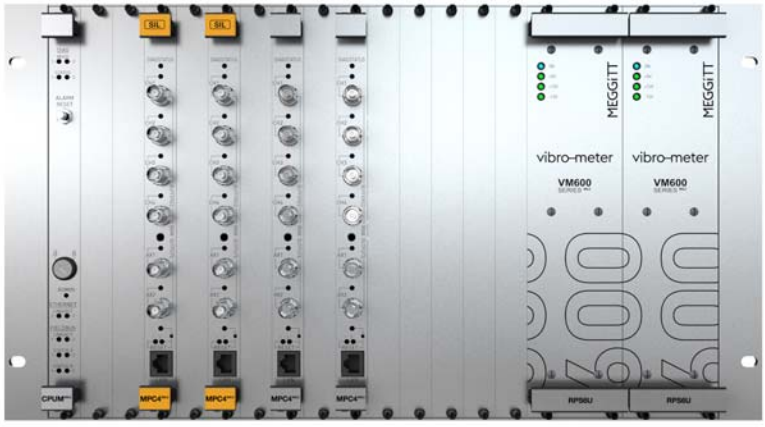
SAFETY MANUAL

vibro-meter®

VM600^{Mk2} machinery monitoring system – IEC 61508 SIL 2



SIL Safety

This document contains important information about products that are intended for use in safety-related applications.

CERTIFIED • IEC 61508 • SIL 2 CAPABLE •

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PREFACE

About this manual

This manual provides reference information on using a VM600^{Mk2} rack-based machinery monitoring system, from Parker Meggitt's vibro-meter® product line, as a machinery protection system (MPS) in safety-related applications (functional-safety contexts).

It is applicable to VM600^{Mk2} machinery monitoring systems using the following modules for machinery protection:

- VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} SIL machinery protection and condition monitoring module.
- VM600^{Mk2} RLC16^{Mk2} SIL relay module.

NOTE: Only VM600^{Mk2} machinery monitoring systems using the SIL versions of modules for machinery protection system (MPS) applications are suitable for use in safety-related applications (functional-safety contexts).

About Parker Meggitt and vibro-meter®

Parker Hannifin Corporation – usually referred to as just Parker – is a global leader in motion and control technologies, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. For more than a century the company has been enabling engineering breakthroughs that lead to a better tomorrow.

Parker Meggitt joined the Parker Aerospace Group in September 2022 following the successful acquisition of Meggitt PLC, a world leader in aerospace, defense and energy. This included the Meggitt facility in Fribourg, Switzerland, operating as the legal entity Meggitt SA (formerly Vibro-Meter SA). Accordingly, the vibro-meter® product line is now owned by Parker.

Working closely with its customers, Parker Meggitt delivers technologically differentiated systems and products for the most demanding environments with high certification requirements for applications across its core end markets: aerospace, energy and industrial.

For the energy market (power generation, oil & gas and other industrial markets), vibro-meter® products and solutions include a wide range of vibration, dynamic pressure, proximity, air-gap and other sensors / measurement chains capable of operation in extreme environments, machinery protection and condition monitoring systems, and innovative software.

To learn more about Parker Meggitt (Meggitt SA), our proud tradition of innovation and excellence, and our solutions for energy markets and applications, visit our website at www.meggittsensing.com/energy

Who should use this manual?

This manual is written for personnel such as designers and operators of machinery protection and/or monitoring systems – using a VM600^{Mk2} machinery monitoring system as a machinery protection system (MPS) – in safety-related applications (functional safety contexts).

The system designers and operators are assumed to have the necessary technical training in safety, reliability, electronics and/or mechanical engineering (professional certificate/diploma or equivalent) to enable them to design, install, configure, use and maintain such safety instrumented systems.

Structure of the manual

This section gives an overview of the structure of the manual 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 your safety-related applications and then keep the document at hand for future reference.

The structure of the document is as follows:

Chapter 1	Introduction Explains the purpose and scope of this safety manual. Introduces the VM600^{Mk2} machinery monitoring system and system components for machinery protection system (MPS) applications.
Chapter 2	Communications Explains how to communicate with a VM600^{Mk2} machinery monitoring system, describes the VM600^{Mk2}/VM600 rack backplane and provides an overview of the VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} SIL module and RLC16^{Mk2} SIL module.
Chapter 3	How to use the system for safety Explains how a VM600^{Mk2} machinery monitoring system is used in safety-related applications in terms of the various safety properties. And provides safety parameters and highlights safety considerations relevant to the design, installation, configuration, use and maintenance of these systems.
Chapter 4	Configuration Provides configuration information for VM600^{Mk2} machinery monitoring systems.
Chapter 5	Installation and commissioning Provides installation and commissioning information for VM600^{Mk2} machinery monitoring systems.
Chapter 6	Operation and maintenance Provides proof test and other operation and maintenance information for VM600^{Mk2} machinery monitoring systems.
Chapter 7	Service and support Provides contact information for technical support. Includes information regarding important SIL safety product information and the procedure to follow in order to opt in and receive such SIL product communications. Includes information regarding product returns and the procedure to follow in order to report problems and return Parker Meggitt (Meggitt SA) energy products for repair.

Related publications and documentation

See 1.12 Related documentation and 1.13 Applicable functional safety standards.

Abbreviations

The following table defines some abbreviations useful to this safety manual and related documentation.

Abbreviation	Meaning
1oo1	one out of one voting logic architecture
1oo2	one out of two voting logic architecture
2oo2	two out of two voting logic architecture
ABE04x	VM600^{Mk2}/VM600 system rack (19″ rack with a height of 6U), from vibro-meter®
AC	alternating current
BIST	built-in self-test
CMS	condition monitoring system
COM	common
CPU	central processing unit
CPUM^{Mk2}	VM600^{Mk2} rack controller and communications interface module, from vibro-meter®. Note: Processing module, front of rack.
DC	diagnostic coverage
DC	direct current
DCS	distributed control system
ESD	emergency shutdown system
EUC	equipment under control
Exida	A product certification and knowledge company specialising in system safety
FMEDA	failure modes, effects and diagnostic analysis
HFT	hardware fault tolerance
IEC 61508	IEC standard “Functional safety of electrical/electronic/programmable electronic safety-related systems”
IOC4^{Mk2}	Standard version of the VM600^{Mk2} machinery protection and condition monitoring module, from vibro-meter®. Note: Input/output module, rear of rack.
IOC4^{Mk2} SIL	SIL version of the VM600^{Mk2} machinery protection and condition monitoring module, from vibro-meter®. Note: Input/output module, rear of rack.
IOCN^{Mk2}	VM600^{Mk2} rack controller and communications interface module, from vibro-meter®. Note: Input/output module, rear of rack.
IVP	interface vibration processor. Note: PMM on the MPC4^{Mk2} SIL.

Abbreviation	Meaning
MPC4^{Mk2}	Standard version of the VM600^{Mk2} machinery protection and condition monitoring module, from vibro-meter®. Note: Processing module, front of rack.
MPC4^{Mk2} SIL	SIL version of the VM600^{Mk2} machinery protection and condition monitoring module, from vibro-meter®. Note: Processing module, front of rack.
MPS	machinery protection system
MRT	mean repair time Note: See also MTTR.
MTTR	mean time to repair/restoration Note: MTTR = MRT, where mean time to restoration (hour) = mean repair time (hour) as per IEC 61508-6 © IEC:2010 Table B.1.
N/A	not applicable, not available
NC	normally closed
NDE	normally de-energized
NE	normally energized
NO	normally open
PFD	probability of failure on demand (low-demand system)
PFDavg	average probability of failure on demand
PFH	probability of failure per hour (high-demand system)
PL	performance level
PLC	programmable logic controller
PMM	processing mezzanine module
PNR	part number
PST	process safety time
PSU	power supply unit
PTC	proof test coverage
PTI	proof test interval
RLC16^{Mk2}	Standard version of the VM600^{Mk2} relay module, from vibro-meter®. Note: Rear of rack.
RLC16^{Mk2} SIL	SIL version of the VM600^{Mk2} relay module, from vibro-meter®. Note: Rear of rack.
RPM	revolutions per minute
RPS6U	VM600^{Mk2}/VM600 rack power supply, from vibro-meter®. Note: Front of rack.
RTD	resistance temperature detector
SFF	safe failure fraction

Abbreviation	Meaning
SIF	safety instrumented function
SIL	safety integrity level
SIS	safety instrumented system
SNR	serial number
SRS	safety-related system
SSI	site safety index
SVP	safety vibration processor. Note: PMMs (SVP A and SVP B) on the MPC4^{Mk2} SIL.
vibro-meter®	Parker Meggitt product line
VibroSmart®	VibroSmart® distributed monitoring system (DMS) based machinery monitoring and protection systems, from vibro-meter®.
VibroSight®	VibroSight® machinery monitoring system software, from vibro-meter®. The VibroSight software is a highly-integrated software suite that supports the effective monitoring of all rotating machinery. Designed for operation with VM600^{Mk2}/VM600 rack-based systems and VibroSmart® distributed monitoring systems (DMSs), the VibroSight software is an essential part of these machinery monitoring systems. The software is used for system configuration, operation and management and enables the predictive methodologies which can be used to optimise the operational efficiency of industrial machinery.
VM600	VM600 series of rack-based monitoring and protection systems, from vibro-meter®. Specifically VM600 system hardware (that is, the first generation (Mk1) of VM600), namely the MPC4 / IOC4T, AMC8 / IOC8T and RLC16, and CPUM / IOCN cards. Note: Compatible with the VM600 MPSx software.
VM600^{Mk2}	VM600^{Mk2} series rack-based monitoring and protection systems, from vibro-meter®. Specifically VM600^{Mk2} system hardware (that is, the second generation (Mk2) of VM600), namely the MPC4^{Mk2} + IOC4^{Mk2} modules (standard and SIL versions), the RLC16^{Mk2} module (standard and SIL versions) and the CPUM^{Mk2} + IOCN^{Mk2} module. Note: Compatible with the VibroSight® software.
VME	Versa module Eurocard (a computer bus standard)
WEEE	waste electrical and electronic equipment

Abbreviation	Meaning
XIO16T	VM600^{Mk2}/VM600 extended condition monitoring modules, from vibro-meter®: XMC16 + XIO16T for combustion and XMV16 + XIO16T for vibration. Note: Input/output module, rear of rack.
XMx16	VM600^{Mk2}/VM600 extended condition monitoring modules, from vibro-meter®: XMC16 + XIO16T for combustion and XMV16 + XIO16T for vibration. Note: Processing module, front of rack.

Terminology

Relays

By convention, the normally closed (NC) and normally open (NO) relay terminology refers to the state of the relay contacts when the relay's coil is de-energized. This use of the word "normally" is not directly related to the "normal" operation/state of the machinery being monitored, as explained below.

When the power supply to a device is turned off:

- There is a closed circuit between the normally closed (NC) and common (COM) contacts.
- There is an open circuit between the normally open (NO) and common (COM) contacts.

When the power supply to a device is turned on, the state of the relay contacts depends on whether the relay's coil is energized or de-energized.

When the relay's coil is energized:

- There is an open circuit between the normally closed (NC) and common (COM) contacts.
- There is a closed circuit between the normally open (NO) and common (COM) contacts.

Whether a relay's coil is energized or de-energized depends on how the relay has been configured, for example, as normally de-energized (NDE) or normally energized (NE) and as latched or not latched. It also depends on the control signal that is used to drive the relay. For example, specific alarms (alert (A), danger (D) and so on) generated by a MPC4^{Mk2} + IOC4^{Mk2} module.

A relay can be configured to be either normally de-energized (NDE) or normally energized (NE).

Normally de-energized (NDE) and normally energized (NE) refer to the relay coil state (that is, the relay switching circuit) when the hardware is powered and the signal driving the relay's control circuit is in a normal (non-alarm) state.

- For relays configured as normally de-energized (NDE), the control input to the relay's coil is off by default so there is a closed circuit between the NC and COM contacts (and an open circuit between the NO and COM contacts) for a normal state.
- For relays configured as normally energized (NE), the control input to the relay's coil is on by default so there is an open circuit between the NC and COM contacts (and a closed circuit between the NO and COM contacts) for a normal state.

NOTE: Relays configured as normally energized (NE) must de-energize to trip. That is:
- The relay is energized when the monitored levels are within their specified tolerances, in order to indicate normal operation.
- The relay is de-energized when the monitored levels are outside their specified tolerances, in order to indicate an alarm.

An advantage of normally energized (NE) relays is that the "de-energize to trip principle" allows problems with hardware to be detected (for example, due to power supply or wiring failures).

See 3.1 VM600^{Mk2} in a safety-related system for addition information.

To help distinguish between the different generations of VM600^{Mk2}/VM600 machinery monitoring system racks and modules/cards from Parker Meggitt's vibro-meter® product line, the following terminology is used in this document.

Hardware

VM600^{Mk2} MPS, rack or system – used to refer to a VM600^{Mk2}/VM600 rack containing one or more of the following machinery monitoring system modules: MPC4^{Mk2} + IOC4^{Mk2} machinery protection and condition monitoring module, RLC16^{Mk2} relay module, and CPUM^{Mk2} + IOCN^{Mk2} rack controller and communications interface module, (that is, a second-generation VM600^{Mk2} system).

VM600 MPS, rack or system – used to refer to a VM600 rack containing one or more of the following machinery protection system cards (modules): MPC4 / IOC4T machinery protection card pair, RLC16 relay card, AMC8 / IOC8T analog monitoring card pair, and CPUx / IOCx (CPUM) rack controller and communications interface module (that is, first-generation VM600 systems (VM600^{Mk1})).

Software

VibroSight® is proprietary software from Parker Meggitt's vibro-meter® product line for the configuration, operation and management of VM600^{Mk2}/VM600 rack-based systems and VibroSmart® distributed monitoring system (DMSs).

VibroSight Protect is a separate VibroSight® software module used for the configuration and operation of a VM600^{Mk2} MPS. This helps ensure complete separation ("segregation") of machinery protection system (MPS) and condition monitoring system (CMS) in a single VM600^{Mk2}/VM600 rack.

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SAFETY

Symbols and styles used in this manual

The following symbols are used in this manual where appropriate:

The WARNING safety symbol

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

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.

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

Important remarks on safety-related applications

USE OF A VM600^{Mk2} MACHINERY MONITORING SYSTEM AS A MACHINERY PROTECTION SYSTEM (MPS) IN A SAFETY-RELATED APPLICATION (FUNCTIONAL-SAFETY CONTEXT) ASSUMES THAT THE INSTRUCTIONS AND RECOMMENDATIONS IN THIS SAFETY MANUAL ARE IMPLEMENTED AS APPROPRIATE BY THE END-USER.

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

Important remarks on safety

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

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

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

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

Parker 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 Parker Meggitt (Meggitt SA). Any modification, transformation or repair carried out on the equipment without written permission from Parker Meggitt will invalidate any warranty.

Electrical safety and installation

WHEN INSTALLING SENSORS / MEASUREMENT CHAINS AND A VM600^{Mk2} MACHINERY MONITORING SYSTEM USED AS A MACHINERY PROTECTION SYSTEM (MPS) IN A SAFETY-RELATED APPLICATION (FUNCTIONAL-SAFETY CONTEXT), OBSERVE ALL SAFETY (WARNING AND CAUTION) STATEMENTS IN THE RELEVANT MANUALS, INCLUDING THIS SAFETY MANUAL, THE *VM600^{Mk2} MACHINERY PROTECTION SYSTEM (MPS) QUICK START MANUAL* AND THE *VM600 MACHINERY PROTECTION SYSTEM (MPS) HARDWARE MANUAL*, AND FOLLOW ALL NATIONAL AND LOCAL ELECTRICAL CODES. SEE 1.12 RELATED DOCUMENTATION FOR A LIST OF INSTALLATION MANUALS.

ONLY TRAINED AND QUALIFIED PERSONNEL (SUCH AS A QUALIFIED/LICENSED ELECTRICIAN) SHOULD BE ALLOWED TO INSTALL OR REPLACE THIS EQUIPMENT. CHECKS TO ENSURE ELECTRICAL SAFETY SHOULD BE CARRIED OUT BY A COMPETENT PERSON.

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

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^{Mk2}/VM600 systems that have been approved by Parker Meggitt (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 Parker Meggitt website at www.meggittsensing.com/energy
- Contact your local Parker Meggitt representative.

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1 INTRODUCTION

1.1 Purpose

This safety manual provides the specific information required to use a VM600^{Mk2} machinery monitoring system as a machinery protection system (MPS) in a safety-related application (functional safety context), in accordance with the IEC 61508 “functional safety” standard.

Refer to the *VM600^{Mk2} machinery protection system (MPS) quick start manual* and the *VM600 machinery protection system (MPS) hardware manual* for more general information on the VM600^{Mk2} machinery monitoring system and the information required to use a VM600^{Mk2} system in standard (non-safety-related) applications. See 1.12 Related documentation.

1.2 VM600^{Mk2} system overview

The VM600^{Mk2} series of machinery monitoring systems, from Parker Meggitt’s vibro-meter® product line, is based around a VM600^{Mk2}/VM600 rack containing various types of modules, depending on the application.

Basically, three types of system are possible:

- VM600^{Mk2} machinery protection system (MPS).
- VM600^{Mk2} condition monitoring system (CMS).
- VM600^{Mk2} machinery protection system (MPS) and condition monitoring system (CMS).

That is, it is possible to implement machinery protection system (MPS) and condition monitoring system (CMS) functionality in the same VM600^{Mk2}/VM600 rack.

A VM600^{Mk2} system can implement condition monitoring system (CMS) functionality in two ways:

- Using VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} machinery protection and condition monitoring modules to implement the condition monitoring.
- Using VM600^{Mk2} XMx16 + XIO16T extended condition monitoring modules to implement the condition monitoring.

In a SIL-certified VM600^{Mk2} machinery monitoring system which is part of a plant safety instrumented function (SIF), the instrumented system typically consists of a variety of measurement and protection modules with corresponding output relays, for example, the SIL version of the VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} machinery protection and condition monitoring module. These machinery monitoring modules provide alarm and status information to one or more relays which can be either an integral part of the module itself or a standalone relay module within the same rack, for example, the SIL version of the VM600^{Mk2} RLC16^{Mk2} relay module. These relays use the alarm and status information to resolve machine trip logic and drive their relay outputs which are further connected to plant emergency shutdown systems (ESDs) or logic solvers.

Further, VM600^{Mk2} machinery monitoring systems can combine alarm and status information from different modules, using user-configurable logical functions, in order to perform alarm/trip logic as required before driving the relays.

The relays of a SIL-certified VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) are the VM600^{Mk2} system’s safety output function. See Figure 1-1.

Figure 1-1: VM600Mk2 machinery monitoring system used as a machinery protection system (MPS) in safety-related applications (safety instrumented system (SIF))

NOTE: Only VM600Mk2 SIL system relays (that is, MPC4Mk2 + IOC4Mk2 SIL relays and RLC16Mk2 SIL relays) are safety outputs. More specifically, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown ("trip") of a machine. VM600Mk2 SIL system analog outputs are not safety outputs and should not be used for critical functionality.

It is important to note that relay outputs from the VM600Mk2 system are used as inputs to the plant safety instrumented function (SIF) and it is the plant SIF which ultimately brings the process to a safe state.

While a VM600Mk2 machinery monitoring system's machinery protection system (MPS) functionality provides for the safety function in association with the plant logic controllers or emergency shutdown systems (ESDs), any condition monitoring system (CMS) functionality provides analytical and diagnostic information to plant personnel in order to support health condition monitoring and/or predictive analysis of the machinery and its components.

It is important to note that while both machinery protection system (MPS) and condition monitoring system (CMS) functionality can coexist in same VM600Mk2/VM600 rack, only the MPS can be part of the SIF. See 1.9 Other modules in a VM600Mk2 machinery protection system (MPS).

In its most basic configuration, a VM600Mk2 machinery protection system (MPS) consists of the following hardware:

- 1 × VM600Mk2/VM600 ABE04x system rack – a 19" 6U rack.
- Up to 2 × VM600Mk2/VM600 RPS6U rack power supplies.
- 1 or more × VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules.
- Optionally, 1 or more × VM600Mk2 RLC16Mk2 SIL modules.

  Note: VM600Mk2 RLC16Mk2 relay modules are used to provide additional user-configurable relays (16 per RLC16Mk2 module) for when the four relays provided by a VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module are not enough for an application.

In addition the following optional modules may also be present in a VM600Mk2 MPS.

- 1 × VM600Mk2 CPUMk2 + IOCNMk2 module.

Figure 1-2 shows an example VM600Mk2 MPS in a VM600Mk2 system rack (ABE04x).

In this particular rack (Figure 1-2), the VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules in rack slots 3 and 5 provide a SIL 2 capable machinery protection system.

The other modules in the rack Figure 1-2, VM600Mk2 MPC4Mk2 + IOC4Mk2 modules in rack slots 7 and 9 and VM600Mk2 CPUMMk2 + IOCNMk2 module in rack slot 0, are not relevant to the safety function and provide other functionality, such as machinery protection of less critical machinery and/or condition monitoring.

More detailed information on each of the VM600Mk2 modules listed above is provided in the following sections.

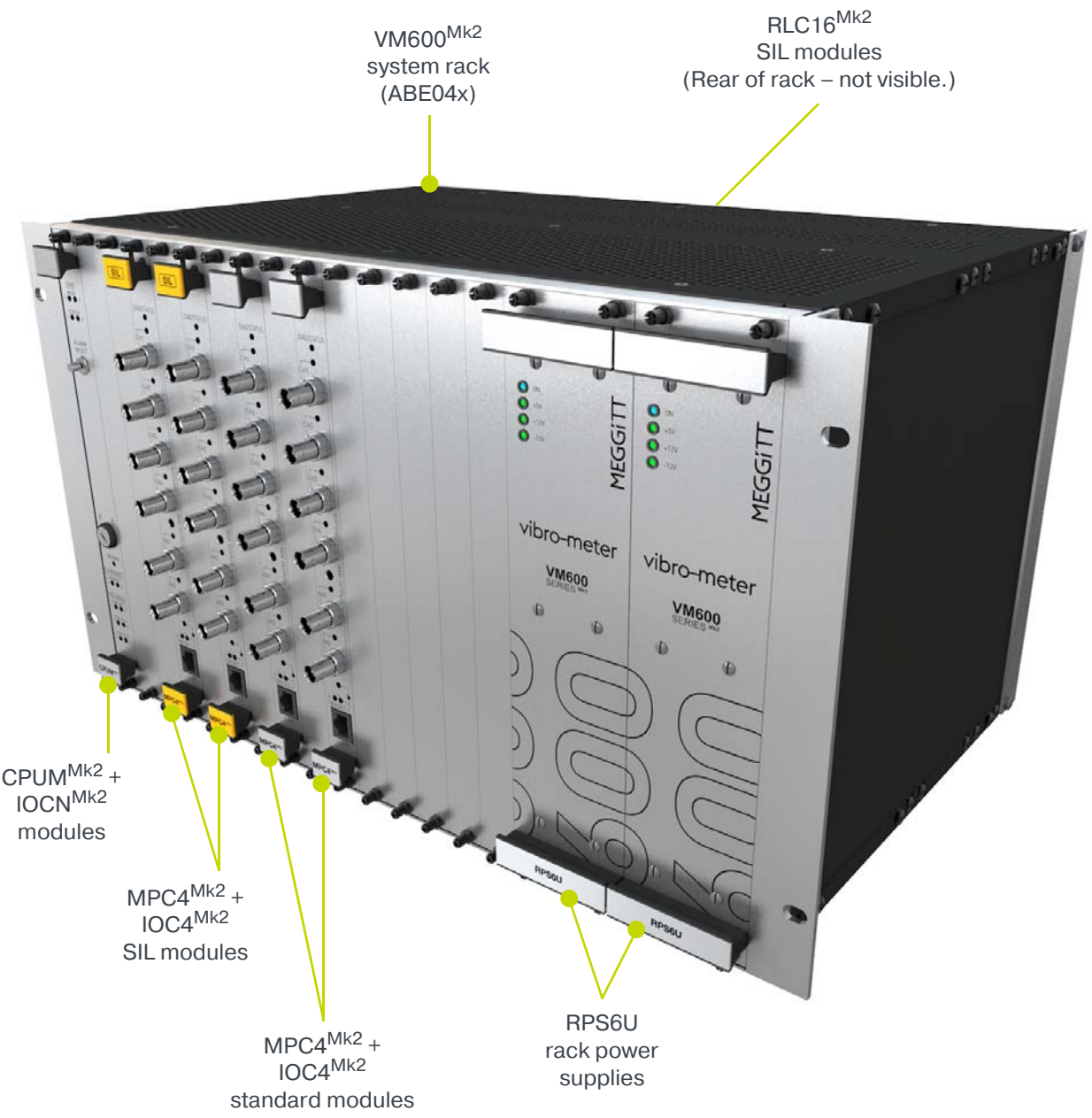

Figure 1-2: Front-view of an example VM600Mk2 MPS featuring MPC4Mk2 + IOC4Mk2 SIL modules in a VM600Mk2 system rack (ABE04x)

1.3 VM600Mk2/VM600 ABE04x system rack

The VM600Mk2/VM600 ABE04x system rack is used to house components (hardware) for the VM600Mk2 series of machinery monitoring systems. See Figure 1-3.

Two types of VM600Mk2/VM600 ABE04x system rack are available: the ABE040 and the ABE042. These are very similar, differing only in the position of the mounting brackets. Both racks have a standard height of 6U and provide mounting space (rack slots) for up to 15 single-width VM600Mk2/VM600 modules/cards, or a combination of single-width and multiple-width modules/cards. These racks are particularly suitable for industrial environments, where equipment must be permanently installed in a 19″ cabinets or panels.

The different versions of VM600Mk2/VM600 ABE04x system rack enable different mounting options to support various markets and applications.

NOTE: ABE04x refers to both the ABE040 and ABE042, which are identical apart from the position of the rack mounting brackets.

The VM600Mk2/VM600 system rack has an integrated VME backplane which provides the electrical interconnections between the installed VM600Mk2/VM600 modules/cards: power supply, signal processing, input /output, relay and CPUx “rack controller”. It also includes a power supply check relay, available at the rear of the rack, which is used to indicate that the installed RPS6U rack power supplies are operating normally.

Either one or two VM600Mk2/VM600 RPS6U rack power supplies can be installed in a VM600Mk2/VM600 system rack. A rack with one RPS6U power supply (330 W version) supports the power requirements for a full rack of modules/cards in applications with operating temperatures up to 50°C (122°F). Alternatively, a rack can have two RPS6U power supplies installed in order to either support rack power supply redundancy or in order to supply power to the modules/cards non-redundantly over a wider range of environmental conditions. See 1.4 VM600Mk2/VM600 RPS6U rack power supply.

VM600Mk2/VM600 processing modules/cards are installed in the front of the rack and the associated input/output modules/cards are installed in the rear. The input/output modules/cards provide connectors for the connection of sensors/measurement chains and for the sharing of various signals with external third-party systems such as a DCS/PLC or plant process computer.

In general, VM600Mk2/VM600 ABE04x system racks and modules/cards are configured in the factory before delivery so they are supplied ready-to-use. Optionally, each module/card can be reconfigured to meet the needs of a particular machinery monitoring application using the appropriate software package from Parker Meggitt’s vibro-meter® product line – which is VibroSight® for VM600Mk2 machinery monitoring systems.

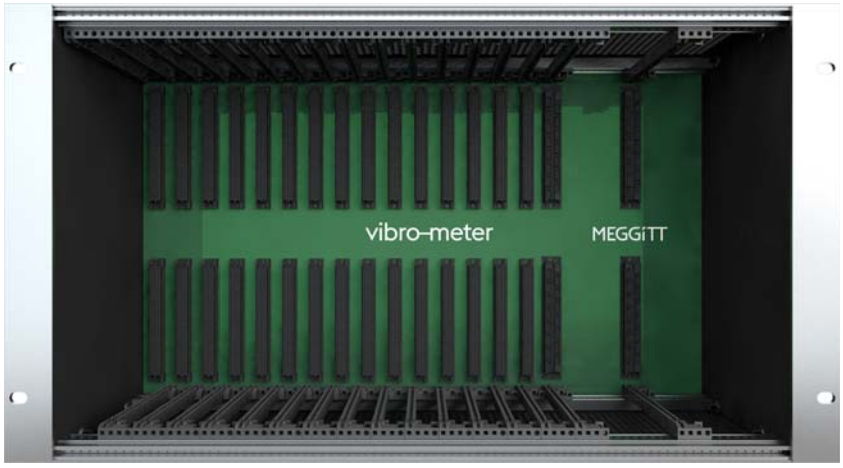

Figure 1-3: VM600Mk2/ VM600 ABE040 system rack (empty)

NOTE: Only VM600Mk2 machinery protection systems (MPSs) in a VM600Mk2/VM600 ABE04x system rack are suitable for use in safety-related applications (functional-safety contexts).
That is, a VM600Mk2 system in a VM600Mk2/VM600 ABE056 slimline rack is not SIL 2 (and is not covered by this safety manual).

1.4 VM600Mk2/VM600 RPS6U rack power supply

The VM600Mk2/VM600 RPS6U rack power supplies are designed for use in the VM600Mk2 series of machinery monitoring systems. See Figure 1-4.

A VM600Mk2/VM600 RPS6U rack power supply is installed in the front of a VM600Mk2/VM600 ABE04x system rack and connects via two high-current connectors to the VME bus of the rack's backplane. The RPS6U power supply provides +5 V_{DC} and ±12 V_{DC} to the rack itself and all installed modules/cards in the rack via the rack's backplane.

Either one or two VM600Mk2/VM600 RPS6U rack power supplies can be installed in a VM600Mk2/VM600 system rack. A rack with one RPS6U power supply (330 W version) supports the power requirements for a full rack of modules/cards in applications with operating temperatures up to 50°C (122°F).

Alternatively, a rack can have two RPS6U power supplies installed in order to either support rack power supply redundancy or in order to supply power to the modules/cards non-redundantly over a wider range of environmental conditions.

A VM600Mk2/VM600 system rack with two RPS6U power supplies installed can operate redundantly (that is, with rack power supply redundancy) for a full rack of modules/cards. This means that if one RPS6U fails, the other will provide 100% of the rack's power requirement so that the rack will continue to operate, thereby increasing the availability of the machinery monitoring system.

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

A VM600Mk2/VM600 system rack with two RPS6U power supplies installed can also operate non-redundantly (that is, without rack power supply redundancy). Typically, this is only necessary for a full rack of modules/cards in applications with operating temperatures above 50°C (122°F), where RPS6U output power derating is required.

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

Different versions of the RPS6U rack power supply enable a VM600Mk2/VM600 system rack to be powered using external AC and/or DC mains supplies:

- AC-input version (RPS6U AC) with a nominal input (line) voltage of 115/230 V_{AC}.
  Note: PNRs 200-582-500-12h (VM600Mk2) and 200-582-500-02h (VM600).
- DC-input version (RPS6U 24 DC) with a nominal input (line) voltage of 24 V_{DC}.
  Note: PNRs 200-582-200-12h (VM600Mk2) and 200-582-200-02h (VM600).
- DC-input version (RPS6U 110 DC) with a nominal input (line) voltage of 110 V_{DC}.
  Note: PNRs 200-582-600-12h (VM600Mk2) and 200-582-600-02h (VM600).

All RPS6U power supplies support a wide input voltage range.

A power supply check relay, available on the associated rear panel at the rear of a VM600Mk2/VM600 system rack, is used to indicate that the RPS6U power supplies are operating normally. It is strongly recommended that such relays are be used in SIF applications in order to determine the VM600Mk2/VM600 systems non-availability due to loss of power and hence help to increase the safety functions availability on demand.

Figure 1-4: VM600Mk2/VM600 RPS6U rack power supplies
(VM600Mk2 RPS6U (left) and VM600 RPS6U (right))

1.5 VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module

The VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module is designed for use in the VM600Mk2 series of rack-based machinery monitoring systems. See Figure 1-5.

A VM600Mk2 MPC4Mk2 + IOC4Mk2 module consists of a processing module and a input/output (interface) module that together provide 4 dynamic channels and 2 auxiliary channels of machinery protection and optional condition monitoring in VM600Mk2 systems.

NOTE: The VM600Mk2 MPC4Mk2 module is available in standard (MPC4Mk2 + IOC4Mk2) and SIL safety (MPC4Mk2 SIL + IOC4Mk2 SIL) versions.
See 1.5.1 Different versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module.

The VM600Mk2 MPC4Mk2 + IOC4Mk2 module includes 4 × user-configurable relays (RL1 to RL4) and 1 × status relay (common circuit-fault relay (FAULT)). The user-configurable relays can be configured to remotely indicate system alarm and/or status information, as required by the application. The status relay is dedicated to indicating a problem with the MPC4Mk2 + IOC4Mk2 module, as detected by the module's diagnostics (built-in self-test (BIST)).

NOTE: The VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module's user-configurable relays (RL1 to RL4) and status relay (common circuit-fault relay (FAULT)) are safety outputs, that is, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown ("trip") of a machine.

NOTE: In safety-related applications, use of the VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module's status relay (common circuit-fault relay (FAULT)) is mandatory.

The relays in a VM600Mk2 system (specifically one or more MPC4Mk2 + IOC4Mk2 modules and any associated RLC16Mk2 modules), are driven by control circuitry that supports a VM600Mk2 system safety-line, that is, a system-wide control signal that automatically drives all system relays (IOC4Mk2 and RLC16Mk2) and analog outputs (IOC4Mk2) to a safe state should a problem be detected. In this way, IOC4Mk2 and RLC16Mk2 relays configured as normally energized (NE) can always be de-energized in the event of a problem with one of the components of the relay coil control signal.

NOTE: In safety-related applications, VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL and RLC16Mk2 SIL relays must be configured as normally energized (NE). This supports the "de-energize to trip principle" required in safety-related applications.

A VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module is used as part of a VM600Mk2 machinery monitoring system. The MPC4Mk2 module is always used with an associated IOC4Mk2 module as a pair/set of modules. Both the MPC4Mk2 and the IOC4Mk2 are single-width modules that occupy a single VM600Mk2 rack slot (module position). The MPC4Mk2 is installed in the front of a VM600Mk2 rack and the associated IOC4Mk2 is installed in the rear of the rack, in the slot directly behind the MPC4Mk2. Each module connects directly to the rack's backplane using two connectors. See Figure 1-3.

(a) VM600Mk2 MPC4Mk2 + IOC4Mk2 module (standard version)

(b) VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module (SIL version)

Figure 1-5: VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring modules

While the VM600Mk2 MPC4Mk2 + IOC4Mk2 module supports both machinery protection system (MPS) and condition monitoring system (CMS) functionalities, it is important to note that the MPS functionality is available by default but the CMS functionality is optional and depends on the purchased VibroSight® software license.

1.5.1 Different versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module

The VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module (and the RLC16Mk2 relay module) is available in different versions – standard and SIL – as follows:

- VM600Mk2 MPC4Mk2 + IOC4Mk2 – this is the standard version of the module, suitable for most applications.

  Note: PNRs 600-041 (no CMS license) and 603-041 (with CMS license) for the MPC4Mk2, PNR 600-043 for the IOC4Mk2 (and PNR 600-045 for the RLC16Mk2).
- VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL – this is the SIL safety version of the module, suitable for critical applications demanding the highest level of protection.

  Note: PNRs 600-040 (no CMS license) and 603-040 (with CMS license) for the MPC4Mk2 SIL, PNR 600-042 for the IOC4Mk2 SIL (and PNR 600-044 for the RLC16Mk2 SIL).

The VM600Mk2 MPC4Mk2 + IOC4Mk2 (standard) is the original version of the module and supports all features and processing functions. This standard version (VM600Mk2 MPC4Mk2 + IOC4Mk2) can be identified by the product name on the lower handle of the front panel, which is aluminium (silver) in colour. See Figure 1-5 (a), top.

The VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL is the SIL version of the module optimised for use in safety-related applications (functional-safety contexts). More specifically, it has been designed in accordance with the IEC 61508 “functional safety” standard and is certified as SIL 2 capable by design. This SIL version (VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL) can be identified by the product name on the lower handle of the front panel, which uses yellow/orange “SIL Safety” labeling. See Figure 1-5 (b), bottom.

In general, the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module support the same signal processing functions and measurements but SIL versions of modules are visually distinct, and feature some important differences in order to meet the strict requirements of SIL safety systems.

For example, the MPC4Mk2 SIL module uses three electronics processing modules in order to help ensure that measurements can always be trusted (compared to one processing module for the MPC4Mk2 (standard) module). The MPC4Mk2 SIL also completely separates machinery protection system (MPS) and condition monitoring system (CMS) functionality so that the safety function is never compromised, as well as implementing more comprehensive diagnostics.

Table 1-1 provides a more detailed comparison of the differences between the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module (and VM600Mk2 RLC16Mk2 module). See also Table 1-2).

Table 1-1: Differences between the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2) module(s)

Standard versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2)	**SIL versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL (and RLC16Mk2 SIL)**
Aluminium (silver) front panels (MPC4Mk2 + IOC4Mk2, RLC16Mk2)	Aluminum (silver) front panels with yellow/orange “SIL Safety” labeling (MPC4Mk2 + IOC4Mk2 SIL, RLC16Mk2 SIL)
One electronics processing module on MPC4Mk2 for all functionality (measurements, management and interfacing)	Three electronics processing modules on MPC4Mk2 SIL: • 2 × processing modules for measurements (with measurement redundancy with cross-checking) • 1 × processing module for management and interfacing
Separation (firmware only) of machinery protection system (MPS) and condition monitoring system (CMS) functionality/processing on the MPC4Mk2 module	Complete separation (hardware and firmware) of machinery protection system (MPS) and condition monitoring system (CMS) functionality/processing on the MPC4Mk2 SIL module
MPC4Mk2 + IOC4Mk2 module only runs diagnostics	MPC4Mk2 + IOC4Mk2 SIL module and RLC16Mk2 SIL module both run diagnostics
Up to 2 × tachometer (speed) signals/channels per module	1 × tachometer (speed) signal per module
Tachometer (speed) channel signals can be freely shared via the VM600Mk2/VM600 rack’s Tacho bus. That is, MPC4Mk2 + IOC4Mk2 modules can put signals on the Tacho bus and can take signals from it too.	Tachometer (speed) channel signals cannot be as freely shared via the VM600Mk2/VM600 rack’s Tacho bus. That is, MPC4Mk2 + IOC4Mk2 SIL modules can put signals on the Tacho bus but cannot take signals from it.
Digital high-pass filter (HPF) cutoff frequency up to 15 kHz	Digital high-pass filter (HPF) cutoff frequency up to 400 Hz
Up to 4 × user-configurable relays (RL1 to RL4) and 1 × common circuit-fault relay (FAULT). Note: In standard applications, use of the FAULT relay is optional.	Up to 4 × user-configurable relays (RL1 to RL4) and 1 × common circuit-fault relay (FAULT). Note: In safety-related applications, use of the FAULT relay is mandatory.
Up to 16 × user-configurable relays (RL1 to RL16) per additional RLC16Mk2 / RLC16Mk2 SIL module	
User-configurable relays can be configured as normally energized (NE) or normally de-energized (NDE)	User-configurable relays must be configured as normally energized (NE)
Alarms and relays can be configured as latched or not latched	

Table 1-1: Differences between the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2) module(s) (continued)

Standard versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2)	**SIL versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL (and RLC16Mk2 SIL)**
Machinery is protected when the MPC4Mk2 module's main operating mode is Locked or Unlocked.	Machinery is protected only when the MPC4Mk2 SIL module's main operating mode is Locked. Note: In safety-related applications, a MPC4Mk2 SIL module can only run in the Locked state. Note: For further information on the MPC4Mk2 module's operating modes, see 4.3 MPC4Mk2 module operating modes.
VM600Mk2 system (MPC4Mk2 + IOC4Mk2 module and any RLC16Mk2 modules) does not enter the safe state (fail-safe mode) if an input channel saturates	VM600Mk2 system (MPC4Mk2 + IOC4Mk2 SIL module and an RLC16Mk2 SIL module) enters the safe state (fail-safe mode) if an input channel saturates for more than 1 hour
Live insertion and removal of modules (hot-swapping) is permitted with automatic reconfiguration of modules. That is, a replaced MPC4Mk2 module will be auto-configured by its associated IOC4Mk2 module.	Live insertion and removal of modules (hot-swapping) is permitted but automatic reconfiguration of modules is not supported. That is, a replaced MPC4Mk2 SIL module will not be auto-configured by its associated IOC4Mk2 SIL module. (It can only be configured manually using the VibroSight® software.)
Verification of MPC4Mk2 serial number by the VibroSight® software	Verification of MPC4Mk2 SIL and IOC4Mk2 SIL serial numbers by the VibroSight® software
Protection configuration signature not required	Protection configuration signature (SIL system signature) required
Enforcing of VM600Mk2 system (MPC4Mk2 + IOC4Mk2 and RLC16Mk2) configuration rules by the VibroSight® software	Enforcing of VM600Mk2 SIL system (MPC4Mk2 + IOC4Mk2 SIL and RLC16Mk2 SIL) configuration rules by the VibroSight® software
Maximum altitude of 2000 m (6560 ft) for VM600Mk2 systems	Maximum altitude of 1600 m (5250 ft) for VM600Mk2 SIL systems

Notes

For standard applications, a VM600Mk2 system consists of only standard versions of modules: MPC4Mk2 + IOC4Mk2 modules and optional RLC16Mk2 modules. Accordingly, a CPUMMk2 + IOCNMk2 rack controller and communications interface module and other standard modules such as VM600Mk2/VM600 XMx16 + XIO16T extended condition monitoring modules can also be used in such systems.

For safety-related applications (functional-safety contexts), a VM600Mk2 SIL system consists of only SIL versions of modules: MPC4Mk2 + IOC4Mk2 SIL modules and optional RLC16Mk2 SIL modules. Accordingly, a CPUMMk2 + IOCNMk2 module and other standard modules such as VM600Mk2/VM600 XMx16 + XIO16T extended condition monitoring modules cannot be used as part of the SIL system. However, these standard modules are not relevant to the safety function and can coexist within a VM600Mk2/VM600 system rack used in a safety application provided that the recommendations in this safety manual are followed.

Continued ...

Table 1-1: Differences between the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2) module(s) (continued)

Standard versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2)	SIL versions: VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL (and RLC16Mk2 SIL)

Notes *(continued)*

Standard versions of VM600Mk2 modules must be used with other standard VM600Mk2 modules, while VM600Mk2 SIL modules must be used with other VM600Mk2 SIL modules. More specifically, VM600Mk2 modules and VM600Mk2 SIL modules are not compatible, for example, it is not possible to use a MPC4Mk2 module with a IOC4Mk2 SIL module, and vice versa.

A VM600Mk2 SIL system (MPC4Mk2 + IOC4Mk2 SIL) allows only 1 × tachometer (speed) signal per module because both auxiliary channels are used to provide a redundant and cross-checked tachometer input in safety-related applications (functional-safety contexts).

For further information, see 2.5.1 VM600Mk2 MPC4Mk2+ IOC4Mk2 SIL and tachometer (speed) signals.

A VM600Mk2 SIL system (MPC4Mk2 + IOC4Mk2 SIL and an optional RLC16Mk2 SIL) will enter the safe state (fail-safe mode) whenever the module diagnostics (built-in self-test (BIST)) detects an issue that prevents normal operation, for example, hardware faults/problems, significant differences in the measurements from the redundant electronics processing modules, etc.

In the safe state (fail-safe mode), the MPC4Mk2 SIL module activates the system-wide VM600Mk2 system safety-line control signal in order to automatically drive all system relays and analog outputs to a safe state. However, it is important to note that only VM600Mk2 SIL system relays (that is, MPC4Mk2 + IOC4Mk2 SIL relays and RLC16Mk2 SIL relays) are safety outputs. More specifically, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown ("trip") of a machine. VM600Mk2 SIL system analog outputs are not safety outputs and should not be used for critical functionality.

In the safe state (fail-safe mode), the MPC4Mk2 SIL module also activates its status relay (common circuit-fault relay (FAULT) relay) in order to allow issues to be remotely detected/indicated. Front-panel LEDS are used for local indication.

For more detailed information on the VM600Mk2 MPC4Mk2 + IOC4Mk2 modules – standard and SIL versions – refer to the *VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring modules data sheet* and/or the *VM600Mk2 machinery protection system (MPS) quick start manual* (see 1.12 Related documentation).

1.5.2 Identifying different versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module

The different versions – standard and SIL – of the VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module (and the RLC16Mk2 relay module) can be visually identified from their front panels, as the colours and labeling on the handles are different, as shown in Table 1-2. They also have different part numbers and use different names in the VibroSight® software (see Table 1-2).

Table 1-2: Identifying different versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 (and RLC16Mk2) module(s)

Identifying different versions of the MPC4Mk2 + IOC4Mk2 (and RLC16Mk2)	**Standard versions: MPC4Mk2 + IOC4Mk2 (and RLC16Mk2)**	**SIL versions: MPC4Mk2 + IOC4Mk2 SIL (and RLC16Mk2 SIL)**
Colours and labeling	Aluminum (silver) front panels. For example, MPC4Mk2: 	Aluminum (silver) front panels with yellow/orange “SIL Safety” labeling. For example, MPC4Mk2 SIL: 
Part numbers (PNRs)	MPC4Mk2: 600-041 (no CMS) and 603-041 (with CMS) IOC4Mk2: 600-043 RLC16Mk2: 600-045	MPC4Mk2 SIL: 600-040 (no CMS) and 603-040 (with CMS) IOC4Mk2 SIL: 600-042 RLC16Mk2 SIL: 600-044
VibroSight® software	MPC4Mk2: MPC4 IOC4Mk2: IOC4 RLC16Mk2: RLC16	MPC4Mk2 SIL: MPC4 SIL IOC4Mk2 SIL: IOC4 SIL RLC16Mk2 SIL: RLC16 SIL

1.6 VM600Mk2 RLC16Mk2 relay module

The RLC16Mk2 relay module is designed for use in the VM600Mk2 series of rack-based machinery monitoring systems. See Figure 1-6.

A VM600Mk2 RLC16Mk2 relay module consists of a single module that provides 16 × user-configurable relays per module, for when the 4 × user-configurable relays provided by a VM600Mk2 MPC4Mk2 + IOC4Mk2 module are not enough for an application.

NOTE: The VM600Mk2 RLC16Mk2 module is available in standard (RLC16Mk2) and SIL safety (RLC16Mk2 SIL) versions.
See 1.6.1 Different versions of the VM600Mk2 RLC16Mk2 module.

A VM600Mk2 RLC16Mk2 relay module is used as part of a VM600Mk2 machinery monitoring system. The RLC16Mk2 module is always controlled by the associated MPC4Mk2 + IOC4Mk2 module. The RLC16Mk2 is a single-width modules that occupies a single VM600Mk2 rack slot (module position). The RLC16Mk2 is installed in the rear of the rack and connects directly to the rack's backplane using two connectors. See Figure 1-2.

The VM600Mk2 RLC16Mk2 module includes sixteen user-configurable relays (RL1 to RL16) that can be used by a VM600Mk2 system to remotely indicate system alarm and/or status information.

NOTE: The VM600Mk2 RLC16Mk2 SIL module's user-configurable relays (RL1 to RL16) are safety outputs, that is, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown ("trip") of a machine.

The relays in a VM600Mk2 system (specifically one or more MPC4Mk2 + IOC4Mk2 modules and any associated RLC16Mk2 modules), are driven by control circuitry that supports a VM600Mk2 system safety-line, that is, a system-wide control signal that automatically drives all system relays (IOC4Mk2 and RLC16Mk2) and analog outputs (IOC4Mk2) to a safe state should a problem be detected. In this way, IOC4Mk2 and RLC16Mk2 relays configured as normally energized (NE) can always be de-energized in the event of a problem with one of the components of the relay coil control signal.

NOTE: In safety-related applications, VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL and RLC16Mk2 SIL relays must be configured as normally energized (NE). This supports the "de-energize to trip principle" required in safety-related applications.

(a) VM600^{Mk2} RLC16^{Mk2} module (standard version)

(b) VM600^{Mk2} RLC16^{Mk2} SIL module (SIL version)

Figure 1-6: VM600^{Mk2} RLC16^{Mk2} relay modules

1.6.1 Different versions of the VM600Mk2 RLC16Mk2 module

The VM600Mk2 RLC16Mk2 relay module is available in different versions, as follows:

- VM600Mk2 RLC16Mk2 – this is the standard version of the module, suitable for most applications.
- VM600Mk2 RLC16Mk2 SIL – this is the SIL safety version of the module, suitable for critical applications demanding the highest level of protection.

The VM600Mk2 RLC16Mk2 (standard) is the original version of the module and supports all features and functions. This standard version (VM600Mk2 RLC16Mk2) can be identified by the product name on the lower handle of the front panel, which is aluminium (silver) in colour. See Figure 1-6 (a), top.

The VM600Mk2 RLC16Mk2 SIL is the SIL version of the module optimised for use in safety-related applications (functional-safety contexts). Accordingly, it has been designed in accordance with the IEC 61508 “functional safety” standard and is certified as SIL 2 capable by design. This SIL version (VM600Mk2 RLC16Mk2 SIL) can be identified by the product name on the lower handle of the front panel, which uses yellow/orange “SIL Safety” labeling. See Figure 1-6 (b), bottom.

In general, the standard and SIL versions of the VM600Mk2 RLC16Mk2 module support the same functionality but SIL versions of modules are visually distinct and feature some important differences in order to meet the strict requirements of SIL safety systems.

For example, the RLC16Mk2 SIL module’s relays must be externally hard-wired in order to help meet safety system requirements and the RLC16Mk2 SIL module also runs diagnostics.

Table 1-1 provides a detailed comparison of the differences between the standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 module (and VM600Mk2 RLC16Mk2 module). See also Table 1-2.

For more detailed information on the VM600Mk2 RLC16Mk2 modules – standard and SIL versions – refer to the *VM600Mk2 RLC16Mk2 relay modules data sheet* and/or the *VM600Mk2 machinery protection system (MPS) quick start manual* (see 1.12 Related documentation).

1.7 VM600Mk2 CPUMMk2 + IOCNMk2 rack controller and communications interface module

The VM600Mk2 CPUMMk2 + IOCNMk2 rack controller and communications interface is designed for use in the VM600Mk2 series of rack-based machinery monitoring systems.

A VM600Mk2 CPUMMk2 + IOCNMk2 module consists of a central processing unit (CPU) module and a input/output (interface) module that together act as a system controller and data communications gateway for VM600Mk2 systems.

As a fieldbus communications interface for a VM600Mk2 machinery monitoring system monitoring system, the CPUMMk2 module communicates with other VM600Mk2 modules in the rack (such as the MPC4Mk2 + IOC4Mk2 SIL) via the VM600Mk2/VM600 rack's VME bus, and with VM600Mk2/VM600 XMx16 + XIO16T modules via a system Ethernet link, in order to obtain measurement data and then share this information with external third-party systems such as a DCS/PLC or plant process computer.

NOTE: Only SIL versions of modules, such as the VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL and RLC16Mk2 SIL, are suitable for use in safety-related applications (functional-safety contexts).
That is, the VM600Mk2 CPUMMk2 + IOCNMk2 module is not SIL 2 (and is not covered by this safety manual).

For more information on the VM600Mk2 CPUMMk2 + IOCNMk2 module, refer to the *VM600Mk2 CPUMMk2 + IOCNMk2 data sheet* and/or the *VM600Mk2 machinery protection system (MPS) quick start manual* (see 1.12 Related documentation).

1.8 VM600Mk2 machinery protection system (MPS) summary

VM600Mk2 machinery monitoring systems used as machinery protection systems (MPSs) in safety-related applications (functional-safety contexts) are flexible and modular by design. This means that modules can generally be installed in any available rack slot (module position) in any combination and quantities.

Accordingly, a VM600Mk2 machinery monitoring system used as a machinery protection system (MPS) in safety-related applications (SIL 2) may consist of:

- One VM600Mk2/VM600 ABE04x system rack.
- One or two VM600Mk2/VM600 RPS6U rack power supplies.
- One or more VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules.
  Note: Up to a maximum of 12 modules.
- One or more VM600Mk2 RLC16Mk2 SIL modules.
  Note: Up to a maximum of 6 modules.
  Note: A VM600Mk2 RLC16Mk2 SIL module can be associated with and used by a single VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module only.
- Optionally, standard versions of VM600Mk2/VM600 modules that are not relevant to the safety function.
  Note: See 1.9 Other modules in a VM600Mk2 machinery protection system (MPS).

Ultimately, for a SIL-certified VM600Mk2 machinery protection system (MPS) which is part of a plant safety instrumented function (SIF), it is the requirements of the customer's application (total number of channels to be measured/monitored/protected, etc.) which determines the exact number and type of modules and the detail of the system configuration. As a result, the quantity of each module in a rack varies and certain modules may or may not be present, depending on the application.

VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules and VM600Mk2 RLC16Mk2 SIL modules have the features and capabilities to perform the alarm/trip logic (simple or complex) typically required in machinery protection system (MPS) applications.

The VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module has five relays. The four user-configurable relays (RL1 to RL4) can be used by a VM600Mk2 system to remotely indicate system alarm and/or status information. While, a status relay (common circuit-fault (FAULT) relay) is used to indicate a problem with the MPC4Mk2 + IOC4Mk2 SIL module, as detected by the module's diagnostics (built-in self-test (BIST)).

Similarly, the VM600Mk2 RLC16Mk2 SIL module has includes sixteen user-configurable relays (RL1 to RL16) that can be used by a VM600Mk2 system to remotely indicate system alarm and/or status information.

In practice, the system alarm and/or status information communicated by relay to external third-party systems such as a DCS/PLC or plant process computer includes measurement alarms (Alert/Danger), sensor / measurement chain problems, system diagnostics and/or various combinations of system signals (using logical functions).

NOTE: A VM600Mk2 system can provide up to 144 user-configurable relays per rack, that is, 48 relays from MPC4Mk2 + IOC4Mk2 modules (12 modules × 4 relays) and 96 relays from RLC16Mk2 modules (6 modules × 16 relays).

In safety-related applications, it is recommended that safety relay outputs are implemented as relay pairs, that is, two relays connected in series or parallel, depending on whether the application requires "open to trip" or "close to trip".

All the above features and capabilities can be used to make a standalone VM600Mk2 machinery protection system (MPS), that is, a system/solution one that is not connected to a network.

Networked VM600Mk2 MPS systems/solutions are equally possible by connecting the rack/modules via Ethernet to external third-party systems such as a DCS/PLC or plant process computer (see Figure 2-4 (c)). This has no effect or impact on the safety system (MPS) functionality which runs on the VM600Mk2 system (specifically one or more MPC4Mk2 + IOC4Mk2 SIL modules and any associated RLC16Mk2 SIL modules) irrespective of any external connections.

1.9 Other modules in a VM600Mk2 machinery protection system (MPS)

In a SIL-certified VM600Mk2 machinery protection system (MPS), use of standard versions of VM600Mk2/VM600 modules such as the MPC4Mk2 + IOC4Mk2, RLC16Mk2, CPUMMk2 + IOCNMk2 and/or XMx16 + XIO16T is considered as optional.

That is, standard versions of VM600Mk2/VM600 modules that are not relevant to the safety function can coexist within a VM600Mk2/VM600 system rack used in a safety-related application (functional-safety context) provided that the standard and SIL versions of the modules are not connected to one another and do not interact at all.

1.10 Reference part numbers

Table 1-3 lists the VM600^{Mk2} machinery monitoring system components that can be used as part of a machinery protection system (MPS) in safety-related applications.

Table 1-3: Reference part numbers for VM600^{Mk2} SIL safety-system components

VM600^{Mk2} system component			Mandatory*
Name	**Description**	**Part number (PNR)**	
ABE04x	VM600^{Mk2}/VM600 system rack	204-040-100-016	Yes
RPS6U	VM600^{Mk2}/VM600 rack power supply	200-582-500-12x (RPS6U AC) 200-582-200-12x (RPS6U 24 DC) 200-582-600-12x (RPS6U 110 DC)	Yes
PSB9xx	Power supply back panel (for RPS6U)	200-582-9xx-xxx	Yes
MPC4^{Mk2} SIL	VM600^{Mk2}/VM600 machinery protection and condition monitoring module	600-040 (no CMS) 603-040 (with CMS) (600-040-vvv-vvv)	Yes
IOC4^{Mk2} SIL	Input/output module for the MPC4^{Mk2} SIL	600-042 (620-024-vvv-vvv)	Yes
RLC16^{Mk2} SIL	VM600^{Mk2}/VM600 relay module	600-044 (600-026-vvv-vvv)	No
VibroSight® Protect	VibroSight® configuration software for VM600^{Mk2} machinery protection systems	VibroSight software license: 608-001-000-001/Codes. Note: Electronic delivery (for example, via email/FTP). The VibroSight software must be accessed and installed separately. VibroSight software: 609-010-000-001 Note: On physical media (USB device (flash drive/key)).	Yes

Notes

* Mandatory indicates the VM600^{Mk2}/VM600 system components that are required to implement a “basic” machinery monitoring system.

Part numbers (PNRs) provided are the current versions and are subject to change.

In the Part number (PNR) column, “x” represents different variants of the Item/product in the part ordering code, “vvv” represents different firmware (embedded software) versions and hardware versions. Refer to the appropriate individual VM600^{Mk2}/VM600 system component data sheet for further information.

1.11 Use in safety-related applications

It is the end-user's responsibility to ensure that a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in a safety-related application (functional safety context) uses only suitable and approved VM600^{Mk2} safety-system components, and that the recommendations in this safety manual are implemented as appropriate by the end-user.

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

Always check the product labels to ensure that the part numbers (PNRs) and ordering option codes are correct before installing or replacing VM600^{Mk2} machinery monitoring system components used as part of a machinery protection system (MPS). See 1.10 Reference part numbers.

1.12 Related documentation

This safety manual is limited to the information and actions that are required to ensure compliance with the relevant safety certifications and standards.

Table 1-4 lists other documentation, such as manuals and data sheets, that must be referred to for information outside the scope of this safety manual.

Table 1-4: Related documentation

Document name	Document reference
VM600^{Mk2} machinery protection system (MPS) quick start manual	MAVM600MK2MPS-QS/E
VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} machinery protection and condition monitoring modules data sheet	268-121
VM600^{Mk2} RLC16^{Mk2} relay modules data sheet	268-125
VM600 machinery protection system (MPS) hardware manual	MAMPS-HW/E
VibroSight® software release notes and/or *help files*	VIBROSIGHT-RN/E (660-010-013-xxx)

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

1.13 Applicable functional safety standards

Table 1-5 lists the relevant functional safety standards.

Table 1-5: Applicable functional safety standards

Document name	Document reference
IEC 61508: Functional safety of electrical/electronic/programmable electronic safety-related systems	Edition 2 (2010)

2 COMMUNICATIONS

2.1 VM600Mk2/VM600 ABE04x system rack overview

The VM600Mk2 machinery monitoring system uses the VM600Mk2/VM600 ABE04x system rack – a 19" 6U rack with a custom-designed backplane that combines features of a VME backplane and other special features to support the Parker Meggitt vibro-meter® product line (see Figure 2-1 and Figure 2-2).

As shown in Figure 2-1, the VM600Mk2 system rack backplane consists of 3 different systems:

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

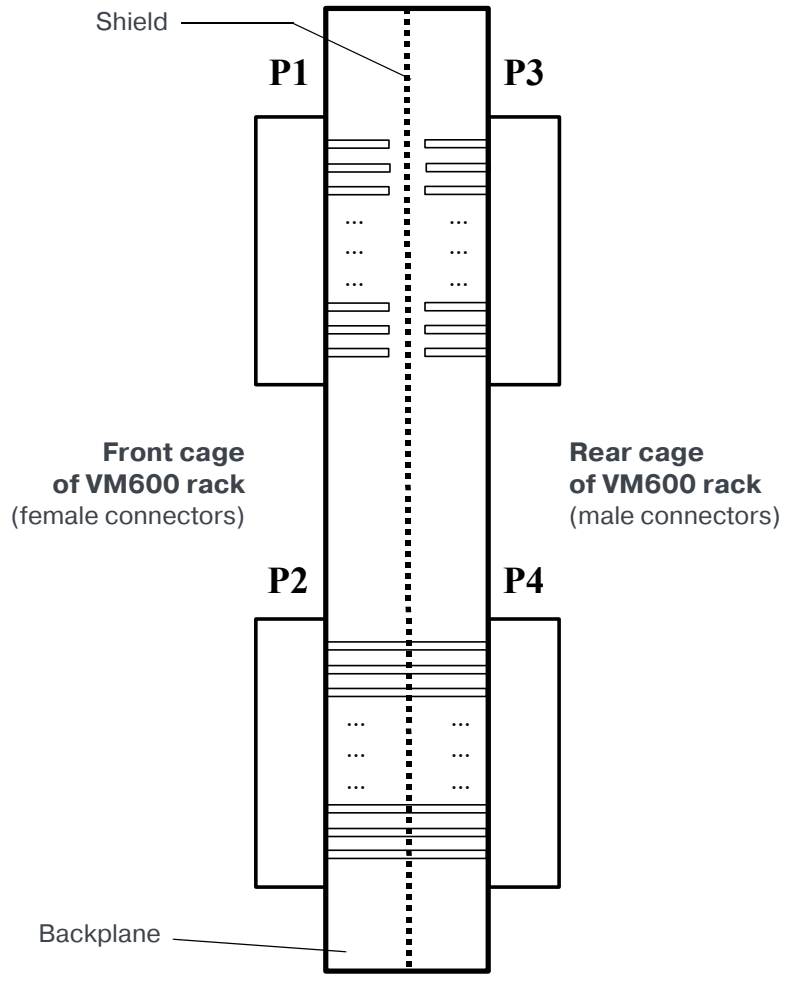

Figure 2-1: Cross-section view of a VM600Mk2 system rack backplane showing the buses and connectors

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

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

Slots 15 and 18 of the rack are reserved for VM600^{Mk2}/VM600 RPS6U rack power supplies. The backplane is equipped with special high-current connectors (type H15) for these power supplies.

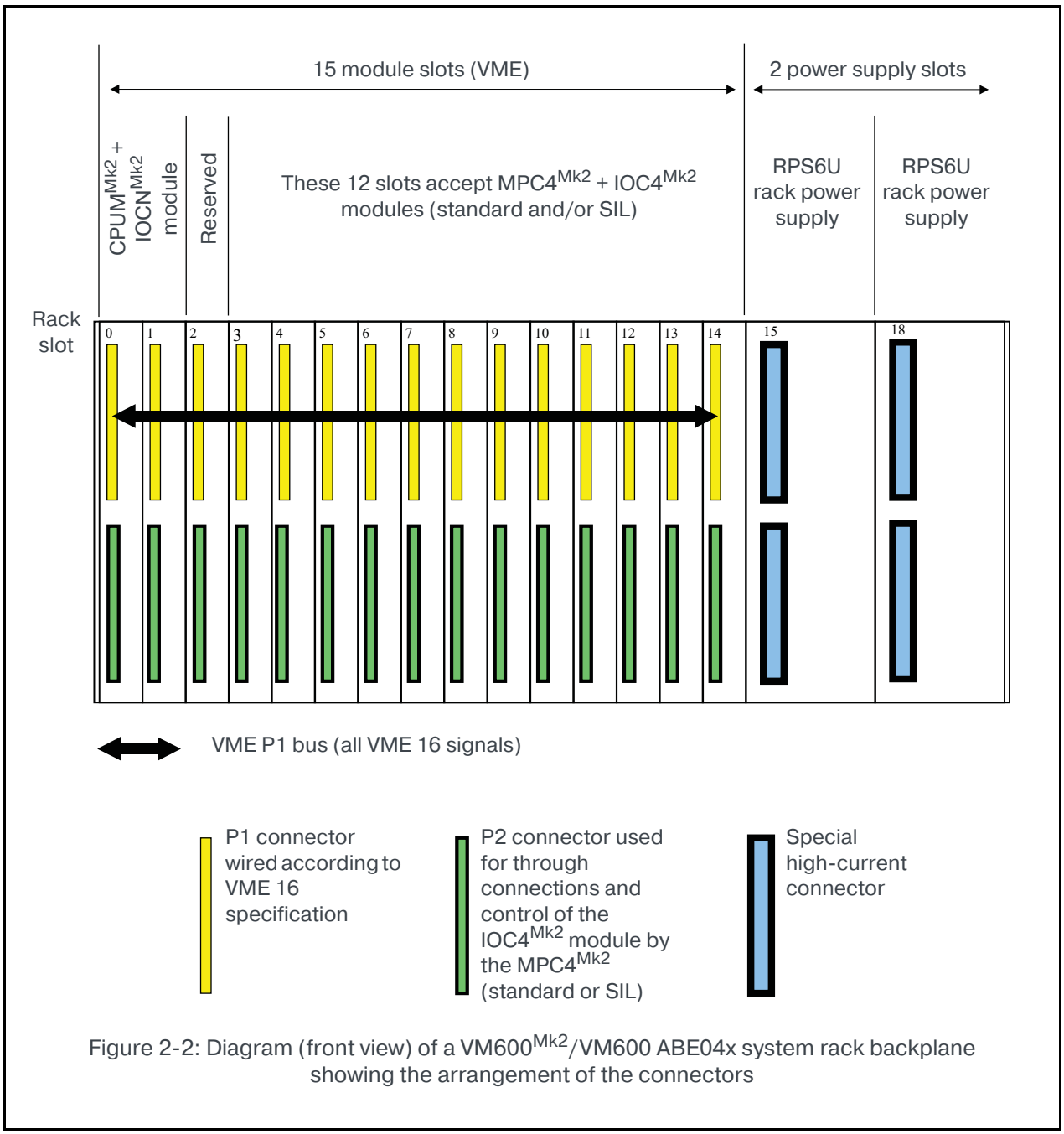

Figure 2-2: Diagram (front view) of a VM600^{Mk2}/VM600 ABE04x system rack backplane showing the arrangement of the connectors

The P3 bus, on the rear side of the VM600Mk2/VM600 ABE04x system rack, actually consists of three buses:

- Tacho bus

  The Tacho bus is composed of 8 lines with passive terminations and it is common to rack slots 03 to 14.

  The Tacho bus is intended for the sharing of auxiliary channel speed and phase reference (1/REV, "one per revolution") input signals between modules/cards in the rack, such as between VM600Mk2 MPC4Mk2 + IOC4Mk2 modules, but can also be used for sharing cold-junction compensation (CJC) signals.

  NOTE: For VM600Mk2 machinery monitoring systems using the SIL versions of VM600Mk2 modules for machinery protection system (MPS) applications, the Tacho bus cannot be used for speed/tacho signal sharing.
  VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules require that speed/tacho signals are hardwired from the sensor / measurement chain to the module's auxiliary channel inputs via the IOC4Mk2 SIL module's J1 connector (rear of rack), that is, using external cabling.

- Open Collector (OC) bus

  The Open Collector (OC) bus is composed of 96 open collector ("ground/open") lines without terminations and is across rack slots 03 to 14.

  It is sub-divided into 6 buses each having 16 lines (these buses are called OC Bus A, OC Bus B, OC Bus C, OC Bus D, OC Bus E, OC Bus F). Each of these six buses is associated with three rack slots (with each rack slot associated with only one OC bus). See Figure 2-3.

  The OC bus is intended for the sharing of alarm and status information between modules/cards in the rack, such as connecting logical function outputs of VM600Mk2 MPC4Mk2 + IOC4Mk2 modules to relay inputs on VM600Mk2 RLC16Mk2 modules in order to control/drive the relays.

- Raw bus

  The Raw bus is composed of 32 × 2 lines without terminations and is common to rack slots 01 to 18. See Figure 2-3.

  The Raw bus is intended for the sharing of dynamic channel input signals between modules/cards in the rack, such as between VM600Mk2 MPC4Mk2 + IOC4Mk2 modules and VM600Mk2/VM600 XMx16 + XIO16T extended condition monitoring modules.

  NOTE: VM600Mk2 MPC4Mk2 + IOC4Mk2 modules (standard and SIL) can put signals onto the Raw bus but they cannot take signals from the Raw bus.

  In addition, for VM600Mk2 systems, the Raw bus is also used as follows:

  - A VM600Mk2 MPC4Mk2 + IOC4Mk2 module uses one Raw bus line to monitor the status of any VM600Mk2 RLC16Mk2 modules that it is using (if being used). (In the VibroSight Protect configuration software, this is known as a "Status" signal.)
  - A VM600Mk2 MPC4Mk2 + IOC4Mk2 module uses one Raw bus line to provide the system-wide VM600Mk2 system safety-line control signal that is used to automatically drive all system relays and analog outputs to a safe state (fail-safe mode). In the VibroSight Protect configuration software, this is known as a "Redline" signal.

NOTE: Only VM600Mk2 SIL system relays (that is, MPC4Mk2 + IOC4Mk2 SIL relays and RLC16Mk2 SIL relays) are safety outputs. More specifically, they are SIL certified and can be used for critical functions in machinery protection applications, such as initiating the shutdown ("trip") of a machine. VM600Mk2 SIL system analog outputs are not safety outputs and should not be used for critical functionality.

For a VM600Mk2 machinery monitoring system used as a machinery protection system (MPS) in a safety-related application, where the Raw bus is being used to drive an alarm on a relay module, use of the Raw bus for sharing analog signals with VM600Mk2/VM600 XMx16 + XIO16T modules is not allowed for safety-relevant signals. Instead, such input signals should be shared via the XIO16T module's connector (rear of rack), that is, using external cabling.

NOTE: The Raw bus must not be used to share safety-relevant signals between modules/cards.

NOTE: The VibroSight Protect software includes a consistency checker that automatically helps to enforce configuration rules for the three buses (Tacho, Open Collector (OC) and Raw) on the backplane of the VM600Mk2/VM600 ABE04x system rack.

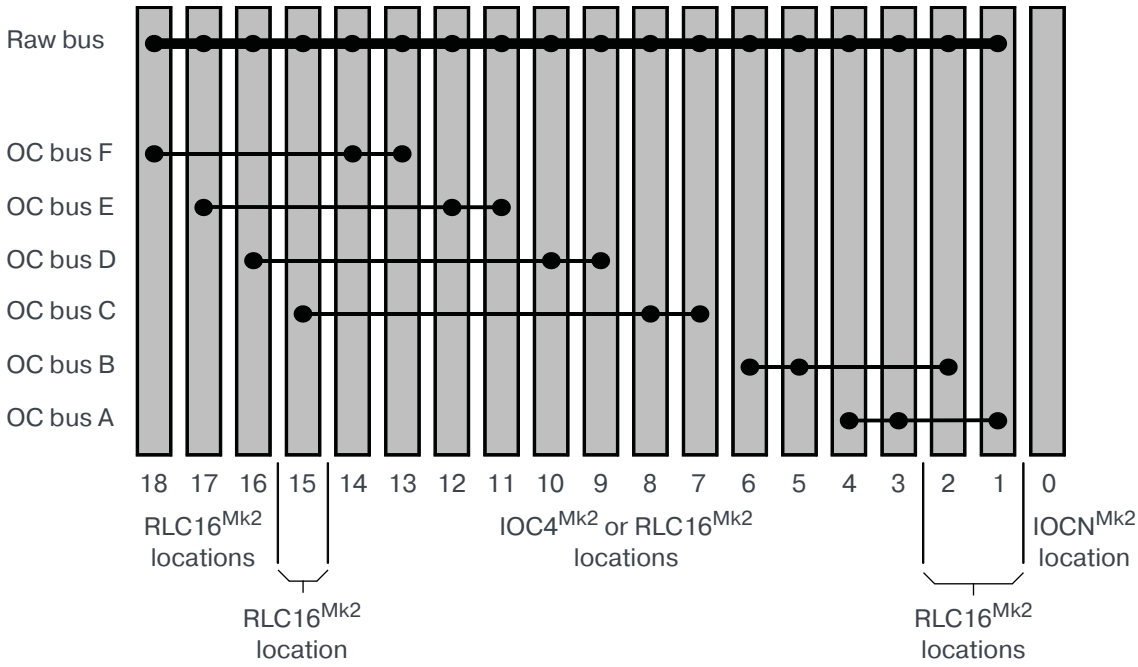

Figure 2-3: Diagram (rear view) of a VM600Mk2/VM600 ABE04x system rack showing the Raw bus and the OC bus

2.2 Communicating with a VM600Mk2 system

The various possibilities for communicating with a VM600Mk2 machinery monitoring system are shown in Figure 2-4. In all cases, a computer running the VibroSight® software is required for the configuration, operation and management of the system.

NOTE: Once configured, a VM600Mk2 machinery monitoring system used as a machinery protection system (MPS) can operate standalone, that is, without a computer permanently connected.

To configure a VM600Mk2 MPS:

- For a VM600Mk2 MPS consisting of a VM600Mk2/VM600 system rack with a single VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module (and optional VM600Mk2 RLC16Mk2 SIL module)

  In this case, a computer running the VibroSight® software is typically connected to the MPC4Mk2 + IOC4Mk2 SIL module using the “LAN” connector available on the front panel of the MPC4Mk2 module, either directly or via a network switch. This is shown in Figure 2-4 (a).
- For a VM600Mk2 MPS consisting of a VM600Mk2/VM600 system rack with multiple VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules (and optional VM600Mk2 RLC16Mk2 SIL modules)

  In this case, a computer running the VibroSight® software is typically connected to the MPC4Mk2 + IOC4Mk2 SIL modules using the “LAN” connector available on the front panel of the MPC4Mk2 modules, via one or more network switches. This is shown in Figure 2-4 (b).

In addition:

- For a VM600Mk2 MPS that also contains a VM600Mk2 CPUMMk2 + IOCNMk2 module

  In this case, the VM600Mk2 CPUMMk2 + IOCNMk2 module can act as communications interface by obtaining data from VM600Mk2 MPC4Mk2 + IOC4Mk2 module(s) via the rack’s VME bus and subsequently sharing this information with external third-party systems. This is shown in Figure 2-4 (c).

  NOTE: Only VM600Mk2 machinery protection systems (MPSs) containing SIL versions of MPC4Mk2 + IOC4Mk2 and RLC16Mk2 modules are suitable for use in safety-related applications (functional-safety contexts).
  Other standard versions of modules, such as standard versions of MPC4Mk2 + IOC4Mk2 and RLC16Mk2 modules, and the CPUMMk2 + IOCNMk2 module, can optionally be used in the same system rack but any such standard modules are not part of the safety function (see 1.9 Other modules in a VM600Mk2 machinery protection system (MPS).

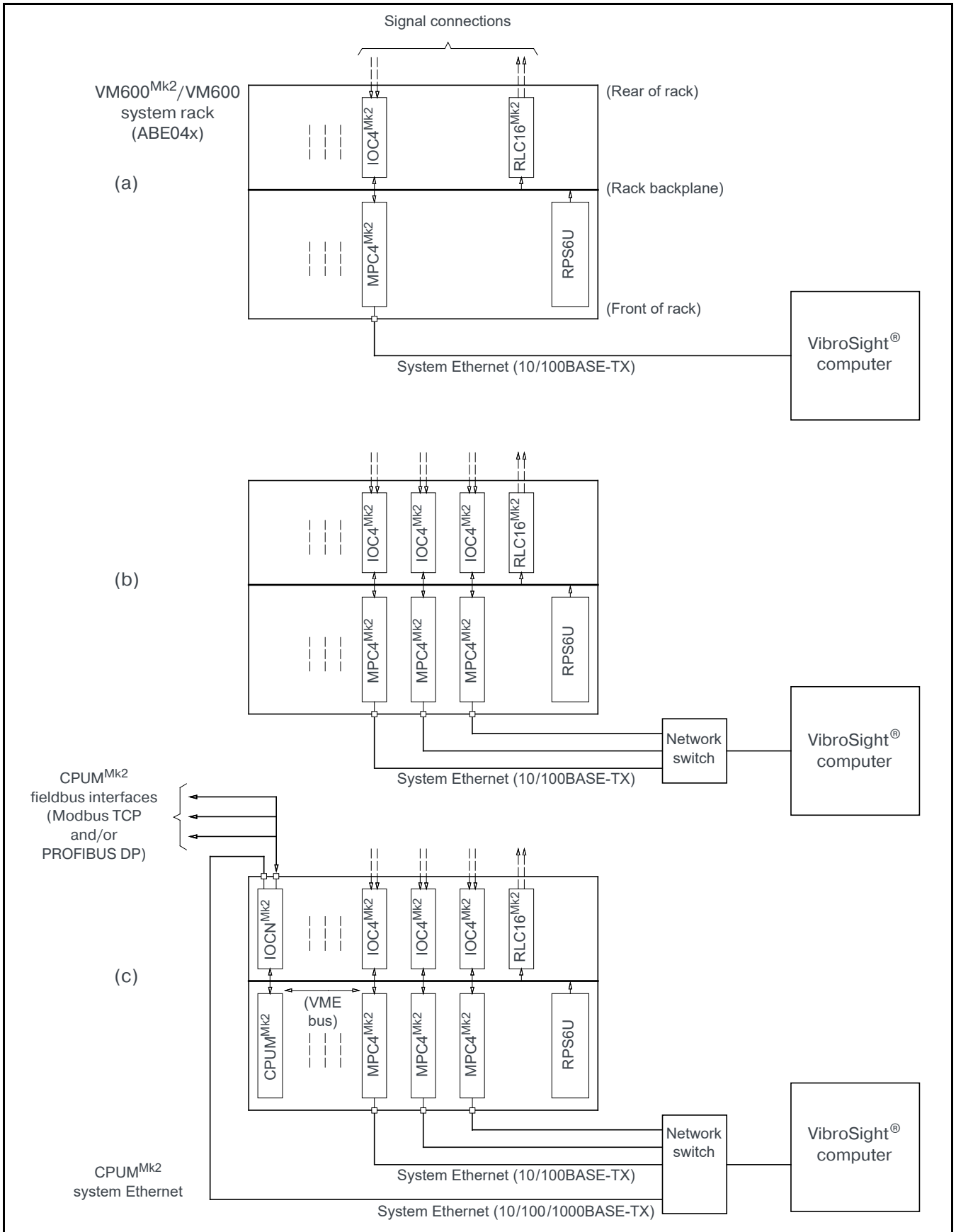

Figure 2-4: Communicating with a VM600^{Mk2} machinery protection system (MPS) in a VM600^{Mk2}/VM600 system rack

2.3 Connecting a VM600Mk2 system to a computer

BEFORE ACCESSING, CONNECTING TO OR COMMUNICATING WITH A VM600Mk2 MACHINERY MONITORING SYSTEM USED AS A MACHINERY PROTECTION SYSTEM (MPS) IN A SAFETY-RELATED SYSTEM (SRS), THE SECURITY AND CYBERSECURITY REQUIREMENTS OF THE END-USER'S APPLICATION MUST HAVE BEEN ADDRESSED. SEE 3.15 SECURITY AND CYBERSECURITY CONCERNS.

The standard and SIL versions of the VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring module have one system communication interface available via the "LAN" connector on the front panel of the MPC4Mk2 module (front of rack). See Figure 1-5 and Figure 2-4. This system communication interface is a Ethernet interface (10/100BASE-TX (up to 100 Mbps)) that is used for all system communications with the MPC4Mk2 + IOC4Mk2 module. The MPC4Mk2 module supports a proprietary TCP/IP-based protocol that communicates with the VibroSight® and VibroSight Protect software running on a computer.

Standard Ethernet cables (Cat 5 or better) can be used for networking between a VM600Mk2 machinery monitoring system and network switches or computers.

For a VM600Mk2 MPS consisting of a single VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module or when working with an individual MPC4Mk2 + IOC4Mk2 module, the MPC4Mk2 module can be connected to a VibroSight® computer, either directly or via a network switch (see Figure 2-4 (a) or (b)).

For a VM600Mk2 MPS consisting of h multiple VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL modules, the MPC4Mk2 modules are typically connected to a VibroSight® computer via one or more network switches (see Figure 2-4 (b)).

2.4 System configuration

2.4.1 Software configuration

The modules in a VM600Mk2 machinery monitoring system must be software configured before the system can be used.

NOTE: A VibroSight / VM600Mk2 MPS must be configured as a whole, that is, the VibroSight Protect software requires concurrent access to all modules in the VM600Mk2/VM600 system rack in order to configure the system (see 2.2 Communicating with a VM600Mk2 system and 2.3 Connecting a VM600Mk2 system to a computer).

While the majority of settings are normally configured in the factory before delivery, the user is nevertheless able to modify certain parameters using the VibroSight Protect software and any associated hardware jumpers on the IOC4Mk2 and RLC16Mk2 modules, if required.

NOTE: For further information on the VibroSight® software, refer to the *software release notes* and/or *help files*.

In general, the VibroSight Protect software is used for software configuration as follows:

- To configure the system properties for the VM600^{Mk2}/VM600 rack.
  For example, type of rack (system rack (ABE04x)); type and organisation of power supplies (AC and/or DC input, rack power supply redundancy); type (MPC4^{Mk2} + IOC4^{Mk2} or RLC16^{Mk2}), number (up to 12) and location (rack slot number/position) of VM600^{Mk2} modules.
  Global system properties are configured and summarised on the Layout tab/page of VibroSight Protect.

  To configure the settings for the VM600 Mk2 modules (MPC4^{Mk2} + IOC4^{Mk2}, RLC16^{Mk2}, and CPUM^{Mk2} + IOCN^{Mk2}) in the VM600^{Mk2}/VM600 rack.
  For example, for a MPC4^{Mk2} + IOC4^{Mk2} module, enabled or disabled, network settings (IP address); sensor/measurement chain, processing and alarms for each channel (dynamic and auxiliary); logical functions; relays (user-configurable and status) and analog outputs.
  For example, for a RLC16^{Mk2} module, enabled or disabled, mode (normally energized (NE) or normally de-energized (NDE)), input (logical function), latched or not, for each relay.

  For example, for a CPUM^{Mk2} + IOCN^{Mk2} module, enabled or disabled, network settings (IP address), and fieldbus configuration.
  Individual module settings are configured and summarised on the Configure tab/page of VibroSight Protect.
- To upload the configuration to the VM600^{Mk2} machinery monitoring system – SIL 2 MPS in the VM600^{Mk2}/VM600 rack.
  Once a configuration has been completed and passed all of the automatic consistency and error checking (Consistency check window), it can be uploaded to the VM600^{Mk2} machinery monitoring system – SIL 2 MPS, that is, to the MPC4^{Mk2} + IOC4^{Mk2}, RLC16^{Mk2}, and CPUM^{Mk2} + IOCN^{Mk2} modules.
  In VibroSight Protect, the Dashboard tab/page is used to upload a valid configuration to a connected the VM600^{Mk2} machinery monitoring system – SIL 2 MPS.

See also 4 Configuration.

In addition, the VibroSight System Manager software is used for other infrequent system maintenance and operation tasks, such as module firmware updates or accessing module diagnostic log files.

NOTE: In general, VibroSight Protect is used for the configuration/operation of a VM600^{Mk2} MPS, while VibroSight System Manager is used more for supporting operation/management tasks.

For further information on VM600^{Mk2} machinery monitoring system configuration and operation, refer to the *VM600^{Mk2} machinery protection system (MPS) quick start manual*.

2.5 VM600Mk2 MPC4Mk2+ IOC4Mk2 SIL and RLC16Mk2 SIL module overview

Figure 2-5 shows a block diagram of a VM600Mk2 system rack (ABE04x) featuring a MPC4Mk2 + IOC4Mk2 SIL module and a RLC16Mk2 SIL module.

The VM600Mk2 MPC4Mk2 + IOC4Mk2 SIL module provides 4 × dynamic channels and 2 × auxiliary channels configurable as either tachometer inputs or DC inputs. See also 2.5.1 VM600Mk2 MPC4Mk2+ IOC4Mk2 SIL and tachometer (speed) signals.

The dynamic signals coming from the sensors / measurement chains (such as accelerometers, pressure sensors and/or proximity sensors) are connected to the front panel of the IOC4Mk2 SIL via an inputs connector (J1, INPUTS CH1-CH4) which is accessible at the rear of the rack. Buffered versions of these “raw” analog signals are available to the user on BNC connectors (BUFFERED RAW OUTPUTS CH1-CH4) which are accessible on the front panel of the MPC4Mk2 SIL module (front of rack). These buffered “raw” signals are also available via a connector (J2, RAW CH1-CH4) on the front panel of the IOC4Mk2 SIL (rear of rack).

The auxiliary signals coming from the sensors / measurement chains (such as speed sensors, thermometers and/or slowly varying process sensors) are connected to the front panel of the IOC4Mk2 SIL via an inputs connector (J1, INPUTS AX1-AX2) which is accessible at the rear of the rack. Buffered versions of these “raw” analog signals are available to the user on BNC connectors (BUFFERED RAW OUTPUTS AX1-AX2) which are accessible on the front panel of the MPC4Mk2 SIL module (front of rack). These buffered “raw” signals are also available via a connector (J2, RAW AX1-AX2) on the front panel of the IOC4Mk2 SIL (rear of rack).

When an auxiliary input is configured as a tachometer input, a buffered TTL-level signal corresponding to the auxiliary input channel (AX1 or AX2) is available via a connector (J2, TTL AX1-AX2) on the front panel of the IOC4Mk2 module (rear of rack). When an auxiliary input is configured as a DC input, no digital TTL-level signal is available.

Analog signal processing of the raw signals is implemented on the IOC4Mk2 SIL module and digital signal processing is implemented on the MPC4Mk2 SIL module, which also handles the management of signals, alarm levels, communications and so on.

On the MPC4Mk2 SIL module, there are three separate electronics processing modules:

- 2 × identical processing modules for measurements (with measurement redundancy with cross-checking).
  These are the PMM (SVP A and SVP B) modules shown in Figure 2-5.
- 1 × processing module for management and interfacing.
  This is the PMM (IVP) module shown in Figure 2-5.

The SVP A, SVP B and IVP PMM modules communicate via a serial interface. However, communication between the SVP A and SVP B PMMs and the IVP PMM are blocked when the MPC4Mk2 SIL module’s operational mode is Locked (see 4.3 MPC4Mk2 module operating modes).

Up to four alarm levels can be set for each measurement channel (named Alert−, Alert+, Danger− and Danger+). These alarms, or logical combinations of them, can be used to drive alarm outputs

(relay outputs) on the IOC4Mk2 SIL module. Similarly, the Open Collector (OC) bus can be used to drive relays on an optional RLC16Mk2 SIL module, if required.

Four DC outputs are available via a connector (J2, DC OUT 1-4) on the front panel of the IOC4Mk2 SIL (rear of rack). These analog outputs are for use with the module's dynamic measurement channels and can be configured to provide a current (4 to 20 mA nom.) or voltage (0 to 10 V) outputs signal corresponding to a channel's processed output (quasi-static measurement).

Three discrete signal interface (DSI) control inputs are available on the IOC4Mk2 SIL (rear of rack):

- Alarm bypass (AB) – Used to inhibit the activation of alarms and relays on the MPC4Mk2 + IOC4Mk2 SIL module.
- Alarm reset (AR) – Used to reset (clear) the alarms and relays latched by the MPC4Mk2 + IOC4Mk2 SIL module.
- Trip multiply (TM) – Used to multiply the configured alarm levels for the MPC4Mk2 + IOC4Mk2 SIL module by a scale factor (software configurable).

The VibroSight® Protect software is used to modify parameters and configure the operation of the VM600Mk2 SIL system (MPC4Mk2 + IOC4Mk2 SIL and RLC16Mk2 SIL). In addition, during operation, VibroSight Protect can be used to send control signals to a VM600Mk2 SIL system, notably, Trip multiply (TM) and Alarm reset (AR). It can also be used to send sensor/channel bypass (inhibit) signals to a system in order to temporarily bypass a sensor/channel, that is, temporarily inhibit the protection offered by any associated relays.

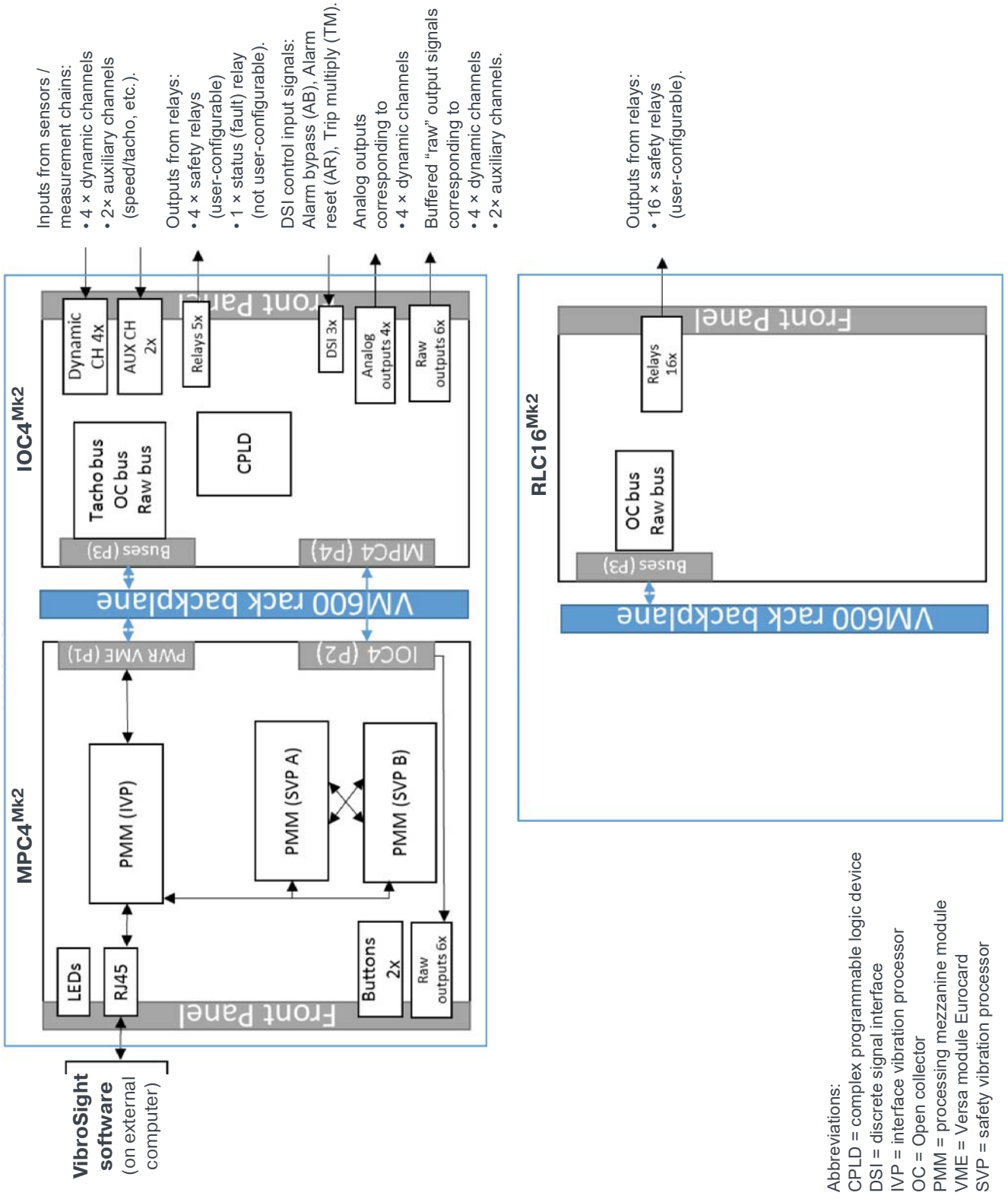

Figure 2-5: Block diagram of MPC4Mk2 + IOC4Mk2 SIL module and RLC16Mk2 SIL module in a VM600Mk2 system rack (ABE04x)

2.5.1 VM600Mk2 MPC4Mk2+ IOC4Mk2 SIL and tachometer (speed) signals

As per Table 1-1, a VM600Mk2 SIL system (MPC4Mk2 + IOC4Mk2 SIL) allows only one tachometer (speed) signal per module because both auxiliary channels are used to provide a redundant and cross-checked tachometer input in safety-related applications (functional-safety contexts).

More specifically, for a MPC4Mk2 + IOC4Mk2 SIL module, if the first auxiliary channel (AX1) is configured as a tachometer (speed) channel, then the second auxiliary channel (AX2) is automatically configured and used as a duplicate tachometer. This happens in the background but requires that both auxiliary channels are connected to the tachometer signal externally, that is, via the AX1 and AX2 inputs on the IOC4Mk2 SIL module's J1 connector. See also 4.2.1 Configuring a VM600Mk2 SIL system.

This is part of the module's diagnostics (built-in self-test (BIST)), which verifies that, if used, there is a valid and reliable tachometer for a system. The diagnostics checks the time-of-arrival of the tachometer signals and if they are not within 5 µs of each other, then a class 2 error-level diagnostic fault is generated (fault code 2: FAULT_TACHO_COMPARATOR_FAILURE) and the system enters the safe state (fail-safe mode).

Note: A tolerance of 10 times per hour max. outside of this value (that is, difference in time-of-arrival >5 µs) is permitted by the diagnostics.

As a result, a MPC4Mk2 + IOC4Mk2 SIL module can repeatedly enter the safe state if a tachometer (speed) signal with too low of an amplitude is used. For example, sine-like signals (or other non-pulse-like signals) with amplitudes less than 2 $V_{PEAK-PEAK}$.

Accordingly, when MPC4Mk2 + IOC4Mk2 SIL auxiliary channels are used as tachometers, it is important that the following voltage / frequency range requirements for tachometer input signals are met:

- Sine-like signals:
  - 2 to 50 $V_{PEAK-PEAK}$ from 2 Hz to 50 kHz.
- Pulse-like signals:
  - 0.8 to 50 $V_{PEAK-PEAK}$ from 2 Hz to 10 kHz, with a 1% min. duty cycle.
  - 1 to 50 $V_{PEAK-PEAK}$ from 10 Hz to 1 kHz, with a 5% min. duty cycle.
  - 2 to 50 $V_{PEAK-PEAK}$ from 1 kHz to 50 kHz, with a 15% min. duty cycle.

For more detailed information, refer to the *VM600Mk2 MPC4Mk2 + IOC4Mk2 machinery protection and condition monitoring modules data sheet* (see 1.12 Related documentation).

3 HOW TO USE THE SYSTEM FOR SAFETY

3.1 VM600Mk2 in a safety-related system

WHEN A VM600Mk2 MACHINERY MONITORING SYSTEM IS USED AS A MACHINERY PROTECTION SYSTEM (MPS) IN A SAFETY-RELATED SYSTEM (SRS), CERTAIN CONFIGURATION RESTRICTIONS MUST BE APPLIED.

In general, for VM600Mk2 machinery monitoring system:

- VM600Mk2 alarms can be configured as either:
  - Latched
  - Not latched.
- VM600Mk2 relays can be configured as either:
  - Normally energized (NE), that is, de-energized to trip
  - Normally de-energized (NDE), that is, energized to trip.

NOTE: VM600Mk2 system safety relays corresponding to alarms are refreshed every 100 ms. See also 3.4 Process safety time.

In particular, for a VM600Mk2 machinery monitoring system is used as a machinery protection system (MPS) in safety-related applications (functional-safety contexts):

- The alarms and relays must be configured depending on the role of the VM600Mk2 system in the safety loop:
  - If a safety function is performed by a VM600Mk2 system only, any safety relay corresponding to an alarm must be configured as latched and normally energized (NE).
  - If a safety function is performed by an external system using an alarm detected by a VM600Mk2 system as an input, the relay corresponding to this alarm may be configured as not latching.

    However, an analysis must be carried out at the safety-related system level to ensure that no alarm can be missed or to identify all possible impacts and acceptability of residual risks in case of a missed alarm.
- Use of the Alarm bypass (AB) function is not allowed.
- Use of the sensor/channel bypass (inhibit) function is not allowed.

3.2 Safety function

A VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) conditions and processes sensor / measurement chain inputs in order to generate measured values and compares these measured values against defined safety level thresholds (configured alarm limits).

As a result of these comparisons, the VM600^{Mk2} MPS can generate alarms and activate (“trip”) relays that initiate the shutdown (“trip”) of a machine in order to put the monitored machinery/process into a safe state, and/or communicate an alarm detected to an external third-party monitoring system.

Accordingly, the safety function is the VM600^{Mk2} MPS's generation of alarms and relay trips for the machinery/process being monitored (EUC) when a measured value is higher than a safety level threshold. A VM600^{Mk2} MPS output relay contact de-energizing to trip will be interpreted by the EUC (and the VM600^{Mk2} itself) as a safe state.

3.3 Demand mode

A VM600^{Mk2} MPS can be used in the low-demand or high-demand mode of operation as per the recommended hardware fault tolerance (HFT) in the safety certificate. See 3.16 Safety certificate(s).

NOTE: The useful lifetime of a VM600^{Mk2} MPS depends on the demand mode, as follows:
- 50 years for a low-demand mode application.
- 8-10 years for a high-demand mode application.

NOTE: In a high-demand mode application, the useful lifetime is limited by whichever results in the shortest lifetime: 8-10 years or 100 000 relay cycles/operations.

3.4 Process safety time

For VM600^{Mk2} systems, the process safety time (PST) is the alarm update rate for the VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} SIL module, which is < 200 ms.

NOTE: This is the time required for a VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} SIL module to detect and initiate an alarm, including output relay activation.

In other words, after a defined safety level threshold (configured alarm limit) has been exceeded, a VM600^{Mk2} systems will activate the associated safety relay within < 200 ms.

3.5 Safety properties

Table 3-1 summarises important safety properties for a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in safety-related applications, including some typical failure rates calculated by Exida (Exida LLC, USA).

Table 3-1: Safety properties for a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in safety-related applications

Safety property	Description / value
SIL level (IEC 61508)	SIL 2
Systematic capability (IEC 61508)	SC 2 (SIL 2 capable)
Mode of operation	Low-demand mode or high-demand mode
Type of subsystem	Type B element (random capability)
Hardware fault tolerance (HFT) See note 1	HFT=0 or HFT=1
Safe-detected failures (λ_{SD})	1081 failure rate (FIT)
Safe-undetected failures (λ_{SU}) See note 2	924 failure rate (FIT)
Dangerous-detected failures (λ_{DD})	40360 failure rate (FIT)
Dangerous-undetected failures (λ_{DU})	2315 failure rate (FIT)
No effect failures (#) See note 2	21072 failure rate (FIT)
Diagnostic coverage (DC) See note 3	95%
Proof test coverage (PTC)	74%
Process safety time (PST)	<200 ms
Mean time to repair (MTTR)	48 hours

Notes

The FMEDA failures / failure rates (FIT) in this table were calculated for a VM600^{Mk2} SIL system (MPC4^{Mk2} + IOC4^{Mk2} SIL and RLC16^{Mk2} SIL) with a good site safety index (SSI) of 2 (that is, a site with "good" site maintenance practices), in accordance with IEC 61508, edition 2 (2010). Further, the FMEDA calculations and analysis were performed using a maximum altitude of 1600 m (5250 ft).

1. The VM600^{Mk2} SIL system has been designed for a HFT = 0. HFT = 1 can be achieved by implementing redundancy.
2. It is important to note that No effect failures (#) are no longer considered as safe-undetected failures (λ_{SU}), according to IEC 61508, edition 2 (2010).
3. Diagnostic coverage (DC) is the fraction of dangerous-detected failures (λ_{DD}) detected by automatic online diagnostic tests, that is, by the module's diagnostics (built-in self-test (BIST)).

See also 3.12 Failure rates.

3.6 Proof test

While the typical proof test interval (PTI) considering industry standards is 1 year, a longer PTI may be recommended based on the optimal PFDavg value as required for SIL 2 compliance.

See 6.1 Proof test for the actual proof test procedure, coverage and other necessary information.

All queries related to proof testing can be resolved by contacting your local Parker Meggitt representative or Meggtt SA.

3.7 Hardware requirements

A VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in a safety-related application must meet the following hardware requirements:

- The VM600^{Mk2} ABE04x system rack shall always be installed with redundant RPS6U rack power supplies.
- When the VM600^{Mk2} system (ABE04x rack) is turned on (powered), module's can only be inserted one at a time (that is, no more than one board can be plugged in at the same time).
- The VM600^{Mk2} system (ABE04x rack) must contain at least one MPC4^{Mk2} + IOC4^{Mk2} SIL machinery protection and condition monitoring module.
- At least one relay on each MPC4^{Mk2} + IOC4^{Mk2} SIL module shall be configured for system diagnostics which shall include (but not be limited to) sensor / measurement chain input status, module status or safety level thresholds (configured alarm limits) violation.

  This relay shall be connected to an emergency shutdown system (ESD) or logic solver in order to provide a safe state when a failure is diagnosed or an alarm alert/danger is detected by the module.
- The maximum current rating used by relays (safety outputs) must be two-thirds (⅔) of the maximum operational rating.
- Relay outputs (safety outputs) must be protected by external fuses, in order to avoid welding due to transient over-currents.
- Safety loops and non-safety loops (inputs and outputs) shall not be connected in the same module, that is, they shall be provided in separate modules.
- A proof test shall be performed by trained and authorised personnel periodically in accordance with this safety manual (*VM600^{Mk2} machinery monitoring system – SIL 2 MPS safety manual*). See 6.1 Proof test.
- A complete proof test of the VM600^{Mk2} system shall be performed after removing or replacing any modules or subcomponents that are part of the critical safety path. See 6.1 Proof test.
- If VM600^{Mk2}/VM600 XMx16 + XIO16T extended condition monitoring modules are also part of the VM600^{Mk2} MPS (rack), use of the Raw bus for sharing analog signals with these modules is not allowed for safety-relevant signals. Instead, such input signals should be shared via the XIO16T module's connector (rear of rack), that is, using external cabling.

  NOTE: The Raw bus must not be used to share safety-relevant signals between modules/cards.

- Use of the Alarm bypass (AB) function is not allowed.
- Use of the sensor/channel bypass (inhibit) function is not allowed.
- Upon detection of a failure by system diagnostics (that is, built-in self-test (BIST) running on MPC4^{Mk2} + IOC4^{Mk2} SIL and RLC16^{Mk2} SIL modules), the output relays or a separate alarm relay must de-energize to signal the failure.

- No more then 50 V isolation shall be claimed, as per IEC 61000.
- Physical access to and connections with a VM600^{Mk2} system (ABE04x rack) must comply with the security and cybersecurity requirements of the end-user's application (see 3.14 Environmental and application limits).

3.8 Software requirements

A VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in a safety-related application must meet the following software requirements:

- The VibroSight® software shall not be permanently connected to the VM600^{Mk2} system (ABE04x rack) for either standalone or networked systems/solutions.

  NOTE: Once configured, a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) can operate standalone, that is, without a computer permanently connected.

  A "functional safety program" shall restrict overall access to the VM600^{Mk2} MPS during normal operation.
- The alarms and relays must be configured depending on the role of the VM600^{Mk2} MPS in the safety loop. See 3.1 VM600^{Mk2} in a safety-related system.
- If a safety function is performed by the VM600^{Mk2} MPS only, any safety relay corresponding to an alarm must be configured as latched and normally energized (de-energized to trip).
- If a safety function is performed by an external system using an alarm detected by a VM600 system as an input, the relay corresponding to this alarm may be configured as not latched.
  However, an analysis must be carried out at the safety-related system level to ensure that no alarm can be missed or to identify all possible impacts and acceptability of residual risks in case of a missed alarm.
- The configuration of MPC4^{Mk2} + IOC4^{Mk2} SIL modules must detect faults in the module's sensor power supply outputs.
- The system configuration must be error free and signed for (authorized by a SIL system signature) using the VibroSight Protect configuration software. See 3.9 Configuration requirements.
- The VM600^{Mk2} MPS's processing options must be configured in accordance with this safety manual (*VM600^{Mk2} machinery monitoring system – SIL 2 MPS safety manual*).
- Any configuration changes to the VM600 MPS should be checked in accordance with this safety manual (*VM600^{Mk2} machinery monitoring system – SIL 2 MPS safety manual*).
- Software access to and communications with a VibroSight / VM600^{Mk2} system must comply with the security and cybersecurity requirements of the end-user's application (see 3.14 Environmental and application limits).

3.9 Configuration requirements

A VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in a safety-related application must meet the following configuration requirements:

- It is the end-user's responsibility to validate that the activated configuration performs as required within their overall safety-related system (SRS) via commissioning tests.
- By reading and interpreting the configuration (human-readable format (text-based XML)) displayed by the VibroSight Protect software when authorizing with a SIL system signature, the operator must check that the parameters are the correct ones for their specific use case (machine, speed, load, etc.) and execute a manual test.
- The end-user must approve the configuration by signing for it in the VibroSight Protect software (SIL system signature).

  This configuration verification and validation shall be formally recorded by the end-user (verification evidence).
- Live insertion and removal of modules (hot-swapping) with automatic reconfiguration is not permitted for the VM600^{Mk2} MPC4^{Mk2} + IOC4^{Mk2} SIL (see Table 1-1).

See also 4 Configuration and 4.2 Using VibroSight Protect

3.10 Systematic capability

Functional safety assessment has shown that the VM600^{Mk2} MPS meets all the relevant requirements of IEC 61508.

The internal inspection resulted in a systematic capability of SC 2 (SIL 2 capable) based on techniques and measures, including:

- Quality management systems in accordance with ISO 9001 and environmental management systems in accordance with ISO 14001.
- Development, documentation and review activities controlled by a formal quality system.
- Electromagnetic compatibility (EMC) and environmental tests with increased levels for safety-related products, with reference to the levels defined by IEC 61131-2.
- Functional testing.
- Systematic safety integrity route of 1s (that is, "by design").
- Thorough and comprehensible manuals covering installation, operation and maintenance.

3.11 Architectural and random constraints

Exida (Exida LLC, USA) has certified the VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) as SIL 2 capable in accordance with the IEC 61508 standard in a 1oo1 architecture. Therefore, a hardware fault tolerance of zero (HFT=0) has been assigned.

To achieve the targeted SIL 2, the VM600^{Mk2} MPS's safety-related parameters are:

- Average probability of dangerous failure on demand (PFDavg) of $<10^{-2}$.
- Useful lifetime of 50 years in low-demand mode or 8-10 years in high-demand mode.
- Type B safety-related device/subsystem.
- Hardware fault tolerance of zero (HFT=0) when used in a 1oo1 configuration.

  A HFT = 1 can be achieved by implementing redundancy.

3.12 Failure rates

Failure rates for individual VM600^{Mk2} machinery monitoring systems used as machinery protection systems (MPSs) can be assessed using the failure modes, effects and diagnostic analysis (FMEDA) report which can be made available on request. Contact your local Parker Meggitt representative or Meggitt SA for further information.

3.13 Diagnostic test interval

For VM600^{Mk2} systems, the cycle intervals (update rates) between system diagnostic tests (that is, the built-in self-test (BIST) running on MPC4^{Mk2} + IOC4^{Mk2} SIL and RLC16^{Mk2} SIL modules) are as follows:

- The main diagnostic function is called every processing cycle: 20 milliseconds.
- Some diagnostics can take up to 1 hour to run (for example, checking the DC saturation on module input channels) but most are very fast (on the order of milliseconds or seconds).
- One of the diagnostics is the temporal and logical monitoring. If it is failing (stuck in an infinite loop), the external watchdog will not be refreshed with the result that the system (modules) will be brought to a safe state (fail-safe mode) within 2 seconds maximum.

3.14 Environmental and application limits

VM600^{Mk2} SIL systems are limited to a maximum altitude of 1600 m (5250 ft), as this was the value used for the FMEDA calculations and analysis (see Table 3-1).

NOTE: Refer to the appropriate individual VM600^{Mk2} system component data sheets for general information on environmental and applications limits such as temperature, humidity, protection rating, vibration and shock.

See 1.12 Related documentation.

3.15 Security and cybersecurity concerns

NOTE: For a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in a safety-related system (SRS), the security and cybersecurity requirements of the end-user's application must be addressed.

A VM600^{Mk2} system (ABE04x rack) is designed to be connected to and communicate via a network (Ethernet interface(s)). So it is the responsibility of the system designers and operators (end-user) to provide and ensure a secure connection between the VM600^{Mk2} system (MPS) and their network and/or any other networks required by the application.

Accordingly, the end-user should establish and maintain appropriate security and cybersecurity measures in order to protect the VM600^{Mk2} system (MPS), the network, and any connected systems and interfaces against potential security threats. For example, unauthorized access, interference, leakage and/or data/information theft.

Typically, this involves requirements and user conduct for safe and secure operation such as:

- Restricting physical access to and/or securing equipment against physical tampering.
- Restricting software access through the use of strong passwords and keeping passwords private (that is, limited to authorized personnel only).

NOTE: The strongest passwords are created by password manager software, so the use of a password manager is recommended.

- To prevent session stealing, once logged in and after making changes, the user must immediately log out of the configuration computer. Never leave the computer without logging out.
- The configuration computer must not be accessible via an open/unprotected Ethernet (TCP/IP) network.

NOTE: The physical and logical isolation of critical networks, and their independence from non-control system networks is recommended. For example, a “safety domain” separated from the “control domain” either by firewalls or by implementation of a localised networks.

- VM600^{Mk2} system configuration information must only be disseminated to authorized personnel.
- Personnel must be properly trained to prevent authorized, improper configuration of the a VM600^{Mk2} system.
- The VibroSight software and VM600^{Mk2} system (MPC4^{Mk2} SIL module) firmware must be kept up-to-date, as directed by Parker Meggitt (Meggitt SA).

3.16Safety certificate(s)

The VM600^{Mk2} machinery monitoring systems used as machinery protection systems (MPSs) described in this safety manual are certified by Exida (Exida LLC, USA).

Accordingly, the Exida safety certificate and functional safety assessment report can be obtained:

- From the Parker Meggitt website at www.meggittsensing.com/energy
- From the safety/security automation equipment List (SAEL) pages of the Exida website at www.exida.com/SAEL-safety
- By contacting your local Parker Meggitt representative or Meggitt SA.

In addition, an Exida failure modes, effects and diagnostic analysis (FMEDA) report can be made available on request. Contact your local Parker Meggitt representative or Meggitt SA for further information.

3.17Operation and maintenance

Refer to the *VM600^{Mk2} machinery protection system (MPS) quick start manual* and the *VM600 machinery protection system (MPS) hardware manual* for general information on installation, commissioning, operation and maintenance. See 1.12 Related documentation.

4 CONFIGURATION

4.1 Configuring the system

FOR A VM600^{Mk2} MACHINERY MONITORING SYSTEM USED AS A MACHINERY PROTECTION SYSTEM, IT IS IMPORTANT THAT THE LEVELS (VIBRATION, PROXIMITY, PRESSURE, POSITION, SPEED, ETC.) ARE ADJUSTED TO PROVIDE THE PROTECTION REQUIRED BY THE EQUIPMENT/MACHINERY BEING MONITORED AND THAT A MANUAL VERIFICATION IS MADE OF THE PARAMETERS THAT ARE UPLOADED TO THE VM600^{Mk2} MPS (MPC4^{Mk2} + IOC4^{Mk2} SIL AND RLC16^{Mk2} SIL MODULES).

NOTE: The procedures described should only be performed by competent and authorised personnel following the plant specific guidelines in force at the installation site.

4.1.1 Define the levels

The choice of alarm limits (safety level thresholds) must be made in consultation with the site manager. It is the end-user's responsibility to ensure that the alarm levels are appropriate for the particular system being protected.

The levels are defined using the VibroSight Protect configuration software. Please refer to the appropriate documentation for complete information.

NOTE: Refer to the *VibroSight software* documentation for further information (see 1.12 Related documentation).

4.1.2 Define the alarm outputs

Any relay in a VM600^{Mk2} system (MPC4^{Mk2} + IOC4^{Mk2} SIL and/or RLC16^{Mk2} SIL modules) can be configured to provide the safety function. As previously noted in 3.1 VM600^{Mk2} in a safety-related system, for a safety relay corresponding to an alarm, the alarms and relays must be configured depending on the role of the VM600^{Mk2} MPS in the safety loop (see 3.1 VM600^{Mk2} in a safety-related system).

4.1.3 Upload the levels and configuration

Once the system parameters have been correctly defined using the VibroSight Protect configuration software, the configuration must be uploaded to the VM600^{Mk2} system (MPC4^{Mk2} + IOC4^{Mk2} SIL modules). In VibroSight Protect, the File > System activation command is used to upload the configuration to a system.

A configuration must be error free before it can be uploaded to a VM600^{Mk2} SIL system. In VibroSight Protect, a consistency checker (Consistency checks) automatically runs in the background to help with the generation of configurations.

After a configuration has been uploaded to a VM600^{Mk2} SIL system, the configuration must be signed in order to authorize it (that is, confirm that the configuration has been checked and is valid). In VibroSight Protect, the File > SIL system signature command is used to sign for and authorize any changes to the configuration of a VM600^{Mk2} SIL system. If a SIL system configuration is not signed for, a MPC4^{Mk2} SIL module will not run it.

For further information on configuring a VM600^{Mk2} SIL system, including activating and signing for a configuration, see 4.2 Using VibroSight Protect, 4.2.1 Configuring a VM600^{Mk2} SIL system, 4.2.2 Activating a VM600^{Mk2} SIL system and 4.2.3 Signing for a VM600^{Mk2} SIL system.

In addition, after a configuration has been uploaded to a VM600^{Mk2} SIL system and signed for (authorized), a MPC4^{Mk2} SIL module's Operational mode must be changed to Locked in order to actually run the configuration.

NOTE: For a VM600^{Mk2} SIL system (MPC4^{Mk2} + IOC4^{Mk2} SIL and RLC16^{Mk2} SIL modules), the MPC4^{Mk2} SIL module must run in the Locked Operational mode. See 4.3 MPC4^{Mk2} module operating modes.

For further information on the MPC4^{Mk2} module's operating modes, see 4.3 MPC4^{Mk2} module operating modes.

4.2 Using VibroSight Protect

4.2.1 Configuring a VM600^{Mk2} SIL system

In the VibroSight Protect configuration software, configuring a VM600^{Mk2} SIL system is very similar to configuring a standard VM600^{Mk2} system. However, there are a few important differences for VM600^{Mk2} SIL systems, as follows:

- On the Layout tab/page, when adding modules to a VM600^{Mk2}/VM600 rack, only SIL versions of the VM600^{Mk2} modules should be used, that is, MPC4^{Mk2} SIL (+ IOC4^{Mk2} SIL) and RLC16^{Mk2} SIL.
- On the Configure tab/page, when configuring a MPC4^{Mk2} + IOC4^{Mk2} SIL module, the serial numbers of both the MPC4^{Mk2} SIL and the corresponding IOC4^{Mk2} SIL must be specified.

  Note: In comparison, when configuring a (standard) VM600^{Mk2} module, only the serial number for the MPC4^{Mk2} module must be specified.
- On the Configure tab/page, when configuring a MPC4^{Mk2} SIL module, the Watch RLC16 relay status control is always enabled/selected, that is, a MPC4^{Mk2} SIL module must monitor the status of the relays on an associated RLC16^{Mk2} SIL module, if used.

  Note: In comparison, when configuring a (standard) VM600^{Mk2} module, monitoring the status of the relays on an associated RLC16^{Mk2} module is optional. That is, the Watch RLC16 relay status control is not used by default but can be enabled/selected, as required.
- On the Configure tab/page, when configuring a MPC4^{Mk2} SIL module, if the first auxiliary channel (AX1) is configured as a tachometer (speed) channel, then the second auxiliary channel (AX2) is automatically configured and used as a duplicate tachometer in the background.

  When the first auxiliary channel (AX1) is configured as a tachometer (speed) channel, VibroSight Protect will continue to display auxiliary 1 (AX1) as a tachometer but auxiliary 2 (AX2) will be hidden (that is, auxiliary 2 (AX2) is not displayed). It is still required that both auxiliary channels are connected to the tachometer signal externally, that is, via the AX1 and AX2 inputs on the associated IOC4^{Mk2} SIL module's J1 connector.

  See also 2.5.1 VM600^{Mk2} MPC4^{Mk2}+ IOC4^{Mk2} SIL and tachometer (speed) signals.

- On the Configure tab/page, when configuring a MPC4^{Mk2} SIL module, the Fault relay is selected by default, that is, a MPC4^{Mk2} SIL module's fault relay must always be used. The input to the fault relay can be configured as one of either: A failure in the MPC4 card or the VM600 power supply (the default) or A failure in the MPC4 card or the sensor chains or the VM600 power supply.

  Note: In comparison, when configuring a (standard) VM600^{Mk2} module, use of the MPC4^{Mk2} module's fault relay is optional. That is, the Fault relay is not used by default but can be enabled/selected and configured as required by the user.
- When configuring a RLC16^{Mk2} SIL module, there are no Logical functions on the relay module. Only Logical functions on MPC4^{Mk2} SIL modules can be used in a VM600^{Mk2} SIL system.

  Note: In comparison, when configuring a (standard) RLC16^{Mk2} module, there are Logical functions on the relay module that can be configured as required by the user.

NOTE: When configuring a VM600^{Mk2} SIL (or standard) system, the Consistency checks window (bottom) should be used to help detect and correct any configuration errors in order to help ensure that the configuration is correct and valid.

4.2.2 Activating a VM600^{Mk2} SIL system

In the VibroSight Protect configuration software, activating a VM600^{Mk2} SIL system is very similar to activating a standard VM600^{Mk2} system.

1- To activate a configuration, either the File > System activation menu command or the Activate control (under Module status) on the Dashboard tab/page can be used.

2- Then, after the Activate configuration window checks the system status and warns the user that the machinery protection function will temporarily interrupted, click Proceed to continue.

3- The configuration will be downloaded to the VM600^{Mk2} SIL system and start running – with measurement, status and control information displayed on the Dashboard tab/page.

However, there are a few important differences for VM600^{Mk2} SIL systems, as follows:

- When the configuration is activated and initially starts running on a VM600^{Mk2} SIL system, the MPC4^{Mk2} SIL module status is Unlocked but must be changed to Locked in order to be SIL compliant!

  Note: On the Dashboard tab/page, under Module status in the main window (right), Running Unlocked is displayed, and the LOCK/SAFE LED on the front panel of the module is red.
- To change a MPC4^{Mk2} SIL module status to Locked, either the Lock card control on the Dashboard tab/page can be used or button 2 (right) on the front panel of the module can be pressed and held for at least 1 s.
- Before a MPC4^{Mk2} SIL module can be Locked, its configuration (more specifically, the SIL machine protection configuration) must be signed! This is necessary in order to help ensure that any changes to a SIL system are authorised and that there is traceability of the changes made to a SIL configuration.

  Note: On the Dashboard tab/page, under Module status in the main window (right), Machinery protection configuration not signed is displayed, and the LOCK/SAFE LED on the front panel of the module is red.

4.2.3 Signing for a VM600^{Mk2} SIL system

In the VibroSight Protect configuration software, a VM600^{Mk2} SIL system configuration must be signed for – as proof of approval – before the VM600^{Mk2} SIL system can be Locked and thereby run as a SIL compliant system!

To sign a configuration, the configuration must first be downloaded to the VM600^{Mk2} SIL system, then either the File > SIL system signature menu command or the Sign control (under Module status) on the Dashboard tab/page can be used.

Then, the Sign SIL system window will download the configuration from the MPC4^{Mk2} SIL module and display it in a human-readable format (text-based XML) that allows it to be checked/verified. (Note that a CRC32 check value code that uniquely identifies the SIL configuration is also calculated and displayed.)

When the user is happy with the configuration, they can enter their identifier/signature (Signatory) and click Sign configuration (bottom right). The VibroSight software will then attach a digital signature, with a timestamp, to the SIL configuration that is stored on the module. Click Close to continue.

Note: On the Dashboard tab/page, under Module status in the main window (right), Machinery protection configuration signed by … is now displayed, and the LOCK/SAFE LED on the front panel of the module is red.

Once the VM600^{Mk2} SIL system configuration has been signed, the system can now be Locked in order to run as a SIL compliant system!

To lock a system (MPC4^{Mk2} SIL module), either use the Lock card control (under Module status) on the Dashboard tab/page or press and hold button 2 (right) on the front panel of the module for at least 1 s.

Note: On the Dashboard tab/page, under Module status in the main window (right), Running as SIL and Locked are displayed, and the LOCK/SAFE LED on the front panel of the module is green.

NOTE: Once a VM600^{Mk2} SIL system has been locked, it can only be unlocked by pressing button 2 (right) on the front panel of the MPC4^{Mk2} SIL module 5 times within 5 s. Accordingly, physical access to the MPC4^{Mk2} SIL module (front of VM600^{Mk2}/VM600 rack) is required to unlock a VM600^{Mk2} SIL system.

Finally, there are a few important differences for VM600^{Mk2} SIL systems that it is important to be aware of, as follows:

- When the configuration is activated and initially starts running on a VM600^{Mk2} SIL system, the MPC4^{Mk2} SIL module status is Unlocked but must be changed to Locked in order to be SIL compliant!

  Note: On the Dashboard tab/page, under Module status in the main window (right), Running Unlocked is displayed, and the LOCK/SAFE LED on the front panel of the module is red.
- To change a MPC4^{Mk2} SIL module status to Locked, either the Lock card control on the Dashboard tab/page can be used or button 2 (right) on the front panel of the module can be pressed and held for at least 1 s.
- Before a MPC4^{Mk2} SIL module can be Locked, its configuration (more specifically, the SIL machine protection configuration) must be signed! This is necessary in order to help ensure that any changes to a SIL system are authorised and that there is traceability of the changes made to a SIL configuration.

Note: On the Dashboard tab/page, under Module status in the main window (right), Machinery protection configuration not signed is displayed, and the LOCK/SAFE LED on the front panel of the module is red.

See also 3.9 Configuration requirements.

4.3 MPC4Mk2 module operating modes

The MPC4Mk2 module has a number of different operating modes, as shown in Figure 4-1.

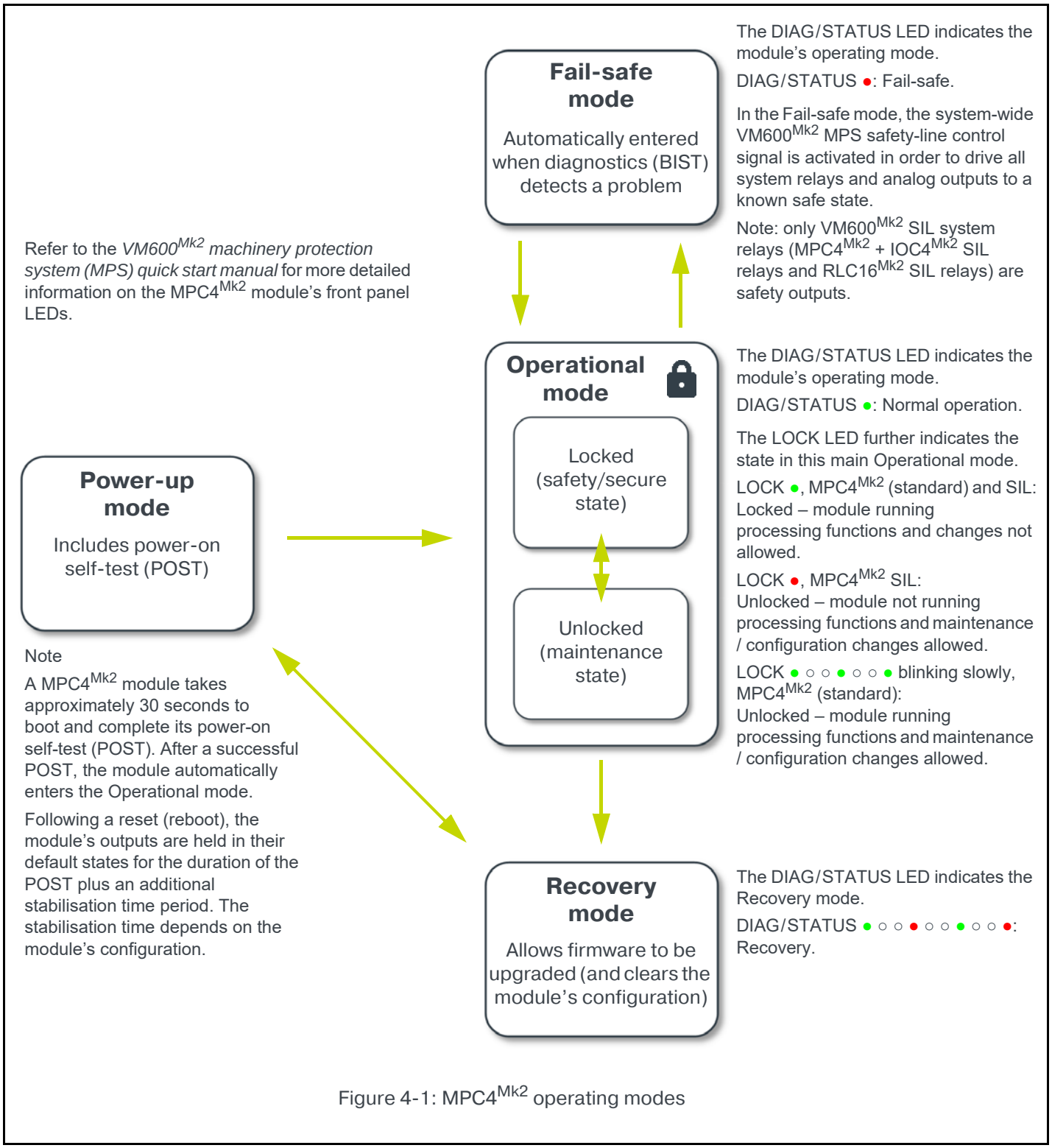

Figure 4-1: MPC4Mk2 operating modes

The VibroSight System Manager software can be used to obtain the operating mode of a MPC4Mk2 module.

4.3.1 Power-up mode

When power is first applied to a MPC4Mk2 module, the module automatically enters the Power-up mode.

In Power-up mode, the MPC4Mk2 module runs a power-on self-test (POST) which takes approximately 30 seconds.

After a successful POST, the module automatically enters the Operational mode if machinery protection firmware is available or enters the Recovery mode if machinery protection firmware is not available. But if the POST is not successful, then the module will enter the Fail-safe mode.

4.3.2 Operational mode

In general, a MPC4Mk2 module enters the Operational mode after successfully passing the power-on self-test (POST) in Power-up mode.

NOTE: Operational mode is the main operating mode of the MPC4Mk2 module, where the module can run all of its processing functions.

In Operational mode, the MPC4Mk2 module can be in one of two states, as follows:

- Locked (safety/secure state)

  When Locked, a MPC4Mk2 module (standard and SIL versions) performs its machinery protection processing functions while ensuring the security of the module/system and its configuration. More specifically, when in the Locked state the configuration cannot be changed and maintenance activities cannot be performed.

- Unlocked (maintenance state)

  When Unlocked:

  - A MPC4Mk2 SIL module does not perform any machinery processing functions, and the configuration can be changed and maintenance activities can be performed.
  - A MPC4Mk2 (standard) module performs its machinery processing functions, and the configuration can be changed and maintenance activities can be performed.
    Note: Although permitted, please note that changes will interrupt processing functions.

In the Operational mode, the MPC4Mk2 module indicates which state it is in, as follows:

- Locked (safety/secure state):
  - LOCK LED ● for MPC4Mk2 (standard and SIL versions).
  - Common circuit-fault relay (FAULT) energized.
- Unlocked (maintenance state)
  - LOCK LED ● for MPC4Mk2 SIL.
    LOCK LED ● ○ ○ ● ○ ○ ● blinking slowly for MPC4Mk2 (standard).
  - Common circuit-fault relay (FAULT) de-energized.

NOTE: The MPC4Mk2 module's LOCK LED indicates its state, as follows:
- LOCK ● for MPC4Mk2 (standard and SIL versions) indicates that it is Locked (safety/secure state).
- LOCK ● for MPC4Mk2 SIL indicates that is Unlocked (maintenance state).
- LOCK ● ○ ○ ● ○ ○ ● blinking slowly for MPC4Mk2 (standard) indicates that is Unlocked (maintenance state).

NOTE: The MPC4Mk2 module's common circuit-fault relay (FAULT) indicates its state/status, as follows:
• Relay energized indicates that the MPC4Mk2 (VM600Mk2 MPS) is Locked (that is, in the safety/secure state).
• Relay de-energized indicates that the MPC4Mk2 (VM600Mk2 MPS) is either Unlocked (that is, in the maintenance state) or is in the Fail-safe mode.

In the Operational mode, to switch between the two states, that is, between Locked (safety/secure state) and Unlocked (maintenance state):

- When Unlocked (maintenance state), press and hold button 2 (right) for at least 1 second to switch to Locked.
  Alternatively, in VibroSight Protect, on the Dashboard tab/page, the Lock control can be used to lock the module.

  NOTE: A MPC4Mk2 SIL module will not switch from Unlocked to Locked unless the configuration has been approved and signed for (SIL system signature). See 4.2.2 Activating a VM600Mk2 SIL system and 4.2.3 Signing for a VM600Mk2 SIL system.

- When Locked (safety/secure state), press button 2 (right) 5 times within 5 seconds to switch to Unlocked.

  NOTE: A MPC4Mk2 module will not switch from Unlocked to Locked when an Alarm bypass (AB) function is active.

4.3.3 Fail-safe mode

A MPC4Mk2 module enters the Fail-safe mode if the module does not pass the power-on self-test (POST) in Power-up mode or if the module does not pass the periodic internal diagnostics (built-in self-test (BIST)) in Operational mode.

In Fail-safe mode:

- The MPC4Mk2 module activates the system-wide VM600Mk2 MPS safety-line control signal in order to automatically drive all system relays (IOC4Mk2 and RLC16Mk2) and analog outputs (IOC4Mk2) to a safe state.

  NOTE: In a VM600Mk2 machinery protection system, the system-wide VM600Mk2 MPS safety-line control signal – associated with the Fail-safe mode – automatically drives all system relays (VM600Mk2 and RLC16Mk2) and analog outputs (IOC4Mk2) to a safe state should a problem be detected by the internal diagnostics (BIST).

- The MPC4Mk2 module de-energizes its common circuit-fault relay (FAULT) in order to indicate that a problem has been detected and that the VM600Mk2 system can no longer ensure the safety of the machinery being monitored.

Refer to the *VM600Mk2 machinery protection system (MPS) quick start manual* for more detailed information on the MPC4Mk2 module's operating modes and front panel LEDs.

5 INSTALLATION AND COMMISSIONING

5.1 Installation

For general information on the installation of a VM600^{Mk2} machinery monitoring system, refer to the *VM600^{Mk2} machinery protection system (MPS) quick start manual* and the *VM600 machinery protection system (MPS) hardware manual* (see 1.12 Related documentation).

NOTE: Environmental restrictions are described in Appendix A of the *VM600 machinery protection system (MPS) hardware manual*. See also 3.14 Environmental and application limits.

5.2 Commissioning

A VM600^{Mk2} MACHINERY MONITORING SYSTEM IS USED AS A MACHINERY PROTECTION SYSTEM (MPS) SHOULD BE COMMISSIONED AS AN INTEGRAL PART OF THE OVERALL SAFETY-RELATED SYSTEM COMMISSIONING.

NOTE: Installation and commissioning should only be performed by competent and authorised personnel following the plant specific guidelines in force at the installation.

5.2.1 Guidelines for commissioning

Installing a VM600^{Mk2} machinery monitoring system is fully described in the *VM600^{Mk2} machinery protection system (MPS) quick start manual* and the *VM600 machinery protection system (MPS) hardware manual* (notably, Part II of the hardware manual). See 1.12 Related documentation.

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6 OPERATION AND MAINTENANCE

6.1 Proof test

For a VM600^{Mk2} machinery monitoring system used as a machinery protection system (MPS) in safety-related applications, the following proof test is required in order to detect failures/faults which remain undetected by automatic online diagnostic tests (that is, by the module's diagnostics (built-in self-test (BIST)).

NOTE: The proof test should be performed in accordance with overall safety-system requirements.

The following proof test provides a proof test coverage (PTC) of 74%, that is, it will detect 74% of dangerous-undetected failures (λ_{DU}) in a VM600^{Mk2} safety-system (MPS) consisting of MPC4^{Mk2} + IOC4^{Mk2} SIL and RLC16^{Mk2} SIL modules.

Procedure

1- At the control system level (such as DCS/PLC or plant process computer), bypass the system safety function and take appropriate action to avoid a false shutdown ("trip") of the equipment/machinery being monitored.

NOTE: It is highly recommended that proof tests are only performed in accordance with the operating procedures for the equipment/machinery being monitored and/or protected, and that appropriate precautions are taken at the control system level.

2- Connect a computer running the VibroSight® software to the VM600^{Mk2} machinery monitoring system via the "LAN" connector on the front panel of the MPC4^{Mk2} module(s) (front of rack), either directly or via a network switch (see 2.3 Connecting a VM600^{Mk2} system to a computer).

3- Use the VibroSight software (digital communications) to retrieve any diagnostics from the VM600^{Mk2} machinery monitoring system and take appropriate action:
   - In VibroSight System Manager, System Explorer (Devices view), use the Save diagnostic logs command to download and save diagnostic information for any VM600^{Mk2} SIL modules.
   - In VibroSight Protect, use the Help > Save diagnostic information command to download and save diagnostic information for the VibroSight software and computer/system.

4- Cycle the power to the VM600^{Mk2} system (rack), for example, by turning the power supply off then on again.

NOTE: Power cycling removes any "soft" errors.

5- For the VM600^{Mk2} SIL modules in the system, for each input / measurement channel with a safety output:
   - Set the input to a signal level/value that should be detected as an alarm and cause the safety output to activate.
   - Ensure that the safety output is activated as expected in response to the change in the input signal level/value, that is, the VM600^{Mk2} MPS's safety function is exercised.

NOTE: The VibroSight Protect software can be used to check the configuration running on the VM600^{Mk2} system, such as alarm limits, logical functions and relay configurations.

6- Inspect the VM600^{Mk2} system (rack and modules) for any visible signs of damage or contamination.

7- At the control system level, remove the bypass of the system safety function and otherwise restore normal operation.

6.2 Maintenance and end-of-life product disposal

For general maintenance and end-of-life product disposal information, refer to the *VM600^{Mk2} machinery protection system (MPS) quick start manual* and the *VM600 machinery protection system (MPS) hardware manual*.
See 1.12 Related documentation.

7 SERVICE AND SUPPORT

7.1 Contacting us

Parker Meggitt's worldwide customer support network offers a range of support, including 7.3 Technical support and 7.4 Sales and repairs support. For customer support, contact your local Parker Meggitt representative. Alternatively, contact our Swiss (Meggitt SA) office:

Customer support department
Meggitt SA
Route de Moncor 4
Case postale
1701 Fribourg
Switzerland

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

7.2 SIL safety product information

For SIL products used in safety-related applications, Parker Meggitt (Meggitt SA) strongly recommends that you opt in and receive SIL product communications as this could include important future information concerning the safety of a product such as safety bulletins and/or product update/replacement information.

If you do not opt in to receive SIL product communications, you might not receive important future information concerning the safety of a product.

For products used in safety-related applications, it is important that:

- Parker Meggitt's technical support team is able to provide you and/or the end-user with product-related safety information such as service bulletins and/or product recalls.

  NOTE: Accordingly, the Energy SIL safety product communications procedure described on page 7-3 should be used in order to opt in and receive such SIL product communications.

- You and/or the end-user provide Parker Meggitt's technical support team with product-related applications information such as operating issues and/or failures.

  NOTE: Accordingly, the Energy product return procedure described on page 7-5 should be used in order to report problems and return Parker Meggitt energy products for repair.

7.3 Technical support

Parker Meggitt's technical support team provide both pre-sales and post-sales technical support, including:

- General advice
- Technical advice
- Troubleshooting
- Site visits.

NOTE: For further information, contact your local Parker Meggitt representative (see 7.1 Contacting us).

7.4 Sales and repairs support

Parker Meggitt's sales team provide both pre-sales and post-sales support, including advice on:

- New products
- Spare parts
- Repairs.

NOTE: If a product has to be returned for repairs, then this should be done in accordance with the Energy product return procedure described on page 7-5.

7.5 Customer feedback

As part of our continuing commitment to improving customer service, we welcome your comments. To provide feedback, complete the Energy customer feedback form on page 7-10 and return it to our Swiss (Meggitt SA) office (see 7.1 Contacting us).

SIL SAFETY PRODUCT INFORMATION

Energy SIL safety product communications procedure

In order for important future information concerning the use of a Parker Meggitt (Meggit SA) energy SIL safety product to be communicated to users, it is important that we have contact and product information for the users of SIL products.

Accordingly, in order to opt in and receive SIL safety product communications, please use the online SIL safety product communications procedure on the Parker Meggitt website at:
www.meggittsensing.com/energy/service-and-support/silproductcommunications

As described on the website, the SIL safety product communications procedure is as follows:

1- Complete and submit online the Energy SIL safety product communications form that is available on the website (note: * indicates a required field).

For each type of energy SIL safety product, a separate energy SIL safety product communications form must be completed and submitted online.

2- An acknowledgement email will be sent by return to confirm that the form was received and that your contact and product information has been added to the energy SIL safety product database managed by our Customer support department.

Accordingly, any important future information concerning the use of an energy SIL safety product will be communicated to you, should this become necessary.

NOTE: The Energy SIL safety product communications form reproduced below is included to support the gathering of information required for completion and submission online.

Energy SIL safety product communications form

Customer contact information

First name:*

Last name:*

Job title:

Company:*

Address:*

Country:*

Email:*

Telephone:*

Fax:

SIL safety product information

Product type:*

Part number (PNR):*

Serial number (SER):

Note: Enter “Unknown” if the serial number (SER) is not known.

Meggitt SA purchase order number:

Date of purchase (dd.mm.yyyy):

Site where installed:

End-user:

SIL safety product communications

Do you want to opt in and receive important communications information concerning your SIL safety product?:*

☐ Yes

☐ No

Note: For SIL safety products used in safety-related applications, Meggitt SA strongly recommends that you opt in to receive SIL product communications as this could include important future information concerning the safety of a product such as safety bulletins and/or product update/replacement information.

REPAIRS AND RETURNS

Energy product return procedure

If a Parker Meggitt (Meggit SA) energy product needs to be returned to our Swiss (Meggitt SA) office, please use the online product return procedure on the Parker Meggitt website at www.meggittsensing.com/energy/service-and-support/repair

As described on the website, all requests for product repair/return should be sent to Parker Meggitt (Meggitt SA), as follows:

1- Please complete and submit online the Energy product return form that is available on the website.

When the form has been processed by Meggitt, a return merchandise authorization (RMA) document and an end-user certificate (EUC) will be emailed by return, which typically takes a few days.

2- It is optional to issue a PO to Parker Meggitt (Meggitt SA) for every product (may include multiple items / serial numbers).

3- Return the product, together with the signed RMA and EUC, to the address indicated on the RMA.

NOTE: Do NOT send goods back to Parker Meggitt (Meggitt SA) without an RMA form! All goods returned must be accompanied by a fully completed and signed RMA form.

Notes:

- An asterisk (*) in the form below indicates a required field. JavaScript must be enabled (in your web browser) for the form to be displayed and completed correctly.
- For every product to be returned:
  - A separate form must be submitted online. Although multiple items of the same product (one part number, different serial numbers) can be covered by a single form.
  - An associated single-use EUC must be included, unless an annual EUC is in place for your company. Although multiple items of the same product can be covered by a single RMA and EUC.
- When a product is returned, all information is sent to our repair center in our Swiss (Meggitt SA) office. For any queries about product returns, please send an email to energysupport@ch.meggitt.com.
- The RMA document contains a unique reference number that should be used in all communications regarding a product return.

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

☐ Calibration / recertification

☐ Out-of-box problem

☐ Return

If the reason for return is “Repair”, please answer the following questions:*

Type of problem:

☐ Continuous

☐ Intermittent

☐ Temperature dependent

How long was the operating time before the problem?

Description of problem:

Note: Please provide a detailed description in order to help with problem diagnosis.

If the reason for return is “Out-of-box problem”, please answer the following questions:*

Type of out-of-box problem:

☐ Product damaged

☐ Incorrect product configuration

☐ Incorrect product delivered

☐ Problem with documentation / labelling

☐ Product dead-on-arrival

Additional information:

Note: 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 the problem?:

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.

When was it installed and first operated (dd.mm.yyyy)?:

When was a proof test last executed (dd.mm.yyyy)?:

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 the 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^{Mk2} machinery monitoring system – SIL 2 MPS safety manual

Reference:	MAVM600MK2-FS1/E	Version:	Edition 1
Date of issue:	March 2024		

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

Note: Please include any additional information in the “Feedback – additional” section below.

Feedback – additional

Additional information:

Note: Please provide as much feedback as possible in order to help us improve our product documentation.
Continue on a separate sheet if necessary …

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