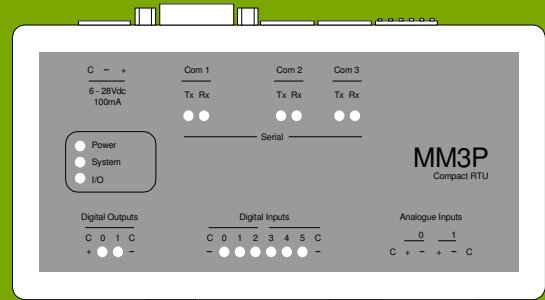


## Compact MM3P

The Compact MM3P is an ultra-compact RTU with the sophisticated IEC61131 programming and telemetry functionality associated with much larger and more expensive devices. Fully compatible with the well-established Metasphere product range and expandable using multiple



Compact MM3Ps or standard field bus devices, the Compact MM3P provides a very low cost, low risk fit-and-forget telemetry solution in a very small footprint.

### Key Functionality:

- Very low cost fit-and-forget unit housed in a compact DIN-rail mountable moulded enclosure.
- Fully compatible with established Metasphere MC2000 Telemetry System and Micro Medina range of RTU devices.
- Fully IEC61131-3 programmable, supporting all standard programming languages: Function Block Diagram (FBD), Ladder Diagram (LD), Sequence Function Chart (SFC), Structured Text (ST) and Instruction List (IL).
- Versatile power supply with wide input range, suitable for both 12Vdc and 24Vdc systems.
- Embedded digital input, counter input, analogue input and digital output channels for flexible, low cost application.
- Multiple serial interfaces with Modbus RTU master and slave protocol support enable flexible I/O expansion and system integration.
- Comprehensive LED status indications for at-a-glance system health monitoring.
- Used in conjunction with an external modem, the Compact MM3P is compatible with a wide variety of communications media, including UHF radio, PSTN, GSM and GPRS.

### EMBEDDED I/O

The following embedded I/O is included on all models:

- 6 digital inputs, five with counter support up to 1KHz
- 2 analogue inputs, configurable as 0-2V, 0-5V, or 0-20mA
- 2 digital outputs, 9-30Vdc, 0.25A continuous

The digital inputs are suitable for clean-contact operation and have individual opto-isolation and common field supply (up to 30Vdc) and return (0V).

The analogue inputs are 12-bit resolution and are individually isolated, differential voltage inputs with optional current to voltage convertor module. The input range is software selectable.

The digital outputs are fully isolated (250Vac), open collector drivers with built-in protection diodes. The outputs are rated for 0.25A continuous operation with a supply of 9-30Vdc.

The internal temperature and power supply voltage are also continuously monitored using internal analogue input channels.

# Product Data Sheet

Compact MM3P



## COMMUNICATIONS INTERFACES

Three asynchronous serial communications interfaces are included:

- COM1 (RS232C) provides all of the standard modem control lines (DCD, DTR, DSR and RI) and RTS/CTS hardware flow control.
- COM2 (RS232C) with RTS/CTS hardware flow control.
- COM3 has build variants for RS232C or RS485, with RTS/CTS hardware flow control on the RS232C variant.

XON/XOFF software flow control is supported for all communications interfaces.

Data rates, data formats and handshake configuration are independently configurable. Standard data rates up to 19200 Baud are supported; data formats supported include 7, 8 and 9-bit data, 1 and 2 stop bits, odd, even and no parity.

Typically, COM1 is for modem connection to the Data Centre, COM2 for local programming workbench (PC) connection and COM3 for expansion I/O.

## IEC61131-3 PROGRAMMABLE

The Compact MM3P supports all five of the IEC61131-3 standard programming languages: Sequential Function Chart (SFC), Function Block Diagram (FBD), Ladder Diagram (LD), Structured Text (ST) and Instruction List (IL). Simply select the programming language to match your engineers' expertise and the application needs; translation between languages is included in the IEC61131 programming workbench.

Sophisticated I/O processing, filtering, alarm and event handling, trending, monitoring and control operations are readily implementable.

The IEC61131 programming workbench includes all of the tools to support the configuration, programming, simulation, on-line debugging and monitoring of Compact MM3P in an integrated environment.

Programs, user functions and function blocks are compiled to space efficient byte-code that is downloaded, stored and executed by the Compact MM3P resident virtual machine; the Compact MM3P has 32Kbytes of compiled memory space sufficient for the most complex control and monitoring applications. 150Kbyte solid-state file space is available for alarm, event, trend data and program storage.

## MODBUS RTU PROTOCOL

The Compact MM3P supports the Modbus RTU communications protocol. Any Compact MM3P serial interface is configurable for Modbus slave operation. COM1 and COM3 may be configured for Modbus master operation.

The Compact MM3P supports the following Modbus function codes:

Code	Purpose	Code	Purpose
01	Read Coil Bits	05	Write single coil
02	Read discrete inputs	06	Write single register
03	Read holding registers	15	Write coil bits
04	Read input registers	16	Write holding registers

Any embedded or remote input and output or internal variable can be mapped to Modbus coils and registers. 32-bit data types (DINT and REAL) are supported by mapped to two consecutive registers.

Modbus master operation allows a single Modbus RTU slave device on RS232C communications (COM1 or COM3) or multiple Modbus slave devices on RS485 (COM3). A maximum of three Modbus slave devices per serial port is recommended for practical applications; more slave devices can be used where slow update and response times are acceptable. User defined data blocks identify the Modbus slave addresses and ranges of coils and registers to be exchanged. Polling interval, "on value change" and "on software call" update methods are configurable for each data block. Internal variables can be allocated to provide Modbus communications status information and control.

Modbus slave operation is available on COM1, COM2 and COM3 configured with any valid Modbus slave address. User defined data blocks identify the ranges of coils and registers to be exchanged.

# Product Data Sheet

Compact MM3P



## STATUS INDICATORS

The Compact MM3P provides a comprehensive set of status indicators on the front of the unit, as follows:

- Individual digital input status indicators
- Individual digital output status indicators
- Transmit and receive activity LEDs for each serial port
- Power on LED
- System status LED
- I/O status LED

Each digital input has an input status LED; the LED is on to indicate that the input is on (switch closed) and off to indicate that the input is off (switch open).

A LED for each digital output indicates the output status; the LED is on to indicate that the output is driven on and off when the output is off.

The serial port LEDs are green for transmit activity and red for receive activity.

- Start-up is the initial mode when power is applied; in this mode the hardware is initialised, start-up tests executed, and the solid-state file system and operating system initialised.
- In Idle mode, re-programming is enabled; no user program or configuration is active.
- RTU mode is the normal operating mode; user programs, communications and I/O are active.
- Diagnostic mode provides local off-line hardware monitoring and test facilities.

Compact MM3P Mode	System status LED condition	Flash Period
Start-up	Very fast flash	200ms
Idle	Fast Flash	1s
RTU (normal)	Slow Flash	2s
Diagnostic	See Note <sup>1</sup>	-

Note<sup>1</sup> In Diagnostic Mode the System and I/O LEDs are controlled directly by the diagnostic functions.

The I/O LED shows local I/O health status; and will be on in RTU mode when the I/O is in use.

For further details of the Compact MM3P Modes, please refer to the User's Manual.

## DIAGNOSTIC MODE

Diagnostic Mode is used locally in conjunction with a VT100-compatible terminal to provide a comprehensive suite of hardware test functions (embedded IO, memory, Com ports etc) which can be used to verify the device functionality in the event of a suspected hardware problem. For details: see Application Note AN004 - Using the MM3P Diagnostic Utilities.

## ACCESSORIES

A number of standard Compact MM3P accessories are available:

- IEC61131 Programming Workbench PC Software (CD)
- Mains adapter (includes power connector)
- RJ11 to RJ11 cable
- RJ11 to DB9(F) Adapter
- DB9(M) to DB9(F) serial extension cable
- 3-way power connectors
- 4-way I/O connectors for DOs
- 6-way I/O connectors for AIs
- 8-way I/O connectors for DIs
- 2.5mm narrow terminal screwdriver
- ACM module
- Compact MM3P Test Interface
- DIN rail mounting bracket

As standard, the Compact MM3P is supplied with a power connector and a full set of I/O connectors.

For first time users, a Compact MM3P starter pack can be purchased containing everything required to get a Compact MM3P up and running.

Other accessories are also readily available to simplify installation of the Compact MM3P at existing or difficult sites. Further details are available upon request.

# Product Data Sheet

Compact MM3P



## POWER SUPPLY

The Compact MM3P requires a supply of 6-28Vdc at 100mA, suitable for the majority of 12Vdc and 24Vdc installations.

Alternatively, a low cost external mains adapter (not included) can provide power.

The supply voltage is continuously monitored using an internal analogue input.

### Power Connector

Function	Pin	
Supply (8-28Vdc)	+	
0V return	-	

## CONNECTORS

All connections to and from the Compact MM3P are made via plug-in connectors so that the device can be removed and/or replaced quickly and without disturbing the plant wiring.

The I/O and power connectors each have separate plug-in screw terminals. The Power connection details are included in the Power Supply Section. The I/O connection details are included in the I/O type in the Plant Wiring Section. The Compact MM3P front labelling also shows the pin assignments for these terminals.

The following tables show the connector pin-outs for the COM ports:

### COM1: 9-way D-type (male)

Function	Pin	
DCD (in)	1	
RXD (in)	2	
TXD (out)	3	
DTR (out)	4	
Signal Ground	5	
DSR (in)	6	
RTS (out)	7	
CTS (in)	8	
RI (in)	9	

### COM2: 6-way RJ11

Function	Pin	
Signal Ground	1	
RTS (out)	2	
RXD (in)	3	
TXD (out)	4	
CTS (in)	5	

### COM3: (RS232C variant only) 6-way RJ11

Function	Pin	
Signal Ground	1	
RTS (out)	2	
RXD (in)	3	
TXD (out)	4	
CTS (in)	5	

### COM3: (RS485 variant only)

Function	Pin	
A	1	
B	2	
Signal Ground	3	

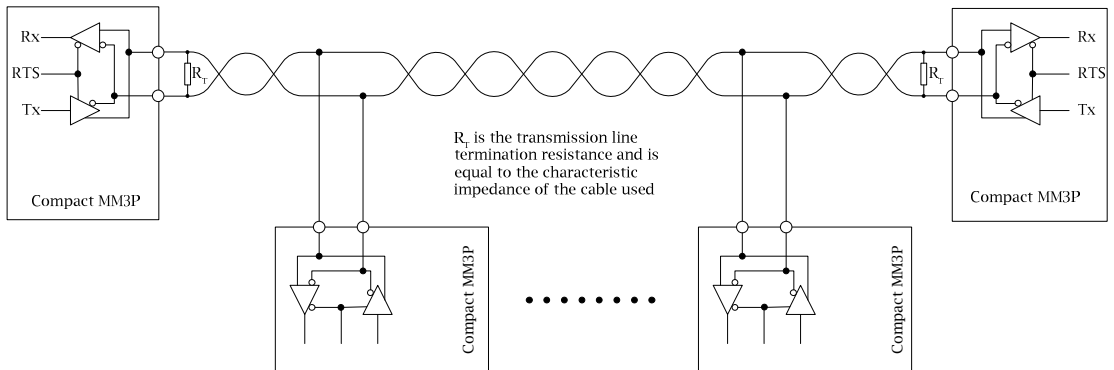
# Product Data Sheet

Compact MM3P



## RS485 INTERFACE

The Compact MM3P is available with an RS485-compliant interface on COM3, which can be used for bidirectional half-duplex communications on balanced multi-point bus transmission lines. Primarily intended for I/O expansion, this interface allows multiple MM3P devices to be interconnected. Alternatively expansion I/O can be implemented using (for example) a PLC or Modbus remote I/O and accessed via COM3 using Modbus RTU protocol.



The standard RS485 receiver input impedance, called a unit load, is  $12K\Omega$ ; a standard RS485 driver can drive up to 32 such loads. The Compact MM3P RS485 transceivers present an eighth of this unit load ( $96K\Omega$ ) which allows up to 256 Compact MM3Ps on a RS485 communication link.

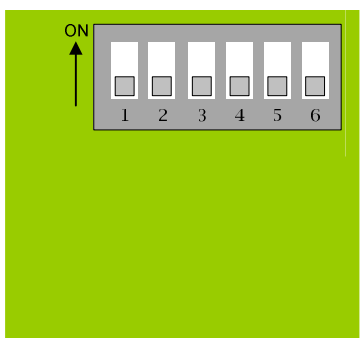
To minimise reflections, terminate the line at both ends with a suitable termination resistor and keep any stub lengths off the main line as short as possible. The value of the termination resistor should be equal to the characteristic impedance of the cable used. A typical value seen in many installations is  $120R$ ; the Compact MM3P includes an internal  $120R$  resistor that can be switched in or out of circuit as required. If the value of  $120R$  is unsuitable, the transmission line can be terminated externally using separate resistors of the required value.

## CONFIGURATION SWITCHES

During start-up, the Compact MM3P reads a bank of six switches mounted on the side of the unit. These switches determine any special start-up actions it must perform and its final operating mode:

Configuration Switches

Switch	Off	On
1	Normal	Clear RTU configuration
2	Normal	Local monitoring enable
3	Normal	Diagnostic mode selected
4	No RS485 Termination	RS485 Termination enabled
5	Normal	Firmware load mode
6	Normal	Hardware reset



Switch 4 (RS485 termination) is unused on the RS232C variant.

Please refer to the user manual for further details of the configuration switch options.

# Product Data Sheet

Compact MM3P



## PLANT WIRING - DIGITAL INPUTS

The Compact MM3P provides 6 digital input channels (DI0 to DI5). DI0 to DI4 include pulse counters (CI0 to CI4) for input transition counting at speeds up to 1KHz.

The digital inputs are in 2 groups, with 3 inputs per group. Each input group is isolated and may have a separate field loop supply (typically 12Vdc or 24Vdc) and return (0V). The digital inputs are isolated from the other inputs, outputs and Compact MM3P power supply.

Typically, the digital inputs monitor the pulse outputs from a flow sensor device. Other digital input type sensors include anti-tamper switches, alarm contacts, smoke detectors etc.

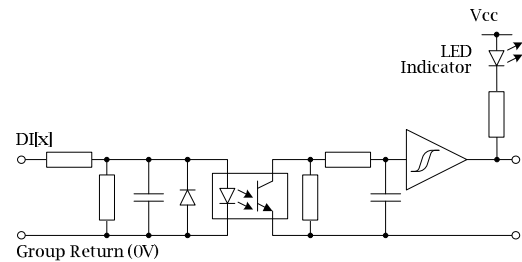
Note: bidirectional flow measurement requires two inputs, for example CI0 and CI1.

### Digital Inputs Connector

Function	Pin	C- 0 1 2 3 4 5 C-
Grp 0 return	C-	
DI0   CI0	0	
DI1   CI1	1	
DI2   CI2	2	
DI3   CI3	3	
DI4   CI4	4	
DI5	5	
Grp 1 return	C-	

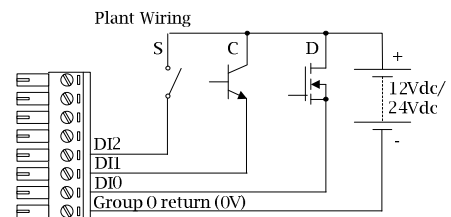
### Digital Input Circuitry

The digital/counter inputs are fully protected optically isolated inputs with true LED status indication. A hardware RC-filter and diode protection is included for each channel.



### Example:

To activate a given input, it must be pulled up to the field supply voltage to switch-on the opto-isolator, typically by wiring the input to the field supply via a mechanical switch (S), an open-collector transistor (C) or an open-drain-transistor (D) as shown. The input channels are identical and any contact type can be used on any input.



## PLANT WIRING - DIGITAL OUTPUTS

The Compact MM3P provides 2 digital output channels (DO0 and DO1). The digital outputs support a common field loop supply (typically 12Vdc or 24Vdc), and return.

The digital outputs are isolated from the other inputs, outputs and Compact MM3P power supply.

### Digital Outputs Connector

Function	Pin	C+ 0 1 C-
Supply (Vext+)	C+	
DO0	0	
DO1	1	
Return (Vext-)	C-	

# Product Data Sheet

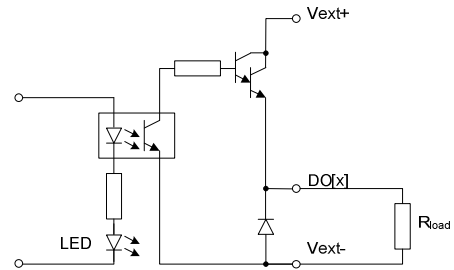
Compact MM3P



## Digital Output Circuitry

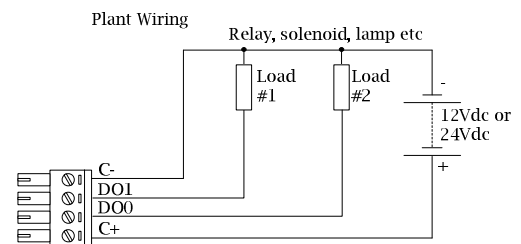
The digital outputs comprise isolated and protected power transistor that switch an external power supply (Vext) to an external load. Built-in diode reverse voltage protection allows direct connection to inductive loads such as a relay or solenoid. Each output has LED status indication.

The 12Vdc or 24Vdc rails commonly found in many telemetry installations can directly provide the output field supply (up-to 30Vdc).



### Example:

To use the digital outputs, connect the required output device (e.g. relay coil) to the relevant DO and provide a suitable field power supply for the output device (e.g. 12Vdc or 24Vdc) across the C+ and C- terminals on the output connector. Field power will be supplied to the output device when the digital output is 'On'; power to the output device will be removed when the digital output is 'Off'.



## PLANT WIRING - ANALOGUE INPUTS

The Compact MM3P provides 2 differential voltage analogue input channels (AI0 and AI1). The inputs are configurable for 0-2V or 0-5V operation. The analogue input channels are individually isolated.

For current loop operation, a plug in Analogue converter module is available, supporting 0-20mA and 4-20mA inputs.

### Analogue Inputs Connector

Function	Pin	
Chassis	0C	
AI0+	0+	
AI0-	0-	
AI1+	1+	
AI1-	1-	
Chassis	1C	

## Analogue Input Circuitry

The Compact MM3P provides two high impedance voltage inputs for analogue measurement. Isolation is achieved using solid-state optical-relays.

Input voltage can be either 0-2V or 0-5V depending on the configuration downloaded to the MM3P.

Used in conjunction with an external ACM (Analogue Converter Module) wired into a standard 4-20mA instrumentation loop, the current flowing within the loop generates a corresponding voltage drop across the precision shunt, which in turn can be read by the MM3P.

# Product Data Sheet

Compact MM3P

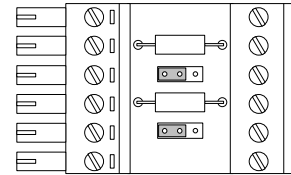


## Analogue Converter Module

The Compact MM3P Analogue Converter Module (ACM) includes very high precision, high stability 100R shunt resistors for use with the analogue voltage input channels of the Compact MM3P RTU.

The ACM supports 0-20mA or 4-20mA inputs and plugs directly into the Compact MM3P, enabling RTU removal without disrupting the connected instruments' current loop.

Jumper links allow the shunt resistors to be removed from the circuit, allowing one or both analogue inputs to revert to voltage measurement.



### Example 1: Analogue Sensor (with 0-2V or 0-5V output)

For analogue sensors providing a 0-2V or 0-5V signal the Compact MM3P can be connected directly as shown here:



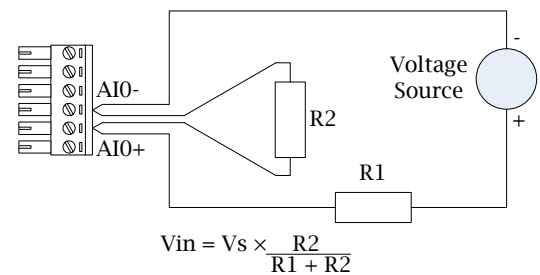
### Example 2: Alternate Voltage Range

This voltage mode input can be adapted to other voltage ranges by adding an external potential divider network. For best results, keep the overall circuit impedance as low as practical without placing undue load on the voltage source. Ideally, R1+R2 should not exceed 10K ohms.

Examples:

0-2.5V range: configure the AI for the 2V range and use R1=600R and R2=2400R.

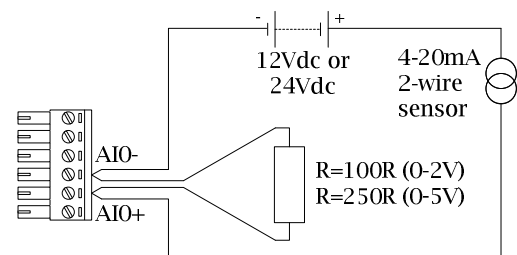
0-10V range: configure the AI for the 5V range and use R1=4K7 and R2=4K7.



$$V_{in} = V_s \times \frac{R_2}{R_1 + R_2}$$

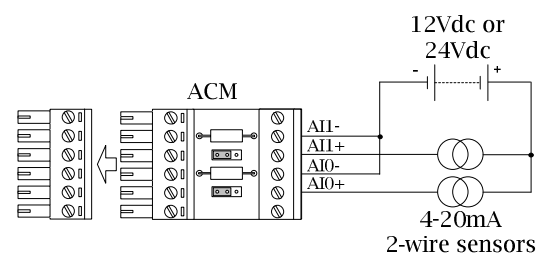
### Example 3: Current Loop

Alternatively, voltage measurement like this is also useful if the Compact MM3P is being used to tap into an existing 4-20mA instrumentation loop which already has an existing shunt in circuit, or if a particular shunt value is required, as shown here:



### Example 4: Current Loop using ACM

This example is similar to Example 3 except that the standard ACM accessory provides the precision 100R shunt resistors.



Note: very high precision resistors should be used for all of these applications, e.g. 0.01%, 5ppm.



# Product Data Sheet

Compact MM3P



## ANALOGUE INPUT CALIBRATION AND SCALING

All of the analogue inputs to the Compact MM3P, including the internal monitoring analogues, are read as required using a 12-bit analogue-to-digital converter. Each raw analogue value is calibrated to span the range 0-4000 using calibration factors held within the RTU. The calibration constants are derived during unit manufacture, and are thereafter stored in the Compact MM3P for the life of the unit.

The resulting 12-bit calibrated values can then be read and scaled using the values shown in the table.

Note that the temperature readings shown in the table are for scaling purposes only. In practice, the useful range of the temperature reading is limited to between -10°C and +55°C (note negative slope).

Input	Range	Reading
AI0 and AI1	0-2V or 0-5V or 0-20mA or 4-20mA	0-4000 0-4000 0-4000 800-4000
Temperature (AI2)	+159.2 to -49.4°C	0-4000
Supply voltage (AI3)	0-13.92V	0-4000

## SPECIFICATIONS

Analogue Inputs	Number of external channels: 2 Type: Passive voltage input Voltage input range: 0-2V or 0-5V software configurable Current input range (with optional ACM): 0-20mA Resolution: 12-bit Input impedance: 1M $\Omega$ Measuring accuracy: $\pm 0.3\%$ or $\pm 8$ lsb (typically $\pm 0.1\%$ or $\pm 4$ lsb) Temperature stability better than $\pm 50$ ppm/ $^{\circ}\text{C}$ Linearity better than $\pm 1$ LSB Isolation: 250Vac isolation between each AI and all other IO channels Absolute maximum ratings: Input voltage $\pm 16$ Vdc Number of internal channels: 2 Measuring accuracy (temperature): $\pm 3^{\circ}\text{C}$ or $\pm 60$ lsb Measuring accuracy (supply voltage): $\pm 3\%$ or $\pm 80$ lsb
Digital Inputs	Number of channels: 6 Type: 0-24Vdc (nominal) opto-isolated Impedance approx. 3K9 $\Omega$ On state voltage: 12/24Vdc nominal, 10Vdc minimum, 30Vdc maximum Off state voltage: -30Vdc to +3Vdc maximum Input current typically 3mA @ 12Vdc or 6mA @ 24Vdc 16-bit hardware counter support on five channels, up to 1KHz Isolation: 250Vac optical isolation between each DI bank and all other IO channels
Digital Output	Type: Isolated open collector PNP Darlington transistors with diode protection Voltage: 9 to 30V Load Current (on): 0.25A continuous per channel Leakage current (off): 0.5mA Isolation: 250Vac optical isolation between the two DOs and all other IO channels
Serial channels	COM1 = RS232 with RTS/CTS flow control plus modem control lines (WAN port) COM2 = RS232 with RTS/CTS flow control (Service Port) COM3 = RS232 as COM2 or half-duplex RS485 (expansion I/O)
Power	6-28Vdc, 100mA max.
Screw Terminals	Max wire size 1.5mm <sup>2</sup>
Unit Size	65mm $\times$ 130mm $\times$ 26mm (excluding mating connectors)
Unit Weight	0.2Kg
Mounting	Separate DIN rail mount available.
ACM	100R, $\pm 0.05\%$ , $\pm 5$ ppm/ $^{\circ}\text{C}$ , 0.25W precision metal-film resistors, link-selectable Overall size: 23mm $\times$ 36mm $\times$ 11mm Absolute maximum ratings: $\pm 50$ mA

## APPROVALS

This product is designed to hold a CE declaration of conformity in accordance with Council Directives 89/336/EEC (Electromagnetic compatibility) and 73/23/EEC Low voltage directive (LVD). The product complies with the following standards:

### EMC:

- EN55011: 1991 Radiated emissions
- EN61131-2: 1994 (+A11: 1996 + A12: 2000), EN61000-3-2: 1995 Electrostatic discharges (4kV contact, 8kV air)
- EN61000-4-3: 1995 Radiated fields (26-1000MHz, 10V/m, AM)
- EN61000-4-4: 1995 Fast transients/bursts (0.25kV)

### Safety:

- EN-61010-1 Safety requirement for electrical equipment for measurement and control
- EN-60950 Safety of information technology equipment

### Environmental to BS EN 60068:

- Operating temp.: -10 to +55°C
- Humidity: 5% to 95% non-condensing
- Vibration: (sinusoidal), 10-150Hz, amplitude 4g, 5 sweeps in 3 orthogonal axes
- Shock: (half sine), acceleration 15g, Pulse time 11ms, 3\*6 shocks

### Ingress Protection:

- IP20, BS EN 60529

Please contact [info@metasphere.co.uk](mailto:info@metasphere.co.uk) for further information

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