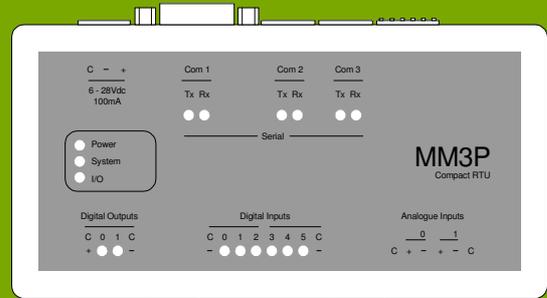# Product Data Sheet

metasphere

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. 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.
- Compatible with established Metasphere MC2000 Telemetry System via DNP3 Interface.
- 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.
- Comprehensive LED status indications for at-a-glance system health monitoring.

- 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.
- DNP3 Slave (subset level 3 with extensions)
- 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 IO

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.

datasheet

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 flow control on the RS232C variant.

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

Data rate, data format and handshake options are independently configurable. Standard data rates up to 19,200 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 PROGRAMMING

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 enable 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. COM1 and COM3 may be configured for Modbus master or Modbus slave 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 mapping 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 and COM3 configured with any valid Modbus slave address. User defined data blocks identify the ranges of coils and registers to be exchanged.

Application Notes APPN-0009 MM3P Modbus RTU Slave Configuration and APPN-0010 MM3P Modbus RTU Master Configuration provide details on setting up Modbus communications on the Compact MM3P.

DNP3 SLAVE COMMUNICATIONS

The Compact MM3P supports DNP3 Slave (subset level 3) communications. In addition to the level 3 subset, the Compact MM3P supports the following object groups:

- Double Bit Binary Inputs
- String objects
- File transfer

A number of object variations beyond the level 3 subset are supported; please refer to the Compact MM3P DNP3 device profile for supported object group and variation details.

Any MM3P input, output or internal variable of the corresponding data type can be mapped to a DNP3 point.

DNP3 Slave operation is available on COM1 or COM3 with configurable serial characteristics.

Device level information is user configurable, including:

- Source address
- Destination address
- User assigned device attributes (device location, device id, and device name)

- Object groups included in the response to a read static data request
- Various timeouts (including application confirm timeout, output select timeout and file transfer timeout)

The Compact MM3P supports 'most recent' and 'all events' modes. In 'most recent' mode the latest event for each point is buffered, a new event overwrites older events. In 'all events' mode, up to 64 events for each object group are buffered, with the older events being kept until they have been read and newer events discarded if the buffer is full. The event mode is selectable for each DNP3 object group.

Individual DNP3 points can be configured to generate class one, two, three or no events. Binary, double bit binary and frozen counter points generate the associated class event on a state or value change. Events for other DNP3 object group points can be generated under program control to enable value filtering and a wide range of event generation strategies to be used.

For further details please refer to Application Note APPN-0012– Compact MM3P DNP3 Slave Configuration

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[1]	-

Note[1] 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.

datasheet

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 DB9(F) PC Serial cable
- 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.

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	+ - C
Supply (6-28Vdc)	+	
0V return	-	

The Compact MM3P has chassis connections associated with the power supply and analogue inputs. The chassis connections are all connected within the Compact. Internally the common chassis connection is used to provide protection to the digital inputs and the digital outputs. Over voltage protection of the unit is provided with respect to this chassis. It is important that the chassis connections are connected to a suitable external local ground connection to provide this protection.

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
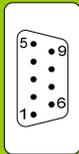
COM2: 6-way RJ11

Function	Pin
Signal Ground	1
RTS (out)	2
RXD (in)	3
TXD (out)	4
CTS (in)	5
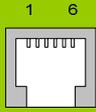
COM3: (RS232C variant only) 6-way RJ11

Function	Pin
Signal Ground	1
RTS (out)	2
RXD (in)	3
TXD (out)	4
CTS (in)	5
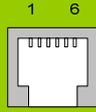
COM3: (RS485 variant only)

| Function	Pin
A (+)	1
B (-)	2
Signal Ground	3

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.

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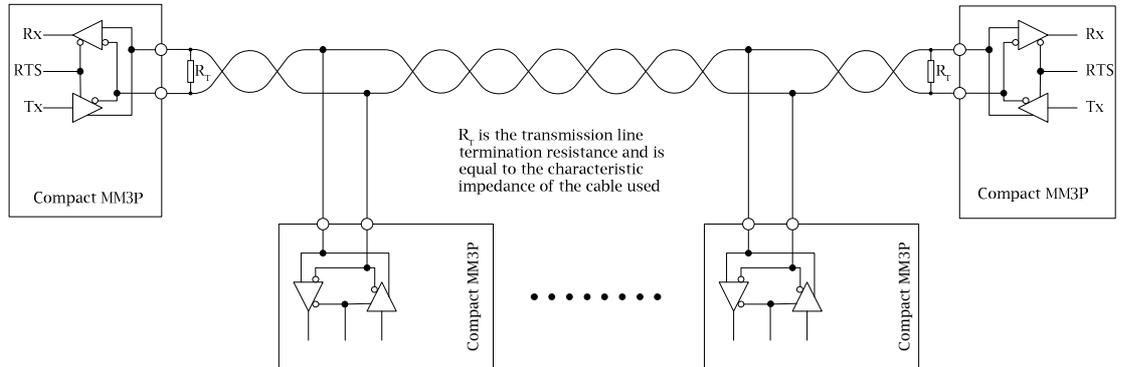
The standard RS485 receiver input impedance, called a unit load, is 12KΩ; a standard RS485 driver can drive up to 32 such loads. The Compact MM3P RS485 transceivers present an eighth of this unit load (96KΩ) which allows up to 256 Compact MM3Ps on a RS485 communication link.

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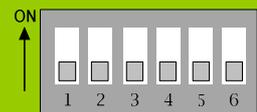
Switch 4 (RS485 termination) is unused on the RS232C variant.

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

datasheet

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
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-
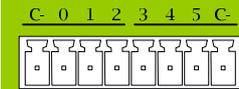
Digital Input Circuitry

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.
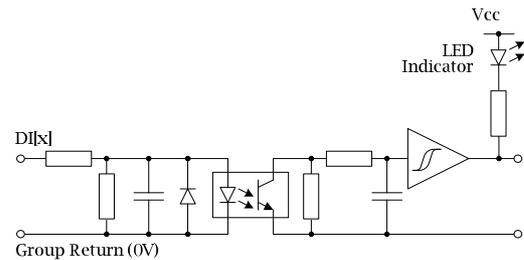
Example:

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.
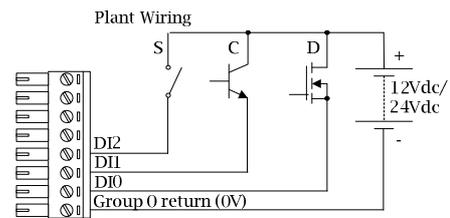

PLANT WIRING - DIGITAL OUTPUTS

The Compact MM3P provides 2 digital output channels (DO0 and D01). 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
Supply (Vext+)	C+
DO0	0
DO1	1
Return (Vext-)	C-

datasheet
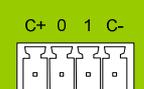
Digital Output Circuitry

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).
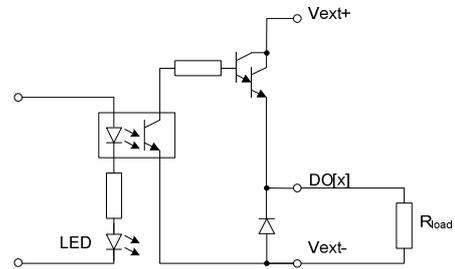
Example:

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'.
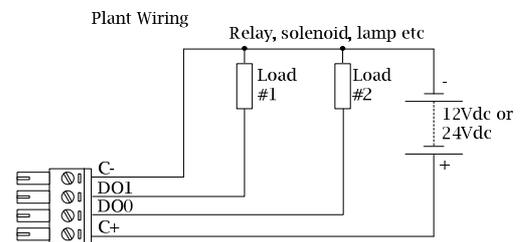

PLANT WIRING – ANALOGUE INPUTS

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.

The chassis connection for the analogue inputs should be connected to the instrument ground, if available.

Analogue Inputs Connector

Function	Pin
Chassis	0C
AI0+	0+
AI0-	0-
AI1+	1+
AI1-	1-
Chassis	1C
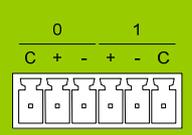
Analogue Input Circuitry

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.

datasheet

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. (Diagram shows ACM configured for current input)
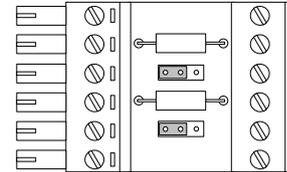
Example 1: Analogue Sensor (with 0-2V or 0-5V output)

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.
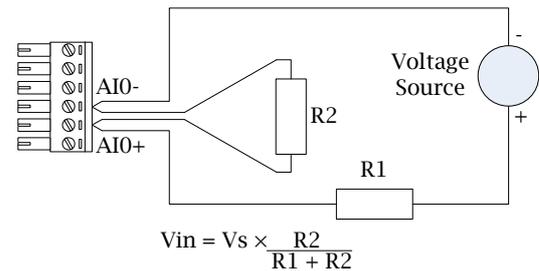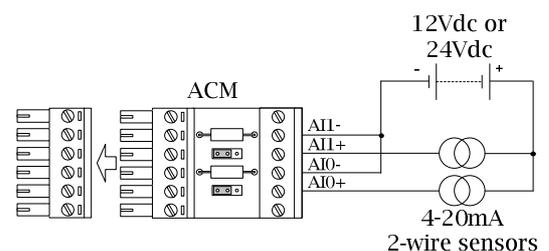
$$Vin = Vs \times \frac{R2}{R1 + R2}$$

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:

R=100R (0-2V)
R=250R (0-5V)
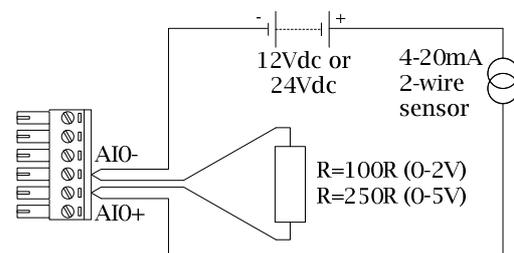
Example 4: Current Loop using ACM

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.

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)	0-35V	0-4000

Product Data Sheet

Compact MM3P

metasphere

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: 1MΩ Measuring accuracy: ±0.5% (typically ±0.1%) Temperature stability better than ±280 ppm/ºC Isolation: 250Vac isolation between each AI and all other IO channels Absolute maximum ratings: Input voltage ±8Vdc
	Number of internal channels: 2 Measuring accuracy (temperature): ±3ºC Measuring accuracy (supply voltage): ±3%
Digital Inputs	Number of channels: 6 Type: 0-24Vdc (nominal) opto-isolated Impedance approx. 3K9Ω On state voltage: 12/24Vdc nominal, 5Vdc minimum, 28Vdc maximum Off state voltage: 0Vdc 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 1.5mm²
Unit Size	65mm × 130mm × 26mm (excluding mating connectors)
Unit Weight	0.2Kg
Mounting	Separate DIN rail mount available.
ACM	100R, ±0.05%, ±10ppm/ºC, 0.25W precision metal-film resistors, link-selectable Overall size: 23mm × 36mm × 11mm Absolute maximum ratings: ±50mA

APPROVALS

This product is designed to hold a CE declaration of conformity in accordance with Council Directives 2004/108/EC Electromagnetic compatibility (EMC) and 2001/95/EC General Product Safety (GPSD).The product complies with the following standards:

EMC:

- EN61000-6-4: 2007 Generic Standards – Emission Standard for Industrial Environments

- EN55016-2-3: 2006 Radiated emissions

- EN61000-6-2: 2005 Generic Standards - Immunity for Industrial Environments

- EN61000-4-2: 1998 +A1 +A2 Electrostatic Discharge

- EN61000-4-3: 2006 +A1: 2008 Radiated Immunity.

- EN61000-4-4: Fast Burst Transients

- EN61000-4-5: Surge Immunity

- EN61000-4-6: Conducted RF Immunity

Safety:

EN-61010-1 Safety requirement for electrical equipment for measurement and control

Environmental:

- Operating temp.: -10 to +55°C

- Humidity: 5% to 95% non-condensing

Ingress Protection:

- IP20

productinfo

Please contact info@metasphere.co.uk for further information