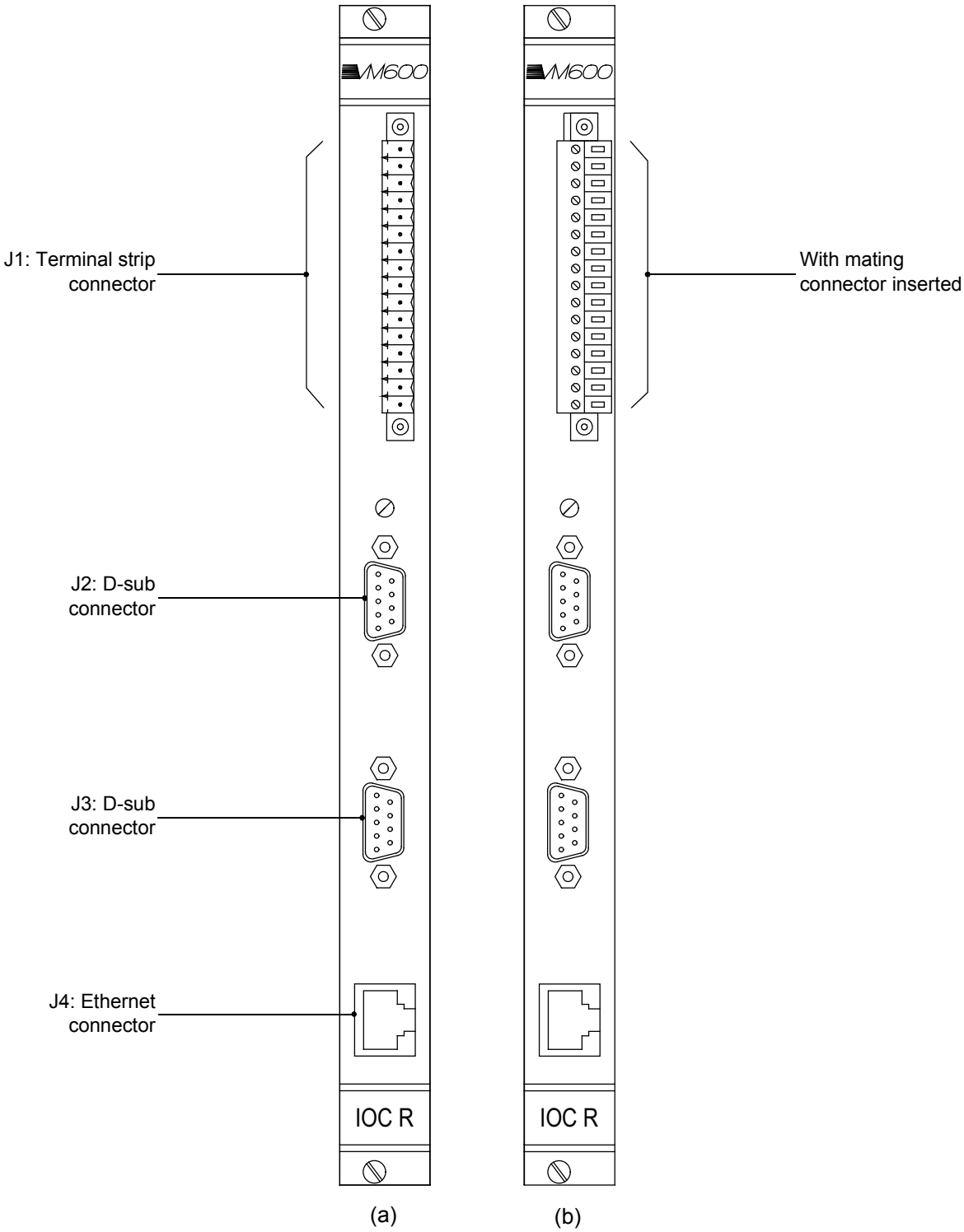

Figure 2-2: Front panel of the IOCR card (on rear of rack)

2.3.1 IOCR front panel connectors

The front panel of the IOCR card (found on the rear of the ABE040 rack) contains one terminal strip connector identified as J1 (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.

The IOCR terminal strip connector, J1, is the interface to the contacts of the relays on the CPUR and IOCR card pair. The details of this connector can be found in Table 2-4.

Table 2-4: IOCR connector J1 – terminal strip connector

Terminal		Direction	Description
Number	Label		
1		Bidir.	Relay 1 – NC contact
2		Bidir.	Relay 1 – NO contact
3		Bidir.	Relay 1 – COM contact
4		Bidir.	Relay 2 – NC contact
5		Bidir.	Relay 2 – NO contact
6		Bidir.	Relay 2 – COM contact
7		Bidir.	Relay 3 – NC contact
8		Bidir.	Relay 3 – NO contact
9		Bidir.	Relay 3 – COM contact
10		Bidir.	Relay 4 – NC contact
11		Bidir.	Relay 4 – NO contact
12		Bidir.	Relay 4 – COM contact
13		Bidir.	Relay 5 – NC contact
14		Bidir.	Relay 5 – NO contact
15		Bidir.	Relay 5 – COM contact
16	- - -	- - -	Not connected

Notes:

NC is normally closed, NO is normally open and COM is common.

The IOCR D-sub connector, J2, is the main serial communications connector and is used for all serial communications links, including the Modbus RTU interface of the CPUR and IOCR card pair. The details of this connector can be found in Table 2-5

.

Table 2-5: IOCR connector J2 – D-sub connector

Terminal		Dir.	Description
Number	Label		
1	- - -	- - -	Not connected
2	RS232_TX	Output	RS-232 transmit data (single-ended)
3	RS232_RX	Input	RS-232 receive data (single-ended)
4	RS485_RXA	Input	RS-485 receive data, non-inverting (balanced)
5	RS485_GND		Ground
6	- - -	- - -	Not connected
7	RS485_RXB	Input	RS-485 receive data, inverting (balanced)
8	RS485_TXA	Output	RS-485 transmit data, non-inverting (balanced)
9	RS485_TXB	Output	RS-485 transmit data, inverting (balanced)

NOTE: The default signal levels and terminations when the serial communications interface is used as an RS-485 link are configured using jumpers (see 7 Configuring a CPUR / IOCR card pair – hardware configuration).

The IOCR D-sub connector, J3, is the second serial communications connector and is used for multidrop (daisy-chained) serial communication networks of CPUR and IOCR card pairs. The details of this connector can be found in Table 2-6.

Table 2-6: IOCR connector J3 – D-sub connector

Terminal		Dir.	Description
Number	Label		
1	- - -	- - -	Not connected
2	- - -	- - -	Not connected
3	- - -	- - -	Not connected
4	- - -	- - -	Not connected
5	RS485_GND		Ground
6	- - -	- - -	Not connected
7	- - -	- - -	Not connected
8	RS485_TXA	Output	RS-485 transmit data, non-inverting (balanced)
9	RS485_TXB	Output	RS-485 transmit data, inverting (balanced)

The IOCR Ethernet connector, J4, is the network communications interface to a CPUR and IOCR card pair. It is used by computers running Meggitt Vibro-Meter® software such as the VibroSight®, VM600 MPSx and VM600 CMS software, and by the Modbus TCP interface. The details of this connector can be found in Table 2-7.

Table 2-7: IOCR connector J3 – Ethernet connector

Terminal		Dir.	Description
Number	Label		
1	TX+	Output	Transmit data+
2	TX−	Output	Transmit data−
3	RX+	Input	Receive data+
4	- - -	- - -	Not connected
5	- - -	- - -	Not connected
6	RX−	Output	Receive data−
7	- - -	- - -	Not connected
8	- - -	- - -	Not connected

2.4 CPUR/IOCR card pair configurations in a VM600 rack

CPUR and IOCR card pairs can be deployed in the following configurations in a standard VM600 rack:

- A non-redundant system (see 1.4 Terminology) consisting of one card pair (that is, one CPUR combined with a corresponding IOCR)
- A redundant system (see 1.4 Terminology) consisting of two card pairs (that is, two CPURs combined with their respective IOCRs).

2.4.1 Non-redundant system

This configuration is the minimum installation needed to have access to the functionality described in 1.3 CPUR/IOCR card pair. However, it provides no redundancy.

2.4.2 Redundant system

This configuration provides all of the functionality described in 1.3 CPUR/IOCR card pair, including redundancy.

In a redundant system, one of the card pairs is defined as the Master CPUR and the other one is the Inactive CPUR (see 1.4 Terminology). Only the Master CPUR communicates with the cards in the VM600 rack (over the internal VME bus). Both the Master CPUR and the Inactive CPUR can communicate with third party devices, such as a DCS/PCS.

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3 GENERAL SYSTEM DESCRIPTION

3.1 System elements

In order to gain an understanding of the operation of the CPUR and IOCR card pair, in both redundant and non-redundant system, it is necessary to consider the interaction of the principal elements making up such a system, namely:

1- ABE04x (19" x 6U) rack assembly

2- MPC4 machinery protection card

3- IOC4T input/output card matching the MPC4

4- AMC8 analog monitoring card

5- IOC8T input/output card matching the AMC8

6- RLC16 relay card (16 relays)

7- IRC4 intelligent relay card (4 DPDT or 8 SPDT relays).

An ABE04x rack can also contain the following:

8- RPS6U rack power supply unit

9- CPUx modular CPU card

10- IOCx input/output card (required for operation of a CPUR).

As outlined in 1.5 Communicating with a CPUR/IOCR card pair on a network, 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 AMC8 / IOC8T card pairs
- Only MPC4 / IOC4T card pairs
- Only CMC16 / IOC16T card pairs
- A combination of these card pairs.

A networked VM600 rack (ABE04x) has one of the following additional possibilities:

- A CPUM/IOCN card pair, as described in the *VM600 machinery protection system (MPS) hardware manual*
- A single CPUR/IOCR card pair for a non-redundant system
- Two CPUR/IOCR card pairs for a redundant system.

NOTE: As the CPUR/IOCR card pair is fully functionally compatible with the CPUM/IOCN card pair in most applications and because these card pairs occupy the same slots in a VM600 rack, a VM600 rack (ABE04x) will never contain both CPUR/IOCR and CPUM/IOCN card pairs.

3.2 VM600 backplane – 6U 19" rack (ABE04x)

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for information on the VM600 backplane, including the tacho, open collector and raw buses used by a VM600 system.

3.2.1 VME utility bus

The latest VM600 rack (see 2.1.1 19" Rack – 6U (ABE04x), required for operation with a CPUR and IOCR card pair, includes a (internal only) VME utility bus that is used to detect CPUR card failure, and therefore enable redundant operation.

See also 1.3.4 Rack compatibility.

3.3 Racks with CPUR and IOCR card pairs

Figure 3-1 shows a block diagram of a networked rack featuring a CPUR and IOCR card pair. It shows the interaction between these two cards as well as between them and other cards in the rack.

Raw signals are processed in analogue and digital circuits by the signal processing/measurement cards such as the MPC4 and CMC16 cards. These cards handle the management of signals, alarm levels, signal processing and so on. The user is able to modify parameters concerning these operations by using the VM600 MPSx software and/or the VM600 CMS software, as appropriate.

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of VM600 cards other than the CPUR and IOCR.

The CPUR and IOCR card pair as a “rack controller” and communicates with the other (signal processing) card pairs (such as the AMC8, CMC16 and MPC4) in the rack over the VME bus. In addition, two CPUR and IOCR installed card pairs in a VM600 rack use a VME utility bus to communicate with each another in order to support redundant behaviour.

NOTE: The CPUR cannot operate on its own in the rack (unlike the CPUM) and is always used with a matching IOCR as a card pair. For example, the simplest rack configuration using the CPUR and IOCR requires a single card pair and a redundant system requires two CPUR and IOCR card pairs.

The CPUR and IOCR, and therefore the rack, communicates with the outside world over Ethernet and serial communications links. Depending on the CPUR/IOCR card pair’s configuration, the IOCR allows communication with a computer running the appropriate software (VibroSight®, VM600 MPSx and/or VM600 CMS) over an Ethernet link or with a network over either an Ethernet link or a serial link (RS-232, RS-485 full-duplex and RS-485 half-duplex). See 4 CPUR and IOCR card pair for more detailed information.

New system features (inputs / outputs) supported by the CPUR and IOCR card pair include:

- Detection of card removal (available via Modbus and VibroSight System Manager)
- Detection of card/rack status (card OK / not OK, available via VibroSight System Manager and/or relay outputs)

- System event logs (available via VibroSight System Manager)
- Measurement event logs (available via VibroSight System Manager)
- Time settings for a CPUR card (available via Modbus and System Manager)
- Synchronising time settings between two CPUR cards
- System diagnostic information (out of the event list, accessible via Modbus and System Manager).

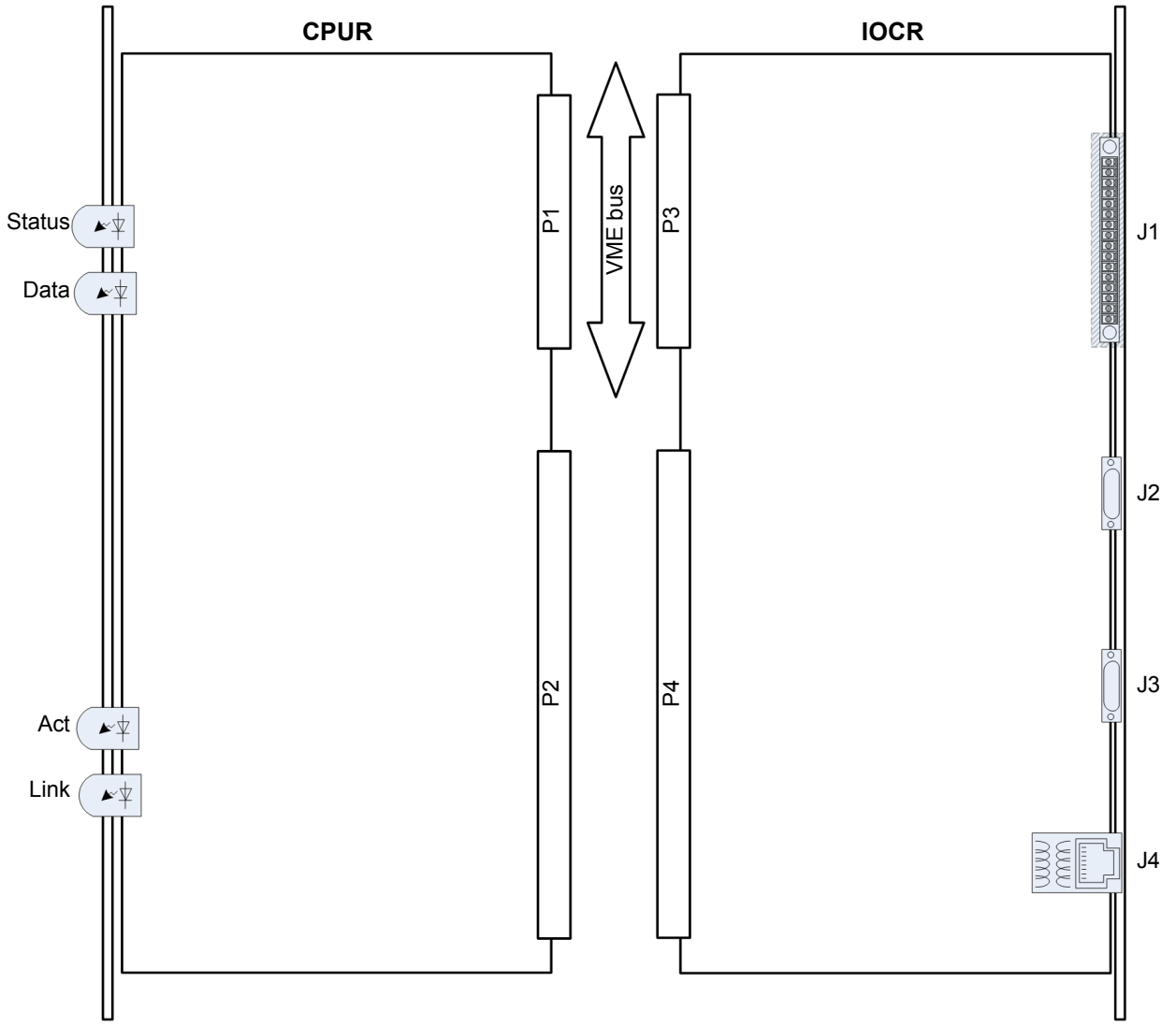

Figure 3-1: Block diagram of CPUR and IOCR card pair in a VM600 rack (MPS or CMS)

3.4 Communication with other CMS and MPS components

The CPUR/IOCR card pair has been designed to communicate with most of the other system components from the Meggitt Vibro-Meter® product line that are used in CMS and MPS applications, as shown in Figure 3-2.

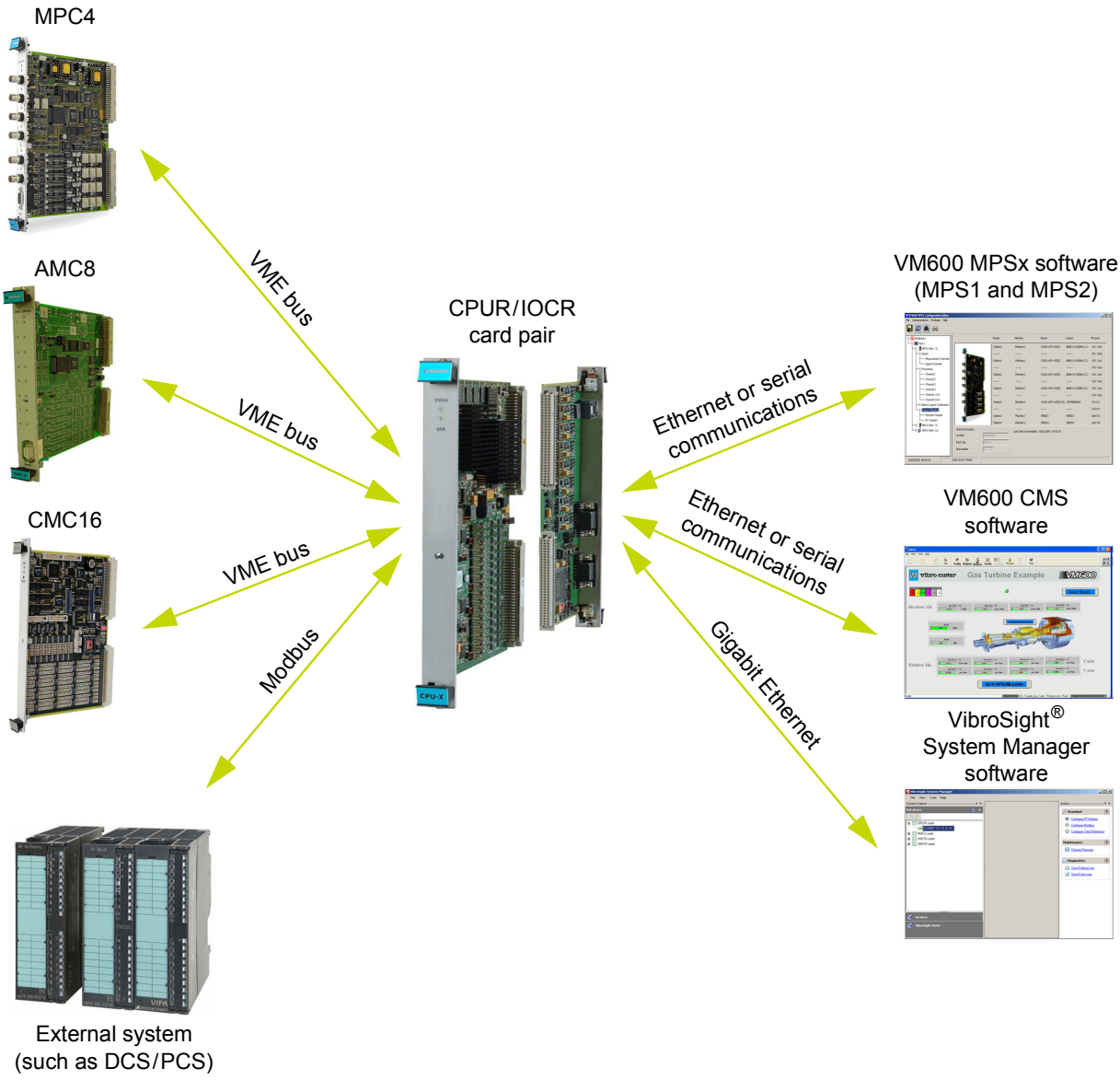

Figure 3-2: CPUR/IOCR card pair communication with other MPS and CMS system components

3.4.1 VM600 signal processing cards

The CPUR/IOCR card pair communicates with the other cards in a VM600 rack (that is, the AMC8, CMC16, MPC4 signal processing cards and their corresponding input/output cards) over the VME bus. This bus is part of the VM600 backplane, internal to the rack.

This allows the CPUR/IOCR card pair to act as a gateway between:

- The VM600 MPSx software and MPC4 and/or AMC8 signal processing cards (see 3.4.3 VM600 MPSx software)
- The VM600 CMS software and CMC16 signal processing cards (see 3.4.4 VM600 CMS software).

NOTE: The CPUR and IOCR rack controller and communications interface card pair with support for Modbus RTU/TCP and card pair redundancy is compatible with earlier generation condition monitoring systems (CMSs) using CMC16/IOC16T card pairs only. It is not compatible with later generation CMSs using XMx16/XIO16T card pairs.

3.4.2 External systems

The CPUR/IOCR card pair implements a Modbus server that supports the industry standard Modbus RTU and Modbus TCP protocols, for communication with external systems, such as a DCS or PCS.

The external system can communicate directly with the CPUR/IOCR card pair ("system controller") using an serial communications or Ethernet connection, as required.

3.4.3 VM600 MPSx software

VM600 MPS1 is the configuration software and VM600 MPS2 is the configuration and trending software for use with a VM600-based machinery protection system. This software is used to configure MPC4 and AMC8 cards (and their corresponding input/output cards) and to retrieve the data generated by them for display and analysis.

In a VM600 rack that contains a CPUR/IOCR card pair, the CPUR/IOCR ("system controller") can act as a gateway between the VM600 MPSx software and the other cards in the rack:

- The CPUR/IOCR card pair connects to the computer running the VM600 MPSx software using the Ethernet connection (connector J4 on the IOCR card).
- The CPUR/IOCR card pair receives the requests sent by the VM600 MPSx software that are destined for the AMC8 and MPC4 cards in the same rack and forwards them to the corresponding card (over the VME bus).

  If a request sent by the VM600 MPSx software via the CPUR/IOCR card pair is a command to configure an AMC8 or MPC4 card then the CPUR/IOCR will store a copy of this configuration information in non-volatile memory for later use.
- The CPUR/IOCR card pair receives the responses sent by the AMC8 or MPC4 cards, based on requests from the MPS software, and forwards them to the VM600 MPSx software.

3.4.4 VM600 CMS software

VM600 CMS is configuration, data presentation and analysis software for use with a VM600 rack-based condition monitoring system. This software is used to configure CMC16 cards (and their corresponding input/output cards) and to retrieve the data generated by them for display and analysis.

In a VM600 rack that contains a CPUR/IOCR card pair, the CPUR/IOCR ("system controller") can act as a gateway between the VM600 CMS software and the other cards in the rack:

- The CPUR/IOCR card pair connects to the computer running the VM600 CMS software using the Ethernet connection (connector J4 on the IOCR card).
- The CPUR/IOCR card pair receives the requests sent by the VM600 CMS software that are destined for the CMC16 cards in the same rack and forwards them to the corresponding card (over the VME bus).

  If a request sent by the VM600 CMS software via the CPUR/IOCR card pair is a command to configure an CMC16 card then the CPUR/IOCR will store a copy of this configuration information in non-volatile memory for later use.
- The CPUR/IOCR card pair receives the responses sent by the CMC16 cards, based on requests from the VM600 CMS software, and forwards them to the VM600 CMS software.

3.4.5 VibroSight System Manager software

VibroSight System Manager is the software module (from the VibroSight® suite of software) that provides the tools to manage a VibroSight-based system's hardware and software. This includes the configuration and management of a CPUR/IOCR card pair, for example, to configure IP addresses, set NTP server addresses and upgrade firmware.

NOTE: Refer to the appropriate Meggitt Vibro-Meter® product data sheet for further information on the VibroSight®, VM600 MPSx and/or VM600 CMS software.

4 CPUR AND IOCR CARD PAIR

4.1 Different versions of the VM600 CPUx card

Different versions of VM600 CPUx “rack controller and communications interface” card are available, including the CPUM, CPUR and CPUR2.

4.1.1 CPUR2

The CPUR2 card is the latest version of CPUR rack controller and communications interface card with support for PROFIBUS (PNR 600-026-000-VVV).

NOTE: The CPUR2 does not support card pair redundancy (unlike the CPUR).

The CPUR2 must be used in conjunction with an associated IOCR2 input/output card as a CPUR2/IOCR2 card pair.

4.1.2 CPUR

The CPUR card is the earlier version of CPUR rack controller and communications interface card with support for Modbus RTU/TCP and card pair redundancy (PNR 600-007-000-VVV).

The CPUR must be used in conjunction with an associated IOCR input/output card as a CPUR/IOCR card pair.

NOTE: This *VM600 CPUR and IOCR redundant card pair manual* provides details and explanations of the CPUR and IOCR.

4.1.3 CPUM

The CPUM card is the original version of rack controller and communications interface card (also known as the modular CPU card), with support for Modbus RTU/TCP and PROFINET (PNR 200-595-0SS-HHH).

The CPUM can be used alone or in conjunction with the associated IOCN input/output card as a CPUM/IOCN card pair card.

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of the CPUM and IOCN.

See also 1.3.4 Rack compatibility.

4.2 Overview

The CPUR is a rack controller and communications interface card (also known as a central processing unit (CPU) card) containing a PowerPC® based processor and an FPGA that work together to act as a “system controller” (rack controller) in a networked VM600 system and provide redundant operation. This card runs the software for configuring, controlling, monitoring and diagnosing all of the processing cards in a VM600 series rack. The redundant function is obtained by using two functionally equivalent CPUR and IOCR card pairs in the same VM600 rack (see 4.4 Redundant behaviour).

The IOCR card acts as a signal and communications interface for the CPUR card. This card includes an 8P8C (RJ45) connector for the Ethernet connection and two D-sub connectors for configuring multi-drop RS-485 networks of VM600 racks. It also protects all of the inputs against electromagnetic interference (EMI) and signal surges to meet electromagnetic compatibility (EMC) standards.

The CPUR and IOCR function as a card pair in the VM600 series of Machinery Protection System (MPS) and Condition Monitoring System (CMS) racks, from Meggitt's Vibro-Meter® product line. The card pair can perform all rack configuration and communications interfacing required by a VM600 rack.

The CPUR is installed in the front of the VM600 rack and the associated IOCR is installed in the rear of the rack (in the slot directly behind its associated CPUR). Only the latest VM600 racks (ABE04x) can be used and each card connects directly to the rack's backplane using two connectors (see Figure 3-1).

4.3 Operation

NOTE: The primary advantage of having two CPUR/IOCR card pairs installed in a rack is to have redundancy in terms of communication with external systems and in terms of automatic configuration of processing card pairs in the rack.

4.4 Redundant behaviour

The functions implemented to support redundant behaviour consist of:

- Data mirroring – external communication links carry the same content
- Dedicated supervision bus – the Master CPUR and the Inactive CPUR constantly monitor each other's status
- Mutual detection mechanism – the Inactive CPUR automatically takes control if the Master CPUR fails
- Status communication – the status of every card in the system is available externally.

Two functionally equivalent CPUR and IOCR card pairs must be installed in a VM600 in order to obtain redundant behaviour, as shown in Figure 4-1. The CPUR and IOCR card pairs can be installed in slots 0, 1 and 2 of a VM600 rack. However, in a typical application, they are installed in slot 0 and slot 1.

NOTE: When two CPUR/IOCR card pairs are installed in a VM600 rack in order to obtain redundant operation, it becomes necessary to make a distinction between the different CPUR/IOCR card pairs (see 1.4 Terminology).

The redundant behaviour is obtained by using two CPUR/IOCR card pairs in the same VM600 rack. Both card pairs are functionally equivalent and the determination of which is the Master CPUR and which is the Inactive CPUR is made when the external power supply to the rack is turned on: the left-most CPUR becomes the Master CPUR and the other CPUR becomes the Inactive CPUR (the 'backup' card).

4.4.1 Data mirroring

During normal operation of a redundant system, both card pairs run simultaneously (see Figure 4-1). The Master CPUR is the 'active' card and processes all external

communications. The Master CPUR also ensures that data is mirrored to the Inactive CPUR in real-time, so that both CPUR/IOCR card pairs remain synchronised (contain identical information).

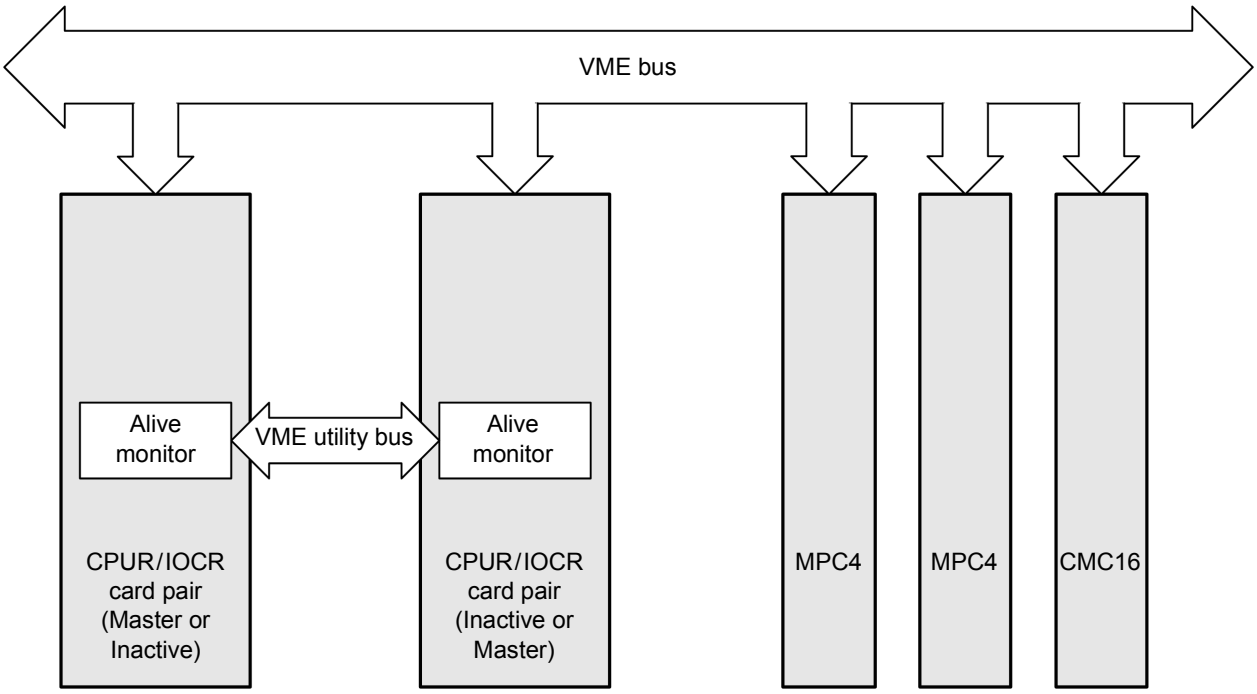

Figure 4-1: A redundant system using two CPUR/IOCR card pairs in a VM600 rack

4.4.2 Dedicated supervision bus

The VME utility bus (see 3.2.1 VME utility bus) is used as an dedicated supervision bus that, in conjunction with the alive monitors on each of the CPUR cards, allows the Master CPUR and the Inactive CPUR to constantly monitor each other's status.

In this way, the status or failure of a CPUR/IOCR card pair can be determined by the other card pair and also made available externally, if required.

4.4.3 Mutual detection mechanism

In the case of a Master CPUR failure, the Inactive CPUR will automatically detect this, become the 'active' card and take control of the system. In this way, there is no impact on the system functionality and the availability of the entire system is increased.

4.4.4 Status communication

Third party devices, such as a distributed control system (DCS) can query either CPUR/IOCR card pair, at any time, to check the status of the system (that is, to obtain the status of the CPUR/IOCR card pairs or any processing cards in the rack).

4.4.5 Switch over

4.4.5.1 Non-redundant system

If only one fully operational CPUR/IOCR card pair is in a VM600 rack then this card pair is the Master CPUR ("system controller") and no switch over is possible.

4.4.5.2 Redundant system

If two fully operational CPUR/IOCR card pairs are in a VM600 rack and the Master CPUR fails, the Inactive CPUR card pair will:

- detect the failure of the Master CPUR, via the alive monitor on the CPUR card
- put (and hold) the Master CPUR in a reset state
- become the Master CPUR ("system controller").

NOTE: If a CPUR card is held in a reset state, this is indicated by its status LED. See 2.2.1 CPUR front panel LEDs.

This redundant system operation is called a switch over. During the switch over, some system functionality may be interrupted, for example, data transmission via Modbus.

NOTE: The time required for a switch over operation in a redundant system shall not exceed 1 second.

The CPUR card that failed will be held in the reset state until either the card is replaced, or the power supply to the rack is turned off and turned on again. If the card that failed is replaced during normal system operation (that is, with the power supply on), the replacement CPUR card will become an Inactive CPUR.

If two fully operational CPUR/IOCR card pairs are in a VM600 rack and the external power supply to the rack is turned off and then turned on, the card pair in the lowest slot number automatically becomes the Master CPUR ("system controller"). The other card pair becomes the Inactive CPUR.

If a single, fully operational CPUR/IOCR card pair (Master CPUR) is present in a VM600 rack and a second fully operational card pair (Inactive CPUR) is inserted in the rack, there will be no switch over. This remains the system behaviour, even if the second, fully operational, card pair (Inactive CPUR) is inserted in a lower slot number in the rack.

However, when the rack power supply is turned off and then turned on, the CPUR/IOCR card pair in the lowest slot number will become the Master CPUR (assuming both card pairs are both fully functional).

4.5 CPUR card

The CPUR card contains two major components – a MPC8347 PowerPC® processor from Freescale and a Spartan FPGA from Xilinx – that work together to act as a system controller for VM600 racks used in MPS and CMS applications. The card interfaces internally to the other (signal processing) cards in a VM600 series rack over the VME bus and communicates externally via its corresponding IOCR card (see 4.6 IOCR card). The CPUR runs the software for configuring, controlling, monitoring and diagnosing all of the processing cards in a rack.

The CPUR card is designed to implement CPUR card redundancy and supports the orderly transition of functions from a Master CPUR to a Inactive CPUR, in the case of a Master CPUR failure.

With two CPURs in the same VM600 rack, it is possible to maintain a fully functional system even in the event of a failure of one of the CPUR cards. A sophisticated mechanism is implemented on the card to report health status to a the redundant CPUR card (Inactive CPUR) present in the system. This mechanism is used to detect if the active CPUR (Master CPUR) has failed allowing the backup CPUR to step in as the new system controller card (see 4.4 Redundant behaviour).

The CPUR/IOCR card pair's Gigabit Ethernet interface (1000BASE-T compliant) is from the PowerPC on the CPUR card (see 4.5.1 CPUR block diagram) and routed to the IOCR (see 4.6.1 IOCR block diagram). The indicator LEDs are brought to the front panel of the CPUR (see 2.2.1 CPUR front panel LEDs).

256 Mbit of NOR flash memory is used to store all of the firmware and the configuration for the CPUR card. This is the device that is updated with the new firmware when the CPUR firmware is changed.

An I^2C interface (VME utility bus) is used to implement the redundancy function of the CPUR card. The I^2C interface also incorporates a 4-bit slot identification code from connections to the VM600 system backplane that identifies the slot in the rack where the card is installed.

The CPUR card supports VME transactions according to the VME A24/D16 standard. This means that VME signalling is limited to connector J1/P1 (as per standard VME standard nomenclature). The CPUR card also supports the "hot-swap" functionality specified in the VME bus standard. (This functionality requires some features to be supported like power control, position sensing handles, ESD strips, pre-biased I/O, blue LED and LI/I and LI/O support to the backplane.)

Hardware monitoring of the CPUR card is achieved using a dedicated device that monitors the power supply rails and device temperatures on the card.

4.5.1 CPUR block diagram

Figure 4-2 shows a block diagram of the CPUR card.

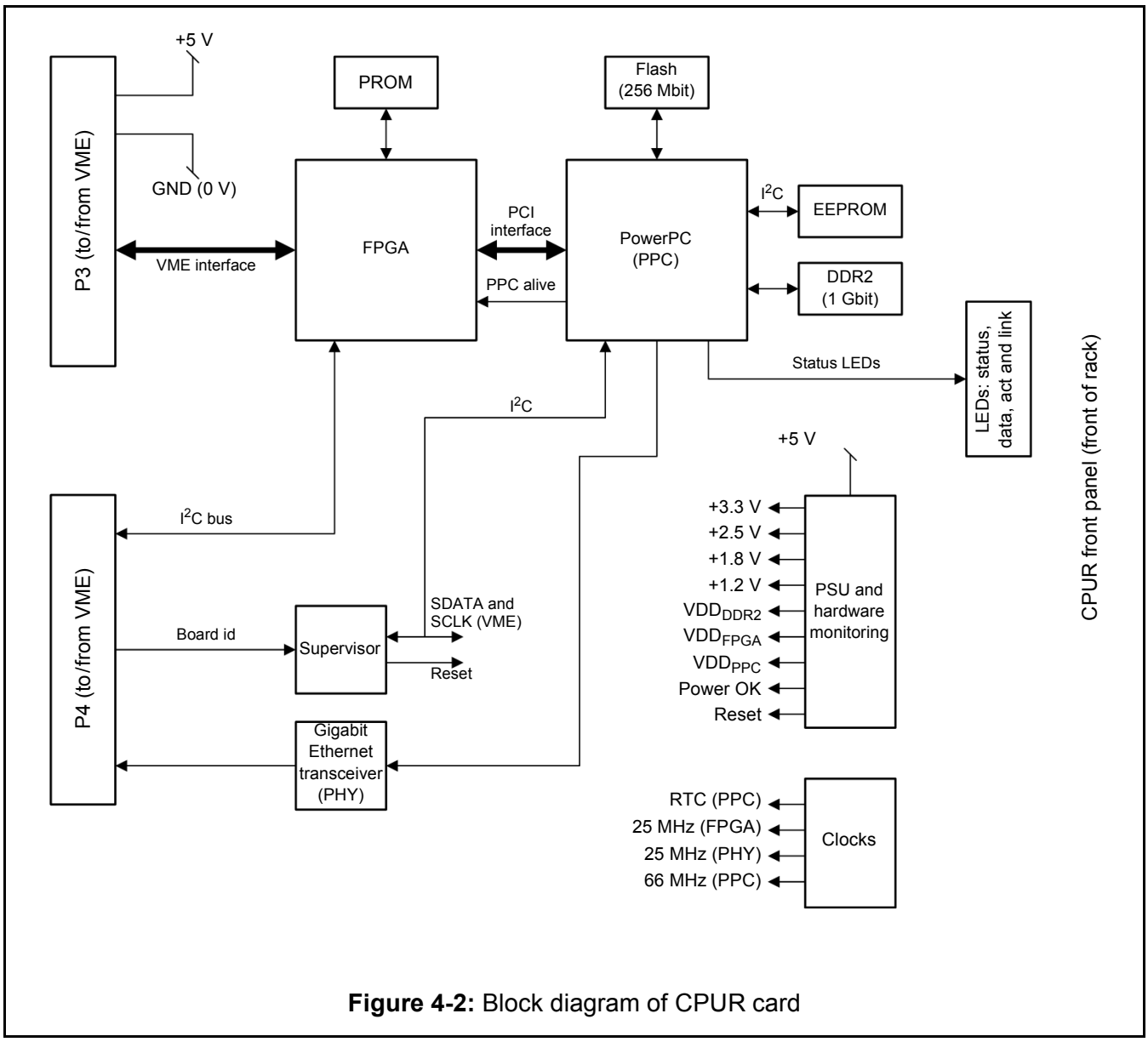

Figure 4-2: Block diagram of CPUR card

4.5.2 Operation of LEDs on CPUR front panel

See 2.2.1 CPUR front panel LEDs.

4.6 IOCR card

The IOCR card acts as a signal and communications interface for a CPUR card (see 4.5 CPUR card). It is installed in the installed in the rear of the rack, in the slot directly behind the corresponding CPUR (the cards connect directly to the VM600rack's backplane).

The IOCR has common communication interfaces like Gigabit Ethernet, UART, and I^2C (internal use only) as shown in Figure 4-3.

The serial communications supported are RS-232, full-duplex RS-485 (4-wire) and half-duplex RS-485 (2-wire). Access to these signals is provided using two D-sub connectors, J2 and J3, on the front-panel of the IOCR (rear of the VM600 rack).

Gigabit Ethernet is provided using a 8P8C (RJ-45) connector, J4, and signals for the five relays are available on a crew-terminal strip connector, J1.

4.6.1 IOCR block diagram

Figure 4-3 shows a block diagram of the IOCR card.

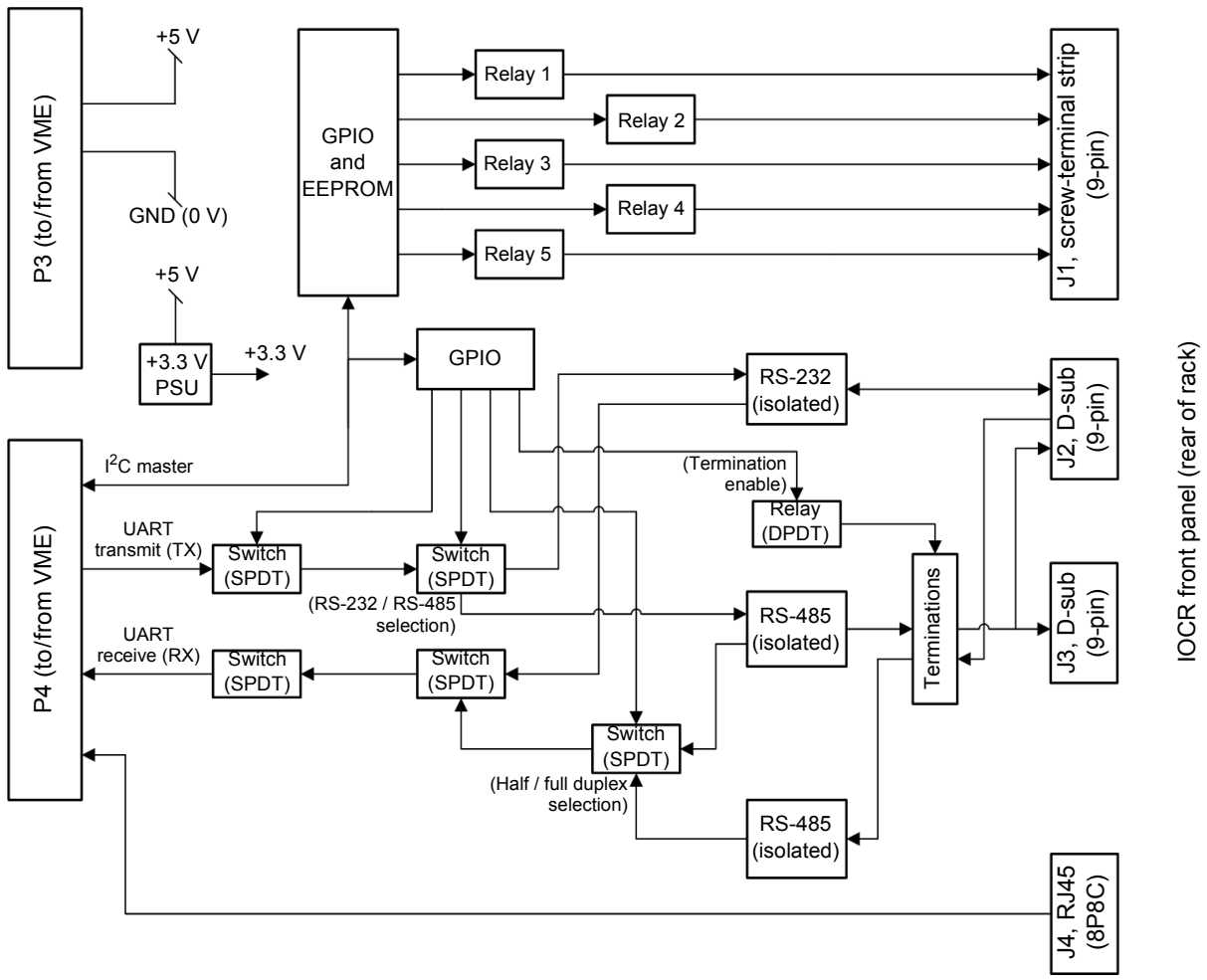

Figure 4-3: Block diagram of IOCR card

4.6.2 Serial communications

The IOCR card uses a high-speed serial port (16550 UART compatible) to provide the following serial communications interfaces: RS-232, full-duplex (4-wire) RS-485 and half-duplex (2-wire) RS-485.

The selection of RS-232, full-duplex or half-duplex RS-485 is configurable by the user in the Modbus configuration file (see 9 Modbus configuration file and event log files). However,

jumpers are used to manually configure the default signal levels and terminations when the serial communications interface is used as an RS-485 link (see 7 Configuring a CPUR / IOCR card pair – hardware configuration).

Only one serial communications interface can be active at a time (there is one high-speed serial port with different transceivers selected depending on the required interface). All of the transceivers implement isolated interfaces.

4.6.2.1 RS-232

This IOCR interface uses the high-speed serial port with an isolated RS-232 transceiver. The transceiver is an ESD protected device specially designed to work in electrically harsh environments where the cables are frequently being plugged and unplugged.

4.6.2.2 Full-duplex (4-wire) RS-485 and half-duplex (2-wire) RS-485

This IOCR interface uses the high-speed serial port with an isolated RS-485 transceiver. The transceiver is an ESD protected device specially designed to work in electrically harsh environments where the cables are frequently being plugged and unplugged.

The following RS-485 interface options are software configurable:

- Selection of full-duplex or half-duplex operation.

The following RS-485 interface options are hardware configurable:

- Enabling or disabling of 120 Ω termination resistance between RS485_TXA and RS485_TXB
- Enabling or disabling of 120 Ω termination resistance between RS485_RXA and RS485_RXB.

4.6.2.3 Multi-drop RS-485 and daisy-chaining serial communications connectors

For a point-to-point connection (link) between a CPUR/IOCR card pair in a VM600 rack using RS-485, it is only necessary to use the first serial communications connector, J2.

It is only becomes necessary to use the second serial communications connector, J3 when a multi-drop RS-485 network is used allow multiple devices to communicate on the same network (link).

4.6.3 Gigabit Ethernet

The IOCR card provides one Gigabit Ethernet interface on a RJ-45 (8P8C) connector (J4).

The Gigabit Ethernet interface can support a distance of up to 60 m at 1000 Mbps. For distances greater than the specified maximums, the cards operate at reduced data transfer rates.

The LED indicators that show if the Ethernet interface is active and the speed of the link are available on the front panel of the CPUR (see 2.2 CPUR rack controller and communications interface card and 2.2.1.2 Act and link LEDs).

4.6.4 Relays

The IOCR card contains five SPDT relays that under the control of the firmware of the CPUR/IOCR card pair.

NOTE: Refer to the CPUR/IOCR *rack controller and communications interface card pair data sheet* for full technical specifications of the relays.

The common (COM), normally closed (NC) and normally open (NO) contacts for each relay are available on the J1 connector (see 2.3.1 IOCR front panel connectors).

The IOCR provides a terminal strip (J1) to connect the relay outputs to external circuitry. Each relay can be mapped to any Modbus bit variable. In a typical application, these relays are used to signal a fault or a problem detected by a common alarm, such as communication status or rack status.

4.7 Configurations

4.7.1 General concepts

There are two configurations associated with a rack containing a CPUR/IOCR card pair:

- The configuration of the CPUR/IOCR card pair itself.

  This requires the use of the VibroSight System Manager software, which communicates directly with the CPUR/IOCR card pair.
- The configuration of the VM600 rack, that is, the configuration of all of the processing cards in the rack and the Modbus configuration file used by the CPUR/IOCR card pair.

  This requires the use of the VM600 MPSx software and/or VM600 CMS software, which communicates indirectly with the individual processing cards using the CPUR/IOCR card pair as a gateway, and the VibroSight System Manager software which uploads the Modbus configuration file to the CPUR/IOCR card pair.

4.7.2 Configuration of a CPUR/IOCR card pair

This configuration of the CPUR/IOCR card pair consists of:

- The configuration of the IP address settings and the time reference settings.
  See 8 Configuring a CPUR / IOCR card pair – configuration and management using VibroSight System Manager.

4.7.2.1 Configuring IOCR card jumpers

While the CPUR/IOCR card pair is software configurable using the VibroSight System Manager software, jumpers on the IOCR card are used to manually configure the default signal levels and terminations when the serial communications interface is used as an RS-485 link.
See 7 Configuring a CPUR / IOCR card pair – hardware configuration.

4.7.3 Configuration of a VM600 rack

This configuration of the VM600 rack consists of:

- The Modbus (text-based) configuration file for the CPUR/IOCR card pairs.
  See 9 Modbus configuration file and event log files.
- The configuration data for all of the processing cards.

NOTE: If a VM600 rack contains a CPUR/IOCR card pair, then the CPUR/IOCR ("system controller") is the "master" of the rack's configuration.

In practice, this means that the user must use the appropriate software from the Meggitt Vibro-Meter® product line (VM600 MPSx and/or VM600 CMS) to upload configurations to the processing cards in the normal way, that is, on a per card or per rack basis.

While acting as a gateway between the software and the signal processing cards, the CPUR/IOCR card pair will store copies of these configurations as they “pass through” it.

NOTE: The CPUR/IOCR card pair can never download a configuration from a processing card (as it would then not be the “master” of the rack’s configuration).

The user should be aware of the following

Individual channel bypass

When a machinery protection card configuration is uploaded to the card (MPC4) from the VM600 MPSx software, the individual channel bypass is automatically reset for all channels – which may cause a machine trip. Therefore, any individual channel bypass required should be maintained throughout a card configuration process.

When a machinery protection card (MPC4) is being reconfigured, the machinery monitoring functions at the card level are stopped, that is, there is no protection function until the configuration procedure has stopped and the new configuration (with its machinery protection function) starts. After the configuration is started, the channels are not bypassed, by default.

For these reasons, the configuration of a card using the VM600 MPSx software is considered a critical maintenance operation and should therefore be performed exclusively when the machinery being monitored is stopped.

NOTE: It is highly recommended that the upload of a new configuration to a machinery protection card (MPC4) is performed under the supervision of the master DCS or ESD system, in order to avoid compromising overall safety.

4.7.3.1 Non-redundant system

Consider the case of a rack with a single CPUR/IOCR card pair (Master CPUR). When the VM600 MPSx software and/or VM600 CMS software is used to configure the processing cards via the CPUR/IOCR gateway, the Master CPUR stores a copy of the configuration for each processing card (in a particular slot).

Therefore, it is possible for the Master CPUR to upload the configuration of a processing cards from its stored copy of the configuration. This happens automatically in two situations:

- At any time, when a card is replaced (“hot-swapped”) in a rack (if the slot and card type of the replacement card match).
- When the power supply to the rack is turn on and the Master CPUR compares the configuration of all cards in a rack with its “master” copies, as a power-on self-test.

  If there are any inconsistencies then the “master” configuration held by the Master CPUR are used to reconfigure any affected cards. If the Master CPUR configuration and the processing card configuration are consistent, then no action is taken. If the Master CPUR does not hold a valid configuration for one or more of the processing cards then it shall indicate an error through its front panel LEDs (see 2.2.1 CPUR front panel LEDs). This error can also be communicated to any external DCS/PCS.

4.7.3.2 Redundant system

A redundant system includes the following behaviour, in addition to the behaviour already described in 4.7.3.1 Non-redundant system.

NOTE: The primary objective of having two CPUR/IOCR card pairs installed in a rack is to have redundancy in respect to the automatic configuration of the card pairs in the rack and in respect to communication with third party devices (such as a DCS/PCS).
Therefore, it is essential that both card pairs have an identical configuration. In order to achieve this, the card pairs synchronise their configuration using the rules defined below.

Consider the case of a rack with two CPUR/IOCR card pairs (Master CPUR and Inactive CPUR). When the VM600 MPSx software and/or VM600 CMS software is used to configure the processing cards via a CPUR/IOCR card pair, either the Master CPUR or the Inactive CPUR can be used. Whichever CPUR/IOCR gateway receives the configuration data (Master CPUR or Inactive CPUR), stores a copy of the data (for a particular slot) and then automatically copies the information to the other CPUR/IOCR card pair in the rack.

Similarly, when the VibroSight System Manager software is used to upload a new Modbus configuration file to a CPUR/IOCR card pair, either the Master CPUR or the Inactive CPUR can be used. Whichever CPUR/IOCR card pair receives the configuration data (Master CPUR or Inactive CPUR), stores a copy of the data and then automatically copies the information to the other CPUR/IOCR card pair in the rack.

NOTE: When new configuration information is uploaded to the cards in a VM600 rack with redundant CPUR/IOCR card pairs, the Master CPUR (or Inactive CPUR) will automatically copy the configuration to the Inactive CPUR (or Master CPUR). This applies to both the configuration information for the processing cards in the rack and to Modbus configuration file for the CPUR/IOCR card pairs in the rack.

In this way, the configuration held on a Master CPUR and an Inactive CPUR will always be the same (see 4.4.1 Data mirroring).

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5 HARDWARE INSTALLATION

5.1 Introduction

The CPUR and IOCR card pair can be installed in a 19" x 6U rack (2.1 Racks). This rack has 21 VME slots, designated slots 0 to 20 (from left to right, as seen from the front of the rack).

The front and rear card cages of a rack are partitioned by a back plane. Each side of the back plane is equipped with connectors allowing modules and cards to be quickly and easily installed.

Depending on the intended use of the rack (MPS, CMS or combined), it can contain the following elements, connected to the back plane by installing them from the front of the rack:

- CPUR redundant CPU card (or CPUM modular CPU card)
- AMC8 analog monitoring card
- CMC16 condition monitoring card
- MPC4 machinery protection card
- RPS6U mains power supply unit (ABE04x only).

The following elements are connected to the back plane by installing them from the rear of the rack:

- IOCR input/output card, for use with a matching CPUR (or IOCN input/output for use with a matching CPUM)
- IOC8T input/output card, for use with a matching AMC8
- IOC16T input/output card, for use with a matching CMC16
- IOC4T input/output card, for use with a matching MPC4
- IRC4 intelligent relay card and RLC16 relay card.

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of VM600 cards other than the CPUR and IOCR.

A condition monitoring system (CMS) using the VibroSight® software from the Meggitt Vibro-Meter® product line can use the following hardware:

- XMC16 extended monitoring card for combustion
- XMV16 extended monitoring card for vibration
- XIO16T extended input/output card, for use with a matching XMC16 or XMV16.

NOTE: VibroSight® compatible signal processing cards (such as XMV16/XIO16T and XMV16/XIO16T card pairs) can coexist with other cards in a VM600 rack. However, the VibroSight® compatible signal processing cards do not utilise the VME bus, so they exist independently of any system controller (CPUR/IOCR or CPUM/IOCN) in a VM600 rack.
Further information on this CMS hardware can be found in the *VibroSight help*.

5.2 Attribution of slots in the rack

Table 5-1 show the installation restrictions that apply to the VM600 (ABE040 and ABE042) racks.

Table 5-1: Attribution of slots in a VM600 (ABE04x) rack

VME slot no.	Card/system component accepted in front card cage	Card/system component accepted in rear card cage
0	Reserved for CPUx	Reserved for IOCx
1		Associated IOCx. Or RLC16 or IRC4
2	Reserved for VME 32 card	RLC16 or IRC4
3 to 14	MPC4, AMC8, CMC16, XMC16, XMV16 or XMVS16	Associated IOC4T, IOC8T, IOC16T or XIO16T. Or RLC16 or IRC4.
15	Reserved for RPS6U (Power supply 2, PS2) (Width of RPS6U = 3 slots)	RLC16 or IRC4
16		RLC16
17		RLC16
18	Reserved for RPS6U (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

A CPUR card must have an IOCR card installed directly behind it in the rack.

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 or in order to supply power to the cards (refer to the *VM600 machinery protection system (MPS) hardware manual*).

5.3 Rack safety requirements

5.3.1 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.

When racks are installed in a cabinet or enclosure in which natural ventilation is used, a space of at least 50 mm should be present below and above each rack for an ABE04x rack (see Figure 5-1, Case A).

It is possible to prevent warm air flowing from one rack to another, by placing inclined plates between them in order to deflect the airflow (see Figure 5-1, Case A). When inclined plates are used with VM600 racks, an inclined plate can also function as a non-flammable

separation barrier, if required (see 5.3.4 Instructions for locating and mounting). In addition, the space of 50 mm or 20 mm should be present below and above each rack.

Always ensure adequate spacing (minimum 50 mm for ABE04x racks) is provided below and above the rack to allow proper natural ventilation.

Failure to adhere to this requirement will cause overheating of the rack and as a consequence will affect the correct operation of the system.

If an ABE04x rack is assembled without empty slots between the MPS and/or CMS processing cards, it is recommended to use forced ventilation if the temperature of the air flowing through the rack exceeds 40 °C. If a 19" x 6U rack has at least one empty slot between each processing card, it is recommended to use forced ventilation if the temperature of the air flowing through the rack exceeds 55 °C.

In a case where forced ventilation by fan units is used, the spacing above, below and between racks can be reduced to zero, providing that the airflow to/from neighbouring racks is ensured.

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 XI.

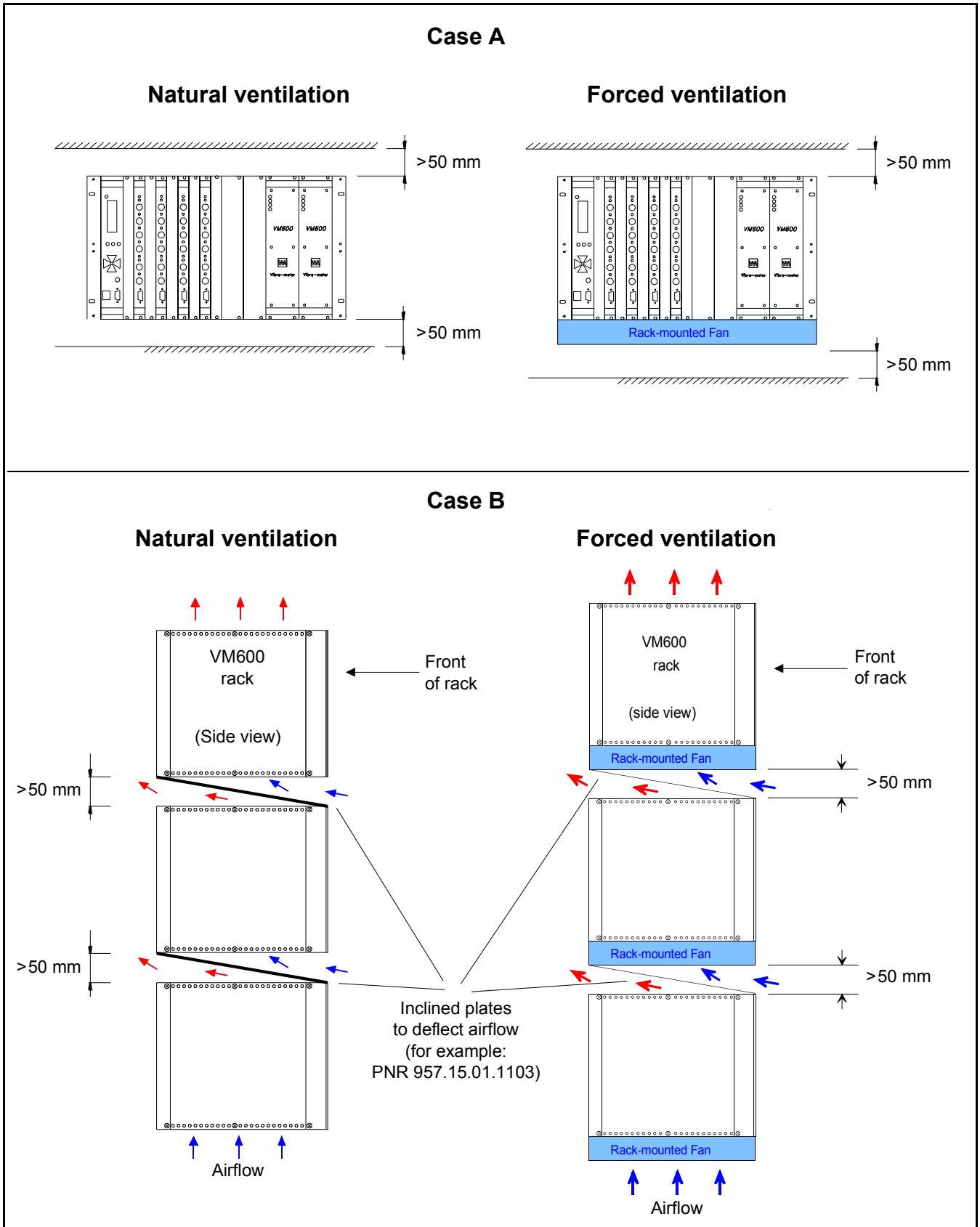

Figure 5-1: Minimum required spacing above, below and between ABE04x racks in an enclosure using natural or forced ventilation

5.3.2 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 as a means of disconnection from the mains supply.

VM600 ABE04x 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 operator must have easy access to the switch or circuit breaker at all times.

Refer to the *VM600 machinery protection system (MPS) hardware manual* for further information.

5.3.3 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.

Refer to the *VM600 machinery protection system (MPS) hardware manual* for further information.

5.3.4 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 XVII.

Refer to the *VM600 machinery protection system (MPS) hardware manual* for further information.

5.4 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 XVII.

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 XVII.

Operating personnel should remember to observe the handling precautions mentioned in Handling precautions for electrostatic sensitive devices on page xviii 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.

5.4.1 First-time installation of the VM600 rack

The initial insertion of elements in the ABE04x rack should be done with the rack powered down.

When a VM600 rack is installed for the first time, the card pairs (and individual cards such as relay cards) within it must be configured according to their intended application.

The CPUR/IOCR card pair is software configurable. However, jumpers are used to manually configure the default signal levels and terminations when the serial communications interface is used as an RS-485 link (see 7 Configuring a CPUR / IOCR card pair – hardware configuration).

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of VM600 cards other than the CPUR and IOCR.

Note, however, that the configuration of individual channels on the signal processing cards (such as the AMC8, CMC16 and MPC4) must be done by software before the system can be used. This is done using the appropriate software such as the VibroSight®, VM600 MPSx and/or VM600 CMS software, once the rack is powered up.

For a rack containing a CPUR/IOCR card pair (or a CPUM card and, optionally, its matching IOC N card), the configuration for all of the VM600 cards can be downloaded over an Ethernet link.

However, for a stand-alone rack, containing AMC8 and MPC4 cards, the configuration can be downloaded from a computer to each card in turn via an RS-232 link. While for a stand-alone rack, containing CMC16 cards, the configuration can be downloaded from a computer to the cards via an RS-485 multi-drop link that connects all of the IOC16T cards together in a “daisy-chain”.

The majority of the system parameters will normally have been configured in the factory before delivery of the MPS or CMS. The user is nevertheless able to modify certain parameters if required, using the appropriate software such as the VibroSight®, VM600 MPSx and/or VM600 CMS software.

NOTE: Refer to the relevant software manual for further information.

5.4.2 Subsequent installation of cards ("hot-swapping”)

5.4.2.1 Which card types can be hot-swapped?

The CPUR/IOCR card pair has “hot-swapping” capability, that is, it can be removed from and inserted into the MPS rack while the electrical power supply to the rack is turned on (a technique also known as “live insertion”).

NOTE: Refer to the *VM600 machinery protection system (MPS) hardware manual* for details and explanations of VM600 cards other than the CPUR and IOCR.

The CPUR has no configurable hardware elements, but its software configuration is stored in an on-board non-volatile memory. When a new configuration is uploaded to a CPUR card (Master CPUR or Inactive CPUR) in a redundant system, the configuration is automatically copied to the other CPUR card (Inactive CPUR or Master CPUR).

For the IOCR, the adjustable hardware elements (jumpers to configure the default signal levels and terminations for an RS-485 link) should be set up appropriately by the user on any new card put into a given slot.

5.4.2.1.1 Cards in a networked rack

NOTE: The following remarks concern networked racks, that is, a VM600 rack (ABE04x) with a CPUx rack controller and communications interface card.

In a networked rack, if a processing card originally used in slot *mm* is inserted in slot *nn*, the CPUxrecognises that the card's configuration does not match the slot. It will then download into the new card's flash memory the appropriate configuration for slot *nn*.

Problems can occur if a card taken from slot *nn* of rack x is inserted into slot *nn* of rack y, as slot *nn* may 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 discussed in the *VM600 machinery protection system (MPS) hardware manual*.

5.4.3 Setting the IP Address of the CPUR card

The IP address of the CPUR must be defined for racks employing this type of card (see 8.4.2 Configuring IP settings).

Refer to the *VM600 networking manual* for general information on networking.

6 SOFTWARE OVERVIEW

This chapter provides a brief overview of the software available to the user for configuring a CPUR/IOCR card pair. This includes:

- VibroSight System Manager
  This (external) application software runs on a host computer and is used to configure and manage the CPUR and IOCR hardware and firmware.
  For example, the VibroSight System Manager module provides a feature to easily check and change firmware versions for VM600 hardware.
- Modbus (`modbusDefault.cfg`)
  This (internal) configuration file resides on the CPUR and is used to configure all of the communications options for a CPUR and IOCR card pair. For example, this includes default communication port options and the configuration of the CPUR's Modbus server.

NOTE: VibroSight System Manager is used to upload and download the `modbusDefault.cfg` file to/from a CPUR card.

6.1 VibroSight

VibroSight System Manager is one of the software modules that forms VibroSight®, a highly integrated software suite from Meggitt's Vibro-Meter® product line.

VibroSight® is a modular system that supports the effective condition monitoring of all rotating machinery supports the predictive methodologies that can be used to improve the effectiveness of your machinery.

The VibroSight® software uses a client-server architecture to distribute the functional requirements of the system across several software modules – Configurator, Event Viewer, Mimic, Scope, Server, System Manager and Vision.

VibroSight System Manager is the software module that provides the tools to manage Vibro-Meter® monitoring system hardware and software.

6.1.1 VibroSight System Manager

VibroSight System Manager is the client application software module that provides the tools to manage Vibro-Meter® monitoring system hardware such as VM600 racks and VibroSmart® systems.

For a CPUR card, for example, VibroSight System Manager is used to configure IP and time reference settings, upload/download Modbus configurations, update firmware and download events logs and diagnostic information.

6.1.1.1 Installing VibroSight System Manager

Refer to the *Getting started with VibroSight® installation guide* for information on computer system requirements and installing the VibroSight® software.

By default, the VibroSight® installer installs the complete VibroSight® software suite.

Alternatively, the VibroSight® installer can be used to selectively install different components of the VibroSight® software, such as VibroSight System Manager only.

(For example, after accepting the terms in the licence agreement, select the **Advanced** button in order to change the installation options and use the **Product features** window to disable (make unavailable) all of the VibroSight® software expect for VibroSight System Manager (will be installed)).

The use of VibroSight System Manager is discussed in 8 Configuring a CPUR / IOCR card pair – configuration and management using VibroSight System Manager.

6.1.2 Other VibroSight software modules

Refer to the VibroSight® software data sheet or the  *VibroSight help* (VibroSight.chm), for information on other VibroSight® software modules.

6.2 Modbus

Refer to the *VM600 networking manual* for background information on Modbus.

6.2.1 Modbus configuration file (`modbusDefault.cfg`)

The CPUR/IOCR card pair uses a Modbus configuration file (`modbusDefault.cfg`) to configure the Modbus server that runs on the implemented on the CPUR card.

The Modbus server and the Modbus configuration file are discussed further in 9 Modbus configuration file and event log files.

7 CONFIGURING A CPUR / IOCR CARD PAIR – HARDWARE CONFIGURATION

Most user options for the CPUR/IOCR card pair are software configurable (see 8 Configuring a CPUR / IOCR card pair – configuration and management using VibroSight System Manager). However, jumpers are used (on the IOCR card only) to manually configure the default signal levels and terminations when the serial communications interface is used as an RS-485 link.

7.1 Configuring jumpers on the IOCR card (serial communications)

Figure 7-2 highlights the location of user configurable jumpers on the IOCR card (see also the block diagrams of the cards in 4.5.1 CPUR block diagram and 4.6.1 IOCR block diagram).

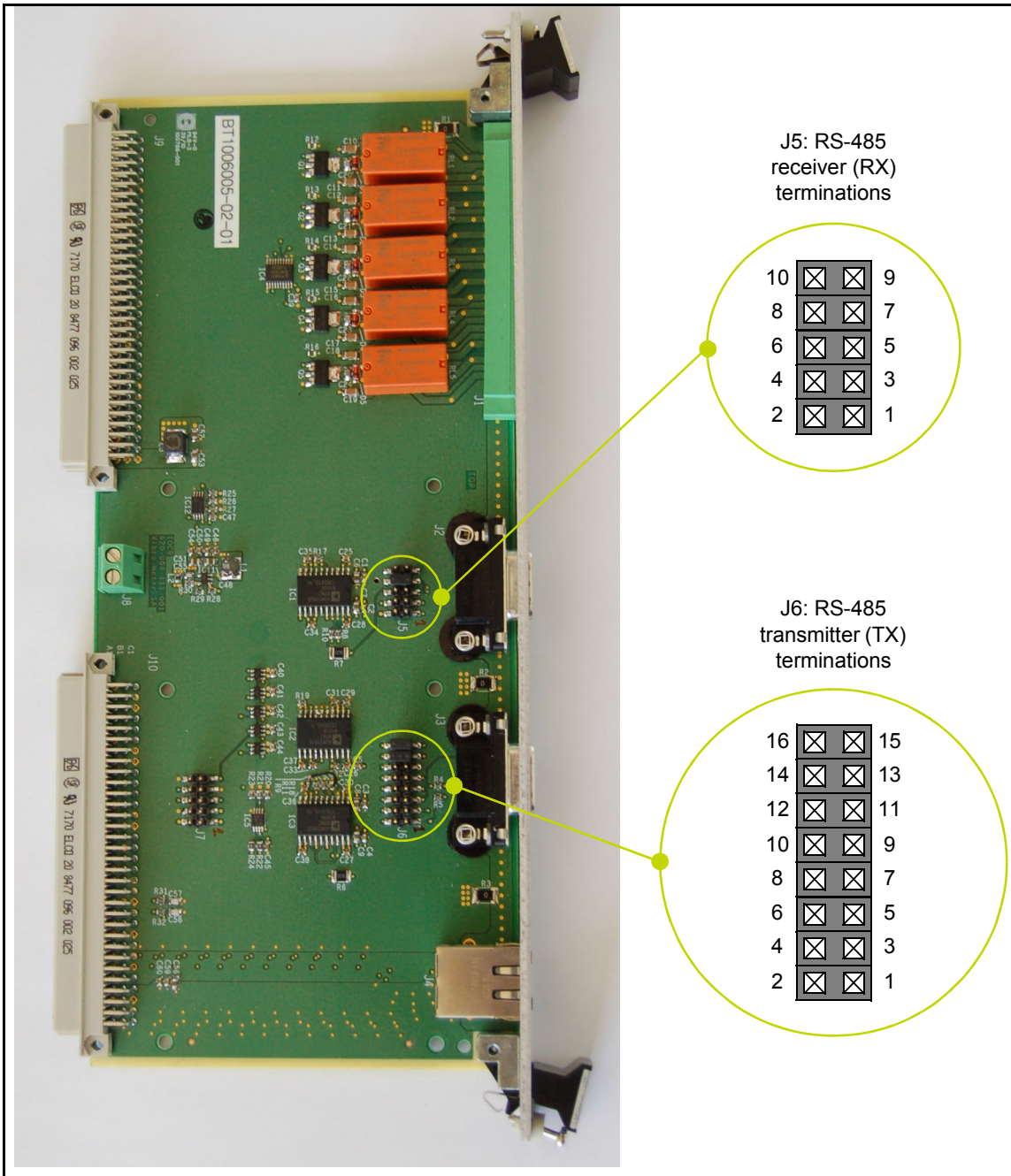

Figure 7-1: Location of jumpers on the IOCR card

7.1.1 RS-485 receiver terminations

The J5 jumper on the IOCR card is used to configure the default signal levels on the receiver (RX) section of the RS-485 interface, as shown in Table 7-1.

Table 7-1: Configuring the default signal levels on the RS-485 receiver

Jumper across pins	Function
1-2	Pulls RS485_RXB low
1-3	Pulls RS485_RXB high
4-2	Pulls RS485_RXA low
4-3	Pulls RS485_RXA high
7-8	Enables a 120 Ω termination resistor between RS485_RXA and RS485_RXB

7.1.2 RS-485 transmitter terminations

The J6 jumper on the IOCR card is used to configure the default signal levels on the transmitter (TX) section of the RS-485 interface, as shown in Table 7-2.

Table 7-2: Configuring the default signal levels on the RS-485 transmitter

Jumper across pins	Function
1-2	Pulls RS485_TXB low
1-3	Pulls RS485_TXB high
4-2	Pulls RS485_TXA low
4-3	Pulls RS485_TXA high
13-14	Enables a 120 Ω termination resistor between RS485_TXA and RS485_TXB
15-16*	Enables a direct connection (short-circuit) between RS485_GND (pin 5 of the D-sub connectors, J2 and J3) and the isolated ground of the RS-485 transceiver on the CPUR card.

* This jumper should always be used.

7.1.3 Configuration examples

The configuration of IOCR card jumpers necessary for full-duplex (4-wire) RS-485 communications over a point-to-point communications link is shown in Figure 7-2 (see 4.6.2.3 Multi-drop RS-485 and daisy-chaining serial communications connectors).

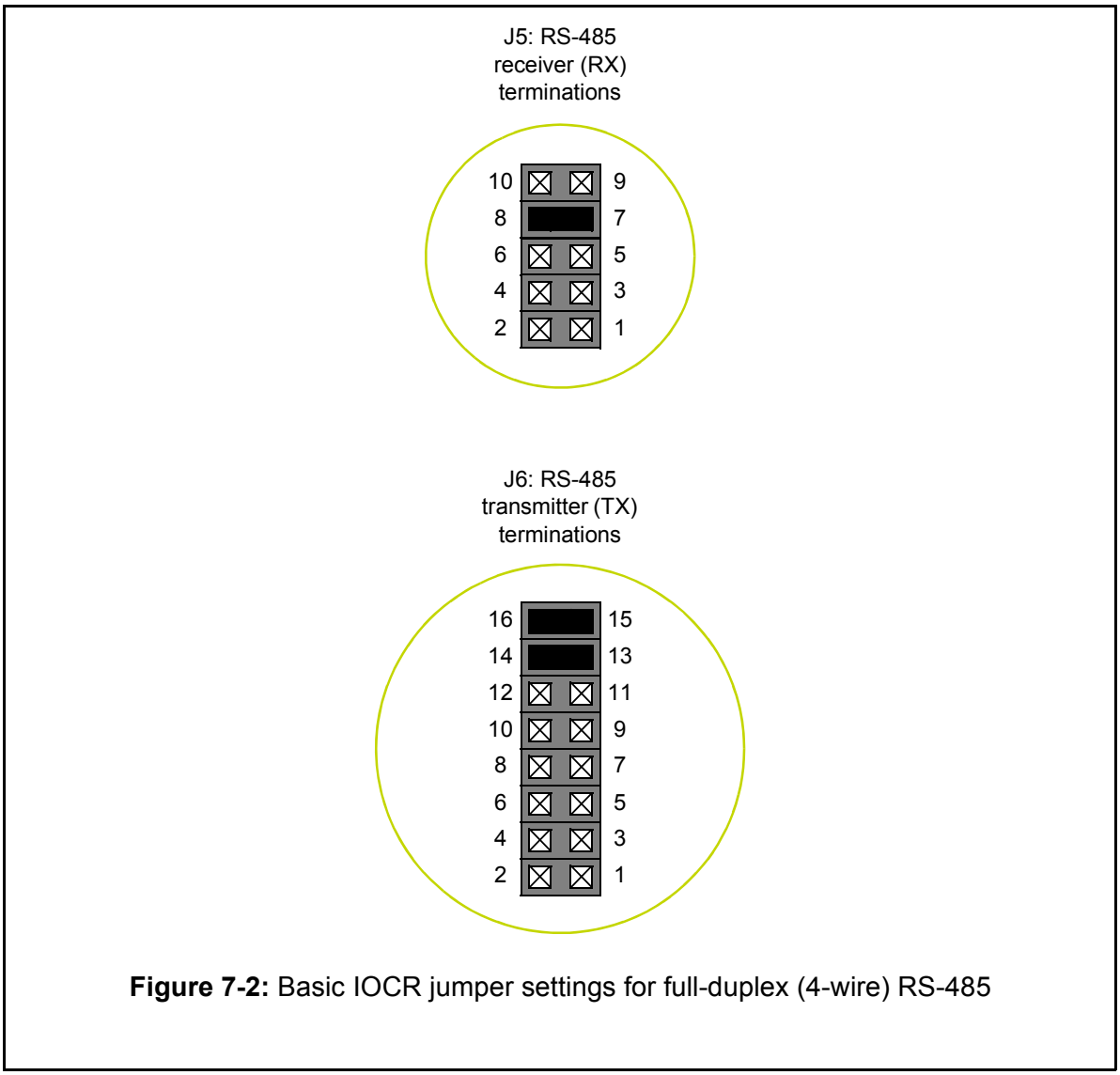

Figure 7-2: Basic IOCR jumper settings for full-duplex (4-wire) RS-485

Note that in this example, the IOCR card takes responsibility for terminating the RS-485 network and the termination resistors are enabled for both transmit and receive.

NOTE: The default configuration for CPUR and IOCR card pairs is full-duplex RS-485, with each differential pair terminated with a 120 Ω resistor.
Accordingly, CPUR/IOCR card pairs will be delivered with this default configuration, unless a different one is specified.

8 CONFIGURING A CPUR / IOCR CARD PAIR – CONFIGURATION AND MANAGEMENT USING VIBROSIGHT SYSTEM MANAGER

8.1 Introduction

This section of the manual introduces the VibroSight System Manager software from the Meggitt Vibro-Meter® product line, that is used with the CPUR and IOCR.

The VibroSight® software uses a client-server architecture to distribute the functional requirements of the system across several software modules and VibroSight System Manager provides the tools to manage the system hardware and firmware.

VibroSight System Manager is used to configure and manage CPUR/IOCR card pairs. For example, to configure IP address and time reference settings, upload Modbus configurations, and to manage firmware versions and diagnostics information.

8.2 CPUR/IOCR card pair configurations

CPUR cards are typically supplied pre-configured with the configuration specified at the time of ordering using the ordering number (PNR) and particular option code.

NOTE: A VM600 rack is usually fully configured in the factory before delivery so that it can be employed as is. If no other configuration is specified, a CPUR card/rack is supplied configured as described in 8.2.1 Standard configurations.
For information on other configuration possibilities, including customer-specific configurations, contact your Meggitt representative or Meggitt SA.

8.2.1 Standard configurations

If no other configuration is specified and agreed, a CPUR card is supplied as follows:

- Default IP settings: IP address of 10.10.56.56 and subnet mask of 0xFFFF0000 (255.255.0.0) for the network interface (ETHERNET).
- Default time reference: Manual time reference is being used (internal CPUR clock).
- Default configuration: No Modbus configuration and no configurations for any other cards in the VM600 rack.

Contact your Meggitt representative, Meggitt SA or Meggitt customer support for information on other configuration possibilities such a standard register mapping for MPC4 and AMC8 cards in slots 3 to 14 of the VM600 rack.

8.2.2 Customer-specific configurations

When specified as part of a complete VM600 rack/system, a CPUR card can be supplied with a customer-specific configuration that corresponds to the system agreed with Meggitt SA.

In such cases, the VM600 rack and cards are typically pre-loaded with the customer-specific configuration before shipping.

8.2.3 Changing configurations

The VibroSight System Manager software is used to download a configuration from a CPUR card or upload a configuration to a CPUR card (see 8.4.4 Configuring Modbus).

Accordingly, this allows the configuration running on a CPUR card to be modified as required. For example, by downloading, modifying and then uploading the configuration or by uploading a new different configuration.

NOTE: It is strongly recommended to use the VibroSight System Manager software to make a backup copy of the configuration running on a CPUR card.

NOTE: A backup copy of the configuration running on a CPUR card is especially important if you are going to make changes to the supplied configuration yourself, as you can revert to the backup copy if you experience problems.

NOTE: If required, an archive copy of the configuration pre-loaded on a CPUR card before shipping can be obtained from Meggitt SA by contacting Meggitt customer support department with customer-specific information such as the Meggitt SA order number, customer order number and/or ordering number (PNR) and particular option code for the CPUM card. See 12.1 Contacting us.

8.2.4 Before using a CPUR/IOCR card pair

Before using a CPUR/IOCR card pair, it is strongly recommended that a time reference is configured for each CPUR card in a system so that the events recorded in its log files (system event logs and measurement event logs) have an accurate timestamp and can be analysed more easily.

See 8.4.3 Configuring a time reference or refer to the NTP topics in the VibroSight *help* for more information (search for “NTP” in the help).

8.3 Installing VibroSight System Manager

See 6.1.1.1 Installing VibroSight System Manager.

8.4 Starting VibroSight System Manager

Start the VibroSight System Manager software module in one of the following ways:

- Click **Start > All Programs > Meggitt > VibroSight > System Manager**.
- Double-click the VibroSight shortcut installed on your desktop as part of the installation process to start the VibroSight Welcome Centre, then click the System Manager.

NOTE: If a VibroSight® software licensing window appears, click the **Continue Evaluation** button to start using VibroSight®. Contact Meggitt SA for information concerning licences.

The software starts and the System Manager window appears. By default, VibroSight System Manager starts with VibroSight Hosts (left) as the default view in the System Explorer window.

8.4.1 Viewing CPUR and IOCR cards

When the VibroSight Hosts view is shown, you can change to the Devices view by clicking on the Devices button (below the Hosts tree structure.

1- Click the Devices button below the VibroSight Hosts tree structure to see the Devices view.

The Devices tree structure is a hierarchical representation of the all of the VM600 related hardware (cards) that System Manager can see on the network.

In the Devices view, the following elements are displayed:

Cards

A node that acts as a collection point for all of the individual cards of a particular type (for example, CPUx, XMC16 or XMV16) that System Manager can see.

Individual card

A node that allows each card to be viewed in isolation. This is useful when a particular card must be selected for an operation, such as configuring an IP address.

2- Double-click on the CPUR cards node to view all of the CPUR cards that can be seen on the network.

The VM600 cards that are available on the network are listed in a serial number (IP address) format, for example, `xxxxxxx` (`xxx.xxx.xxx.xxx`).

NOTE: A device's IP address (`xxx.xxx.xxx.xxx`) can be changed to meet the requirements of a network but the device can always be uniquely identified by its serial number (`xxxxxxx`), which is assigned by Meggitt SA and cannot be changed.

8.4.1.1 Checking communications with a CPUR card

To check that the device is connected to your subnet, type `ping xxx.xxx.xxx.xxx` at a Windows command prompt and then press ENTER (where `xxx.xxx.xxx.xxx` is replaced by the actual IP address of the device, in dot-decimal notation, as displayed by VibroSight System Manager).

If the device replies, it is ready to communicate in your subnet. If the device does not reply, this is probably because its IP address does not belong to the correct subnet, in which case it must be changed.

NOTE: VibroSight System Manager displays all of the VibroSight-compatible hardware (devices) that the computer can see on the network.
Although a device does not need to be in the same subnet as the computer running VibroSight in order to be detected and displayed by VibroSight System Manager, a device does need to be in the same subnet as the computer running VibroSight for a deployed VibroSight system. For example:
It is not necessary for a VibroSight-compatible device and the computer running VibroSight to be in the same subnet in order for VibroSight System Manager to run the IP Settings command and allow the IP address and subnet mask of the device to be changed.
It is necessary for a VibroSight-compatible device and the computer running VibroSight to be in the same subnet for normal system operation.

Refer to the *Configuring IP Settings* topic in the *VibroSight help* for more information (search for "Configuring IP Settings" in the help).

8.4.2 Configuring IP settings

You can configure the IP settings of a Vibro-Meter® card using the Configuration tools in VibroSight System Manager.

In order to communicate with a card, it has to be in the correct subnet. If the predefined IP address of the card does not belong to the same subnet as the computer running VibroSight®, you will need to change it.

The IP address of a card can be changed using either:

- static IP addresses (manually)
- a DHCP server (automatically).

A DHCP server will usually assign IP addresses that are automatically in the correct subnet for a network. However, static IP addressees should be assigned carefully, with consideration for the subnet.

See also 8.4.1.1 Checking communications with a CPUR card.

8.4.2.1 Configuring IP settings using static IP addresses

To change the IP address of a CPUR card using static IP addresses requires that you manually assign a unique IP address (on your network) to the card.

In order to communicate with your card, it has to be in the correct subnet. If the predefined IP address of your card does not belong to your subnet, you will need to change it according to your network settings.

To configure the IP address of a CPUR card:

1- In VibroSight System Manager, select the card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click **IP Settings** in the Configuration group in the Actions area.
The IP Settings window appears.

3- Ensure the **Use static IP** option is selected, then enter the new IP address and subnet mask (and Default gateway, if used), in dot-decimal notation, for the card. Click **Finish**.
The System Explorer will automatically update to show the new IP configuration information in the Devices view. However, this does not necessarily mean that the card is accessible in your subnet.

4- To test if the card is accessible, at a Windows command prompt, type `ping xxx.xxx.xxx.xxx` (where `xxx.xxx.xxx.xxx` is replaced with the new IP address just configured).
If the card replies, this means it is in the same subnet as your computer and that it is ready to be used.

The fact that the device (card or module) appears in the Devices tree structure of the System Explorer does not mean that the card is in your subnet, as zeroconf (the network discovery protocols implemented in VibroSight®) can find cards all over a network. To be able to communicate with the device, configure an IP address belonging to the same subnet as the computer used for this communication.

8.4.2.2 Configuring IP settings using DHCP

To change the IP address of a card using DHCP requires that a DHCP server exists on the same network as the VibroSight® system.

A DHCP server assigns IP addresses to all of the computers on a network, recording the IP addresses used to ensure that there are no conflicts. This helps to reduce the administrative effort required and eliminates the possibility of human error.

NOTE: Contact your IT department or network administrator for information on whether a DHCP server is available on your network.

To configure the IP address of a CPUR card using DHCP:

1- In VibroSight System Manager, select the  card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click  **IP Settings** in the Standard group in the actions area.
The IP Settings window appears.

3- Select the **Use DHCP server** option. Click **Finish**.
The card will communicate with the DHCP server in the background and unique IP address for the card pair will automatically be assigned.
The System Explorer view will automatically update to show the new IP configuration information in the Devices structure view. The card should now be accessible in your subnet.

4- To test if the card is accessible, at a Windows command prompt, type `ping xxx.xxx.xxx.xxx` (where `xxx.xxx.xxx.xxx` is replaced with the new IP address just assigned).
If the card replies, this means it is in the same subnet as your computer and that it is ready to be used.

8.4.3 Configuring a time reference

A time reference should be set for a CPUR/IOCR card pair so that the events recorded in its log files have an accurate timestamp. This impacts system event logs and measurement event logs, both of which are accessible from System Manager (see 8.4.7.2 Saving data logs).

If a time reference is not configured, the events logged by a CPUR/IOCR card pair can not be analysed in time.

NOTE: The CPUR/IOCR card pair uses coordinated universal time (UTC).
For a system using multiple CPUR/IOCR card pairs, it is recommended that the either the NTP Server or Local PC Clock options are used for the time reference selection. This allows events logged by different CPUR/IOCR card pairs to be more accurately compared.
Using an NTP server, when available, ensures the most accurate time keeping across multiple cards.

You can configure the time reference settings of a CPUR/IOCR card pair using the  Configuration tools in VibroSight System Manager.

A CPUR and IOCR card pair can use any of the following as a time reference:

- an NTP server
- a clock internal to the CPUR
- a host computer clock.

It is the application requirements and infrastructure that dictate the best solution. For example, an NTP server may already be available for the VM600 system.

To configure the time reference settings of a CPUR card:

1- In VibroSight System Manager, select the  card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click  **Time Reference** in the Configuration group in the Actions area.
The Time Reference window appears.

NOTE: In the Time Reference window, the **Current time on device** displays the actual time (local and UTC) being used by the CPUR/IOCR card pair.

3- Select **Synchronised with NTP Server**, **Manual** or **Local PC clock** as appropriate.
If an NTP server is being used, enter the IP address, in dot-decimal notation, of the NTP server available on your network.
If a manual time reference is being used (that is, the internal CPUR clock), enter the required time and date to be used using the controls.
If the local PC clock is being used, then the time reported by the host computer running the System Manager software) will automatically be used.

4- Click **Finish**.
The CPUR card will be updated and start using the selected time reference.

NOTE: When the time reference for a CPUR card is changed, the new time reference is used immediately. It is not necessary to turn the power to the card off and on.

NOTE: In a redundant system, the two CPUR/IOCR card pairs will ensure that their time references are synchronised at all times.
For example, if the user changes the time reference settings on one CPUR/IOCR card pair, the settings shall immediately be changed on the other CPUR/IOCR card pair (so that the time difference between the two card pairs is always less than one second).

8.4.4 Configuring Modbus

You can configure the Modbus settings of a VM600 card using the Configuration tools in VibroSight System Manager.

Configuring Modbus involves sending a configuration file from a host computer to the CPUR card. During the upload of the configuration file (`modbusDefault.cfg`) to the card, the file is parsed to ensure it is valid (correct) before being accepted by the CPUR card.

See 9.5 Modbus configuration file for further information on the contents of the Modbus configuration file.

To upload (configure) the Modbus settings of a CPUR card:

1- In VibroSight System Manager, select the card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click **Send Modbus Configuration** in the Configuration group in the Actions area.
The Send Modbus Configuration dialog box appears. Use the dialog box to specify the location and of the `modbusDefault.cfg` configuration file. Click **Execute**.
A progress window appears to provide feedback on the steps of the configure Modbus operation. (The amount of time required to configure Modbus is typically seconds). The configuration is complete when the progress indicators have stopped and the dialog box reports “Configuration completed”. Click **Finish** to close the dialog box.

NOTE: When a new Modbus configuration file is uploaded to a CPUR card, the new configuration takes effect immediately (if it parses correctly). It is not necessary to turn the power to the card off and on.

NOTE: In a redundant system, the two CPUR/IOCR card pairs will ensure that their Modbus configuration files are the same at all times.
When a new Modbus configuration file is uploaded to one CPUR/IOCR card pair (Master CPUR or Inactive CPUR), the CRC of the Modbus configuration file on the other CPUR/IOCR card pair (Inactive CPUR or Master CPUR) is checked. If it is different, the new Modbus configuration file is copied to the CPUR card.

To download (copy) the Modbus settings of a CPUR card:

1- In VibroSight System Manager, select the card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, xxxxxxx) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click **Retrieve Modbus Configuration** in the Configuration group in the Actions area.

The Save As dialog box appears. Use the dialog box to indicate in which folder and under what name the Modbus configuration should be saved. Click **Save**.

The Modbus configuration is saved when the dialog box reports “successfully saved”. Click **OK** to close the dialog box.

8.4.5 Checking the firmware versions running on a card

You can check the firmware versions running on a VM600 card using the Maintenance tools in VibroSight System Manager.

Checking the firmware versions running on a card can help to decide if you need to update the firmware.

NOTE: Each VM600 card contains two types of firmware that can changed by the user: base system firmware and applications firmware.

To check the firmware versions of a CPUR card:

1- In VibroSight System Manager, select the card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, xxxxxxx) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click **Change Firmware** in the Maintenance group in the actions area.

The Change Firmware window appears, listing the current version information for the card in the Firmware Status area. It might be necessary to scroll down to see the base system and applications firmware versions.

3- Click **Cancel** to close the Change Firmware window.

8.4.6 Changing the firmware running on a card

You can change the firmware running on a VM600 card using the Maintenance tools in VibroSight System Manager.

You should only change (update) the firmware running on your cards when instructed to do so by Meggitt SA. You should only use firmware that has been released by Meggitt SA.

NOTE: Each VM600 card contains two types of firmware that can changed by the user: base system firmware and applications firmware. These can be updated independently or at the same time.

NOTE: For a redundant system, only one CPUR card should be installed in the VM600 rack and have its firmware changed at any one time. During an upgrade procedure, the "other" CPUR card should be removed to ensure it is not turned on.
The order in which the CPUR cards have the firmware changed is not important: Master CPUR followed by Inactive CPUR, or Inactive CPUR followed by Master CPUR.

Never do any of the following while upgrading a CPUR card's firmware:

- **Turn the power supply to the rack off and on.**
- **Disconnect the card from the network.**
- **Remove a CPUR card from the rack during the firmware change process. Always wait until the firmware change has been confirmed as successful (5 to 10 minutes).**

To change the firmware versions of a CPUR card:

1- In VibroSight System Manager, select the  card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click  **Change Firmware** in the Maintenance group in the actions area.

The Change Firmware window appears, listing the current version information for the card in the Firmware Status area. It might be necessary to scroll down to see the base system and applications firmware versions.

3- Click **Add** and use the dialog box that appears to navigate the folders on your computer and select the firmware file or files obtained from Meggitt SA. Click **Open**.

The `.tgz` file is added to the list of firmware updates in the Firmware Files area of the Change Firmware window.

NOTE: The default firmware file directory for VM600 CPUR cards is:
`C:\Program Files\Meggitt\VibroSight\Firmware\VM600\CPUR`

The default location for the Windows program files folder depends on the operating system installed on the computer:
- `C:\Program Files` is used for 64-bit programs and applications.
- `C:\Program Files (x86)` is used for 32-bit programs and applications.

As a result, all references to the program files folder may need to be adapted by removing or adding (x86) as required.

NOTE: Firmware files provided by Meggitt SA can be identified by their `.tgz` file name extension. (A `.tgz` file is a compressed archive file format.)

4- If there are multiple firmware upgrades, for example, both Base System and Applications, repeat step 3 to add the second `.tgz` file.

5- Click **Finish** to start the firmware upgrade process.

The card will disappear from the Devices view of the System Explorer for the duration of the firmware upgrade process. When the firmware upgrade is complete, the card will appear again.

NOTE: The upgrade should require less than 5 minutes.

The success of the change firmware operation can be verified using 8.4.5 Checking the firmware versions running on a card.

NOTE: For a redundant system, after the firmware for both CPUR cards has been changed (one card at a time), either insert both CPURs into the rack at the same time or turn the power supply to the rack off and on to ensure that the CPUR on the left (lower slot number) becomes the Master CPUR.

8.4.7 Diagnostics and data logs

System Manager also provides diagnostic information for the management and continuous improvement of VM600 hardware, using log files that are continuously generated by the VM600 cards:

- Diagnostic logs are files that primarily contain information at card level. These lower-level files can be identified by their `.tgz` file name extension. (A `.tgz` file is a compressed archive file format.)

  NOTE: VibroSight® software diagnostic log files contain diagnostic information about the cards and software that can be useful to Meggitt customer support when investigating certain issues, for example, evaluating system behaviour and troubleshooting problems.

- Data logs files that primarily contain information at system level. These higher-level files can be identified by their `.log` file name extension. (A `.log` file is a text file format.) Two types of data log files are available:
  - System events refer to the CMS/MPS itself and concerns the operating conditions experienced by the monitoring system that do not necessarily imply a problem at the machine level. Examples, include running out of disk storage space or problems with time references.
  - Measurement events refer to the criticality of operating conditions experienced at the machine level. For example, when the vibration level of trend data (of an extracted data entity) rises beyond a given level, the integrity of the machine can be endangered.

You can download the diagnostic information from VM600 cards using the  **Diagnostics** tools in VibroSight System Manager.

8.4.7.1 Saving diagnostic logs

The diagnostics logs stored by a card can be used by Meggitt customer support when trying to diagnose certain issues.

To download diagnostics logs from a CPUR card:

1- In VibroSight System Manager, select the  card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click  **Save Diagnostic Logs** in the Diagnostics group in the actions area and use the resultant Save As dialog box to indicate in which folder and under what name the information should be saved.

The VibroSight® software will save the diagnostic log files in a .tar.gz file format.
A “The card logs have been successfully saved” message will be displayed.

3- Click **OK** to continue.

Typically, diagnostic log files are forwarded to Meggitt customer support (for example, to energysupport@ch.meggitt.com).

8.4.7.2 Saving data logs

The data logs (system events and measurement events) stored by a card can be used by Meggitt SA when trying to diagnose certain issues.

To download a data log file (system events and/or measurement events) from a CPUR card:

1- In VibroSight System Manager, select the  card from the Devices view of the System Explorer.

NOTE: Normally, you should identify the card by its serial number (for example, `xxxxxxx`) as the IP address can be easily changed.

The Actions area of the System Manager will show the operations that are available for the card you have selected. If you cannot see the Actions area, click **View > Actions**.

2- Click  **Save Data Logs** in the Diagnostics group in the actions area.
The Save Data Logs dialog box appears.

3- Select **System Events Log** and/or **System Events Log** as appropriate.

For each type of data log file selected, click the  browse button and use the resultant Save As dialog box to choose in which folder the file should be saved. Once a folder is selected, System Manager will give the file a default name (`SystemEvents.log` and `MeasurementEvents.log` respectively), which can be changed if required. Click **Next**.

A progress window appears to provide feedback on the steps of the save data logs operation. The download is complete when the progress indicators have stopped and the dialog box reports “Save data logs completed”. Click **Finish** to close the dialog box.

Typically, data log files (system events and/or measurement events) are forwarded to Meggitt customer support (for example, to energysupport@ch.meggitt.com).

8.5 Further information

Refer to the *CPUR* topics in the  *VibroSight help* for further information (search for "CPUR" in the help).

9 MODBUS CONFIGURATION FILE AND EVENT LOG FILES

9.1 Introduction

This chapter describes the implementation of the Modbus software interface for VM600 racks as used by CPUR/IOCR card pairs.

In the client-server model of Modbus communication, the CPUR implements a Modbus server that responds to external transaction requests from client equipment, such as a computer or DCS. Both the Modbus RTU protocol (serial communication interface) and the Modbus TCP protocol (Ethernet interface) are supported by the CPUR.

NOTE: Refer to the *VM600 networking manual* for background information on Modbus (chapters 5 and 6), and MPC4 register definitions (Appendix A) and AMC8 register definitions (Appendix B).
The information given in this chapter is in addition to the information on Modbus already given in the *VM600 networking manual*.

The CPUR card's Modbus software interface provides a Modbus server for a VM600 rack that features customizable configuration and a robust way to access any measurement data delivered by the following processing cards:

- AMC8
- CMC16
- MPC4.

For the CPUR/IOCR card pair, the Modbus RTU protocol is implemented for the serial communications interface (RS-232 and RS-485) and the Modbus TCP protocol is implemented for the Ethernet interface.

The transmitted data consists of real-time values (vibration level, pressure and so on), status and configuration information (such as alarms). This data can be used by any external system (such as a computer or DCS) for the purposes of machinery monitoring.

9.2 CPUR/IOCR card pair configurations

See 8.2 CPUR/IOCR card pair configurations.

9.3 Features of the Modbus server on a CPUR/IOCR card pair

- The CPUR implements a Modbus server (slave) that responds to external transaction requests from a Modbus client (master), such as a DCS.
- The Modbus server services all Modbus RTU and Modbus TCP requests.
- The Modbus server starts when the CPUR card starts.
- When the Modbus server starts, it reads the current Modbus configuration.
- The Modbus configuration file is parsed, including an error check, by the CPUR.
- The Modbus server is always ready to receive a new Modbus configuration (for example, uploaded by VibroSight System Manager).

- When the Modbus client tries to execute function codes that are not implemented by the CPUR's Modbus server, an illegal function error exception response shall be generated (exception code "01").
- When the Modbus client tries to read a value (Modbus function codes 03 and 04) or bit (Modbus function codes 01 and 02) which is not configured by the CPUR's Modbus configuration, an illegal data address error exception response shall be generated (exception code "02").
- When the Modbus client tries to write a value (Modbus function code 10) or bit (Modbus function code 05) which is not configured by the CPUR's Modbus configuration, an illegal data address error exception response shall be generated (exception code "02").
- If configured, Values can be scaled and converted to a 16 bit unsigned format by the Modbus server.
- If configured, Alarm+, Alarm−, Alert +, Alert−, Danger+ and Danger− levels are readable as a float from the Modbus server.
- If configured, bits (coils) shall be calculated (using bit operation) from existing bits (coils) by the Modbus server. The supported bitwise operations are NOT, AND, OR and XOR.

9.4 Functions of the Modbus server on a CPUR/IOCR card pair

The CPUR/IOCR card pair's Modbus server includes the following functionality:

- Enable/disable the danger bypass (DB) function on the MPC4 and AMC8 processing cards on a per channel basis.
- Reset all latched alarms (AR) currently active on a processing card on a per slot basis.
- Compute and report the time capacity and the non-volatile memory usage of the measurement values log, according to the Modbus configuration file.
- Provide the possibility to switch the time synchronization of a CPUR card between NTP and manual modes. (The default option shall be NTP).

  In manual mode the Modbus server shall provide the possibility to set the time of a CPUR card by writing a timestamp to the Modbus server.

9.5 Modbus configuration file

The CPUR card's Modbus server is configurable using a single file that is stored on the CPUR. The Modbus configuration file is called `modbusDefault.cfg`. It is a user configurable file (text-based) and uploaded to a CPUR/IOCR card pair using VibroSight System Manager (see 8.4.4 Configuring Modbus).

As shown in Figure 9-1, the communication parameters are defined in the top sections of this configuration file, labelled [RTU1] and [TCP].

9.5.1 The RTUx section

Using the example Modbus configuration in Figure 9-1, it can be seen that both Modbus RTU [RTU1] and Modbus TCP [TCP] communications have been enabled, with half-duplex RS-485 (RS485HD) being used for the serial communications. Full-duplex RS-485 (RS485FD) or RS-232 (RS232) are also supported can could have been configured.

The serial communications port defined here for RTU1 is accessed on the main serial communications connector, J2, of the IOCR card. If a multidrop (daisy-chained) serial communication network of CPUR and IOCR card pairs is being used, the second serial communications connector, J3, of the IOCR card is also used.

Only RTU1 (a single RTU) is supported as the CPUR/IOCR card pair has a single serial communications port.

```
[RTU1]
ENABLE   = YES                          //YES/NO (default YES)
TYPE     = RS485HD                      // RS232 / RS485HD / RS485FD
ADDRESS  = 1                            //1-247 (default 1)
DEVICE   = SERIAL_1                     //SERIAL_1
SPEED    = 19200                        //1200-115000 (default 19200)
PARITY   = N                            //N/O/E (default E for EVEN)
STOP     = 1                            //1,2 (default 1 stop bit)
DATABITS = 8                            //7,8 (default 8 data bits)

[TCP]
ENABLE = YES                            // YES/NO (default NO)
PORT   = 502                            //0-65535 (default 502)

[GLOBAL]
DEFAULT_LONG_ORDER = LM2
DEFAULT_FLOAT_ORDER = FM2
IS_FULLY_COMPATIBLE = YES               // YES/NO (default N)
```

Figure 9-1 : Extract from the start of an example CPUR card's `modbusDefault.cfg` file

9.5.2 The TCP section

Refer to chapters 5 and 6 of the *VM600 networking manual*.

9.5.3 The GLOBAL section

Refer to chapters 5 and 6 of the *VM600 networking manual*.

9.5.4 The MAPPING section

Refer to chapters 5 and 6 of the *VM600 networking manual*.

9.5.5 New features for the CPUR/IOCR card pair

9.5.5.1 CPU time value

`Address:Function=CPU:TIME`

This Modbus configuration command allows a special set of Modbus registers to be used to read and write the Modbus CPU time area.

Use the GET_TIME and SET_TIME CPU Modbus configuration commands to actually get and set this value.

The time is expressed using the timestamp format and thus currently requires four Modbus registers.

9.5.5.2 CPU time commands

`Address:Function:U=CPU:Command:x`

This Modbus configuration command requires Modbus function code 06. If the written value is not equal to 0, the command is executed.

In this configuration command, `x` can be one of the following:

`GET_TIME` gets the CPUR card's time and place it in the Modbus server's CPUR time area.

`SET_TIME` sets the CPUR card's time to the value in the Modbus server's CPUR time area.

Table 9-1: Timestamp format

Offset	Data
0	nanoseconds LSW
1	nanoseconds MSW
2	seconds LSW
3	seconds MSW

Note: The timestamp is based on the Unix timespec definition. That is, it is the number of seconds that have elapsed since 00:00:00 Thursday, 01 January 1970, coordinated universal time (UTC), minus leap seconds.

9.5.5.3 CPU relay

`CPU:RELAY:RelayNb=Address:Function`

or

`CPU:RELAY:RelayNb=$bitVariable`

The five relays found on the IOCR card are named R1, R2, R3, R4 and R5 in the Modbus configuration file. So `RelayNb` in the Modbus configuration command (above) should be replaced with R1, R2, R3, R4 or R5 as required.

`Address:Function` maps to an existing bit variable so this Modbus configuration command requires Modbus function code 01 or 02.

`$bitVariable` must be an bit variable previously defined in the Modbus configuration file.

See Appendix A – Example Modbus configuration for an example Modbus configuration that detects the removal of MPC4 machinery protection cards and AMC8 analog monitoring cards, and indicates any such changes using the CPUR/IOCR card pair's relays.

9.5.5.4 Slot status

`SlotNr:Status:x`

In this configuration command, `x` can be one of the following:

`DAU_ID` identifies the card whose status is required.

9.6 Logging service

The CPUR/IOCR card pair also implements a logging service responsible for recording and storing data from the Modbus server in a series of event log files (data logs):

- System events log
  This log is used to record VM600 system events at the rack level, such as the detection of card or configuration events (for example, change of Master CPUR and/or configuration changes).
  See Table 9-3 for a list of the different system event types.
- Measurement events log
  This log is used to record VM600 measurement events at the card level, such as the detection of alarm events (for example, changes to Alert and/or Danger statuses.
  See Table 9-5 for a list of the different measurement event types.

The data logs (system events and measurement events) are stored in non-volatile memory on the CPUR, thereby providing access to the operating history of a system (VM600 rack and cards) via VibroSight System Manager.

The data logs (system events and measurement events) are user readable (text-based) data files. The logging service has built-in mechanisms to manage the size of the stored data. The data logs can be downloaded from a CPUR/IOCR card pair using VibroSight System Manager (see 8.4.7 Diagnostics and data logs and 8.4.7.2 Saving data logs).

9.6.1 System events log

The CPUR card records and stores in non-volatile memory a system events log as defined by the Modbus configuration file. The length of the system events log is fixed at 1000 system events. An example of the information stored in a system events log is shown in Table 9-2.

Table 9-2 is an example of the system event log data and Table 9-3 lists the types of system event that are supported.

Table 9-2: Example system event log data

Timestamp		CardType	SlotId	ApplicationId	Severity	EventType	EventDetail
Date	Time						
1970.01.01	00:00:22.918	MPC	3	VME Server	Information	Card detection	510
1970.01.01	00:23:20.566	CPUR	2	VME Server	Information	New time settings activated	0
197001.01	00:23:20.961	NONE	0	Modbus Server	Information	Modbus configuration succeeded	0
197001.01	00:23:21.263	CMC	12	VME Server	Information	Card detection	510
2011.05.29	16:30:41.794	CPUR	0	unknown	Information	New time settings activated	

Table 9-3: Example system events (EventType)

Event name
Card detected
Card configured
Modbus configuration succeeded
Modbus configuration failed
New NTP settings submitted

9.6.2 Measurement events log

The CPUR card records and stores in non-volatile memory a measurement events log as defined by the Modbus configuration file. The length of the measurement events log is fixed at 1000 measurement events. An example of the information stored in a measurement events log is shown in Table 9-4.

Table 9-4 is an example of the system event log data and Table 9-5 lists the types of system event that are supported.

Table 9-4: Example measurement events (EventType)

Timestamp		CardType	SlotId	ChannelId	OutputId	EventType	EventDetail
Date	Time						
1970.01.01	00:11:15.451	MPC	7	2	1	High alarm	0
1970.01.01	00:11:15.769	CMC	13	6		High alert	0
2011.05.29	14:34:04.398	CMC	13	6		Normal event	0

Table 9-5: Example measurement events (EventType)

Event name
Low danger (Danger−)
Low alarm (Alarm−)
Normal event
High alarm (Alarm+)
High danger (Danger+)
Alarm reset enabled
Alarm reset disabled
Danger bypass enabled
Danger bypass disabled

Table 9-5: Example measurement events (EventType) (continued)

Event name
Basic functions enabled
Basic functions disabled
Advanced functions enabled
Advanced functions disabled
Low Alert (Alert−)
High Alert (Alert+)
Validity fault
Speed reference fault
Value error bit set
Value error bit cleared
SOK failed
SOK passed
Trip multiply enabled
Trip multiply disabled
Sensor bypass enabled
Sensor bypass disabled
Channel check (OK) passed
Channel check (OK) failed
Relay on
Relay off

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10 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 x
- Hazardous voltages and the risk of electric shock on page xi
- Hot surfaces and the risk of burning on page xi
- Heavy objects and the risk of injury on page xi
- Replacement parts and accessories on page xii

10.1 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 personnel, or persons authorised by Meggitt SA, should attempt to modify or repair products from the Vibro-Meter® product line.

NOTE: Any attempt by unauthorised personnel to modify or repair equipment still under guarantee will invalidate the warranty.

See 12 Service and support for contact details for repairing defective hardware.

10.2 Cleaning

It is not required to clean a VM600 rack.

However, if cleaning does become necessary:

- Clean with a dry cloth only.
- 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.

HAZARDOUS VOLTAGES EXIST WITHIN VM600 RACKS.

IF CLEANING BECOMES NECESSARY, USE A DRY CLOTH ONLY AND KEEP AWAY FROM LIVE ELECTRICAL PARTS.

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

10.3 General remarks on fault-finding

The following sections contain information needed to localise a failure, whether this is due to an internal CMS or 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/conditioners
- The cabling between the transducers/conditioners and the signal processing cards

} Front-end components

- The VM600 rack, including cards such as the CPUM and CPUR cards.

The diagnostics of a system failure can be separated into these parts.

NOTE: Before troubleshooting the CMS or MPS, it is worthwhile checking that the overall measuring system (transducer/conditioner and cabling) is correctly installed.

10.4 Detecting problems due to front-end components and cabling

For further information on detecting problems due to front-end components and cabling, refer to the *VM600 machinery protection system (MPS) hardware manual*.

10.5 Detecting problems in a VM600 rack

10.5.1 General checks for racks

The following basic checks should be carried out if a problem is suspected at VM600 rack level:

- Check that the four LEDs on a RPS6U rack power supply are on (refer to the *VM600 machinery protection system (MPS) hardware manual*). 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.
- For the Master CPUR card (see 1.4 Terminology), check that the LEDs on its front panel are as follows:
  - the status LED shows green (continuously)
  - the data LED shows orange (continuously).

  This indicates that the Master CPUR and has a valid configuration for all the cards in the rack. See 2.2.1 CPUR front panel LEDs to diagnose any other LED combinations.
- If a Inactive CPUR card is installed (that is, for a redundant system), check that the LEDs on its front panel are as follows:
  - the status LED shows orange (continuously)
  - the data LED shows orange (continuously).

  This indicates that the card is the Inactive CPUR and has a valid configuration for the cards in the rack, synchronised with the Master CPUR. See 2.2.1 CPUR front panel LEDs to diagnose any other LED combinations.

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 SA for repair. See 12 Service and support for further information.

10.5.2 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 XVII.

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 XVII.

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 xviii 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).

10.5.2.1 General precautions for removing cards

Like most VM600 rack cards, the CPUR and IOCR cards feature a lever mechanism to help the user to easily remove the card. Follow the procedure below (see also Figure 10-1):

1- Unfasten the two captive fixing screws. These are found at the top and at the bottom of the front panel.

2- 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.

3- 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.

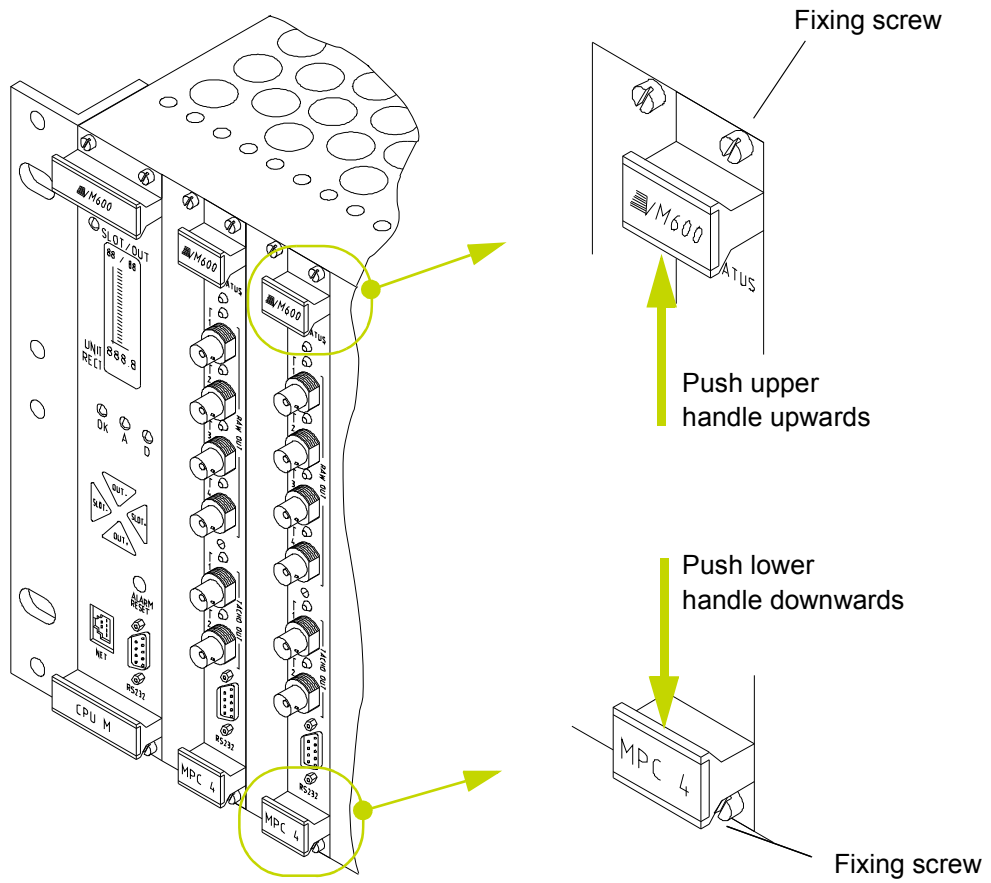

Figure 10-1: Removing a card from the rack

10.5.2.2 CPUR cards

Being a redundant card, the CPUR can be “hot-swapped” (unlike the CPUM). That is, it is not necessary to switch off (or disconnect) the rack power before replacing this type of card in a redundant system or a non-redundant system.

NOTE: In a redundant system, the external power supply to the rack should be on when replacing a CPUR card (see 10.5.2.4.4 Replacing a CPUR card – redundant systems).

There are no user configurable jumper settings (hardware configuration) on a CPUR card.

Once the replacement CPUR card has been installed, the user action required depends on whether it is a redundant system or a non-redundant system:

- For a standard (non-redundant) system (VM600 rack with one CPUR/IOCR card pair), the entire rack configuration (MPS and/or CMS) must be uploaded to the rack using the appropriate configuration software such as the VibroSight®, VM600 MPSx and/or VM600 CMS software.

- For a redundant system (VM600 rack with two CPUR/IOCR card pairs), the entire rack configuration will be automatically uploaded from the Master CPUR to the Inactive CPUR. There is no requirement to use any configuration software (VibroSight®, VM600 MPSx and/or VM600 CMS).

10.5.2.3 IOCR cards

Being a redundant card, the IOCR can be “hot-swapped” (like the IOCN). That is, it is not necessary to switch off (or disconnect) the rack power before replacing this type of card.

The replacement IOCR card must have exactly the same hardware configuration (jumper settings) as the original (suspect) IOCR card, in order to allow the same communications possibilities.

10.5.2.4 Other cards

VM600 signal processing cards (such as the CMC16, MPC4 and their input/output cards) can be replaced.

10.5.2.4.1 Before replacing a card

Where possible, the relevant system parameters and other important information should be noted before replacing a card.

For a CPUR card, for example, this includes the IP address and time settings (such as NTP server address). These parameters can be obtained using the VibroSight System Manager software.

For an IOCR card, for example, this includes the jumper settings, which can be obtained by visually inspecting the original (suspect) card.

10.5.2.4.2 Replacing a CPUR or IOCR card

CPUR cards and IOCR cards can be “hot-swapped”, therefore it is not necessary to switch off (or disconnect) the external power supply to the rack before replacing these types of card.

10.5.2.4.3 Replacing a CPUR card – non-redundant systems

In a non-redundant system, if the (Master) CPUR card develops a fault, there is no “system controller”, communications with the card will fail and the user will notice.

In this case, the system is non-operational, until the faulty CPUR card is replaced with a known good card. To replace the faulty CPUR card in a non-redundant system:

1- Remove the CPUR from its slot.

2- Insert a (new) known good CPUR in the same slot.

3- The user must manually upload the configuration for each of the processing cards using the appropriate configuration software (VibroSight®, VM600 MPSx and/or VM600 CMS). This can be done on a per card or a per rack basis.

4- The CPUR card stores copies of the processing card configurations as they “pass through” it to the relevant processing card.

NOTE: The CPUR card never gets configurations from the processing cards themselves. This ensures that the CPUR is always the “master” of the configurations in a rack (avoiding potential problems).

5- For the (Master) CPUR, configure the card settings – IP address, Modbus and time reference – using VibroSightSystem Manager.

10.5.2.4.4 Replacing a CPUR card – redundant systems

In a redundant system, if the Master CPUR card develops a fault, the Inactive CPUR card will automatically detect this and automatically take control of the system, thereby becoming the Master CPUR ("system controller"). This will be transparent to the user as the system continues to work.

NOTE: When replacing a CPUR card in a redundant system, proper system behaviour requires that the external power supply to the rack is present and the Master CPUR card is booted up and running normally (see 2.2.1 CPUR front panel LEDs). Only one CPUR card should be removed or inserted at any one time.

In this case, although the system is operational, it will no longer be redundant, until the faulty CPUR card is replaced with a known good card. To replace the faulty CPUR card in a redundant system:

1- Remove the faulty CPUR from its slot.

2- Insert a (new) known good CPUR in the same slot.

The Master CPUR card automatically detects the new CPUR and automatically uploads a copy of its known good configuration to the new CPUR. The Master CPUR remains as system controller and the new (good) CPUR becomes the Inactive CPUR.

3- For the (new) Inactive CPUR, configure the card settings – IP address, Modbus and time reference – using VibroSightSystem Manager.

There is no requirement to use VM600 MPSx (MPS1 or MPS2) configuration software.

10.5.2.5 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 (refer to the *VM600 machinery protection system (MPS) hardware manual*).

11 END-OF-LIFE PRODUCT DISPOSAL

Like a VM600-rack based monitoring system, the CPUR and IOCR redundant card pair 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 11-1).

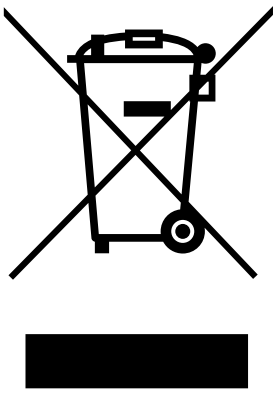

Figure 11-1: WEEE symbol

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, and a CPUR and IOCR redundant card pair 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 Meggitt representative. Alternatively, contact our main office:

Environment, health and safety department
Meggitt SA
Route de Moncor 4
PO Box 1616
CH-1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: ehs@ch.meggitt.com
Website: www.meggittsensing.com/energy

12 SERVICE AND SUPPORT

12.1 Contacting us

Meggitt's worldwide customer support network offers a range of support, including 12.2 Technical support and 12.3 Sales and repairs support. For customer support, contact your local Meggitt representative. Alternatively, contact our main office:

Customer support department
Meggitt SA
Route de Moncor 4
PO Box 1616
CH-1701 Fribourg
Switzerland

Telephone: +41 26 407 11 11
Email: energysupport@ch.meggitt.com
Website: www.meggittsensing.com/energy

12.2 Technical support

Meggitt's 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 SA (see 12.1 Contacting us).

12.3 Sales and repairs support

Meggitt's 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 12-4.

12.4 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 12-7 and return it to the Meggitt SA's main office (see 12.1 Contacting us).

REPAIRS AND RETURNS

Energy product return procedure

If a Meggitt Vibro-Meter® Energy product needs to be returned to Meggitt SA, 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 form was received by Meggitt SA.
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 12.1 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 SA at:

Repairs department, Meggitt SA, Route de Moncor 4, PO Box 1616,
CH-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 CPUR and IOCR rack controller and communications interface card pair manual

Reference:	MACPUR/E	Version:	Edition 2
Date of issue:	September 2019		

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 …

APPENDIX A – EXAMPLE MODBUS CONFIGURATION

Example Modbus configuration

This example Modbus configuration illustrates how to detect the removal of MPC4 machinery protection cards and AMC8 analog monitoring cards, and indicate any such changes using the CPUR/IOCR card pair's relays.

```
////////////////////////////////////////////////////
////////  Card Removal and Card running Relays ////////
////////////////////////////////////////////////////

// NOTE:
// This section requires variables defined in other sections:
//        - Card Status:  at top of this file
//        - Card Running: in each Card section
//

//---- Values for relay bypass:-------------------------------------
//
//     RL1     RL2     RL3     RL4      RL5     All   AND-combination
//
//     12  4     8     16    31    SUM(values)
//
//--------------------------------------------------------------------

//this block is common for any PIB rack

09998:3:U = 510 //MPC4 identifier
09999:3:U = 550 //AMC8 identifier
10000:6:U = 0// RELAY BYPASS switch
10001:3:U = SLOT_STATUS
10002:3:U = Slot3 :Status:DAU_ID //board type in slot 3
10003:3:U = Slot4 :Status:DAU_ID //board type in slot 4
10004:3:U = Slot5 :Status:DAU_ID //board type in slot 5
10005:3:U = Slot6 :Status:DAU_ID //board type in slot 6
10006:3:U = Slot7 :Status:DAU_ID //board type in slot 7
10007:3:U = Slot8 :Status:DAU_ID //board type in slot 8
10008:3:U = Slot9 :Status:DAU_ID //board type in slot 9
10009:3:U = Slot10:Status:DAU_ID //board type in slot 10
10010:3:U = Slot11:Status:DAU_ID //board type in slot 11
10011:3:U = Slot12:Status:DAU_ID //board type in slot 12
10012:3:U = Slot13:Status:DAU_ID //board type in slot 13
10013:3:U = Slot14:Status:DAU_ID //board type in slot 14

//---------Unpack slot status----------------------------------------

$S03_Status = UNPACK(10001, 3, 4)       //get status of slot 3
$S04_Status = UNPACK(10001, 3, 5)       //get status of slot 4
$S05_Status = UNPACK(10001, 3, 6)       //get status of slot 5
$S06_Status = UNPACK(10001, 3, 7)       //get status of slot 6
$S07_Status = UNPACK(10001, 3, 8)       //get status of slot 7
$S08_Status = UNPACK(10001, 3, 9)       //get status of slot 8
$S09_Status = UNPACK(10001, 3, 10)       //get status of slot 9
$S10_Status = UNPACK(10001, 3, 11)       //get status of slot 10
$S11_Status = UNPACK(10001, 3, 12)       //get status of slot 11
$S12_Status = UNPACK(10001, 3, 13)       //get status of slot 12
$S13_Status = UNPACK(10001, 3, 14)       //get status of slot 13
$S14_Status = UNPACK(10001, 3, 15)       //get status of slot 14
```

```
//--------MPC board flags-------------------

$S03_Mpc4Plugged = COMPARATOR(EQ,10002,3, 9998,3) // MPC Board plugged flag slot 3
$S04_Mpc4Plugged = COMPARATOR(EQ,10003,3, 9998,3) // MPC Board plugged flag slot 4
$S05_Mpc4Plugged = COMPARATOR(EQ,10004,3, 9998,3) // MPC Board plugged flag slot 5
$S06_Mpc4Plugged = COMPARATOR(EQ,10005,3, 9998,3) // MPC Board plugged flag slot 6
$S07_Mpc4Plugged = COMPARATOR(EQ,10006,3, 9998,3) // MPC Board plugged flag slot 7
$S08_Mpc4Plugged = COMPARATOR(EQ,10007,3, 9998,3) // MPC Board plugged flag slot 8
$S09_Mpc4Plugged = COMPARATOR(EQ,10008,3, 9998,3) // MPC Board plugged flag slot 9
$S10_Mpc4Plugged = COMPARATOR(EQ,10009,3, 9998,3) // MPC Board plugged flag slot 10
$S11_Mpc4Plugged = COMPARATOR(EQ,10010,3, 9998,3) // MPC Board plugged flag slot 11
$S12_Mpc4Plugged = COMPARATOR(EQ,10011,3, 9998,3) // MPC Board plugged flag slot 12
$S13_Mpc4Plugged = COMPARATOR(EQ,10012,3, 9998,3) // MPC Board plugged flag slot 13
$S14_Mpc4Plugged = COMPARATOR(EQ,10013,3, 9998,3) // MPC Board plugged flag slot 14

$S03_Ioc4DetectionError =  Slot3 :MPC4:Status:Ioc:IDE// MPC's IOC4 Global status slot 3
$S04_Ioc4DetectionError =  Slot4 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 4
$S05_Ioc4DetectionError =  Slot5 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 5
$S06_Ioc4DetectionError =  Slot6 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 6
$S07_Ioc4DetectionError =  Slot7 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 7
$S08_Ioc4DetectionError =  Slot8 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 8
$S09_Ioc4DetectionError =  Slot9 :MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 9
$S10_Ioc4DetectionError =  Slot10:MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 10
$S11_Ioc4DetectionError =  Slot11:MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 11
$S12_Ioc4DetectionError =  Slot12:MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 12
$S13_Ioc4DetectionError =  Slot13:MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 13
$S14_Ioc4DetectionError =  Slot14:MPC4:Status:Ioc:IDE // MPC's IOC4 Global status slot 14

$S03_Ioc4Detected = NOT( $S03_Ioc4DetectionError)// MPC's IOC4 Global status slot 3
$S04_Ioc4Detected = NOT( $S04_Ioc4DetectionError) // MPC's IOC4 Global status slot 4
$S05_Ioc4Detected = NOT( $S05_Ioc4DetectionError) // MPC's IOC4 Global status slot 5
$S06_Ioc4Detected = NOT( $S06_Ioc4DetectionError) // MPC's IOC4 Global status slot 6
$S07_Ioc4Detected = NOT( $S07_Ioc4DetectionError) // MPC's IOC4 Global status slot 7
$S08_Ioc4Detected = NOT( $S08_Ioc4DetectionError) // MPC's IOC4 Global status slot 8
$S09_Ioc4Detected = NOT( $S09_Ioc4DetectionError) // MPC's IOC4 Global status slot 9
$S10_Ioc4Detected = NOT( $S10_Ioc4DetectionError) // MPC's IOC4 Global status slot 10
$S11_Ioc4Detected = NOT( $S11_Ioc4DetectionError) // MPC's IOC4 Global status slot 11
$S12_Ioc4Detected = NOT( $S12_Ioc4DetectionError) // MPC's IOC4 Global status slot 12
$S13_Ioc4Detected = NOT( $S13_Ioc4DetectionError) // MPC's IOC4 Global status slot 13
$S14_Ioc4Detected = NOT( $S14_Ioc4DetectionError) // MPC's IOC4 Global status slot 14

$S03_MPC_IOC_Plugged = AND( $S03_Ioc4Detected,$S03_Mpc4Plugged)//  MPC's  IOC4  Global  status
slot 3
$S04_MPC_IOC_Plugged = AND( $S04_Ioc4Detected,$S04_Mpc4Plugged) // MPC's IOC4 Global status
slot 4
$S05_MPC_IOC_Plugged = AND( $S05_Ioc4Detected,$S05_Mpc4Plugged) // MPC's IOC4 Global status
slot 5
$S06_MPC_IOC_Plugged = AND( $S06_Ioc4Detected,$S06_Mpc4Plugged) // MPC's IOC4 Global status
slot 6
$S07_MPC_IOC_Plugged = AND( $S07_Ioc4Detected,$S07_Mpc4Plugged) // MPC's IOC4 Global status
slot 7
```

```
$S08_MPC_IOC_Plugged = AND( $S08_Ioc4Detected,$S08_Mpc4Plugged) // MPC's IOC4 Global status
slot 8
$S09_MPC_IOC_Plugged = AND( $S09_Ioc4Detected,$S09_Mpc4Plugged) // MPC's IOC4 Global status
slot 9
$S10_MPC_IOC_Plugged = AND( $S10_Ioc4Detected,$S10_Mpc4Plugged) // MPC's IOC4 Global status
slot 10
$S11_MPC_IOC_Plugged = AND( $S11_Ioc4Detected,$S11_Mpc4Plugged) // MPC's IOC4 Global status
slot 11
$S12_MPC_IOC_Plugged = AND( $S12_Ioc4Detected,$S12_Mpc4Plugged) // MPC's IOC4 Global status
slot 12
$S13_MPC_IOC_Plugged = AND( $S13_Ioc4Detected,$S13_Mpc4Plugged) // MPC's IOC4 Global status
slot 13
$S14_MPC_IOC_Plugged = AND( $S14_Ioc4Detected,$S14_Mpc4Plugged) // MPC's IOC4 Global status
slot 14

// AMC board flags

$S03_Amc8Plugged = COMPARATOR(EQ,10002,3, 9999,3) // AMC Board plugged flag slot 3
$S04_Amc8Plugged = COMPARATOR(EQ,10003,3, 9999,3) // AMC Board plugged flag slot 4
$S05_Amc8Plugged = COMPARATOR(EQ,10004,3, 9999,3) // AMC Board plugged flag slot 5
$S06_Amc8Plugged = COMPARATOR(EQ,10005,3, 9999,3) // AMC Board plugged flag slot 6
$S07_Amc8Plugged = COMPARATOR(EQ,10006,3, 9999,3) // AMC Board plugged flag slot 7
$S08_Amc8Plugged = COMPARATOR(EQ,10007,3, 9999,3) // AMC Board plugged flag slot 8
$S09_Amc8Plugged = COMPARATOR(EQ,10008,3, 9999,3) // AMC Board plugged flag slot 9
$S10_Amc8Plugged = COMPARATOR(EQ,10009,3, 9999,3) // AMC Board plugged flag slot 10
$S11_Amc8Plugged = COMPARATOR(EQ,10010,3, 9999,3) // AMC Board plugged flag slot 11
$S12_Amc8Plugged = COMPARATOR(EQ,10011,3, 9999,3) // AMC Board plugged flag slot 12
$S13_Amc8Plugged = COMPARATOR(EQ,10012,3, 9999,3) // AMC Board plugged flag slot 13
$S14_Amc8Plugged = COMPARATOR(EQ,10013,3, 9999,3) // AMC Board plugged flag slot 14

$S03_Ioc8DetectionError =  Slot3 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 3
$S04_Ioc8DetectionError =  Slot4 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 4
$S05_Ioc8DetectionError =  Slot5 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 5
$S06_Ioc8DetectionError =  Slot6 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 6
$S07_Ioc8DetectionError =  Slot7 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 7
$S08_Ioc8DetectionError =  Slot8 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 8
$S09_Ioc8DetectionError =  Slot9 :AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 9
$S10_Ioc8DetectionError =  Slot10:AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 10
$S11_Ioc8DetectionError =  Slot11:AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 11
$S12_Ioc8DetectionError =  Slot12:AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 12
$S13_Ioc8DetectionError =  Slot13:AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 13
$S14_Ioc8DetectionError =  Slot14:AMC8:Status:Ioc:IDE// AMC's IOC8 Global status slot 14

$S03_Ioc8Detected = NOT($S03_Ioc8DetectionError) // AMC's IOC8 Global status slot 3
$S04_Ioc8Detected = NOT($S04_Ioc8DetectionError) // AMC's IOC8 Global status slot 4
$S05_Ioc8Detected = NOT($S05_Ioc8DetectionError) // AMC's IOC8 Global status slot 5
$S06_Ioc8Detected = NOT($S06_Ioc8DetectionError) // AMC's IOC8 Global status slot 6
$S07_Ioc8Detected = NOT($S07_Ioc8DetectionError) // AMC's IOC8 Global status slot 7
$S08_Ioc8Detected = NOT($S08_Ioc8DetectionError) // AMC's IOC8 Global status slot 8
$S09_Ioc8Detected = NOT($S09_Ioc8DetectionError) // AMC's IOC8 Global status slot 9
$S10_Ioc8Detected = NOT($S10_Ioc8DetectionError) // AMC's IOC8 Global status slot 10
$S11_Ioc8Detected = NOT($S11_Ioc8DetectionError) // AMC's IOC8 Global status slot 11
```

```
$S12_Ioc8Detected = NOT($S12_Ioc8DetectionError) // AMC's IOC8 Global status slot 12
$S13_Ioc8Detected = NOT($S13_Ioc8DetectionError) // AMC's IOC8 Global status slot 13
$S14_Ioc8Detected = NOT($S14_Ioc8DetectionError) // AMC's IOC8 Global status slot 14

$S03_AMC_IOC_Plugged = AND( $S03_Ioc8Detected,$S03_Amc8Plugged) // AMC's IOC8 Global status
slot 3
$S04_AMC_IOC_Plugged = AND( $S04_Ioc8Detected,$S04_Amc8Plugged) // AMC's IOC8 Global status
slot 4
$S05_AMC_IOC_Plugged = AND( $S05_Ioc8Detected,$S05_Amc8Plugged) // AMC's IOC8 Global status
slot 5
$S06_AMC_IOC_Plugged = AND( $S06_Ioc8Detected,$S06_Amc8Plugged) // AMC's IOC8 Global status
slot 6
$S07_AMC_IOC_Plugged = AND( $S07_Ioc8Detected,$S07_Amc8Plugged) // AMC's IOC8 Global status
slot 7
$S08_AMC_IOC_Plugged = AND( $S08_Ioc8Detected,$S08_Amc8Plugged) // AMC's IOC8 Global status
slot 8
$S09_AMC_IOC_Plugged = AND( $S09_Ioc8Detected,$S09_Amc8Plugged) // AMC's IOC8 Global status
slot 9
$S10_AMC_IOC_Plugged = AND( $S10_Ioc8Detected,$S10_Amc8Plugged) // AMC's IOC8 Global status
slot 10
$S11_AMC_IOC_Plugged = AND( $S11_Ioc8Detected,$S11_Amc8Plugged) // AMC's IOC8 Global status
slot 11
$S12_AMC_IOC_Plugged = AND( $S12_Ioc8Detected,$S12_Amc8Plugged) // AMC's IOC8 Global status
slot 12
$S13_AMC_IOC_Plugged = AND( $S13_Ioc8Detected,$S13_Amc8Plugged) // AMC's IOC8 Global status
slot 13
$S14_AMC_IOC_Plugged = AND( $S14_Ioc8Detected,$S14_Amc8Plugged) // AMC's IOC8 Global status
slot 14

////////////////////////////////////////////////////
////////  Card Removal and Card running Relays ////////
////////////////////////////////////////////////////

//---- Values for relay bypass:-------------------------------------
//
//     RL1     RL2     RL3     RL4      RL5     All   AND-combination
//
//     12  4     8     16    31    SUM(values)
//
//-------------------------------------------------------------------

$BypRelay1 = UNPACK(10000,6,1)
$BypRelay2 = UNPACK(10000,6,2)
$BypRelay3 = UNPACK(10000,6,3)
$BypRelay4 = UNPACK(10000,6,4)
$BypRelay5 = UNPACK(10000,6,5)

//-------------INVERSION Bypass command-------------------

$NOTBypRelay1 = NOT($BypRelay1)
$NOTBypRelay2 = NOT($BypRelay2)
$NOTBypRelay3 = NOT($BypRelay3)
$NOTBypRelay4 = NOT($BypRelay4)
$NOTBypRelay5 = NOT($BypRelay5)
```

```
//-----------Calculation-----------------------
//   sample relay state for mpc4 in slot3 and amc8 in slot 4:
//

$StatusRunning1 = AND($S03_Status,$S04_Status)
$StatusPlugged1 = AND($S03_MPC_IOC_Plugged,$S04_AMC_IOC_Plugged)

$StatusRunning2 = AND($S05_Status,$S06_Status)
$StatusPlugged2 = AND($S05_MPC_IOC_Plugged,$S06_AMC_IOC_Plugged)

$StatusRunning3 = AND($S07_Status,$S08_Status)
$StatusPlugged3 = AND($S07_MPC_IOC_Plugged,$S08_AMC_IOC_Plugged)

$RelayStatus1=AND($StatusRunning1,$StatusPlugged1)
$RelayStatus2=AND($StatusRunning2,$StatusPlugged2)
$RelayStatus3=AND($StatusRunning3,$StatusPlugged3)

//--------Reversion-----------------------------
//  ( for NE relays)

$NOTRelayStatus1 = NOT($RelayStatus1)
$NOTRelayStatus2 = NOT($RelayStatus2)
$NOTRelayStatus3 = NOT($RelayStatus3)

// set the relay mapping bits.

10000:5:B = AND($NOTBypRelay1,$NOTRelayStatus1) // relay 1
10001:5:B = AND($NOTBypRelay2,$NOTRelayStatus2) // relay 2
10002:5:B = AND($NOTBypRelay3,$NOTRelayStatus3) // relay 3
10003:5:B = 0  // relay 4
10004:5:B = 0  // relay 5

// output bits for debug purposes (optional bits)
10005:1:B = 0
10006:1:B = $S03_Status
10007:1:B = $S04_Status
10008:1:B = $S05_Status
10009:1:B = $S06_Status
10010:1:B = $S07_Status
10011:1:B = $S08_Status
10012:1:B = $S09_Status
10013:1:B = $S10_Status
10014:1:B = $S11_Status
10015:1:B = $S12_Status
10016:1:B = $S13_Status
10017:1:B = $S14_Status
10018:1:B = $S03_MPC_IOC_Plugged
10019:1:B = $S04_MPC_IOC_Plugged
10020:1:B = $S05_MPC_IOC_Plugged
10021:1:B = $S06_MPC_IOC_Plugged
10022:1:B = $S07_MPC_IOC_Plugged
```

```
10023:1:B = $S08_MPC_IOC_Plugged
10024:1:B = $S09_MPC_IOC_Plugged
10025:1:B = $S10_MPC_IOC_Plugged
10026:1:B = $S11_MPC_IOC_Plugged
10027:1:B = $S12_MPC_IOC_Plugged
10028:1:B = $S13_MPC_IOC_Plugged
10029:1:B = $S14_MPC_IOC_Plugged
10030:1:B = $S03_Mpc4Plugged
10031:1:B = $S04_Mpc4Plugged
10032:1:B = $S05_Mpc4Plugged
10033:1:B = $S06_Mpc4Plugged
10034:1:B = $S07_Mpc4Plugged
10035:1:B = $S08_Mpc4Plugged
10036:1:B = $S09_Mpc4Plugged
10037:1:B = $S10_Mpc4Plugged
10038:1:B = $S11_Mpc4Plugged
10039:1:B = $S12_Mpc4Plugged
10040:1:B = $S13_Mpc4Plugged
10041:1:B = $S14_Mpc4Plugged
10042:1:B = 0
10043:1:B = 0
10044:1:B = 0
10045:1:B = 0
10046:1:B = 0
10047:1:B = 0
10048:1:B = 0
10049:1:B = 0
10050:1:B = 0
10051:1:B = 0
10052:1:B = 0
10053:1:B = 0
10054:1:B = $S03_AMC_IOC_Plugged
10055:1:B = $S04_AMC_IOC_Plugged
10056:1:B = $S05_AMC_IOC_Plugged
10057:1:B = $S06_AMC_IOC_Plugged
10058:1:B = $S07_AMC_IOC_Plugged
10059:1:B = $S08_AMC_IOC_Plugged
10060:1:B = $S09_AMC_IOC_Plugged
10061:1:B = $S10_AMC_IOC_Plugged
10062:1:B = $S11_AMC_IOC_Plugged
10063:1:B = $S12_AMC_IOC_Plugged
10064:1:B = $S13_AMC_IOC_Plugged
10065:1:B = $S14_AMC_IOC_Plugged
10066:1:B = $S03_Amc8Plugged
10067:1:B = $S04_Amc8Plugged
10068:1:B = $S05_Amc8Plugged
10069:1:B = $S06_Amc8Plugged
10070:1:B = $S07_Amc8Plugged
10071:1:B = $S08_Amc8Plugged
10072:1:B = $S09_Amc8Plugged
```

```
10073:1:B = $S10_Amc8Plugged
10074:1:B = $S11_Amc8Plugged
10075:1:B = $S12_Amc8Plugged
10076:1:B = $S13_Amc8Plugged
10077:1:B = $S14_Amc8Plugged
10078:1:B = 0
10079:1:B = 0
10080:1:B = 0
10081:1:B = 0
10082:1:B = 0
10083:1:B = 0
10084:1:B = 0
10085:1:B = 0
10086:1:B = 0
10087:1:B = 0
10088:1:B = 0
10089:1:B = 0

//-------------RELAY COMMAND---------------------
CPU:RELAY:R1 = 10000:1
CPU:RELAY:R2 = 10001:1
CPU:RELAY:R3 = 10002:1
CPU:RELAY:R4 = 10003:1
CPU:RELAY:R5 = 10004:1
//-----------------------------------------------

/////// END RELAY SECTION ///////////////
```