

## INTERCONNECTING PRODUCTS AND CABLES

## M-7000

### MODBUS ANALOG DAQ AND CONTROL MODULES

#### Description

The M-7000 Series is a family of Data Acquisition and Control Modules that gives the user an easy way to build a distributed Data Acquisition or Control system using the rugged Modbus RTU or DCON protocols. All modules are controlled over an RS-485 network at rates up to 115,200 baud. The Model M-7015 has 6 RTD input channels. The Model M-7017 has 8 analog input channels. The Models M-7018 and M-7019 have voltage and thermocouple inputs. The Models 7022 and 7024 provide voltage and current outputs. All units are designed for industrial applications with dual watchdog timers, fail safe outputs and have 3000 V isolation to the RS-485 network for noise free operation. Applications include providing analog and temperature inputs and analog outputs for many different types of control systems.

#### RS-485 Communication

The M-7000 series modules are controlled over an RS-485 network using the Modbus RTU or DCON protocol. RS-485 networks use differential signals and have a high degree of noise immunity due to their differential nature. Cable lengths can be up to 4,000 feet. The Modbus RTU and DCON protocols are industry standard packet protocols that guarantee a reply to every



**M-7017 Analog Module**

command, eliminating doubt due to missed messages. Modbus RTU packets use a checksum to validate the packet. All packets are acknowledged and erroneous packets are resent. The module device address can be 01 to 255. All module configuration parameters such as address, baud rate etc. are saved in an internal memory. All units have a LED indicator for power and communication.

#### M-7015

The M-7015's 16-bit A/D converter reads 6 RTD channels at rates up to 12 channels per second rate. Inputs can be Pt100, Pt1000, Ni120, Cu100, Cu1000 RTDs which cover temperatures of -200 °C to +600 °C. The M-7017 supports 2 and 3 wire RTDs with open wire detection and individual channel configuration.

- Distributed Data Acquisition and Control Modules.  
*Data Acquisition and Analog Signals where you need it.*
- Control with Modbus RTU or DCON protocols.  
*Industry standard protocols for control with SCADA/ HMI software and PLCs.*
- RS-485 network with baud rates up to 115.2 kbaud.  
*High speed for quick responses.*
- 3000 V Isolation  
*Reduces noise, no ground loops.*
- Read Analog Signals, temperatures or currents  
Control with analog outputs  
*Select the I/O Modules for your application.*
- Mounts on standard DIN rail.  
*Easy mounting and replacement.*
- RoHS compliant  
*Meets latest specifications.*
- Includes AC Power Adapter.  
*Nothing more to buy.*

**CE** Approved



#### Popular M-7000 Configurations

Model	Description	RoHS Compliant
M-7015	6 ch RTD 2/3 wire inputs, 12 s/sec.	Yes
M-7017	8 ch diff Analog Input, mV/V, 10s/sec.	Yes
M-7017C	8 ch diff Analog Input, 0-20/4-20 or $\pm 20$ mA, 10s/sec.	Yes
M-7018	8 ch diff Analog Input, mV/V/thermocouple, 10 s/sec.	Yes
M-7019R	8 ch diff Analog Input, mV/V/20mA/thermocouple, 8 s/sec.	Yes
M-7022	2 ch Isolated D/A 12-bit, 0-20/4-20 mA or 0-10 Vdc.	Yes
M-7024	4 ch D/A 14-bit, 0-20/4-20 mA or 0-5/ $\pm 50$ -10/ $\pm 10$ Vdc	Yes

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M-7000 DESCRIPTION

M-7017

The M-7017's 16-bit A/D converter reads 8 differential channels at a 10 channel per second rate. Input ranges can be set to +10 V, +5 V, +1 V, +500 mV, +150 mV and 0 to 20 mA with an external resistor. The M-7017R measures the same voltages and current with 240 Vrms overvoltage protection and a faster 60 s/sec sample rate. The Model M-7017C measures 0-20 mA, 4-20 mA or  $\pm 20$  mA currents without external resistors at a 10 s/sec rate. The M-7017RC measures the same currents with 240 Vrms overvoltage protection and a faster 60 s/sec sample rate.

The M7017Z expands the number of analog inputs to 10 differential or 20 single-ended inputs. Input ranges are:  $\pm 500$  mV,  $\pm 1$  V,  $\pm 5$  V,  $\pm 10$  V,  $\pm 20$  mA ,0 to 20 mA, and 4 to 20 mA (jumper selectable).

M-7018

The M-7018's 16-bit A/D converter reads 8 differential channels of voltage or thermocouple inputs. The module has a Cold Junction Compensation circuit and can handle virtually any type of thermocouple. Thermocouple types are: J, K, T, E, R, S, B, N, and C. See Table 1 for thermocouple temperature ranges. Voltage input ranges are from +2.5 V, +1 V, + 500 mV, +100 mV, +50 mV and +15 mV.

TABLE 1  
THERMOCOUPLE TEMPERATURE  
RANGES

Type	Code	Temperature Range °C
J	0E	-210 to +760
K	0F	-270 to +1372
T	10	-270 to +400
E	11	-270 to +1000
R	12	0 to +1768
S	13	0 to +1768
B	14	0 to +1820
N	15	-270 to +1300
C	16	0 to +2320
L	17	-200 to +800
M	18	-200 to +100
L2	19	-200 to +900

Note: L2 is DIN 43710



M-7018 8 Channel A/D Converter on left and M-7018Z 10 Channel A/D Converter with screw terminal block on right

The Model M-7018R provides 240 Vrms overvoltage protection. The Model M-7018Z utilizes an external screw terminal block for 10 input channels with overvoltage protection.

M-7019R

The M-7019R is a Universal Analog Input Module that can handle voltage, millivolt and thermocouple inputs with 240 Vrms overvoltage protection. The M-7019R has 8 differential analog inputs with nine DC voltage ranges from  $\pm 15$  mV to  $\pm 10$  V. Also reads  $\pm 20$  mA current. Resolution is 16-bits with an accuracy of  $\pm 0.1$  %. Sample rate is 8 s/sec. Channels are individually configurable. The M-7019R also handles most commercial thermocouples and includes wire open detection logic. The thermocouple types are: J, K, T, E, R, S, B, N, C, L, M and L2. Table 1 lists the thermocouple types and their temperature ranges.

M-7022

The M-7022 provides 2 isolated analog outputs that can provide 0-10 V, 4-20 mA or 0-20 mA. Channels have 3000 volts of channel-to-channel isolation and 3,750 volts of isolation from the serial input. Features programmable output slopes from 0.125-1024 mA/second and 0.0625-512 V/second.

M-7024

The M-7024 provides 4 isolated analog outputs that can provide  $\pm 10$  V,  $\pm 5$  V, 5 V, 10 V, 4-20 mA or 0-20 mA outputs. Programmable output slopes from 0.125-2048 mA/second and 0.0625-1024 V/second. Power on settings can be stored in the module's internal memory.



M-7024 Analog Output Module

## M-7000 SPECIFICATIONS

### M-7015 Specifications

Channels	6 for 2/3 wire RTD with open wire detection.
RTD Range	Pt100, Pt1000, Ni120, Cu100, Cu1000
Resolution	16-bit
Accuracy	± 0.05% FS
Rate	12 samples/sec
Zero drift	± 0.03µV/°C
Span drift	25ppm/°C
Input Z	> 1 Mohm
CMR	86dB @50/60 Hz typ.
Isolation	3000 Vdc
ESD Protection	4 KV each terminal
RoHS version	Order M-7015 CR

### M-7017 Specifications

Channels	8 differential
Input Ranges	±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V and ±20 mA (ext. res.)
Resolution	16-bit
Rate	10 samples/sec
Accuracy	± 0.1% FS
Zero drift	± 20µV/°C
Span drift	25ppm/°C
CMR	86 dB @50/60 Hz
Overvoltage	± 35V
Isolation	3000Vdc

### M-7017R Specifications

Same as M-7017 except	
Rate	60/10 samples/sec
Drift	± 10uV/°C
OV Protection	240 Vrms
ESD	4 KV each terminal

### M-7017C Specifications

Channels	8 differential
Input Ranges	0-20 mA, 4-20 mA and ±20 mA
Resolution	16-bit
Rate	10 samples/sec
Accuracy	± 0.1% FS
Zero drift	± 20µV/°C
Span drift	25ppm/°C
CMR	86 dB @50/60 Hz
NMR	100 dB @50/60 Hz
Common Mode	± 15Vdc
Isolation	3000Vdc

### M-7017RC Specifications

Same as M-7017 except	
Rate	60/10 samples/sec
DriftMode	±200 Vdc
Isolation	3000 Vrms
ESD	4 KV each terminal

### M-7017Z Specifications

Channels	10 diff/20 Single-end
Input Ranges	±150 mV, ±500 mV, ±1 V, ±5 V, ±10 V and ±20mA ,0~20mA, 4~20mA (jumper selectable)
Resolution	16-bit std, 12-bit fast
Rate	10 s/sec std, 60 s/sec fast
Accuracy	± 0.1% FS, ±0.5% FS fast
Zero drift	± 20µV/°C
Span drift	25ppm/°C
CMR	86 dB @50/60 Hz
Overvoltage	240 V diff, 150 V SE
Isolation	3000Vdc
ESD	4 kV to inputs, 1 kV to RS-485

### M-7018 Specifications

Channels	8 differential
Input Ranges	±15 mV, ±50 mV, ±100 mV, ±1 V, ±2.5 V and ±20 mA (ext. res.)
Thermocouples	J, K, T, E, R, S, B, N, C, L and M
Rate	10 samples/sec
Accuracy	± 0.1% FS
Zero drift	± 0.5µV/°C
Span drift	25ppm/°C
CMR	150 dB @50/60 Hz
NMR	100 dB @50/60 Hz
Overvoltage	± 35V
Isolation	3000 Vdc

### M-7018R Specifications

Same as M-7018 except	
Accuracy	± 0.2% FS
Zero drift	± 10µV/°C
OV Protection	240 Vrms
ESD	4 KV each terminal

### M-7018Z Specifications

Channels	10 differential
Input Ranges	±15 mV, ±50 mV, ±100 mV, ±1 V, ±2.5 V and ±20 mA (ext. res.)
Thermocouples	J, K, T, E, R, S, B, N, C, L and M
Resolution	16-bit
Rate	10 samples/sec
Accuracy	± 0.1% FS
Zero drift	± 0.5µV/°C
Span drift	25ppm/°C
CMR	150 dB @50/60 Hz
NMR	100 dB @50/60 Hz
Input Imp.	>20 Mohm
OV Protection	240 Vrms
ESD	4 KV each terminal

### M-7019R Specifications

Channels	8 differential
Input Ranges	±15 mV, ±50 mV, ±100 mV, ±150 mV, ±500 mV, ±1 V, ±2.5 V, ±5 V, ±10 V and ±20mA (with ext. res.)
Thermocouples	J, K, T, E, R, S, B, N, C, L, M and L2
Input Imp.	>2 Mohm for voltage
Resolution	16-bit
Rate	8 samples/sec
Accuracy	For ±15 mV ± 0.3% FS All others ±0.15% FS
CMR	86 dB @50/60 Hz
OV Protection	240 Vrms
ESD	4 KV each terminal

### M-7022 Specifications

Channels	2
Output Ranges	0-20 or 4-20 mA, 0-10V
Resolution	12-bit
Accuracy	± 0.1% FSR
Readback	± 1 % FSR
Zero drift	± 30µV/°C ± 0.2 µA/°C
Temp coef.	±25 PPM
Prog slope	0.0625 to 64 V/sec 0.125 to 128 mA/sec
Load	5 mA
Current Load	500 ohms with internal power 1050 ohms with external 24 V power
Photo Isolation	3750 Vrms
Isolation	3000 Vdc

### M-7024 Specifications

Channels	2
Output Ranges	0-20 mA, 4-20 mA, 0-10, 0-5, ±5, and ±10V
Resolution	14-bit
Accuracy	± 0.1% FSR
Readback	± 1 % FSR
Zero drift	± 30µV/°C or ± 0.2 µA/°C
Span	± 20ppm/ °C
Prog slope	0.125-2048 mA/second 0.0625 - 1024 V/second
Current Load	1050 ohms with external 24 V power
Photo Isolation	3750 Vrms



## M-7000 SPECIFICATIONS

Operation		Physical		Certifications
INIT pin	Enables configuration mode	Size		CE Certification
Power on Values	- Set at power on or Watchdog reset occurs.	123mm x 72mm x 33 mm (without mounting bracket)		EMC Directive 89/336/EMC
LED Indicator	Shows	Mounting		Emission EN 55022
		DIN rail		Noise immunity EN 50082-2C
Serial Interface				Included Items
RS-485 Interface	is half-duplex.	Indicator		Single unit DIN rail
Protocol	Modbus RTU or DCON	Power and communication		Manual on CD-ROM
Signals	TX/RX pair	Connectors		UL/CSA/VDE approved AC power
Baud Rates	1,200 to 115.2 kbaud.	Serial	Screw terminals for 16 to 26 AWG wires, 0.15 in centers	Adapters provided for:
Format	8 data bits, no parity, and 1 stop bit			US - 115±10% Vac, 60 Hz (std)
Distance	1200 M	Isolation		Europe - 230±10% Vac, 50/60 Hz
ESD	1 kV to RS-485 signals	3000 volts to serial I/O standard		UK - 230±10% Vac, 60 Hz
		Channel isolation in some modules.		
Modbus RTU Specifications		Temperature		
Supported Functions		Operating	-25 °C to 75 °C	
02 (0x02)	Read input status	Storage	-40 °C to 85 °C	
04 (0x04)	Read input channels			
70 (0x46)	Read/write module settings	Relative humidity		
		5 to 95% (not condensing)		
Error Responses		Power		
00	Address, 1 to 247	10 to 30 Vdc supplied by included power adapter		
01	Function code   0x80			
02	Exception code, 01			
CRC mismatch	No response.			
		Power Consumption		
		7015/18/19	1.2 W	
		7017	1.3 W	
		7022	3.0 W	
		7017Z, 24	2.4 W	

## ORDERING INFORMATION-STANDARD VERSIONS

	Part Number
Input Module with 6 RTD channels, 3000 V Isolation	M-7015
Input Module with 8 voltage and thermocouple channels A/D, 3000 V Isolation	M-7017
Input Module with 8 voltage and thermocouple channels fast A/D, 3000 V Isolation plus over-voltage protection	M-7017R
Input Module with 8 low current channels A/D, 3000 V Isolation	M-7017C
Input Module with 8 low current channels fast A/D for current inputs, 3000 V Isolation	M-7017RC
Input Module with 10 differential/20 single-end inputs, fast A/D, 3000 V Isolation	M-7017Z
Input Module with 8 channels A/D for thermocouples, 3000 V Isolation	M-7018
Input Module with 8 channels A/D for thermocouples, 3000 V Isolation plus over-voltage protection	M-7018R
Input Module with 10 channels A/D for thermocouples, 3000 V Isolation, Includes Screw Terminal block	M-7018Z
Input Module with 8 channels A/D for voltage and thermocouples, 3000 V Isolation	M-7019R
Output Module with 2 channels analog output, 3000 V channel to channel Isolation	M-7022
Output Module with 4 channels analog output, 3000 V Isolation	M-7024
For 230 VAC adapter, add suffix to specify country/plug style) -E(Europe), -B(UK), -A(Australia) i.e. M-7015-B	