MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Amikon cover with selected official Vibro-Meter pages

VM600 MACHINERY PROTECTION PLATFORM

VM600 MPC4 200-510-074-113

VM600 MPC4 MACHINERY PROTECTION CARD

OFFICIAL SOURCES

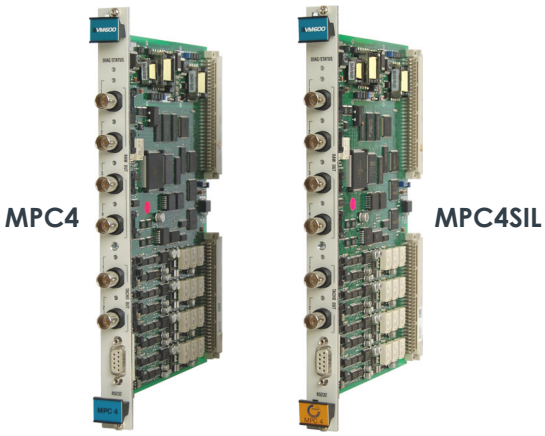
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MEGGITT

DATA SHEET

Vibro-Meter®

VM600 MPC4 machinery protection card



KEY FEATURES AND BENEFITS

- From the Vibro-Meter® product line
- Continuously online machinery protection card
- Real-time measurement and monitoring using state-of-the-art DSP techniques
- 4 dynamic signal channels and 2 tachometer (speed) channels, all individually programmable
- Programmable broad-band and narrow-band filters
- Simultaneous amplitude and phase monitoring in order-tracking mode
- Programmable Alert, Danger and OK set points
- Adaptive Alert and Danger levels
- Front-panel BNC connectors for easy analysis of buffered "raw" sensor signals
- Front-panel LEDs indicate status and alarms

KEY BENEFITS AND FEATURES *(continued)*

- Integrated power supplies for sensors and signal conditioners such as IEPE accelerometers and proximity measurement systems
- Live insertion and removal of cards (hot-swappable)
- Available in "standard", "separate circuits" and "safety" (SIL) versions

APPLICATIONS

- Machinery protection and/or basic condition monitoring

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DESCRIPTION

MPC4 card

The MPC4 machinery protection card is the central element in the VM600 series machinery protection system (MPS), from Meggitt's Vibro-Meter® product line. This very versatile card is capable of measuring and monitoring up to four dynamic signal inputs and up to two speed inputs simultaneously.

The dynamic signal inputs are fully programmable and can accept signals representing acceleration, velocity and displacement (proximity), among others. On-board multi-channel processing allows measurement of various physical parameters, including relative and absolute vibration, S_{max}, eccentricity, thrust position, absolute and differential housing expansion, displacement and dynamic pressure.

Digital processing includes digital filtering, integration or differentiation (if required), rectification (RMS, mean value, true peak or true peak-to-peak), order tracking (amplitude and phase) and measurement of the sensor-target gap.

The speed (tachometer) inputs accept signals from a variety of speed sensors, including systems based on proximity probes, magnetic pulse pick-up sensors or TTL signals. Fractional tachometer ratios are also supported.

The configuration can be expressed in metric or imperial units. Alert and Danger set points are fully programmable, as are alarm time delay, hysteresis and latching. The Alert and Danger levels can also be adapted as a function of the speed or any external information.

A digital output is available internally (on the corresponding IOC4T input/output card) for each alarm level. These alarm signals can drive four local relays on the IOC4T card and/or can be routed using the VM600 rack's Raw bus or Open Collector (OC) bus to drive relays on optional relay cards such as the RLC16 or IRC4.

The processed dynamic (vibration) signals and speed signals are available at the rear of the rack (on the front panel of the IOC4T) as analog output signals. Voltage-based (0 to 10 V) and current-based (4 to 20 mA) signals are provided.

The MPC4 performs a self-test and diagnostic routine on power-up. In addition, the card's built-in "OK system" continuously monitors the level of signals provided by a measurement chain (sensor and/or signal conditioner) and indicates any problem due to a broken transmission line, faulty sensor or signal conditioner.

An LED indicator on the MPC4 front panel indicates whether a processing or hardware error has occurred. Six additional LEDs (one per input channel) indicate whether the OK System has detected a fault and whether an alarm has occurred on the channel.

The MPC4 card is available in three versions: a "standard" version, a "separate circuits" version and a "safety" (SIL) version, all of which function as a card pair using a corresponding IOC4T input/output card.

Different versions of the MPC4 card

The MPC4 card is available in different versions, including "standard", "separate circuits" and "safety" (SIL) versions. In addition, some versions are available with a conformal coating applied to the circuitry of the card for additional environmental protection against chemicals, dust, moisture and temperature extremes.

Both the 'standard' version and the "safety" (SIL) versions of the MPC4 card are certified to IEC 61508 and ISO 13849, for use in functional safety contexts, such as SIL 1 in accordance with IEC 61508 and PL c in accordance with ISO 13849-1.

The "standard" MPC4 card is the original version and supports all features and processing modes. The "standard" MPC4 is intended for safety systems using a VM600 rack with a limited range of cards, that is, "standard" MPC4/IOC4T card pairs and RLC16 relay cards. It has a VME-compatible slave interface so it is software configurable via VME when there is a CPUx card acting as a rack controller in the VM600 rack. It is also software configurable via RS-232 (on the front panel of the card).

DESCRIPTION *(continued)*

The "safety" (SIL) MPC4 card, known as the MPC4SIL, was developed to permit a wider range of installation options. Specifically, VM600 racks that also contain condition monitoring cards such as the XMx16 and relay cards such as the IRC4. To safety certify these configurations, it was necessary to ensure that the MPC4SIL is isolated from the other cards in a VM600 rack, so that there is no possibility of its configuration being inadvertently modified.

Therefore, the MPC4SIL card does not include a VME-compatible slave interface, does not support the tachometer (speed) channels and does not provide all of the signal processing capabilities of the "standard" MPC4 card (see **Additional specifications – for "standard" and "separate circuits" MPC4 cards only on page 9**).

Segregation of MPS and CMS

The VM600 rack, machinery protection cards, condition monitoring cards and associated software are designed for compliance with the machinery protection system (MPS) and condition monitoring system (CMS) segregation requirements of the API 670 standard, which ensures that the functionality of the MPS does not depend on and is not compromised in any way by the operation of the CMS.

So although machinery protection cards and condition monitoring cards can easily share sensor signals from measurement chains, MPC4/IOC4T card pairs do not share any communication buses with XMx16/XIO16T condition monitoring card pairs in a VM600 rack, and MPC4/IOC4T card pairs are configured and operated using the VM600 MPSx software (while XMx16/XIO16T card pairs are configured and operated using the VibroSight® software).

Applications information

When used as a card pair with an IOC4T input/output card, the MPC4 is highly suitable for machinery monitoring and protection in a wide range of industrial applications.

For further information on the use of MPC4/IOC4T card pairs in general, refer to the *VM600 machinery protection system (MPS) hardware manual* and the *VM600 MPSx software manuals*. For information on the use of MPC4/IOC4T card pairs in functional safety contexts, refer to the refer to the *VM600 functional safety manual*.

For specific applications, contact your local Meggitt representative.

SPECIFICATIONS – COMMON TO ALL MPC4 CARDS

Dynamic signal inputs

Number of inputs	: 4 per MPC4 card
DC range	: 0 to +20 V or 0 to −20 V
AC range	: ±10 V max.
Common mode voltage range	: −50 to +50 V
CMRR	: >60 dB at 50 Hz
Crosstalk	: −72 dB
Input impedance	: 200 kΩ
Current input range	
• DC signals	: 0 to 25 mA
• AC signals	: ±8 mA max.
Analog frequency range	: DC to 60 kHz (−3 dB). : Note: Applicable when dynamic signal outputs are shared using the Raw bus (VM600 rack). Dynamic signal outputs can be shared with XMx16/XIO16T card pairs but cannot be shared with other MPC4/IOC4T card pairs.
Analog AC frequency range	
• *Without integration*	: 0.1 Hz to 10 kHz
• *With integration*	: 2.5 Hz to 10 kHz
Current measuring resistor	: 324.5 Ω

Buffered dynamic signal outputs

The buffered "raw" dynamic signal outputs are available on the front-panel BNC connectors (MPC4 card) and the screw-terminal connectors (IOC4T card).

Output impedance	: 50 Ω
Analog frequency range	: DC to 10 kHz (−0.1 dB with a load >1 MΩ). DC to 10 kHz (−0.2 dB with a load >200 kΩ). DC to 40 kHz (−3 dB). Note: Applicable when buffered "raw" dynamic signal outputs are shared using the front-panel BNC connectors (VM600 MPC4 card) and the screw-terminal connectors (VM600 IOC4T card).
Phase error	: <5° (DC to 1 kHz). <30° (DC to 10 kHz).
Transfer ratio	
• Voltage input	: 1 V/V
• Current input	: 0.3245 V/mA

Speed / phase reference inputs and outputs

See **Additional specifications – for "standard" and "separate circuits" MPC4 cards only on page 9**.
The "standard" and "separate circuits" versions of the MPC4 card support speed/phase reference inputs and buffered speed/phase reference outputs but the "safety" version of the card (MPC4SIL) does not.

Discrete signal interface (DSI) inputs

Discrete signal interface (DSI) control signal inputs are available on the associated IOC4T card.
Refer to the IOC4T input/output card data sheet for further information.

SPECIFICATIONS – COMMON TO ALL MPC4 CARDS *(continued)*

Analog (DC) outputs and discrete outputs

Analog (DC) outputs and discrete outputs (relays) are available on the associated IOC4T card.
Refer to the IOC4T input/output card data sheet for further information.

Measurement chain OK check (OK system)

Number of levels	: Two configurable threshold levels (upper and lower)
OK level range	
• Voltage inputs	: ±20 V_{DC}
• Current inputs	: 0 to 23 mA
Operating principle	
• Powered sensors	: Line-fault detection of conditions such as open-circuit or short-circuit
• Unpowered sensors	: Line-fault detection of conditions such as open-circuit

Processing functions

Broad-band processing

Filtering options	: High-pass, low-pass or band-pass
LP/HP ratio in pass band	: 500 max.
Ripple	: ±0.3 dB
Slope	: 6 to 60 dB/octave (software configurable)
Attenuation outside pass band	: >50 dB
Amplitude accuracy	: ±1% of full-scale
Linearity error	: <±1%
Equivalent input noise (without integration)	: <200 µV RMS

Narrow-band (tracking) processing

See **Additional specifications – for "standard" and "separate circuits" MPC4 cards only on page 9**.
The "standard" and "separate circuits" versions of the MPC4 card support narrow-band tracking but the "safety" version of the card (MPC4SIL) does not.

Relative shaft vibration processing

Frequency range	
• Vibration	: 0.1 Hz to 10 kHz
• Gap/position	: DC to 1 Hz
Amplitude accuracy	
• Vibration	: ±1% of full-scale
• Gap/position	: ±1% of full-scale
• Linearity error	: <±1%
Initial gap/offset compensation	: Available

SPECIFICATIONS – COMMON TO ALL MPC4 CARDS *(continued)*

Alarm processing and combination

Level detectors	
• Vibration systems	: Over-level switching (A+, D+) and under-level switching (A−, D−)
• Accelerometer systems	: Over-level switching (A+, D+)
• Speed channel	: 2 Alert levels (A−, A+)
Alarm scanning interval	: 100 ms max.
Alarm level value	: User-programmable within range
Hysteresis	: User-programmable within range
Latching	: User-programmable within range
Alarm delay time	: User-programmable within range
Alarm outputs	: Individual alarms and common alarms (open-collector transistor)
Adaptive monitoring	: Adaptive monitoring uses a control parameter (such as speed) to multiply the configured alarm limits by multiple coefficients configured for different ranges of the control parameter. Trip multiplier uses the DSI TM control signal to multiply the configured alarm limits by a single configurable coefficient.
Adaptation criteria (for adaptive monitoring)	: Speed or digital input
Logical combinations	: AND, OR and majority voting logic
Number of logical combinations	: 8 basic functions and 4 advanced functions

Environmental

Temperature	
• Operating	: −25 to 65°C (−13 to 149°F)
• Storage	: −40 to 85°C (−40 to 185°F)
Humidity	
• Operating	: 0 to 90% non-condensing
• Storage	: 0 to 95% non-condensing

Approvals

Conformity ("standard" and "safety" versions)	: CE marking, European Union (EU) declaration of conformity. EAC marking, Eurasian Customs Union (EACU) certificate / declaration of conformity.
Electromagnetic compatibility	: IEC/EN 61000-6-2 and IEC/EN 61000-6-4. TR CU 020/2011.
Electrical safety	: IEC/EN 61010-1. TR CU 004/2011.
Vibration	: IEC 60255-21-1 (Class 2)
Insulation coordination for measuring relays and protection equipment	: Separate circuits according to IEC 60255-5 for the "separate circuits" version of the MPC4
Safety integrity level	: SIL 1 according to IEC 61508 for the "safety" version of the MPC4
Environmental management	: RoHS compliant
Russian federal agency for technical regulation and metrology (Rosstandart)	: Pattern approval certificate CH.C.28.004.A N° 60224

SPECIFICATIONS – COMMON TO ALL MPC4 CARDS *(continued)*

Communications

VME bus	: A24/D16 slave mode
RS-232 port	: Configuration and communications port, proprietary protocol (see **Connectors on page 8**)
MPC4 to IOC4T bus	: Similar to industry pack (IP)

Note: The VME bus provides access to the MPC4/IOC4T card pair via a CPUx card, in order to support Ethernet and/or fieldbus communications. The RS-232 port (front-panel serial interface) provides access to the MPC4/IOC4T card pair for standalone operation, that is, when a CPUx card is not installed in the VM600 rack. An MPC4/IOC4T card pair is software configurable via VME or RS-232 (see **Configuration on page 7)**.

Note: The "standard" and "separate circuits" versions of the MPC4 card include a VME bus but the "safety" version of the card (MPC4SIL) does not. Therefore, the "standard" and "separate circuits" versions of the MPC4 card are software configurable via RS-232 or VME but the MPC4SIL card is software configurable via RS-232 only.

Configuration

MPC4/IOC4T card pair	: Software configurable via an RS-232 or Ethernet connection, using a computer running the VM600 MPSx software. Hardware configurable using jumpers on the MPC4/IOC4T card pair.

Note: Configuration via an Ethernet connection requires a CPUx card acting as a rack controller in the VM600 rack.

Status indicators (LEDs)

DIAG/STATUS	: One multicolour (green/yellow/red) LED used to indicate the status of the MPC4/IOC4T card pair, such as normal operation, configuration status or internal hardware or firmware failures
RAW OUT 1 to 4	: Four multicolour (green/yellow/red) LED used to indicate the status of the individual dynamic channels
TACHO OUT 1 to 2	: Two multicolour (green/yellow) LED used to indicate the status of the individual tachometer (speed) channels

Power supply to card (input)

Power source	: VM600 rack power supply
Supply voltages	: +5 V_{DC} and ±12 V_{DC}
Consumption from +5 V_{DC} supply	: 12.5 W typ., plus an additional 1 W per sensor used
Consumption from ±12 V_{DC} supply	: 2.5 W max.

Power supply to sensors (output)

Voltage power supply	: +27.2 V ±5% in the range 0 to 25 mA. −27.2 V ±5% in the range 0 to 25 mA. +15.0 V ±5% in the range 0 to 25 mA.
Current power supply	: 6.16 mA ±5% in the range 1 to 23 V
Over-current protection (on-board)	: 11.0 A on +5 V line

SPECIFICATIONS – COMMON TO ALL MPC4 CARDS *(continued)*

Connectors

RAW OUT 1	: BNC connector (female). Buffered "raw" sensor output (analog signal) for dynamic measurement channel 1.
RAW OUT 2	: BNC connector (female). Buffered "raw" sensor output (analog signal) for dynamic measurement channel 2.
RAW OUT 3	: BNC connector (female). Buffered "raw" sensor output (analog signal) for dynamic measurement channel 3.
RAW OUT 4	: BNC connector (female). Buffered "raw" sensor output (analog signal) for dynamic measurement channel 4.
TACHO OUT 1	: BNC connector (female). Buffered "raw" sensor output (digital signal) for tachometer (speed) channel 1.
TACHO OUT 2	: BNC connector (female). Buffered "raw" sensor output (digital signal) for tachometer (speed) channel 2.
RS232	: 9-pin D-sub connector (DCE), female. Serial connection for communication between the MPC4/IOC4T card pair and a computer running the VM600 MPSx software. Note: The RS232 connector allows a connection to a host computer using a standard serial cable.

Physical

Height	: 6U (262 mm, 10.3 in)
Width	: 20 mm (0.8 in)
Depth	: 187 mm (7.4 in)
Weight	: 0.40 kg (0.88 lb) approx.

ADDITIONAL SPECIFICATIONS – FOR "STANDARD" AND "SEPARATE CIRCUITS" MPC4 CARDS ONLY

Speed / phase reference inputs

Number of inputs	: 2 per MPC4 card
Triggering method	: Crossing of thresholds on rising/falling edge of signal
Triggering thresholds	: Rising = 2/3 of peak-peak value, falling = 1/3 of peak-peak value
Tachometer range	: 0.016 Hz to 50 kHz on input. 0.016 Hz to 1092 Hz (1 to 65535 RPM) after division by the wheel teeth number.
Speed resolution	: 0.001 Hz (internal)
Input voltage range	: 0.4 to 500 Vpp in the range 0.3 Hz to 10 kHz. 2.0 to 500 Vpp in the range 10 kHz to 50 kHz.

Minimum input voltage for reliable detection

• Square-wave input signal	: 0.8 Vpp (0.016 Hz to 10 kHz). 2.0 Vpp (10 kHz to 50 kHz).
• Sinusoidal input signal	: 10 Vpp (0.016 Hz to 1 Hz). 2.0 Vpp (1 Hz to 10 Hz). 0.8 Vpp (10 Hz to 10 kHz). 2.0 Vpp (10 kHz to 50 kHz).
Range of DC component	: −20 to +20 V

⚠ For speed/phase reference input channels, it can be more difficult to achieve the minimum input voltage required when current is selected as the signal transmission mode. Therefore, the 200 Ω current-to-voltage conversion resistor used by the MPC4 card for current-modulated input signals should be used in any system design calculations in order to help ensure reliable detection.

Buffered speed / phase reference outputs

The buffered "raw" speed/phase reference outputs are available on the front-panel BNC connectors (MPC4 card).

BNC outputs	: TTL compatible
Outputs to IOC4T and Tacho bus (VM600 rack)	: TTL compatible
Speed resolution	: 1 RPM (external)

Processing functions

Narrow-band (tracking) processing

Constant Q filter	: Q = 28
Frequency range	: 0.15 Hz to 10 kHz
Max. frequency ratio in selected band	: f_{upper} / f_{lower} = 25
Rate of change of speed	: 450 Hz/sec. (in band 25 to 500 Hz)
Order extraction	: 1/3 X, 1/2 X, 1X, 2X, 3X, 4X
Phase error	: <±6° max. <±1° typ. (with order = 1X).
Amplitude accuracy	: ±1.2%
Linearity error	: <±1%

Note: MPC4 card speed/phase reference (tachometer) channels and any associated processing, and narrow-band (tracking) processing are not valid for use in safety-related system applications. That is, these MPC4 card processing modes (signal processing functions) are not included in the SIL 1 certification for the card and should not be configured and used in functional safety contexts. For further information, refer to the *VM600 functional safety manual*.

ORDERING INFORMATION

To order please specify

Type	Designation	Ordering number (PNR)
MPC4	Different versions of the VM600 machinery protection card:	
	– Standard	200-510-SSS-1Hh
	– Separate circuits	200-510-SSS-2Hh
	– SIL safety (MPC4SIL)	200-510-SSS-3Hh

Notes
Versions of the MPC4 card are available with a conformal coating ("varnish") applied to the circuitry of the card for additional environmental protection against chemicals, dust, moisture and temperature extremes.

In 2017, the MPC4 / IOC4T machinery protection card pairs were improved to (1) be RoHS compliant and (2) provide a reduced buffered dynamic signal output impedance, which required a redesign of the underlying buffered "raw" dynamic signal output circuitry. Accordingly, the different versions of the MPC4/IOC4T machinery protection card pairs in use are:

- Later versions of the MPC4 (PNRs 200-510-SSS-115, 200-510-SSS-214 and 200-510-SSS-313 or later) and IOC4T (PNR 200-560-000-114 and 200-560-000-212 or later), which are RoHS compliant and have an output impedance of 50 Ω.
- Earlier versions of the IOC4T (PNRs 200-510-SSS-114, 200-510-SSS-213 and 200-510-SSS-312 or earlier) and IOC4T (PNR 200-560-000-113 and 200-560-000-211 or earlier), which are not RoHS compliant and have an output impedance of 2000 Ω.

"SSS" represents the firmware (embedded software) version and "Hh" the hardware version. "H" increments are for major modifications that can affect product interchangeability. "h" increments are for minor modifications that have no effect on interchangeability.

RELATED PRODUCTS

ABE04x	VM600 system racks	: Refer to corresponding data sheet
ABE056	VM600 slimline rack	: Refer to corresponding data sheet
AMC8 and IOC8T	VM600 analog monitoring card pair	: Refer to corresponding data sheet
CPUM and IOCN	VM600 modular CPU card and input/output card. Note: With a front-panel display and support for Modbus RTU/TCP or PROFINET.	: Refer to corresponding data sheet
CPUR and IOCR	VM600 rack controller and communications interface card pair. Note: With rack controller redundancy and support for Modbus RTU/TCP.	: Refer to corresponding data sheet
CPUR2 and IOCR2	VM600 rack controller and communications interface card pair. Note: With mathematical processing of fieldbus data and support for Modbus TCP and PROFIBUS.	: Refer to corresponding data sheet
IOC4T	VM600 input/output card (for the MPC4)	: Refer to corresponding data sheets
IRC4	VM600 intelligent relay card	: Refer to corresponding data sheet
MPC4G2 and IOC4G2	VM600 machinery protection card pair	: Refer to corresponding data sheet
RLC16	VM600 relay card	: Refer to corresponding data sheet
RLC16G2	VM600 relay card	: Refer to corresponding data sheet
XMx16 and XIO16T	VM600 condition monitoring card pairs	: Refer to corresponding data sheet

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