M1d

High Speed Proportional Pneumatic Control Valve
Product Manual

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Warnings & Notices

WARNING:

Installation and operation of electric and high pressure systems (fluids and compressed gas) involves risk including property damage and personal injury or death.

Installers and users should be properly trained or certified and take safety precautions. This product may cause death, personal injury, or property damage if improperly used or installed.

The information in this document and other information from Enfield Technologies and its authorized representatives are intended for use by persons having technical expertise in selecting and using these products. Product owners ("you") should analyze all technical and safety requirements of your specific application, including the consequences of any possible failure, before selecting a product. This product may not be suitable for all applications, such as those acting upon people. Suitability is solely your responsibility. Because the requirements for each application may vary considerably, you are solely responsible for conducting any testing or analysis that may be required to determine the suitability of the product for your application, and to ensure that all performance, safety and warning requirements for your application are met.

Caution:

While the product is low voltage, it is an open-frame electronic component and care should be taken to prevent un-intentional contact with the product to avoid damage to person or property.

The M1d is an electro-static sensitive device. Use appropriate electro-static discharge (ESD) procedures during handling and installation.

Notice:

Use and purchase of this product is subject to Enfield Technologies' Terms and Conditions of Sale and Use. Improper installation or use voids warranty. Consult factory regarding special applications. Specifications are subject to change. Reasonable efforts have been made to provide useful and correct information in this document, but this document may contain errors and omissions, and it is subject to change.

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Specification	Value	
Physical Characteristics	**SI Units**	**Imperial Units**
Mass (Weight)	0,818 kg	(28.8 oz)
Approximate Physical Dimensions (L x W x H)	158.7 mm x 55.0 mm x 45.0 mm	6.25” x 2.17” x 1.77”
Materials	Aluminum, Nitrile, 440C SS, 316 SS, Nickel Plated Steel, Glass-Filled Nylon	
Valve Function	5-Port Bi-Directional Flow Control Valve, Normally Closed Center	
Valve Type	Lapped Spool and Sleeve	
Control Mechanism	Direct-Acting, Patented Linear Force Motor	
Ports	3/8” NPTF	
Mounting Direction	Stationary: Perpendicular to gravity Moving: Perpendicular to direction of motion	
Performance Characteristics		
Shifting Time (ISO 12238)	2.8 ms	
Bandwidth	110 Hz	
Pressure (at any port)	Vacuum → 1.03 MPa (10.3 bar)	Vacuum → 225 psig
Maximum Effective Aperture	30 mm2	0.047 in2
Flow Capacity and Critical Pressure Ratio (ISO 6358)	C = 4.5 x10-8 s·m4/kg; b ≈ 0.4	Cv = 1.1
Flow Rate of Air at 20 °C (68°F) and 65% RH (refer to Mass Flow Graphs)	900 SLPM (6.0 bar → 5.0 bar)	60 SCFM (80 psig → atm)
Leakage Rate (80psig → atm)	0.3 SCFM	
Turndown Ratio	200:1	
Electrical Characteristics		
Power	20W Max	
Supply Voltage	24Vdc Nom. (12-36Vdc)	
Current	1.1A Max	
Electrical Connections	M8x1 3-Pin (Male)	
Input Impedance	120 kΩ	
Input Signal Ranges	-0 Vdc to 5 Vdc ---0 Vdc to 10 Vdc 0 to 20mA 4 to 20mA PWM >2kHz	
Status LED’s	Power On, Status LED (see below)	
Environmental Characteristics		
Environmental Protection Class	IP65	
Temperature	0°C – 50°C	32°F – 122°F
Humidity	5% - 95% RH	

Filtration Requirements

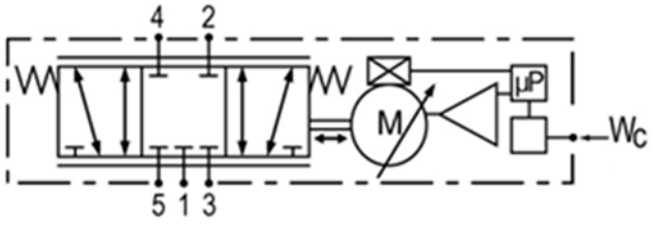
Clean, dry, non-lubricated air; 5 µm particulate and 0.3 µm coalescing filters recommended

Lubrication Requirements

Lubrication is not recommended and may void

Operating Fluids

Inert, non-flammable pneumatic fluids only. No liquids.



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Factory Defaults

Jumpers

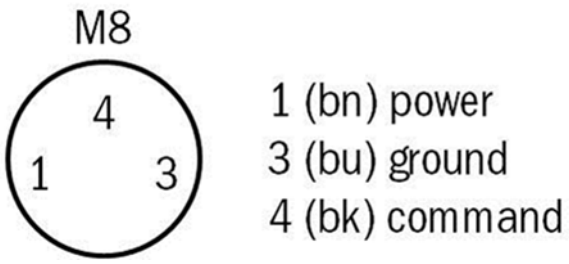
Jumper	Factory Default Condition	Setting
J1 – Command Input	Jumper on pins 1 and 2	0...10V Command
J2 – Custom	Jumper on	Standard Operation
J3 –Current Command	Jumper off	Voltage Command

Potentiometers

Potentiometer	Factory Default Condition	Setting
RP1 – Deadband Elimination	Fully Counter-Clockwise	No deadband elimination
RP2 – Dither Amplitude	Fully Clockwise	Maximum dither amplitude
RP3 – Maximum Drive Current	Fully Clockwise	Maximum current is not being limited

Connections

Pin	Label	Function
1	+Pwr	12 or 24 Vdc, power supply connection
3	Gnd	common (dc ground), connect to power supply common
4	Cmd	+signal input, command signal connection



Adjustments

The M1d has 3 potentiometers (RP1, RP2, RP3) which allow the user to adjust different parameters of the valve. These potentiometers can be accessed by removing the top lid of the M1d. Although these are factory-set for optimal performance, environmental conditions and slight valve-to-valve manufacturing variations may require additional fine tuning by the user. A polymer non-conductive screwdriver is the preferred method for adjusting the potentiometers. Care should be taken not to allow metal screwdrivers to touch other components on the board.

1) **Adjusting the Deadband Elimination (RP1)** – To minimize leakage in the M1d, the seating surface of the spool is machined to be slightly wider than the air flow holes – this is overlap. This construction limits air leakage, but creates a natural deadband' where small spool displacements will cause no change in air flow and thus no overall system response. By adjusting RP1, the user can adjust the effective deadband. Deadband elimination can be increased or decreased by turning RP1 clockwise or counterclockwise, respectively. The dead band elimination range is 0...250mA.

2) **Setting Dither Amplitude (RP2)** – By adjusting RP2, the user can set the dither amplitude value. The dither signal keeps the valve operating in the dynamic friction region as opposed to the static friction region and is recommended for most applications. The dither amplitude value can be increased or decreased by turning RP2 clockwise or counterclockwise, respectively. The dither amplitude range is 0...250mA peak to peak.

3) **Setting Maximum Drive Current (RP3)** – By adjusting RP3, the user can set the maximum current (Imax), which the M1d driver outputs at the highest command set point. This effectively allows the user to select the maximum flow out of the M1d. The maximum current value can be increased or decreased by turning RP3 clockwise or counterclockwise, respectively.

Set Command Input

The command input range can be configured with jumper J1 and J3. The following table goes through the configuration of these jumpers for the different command input signals available.

The M1d's driver comes with J2 installed connecting pins 1 and 2. J2 should not be moved during standard use and is only used with custom applications. Connecting pins 1 and 2 from J2 will cause the driver not work in the desired method and may cause irreversible damage.

A graphic representation of available configurations is presented below.

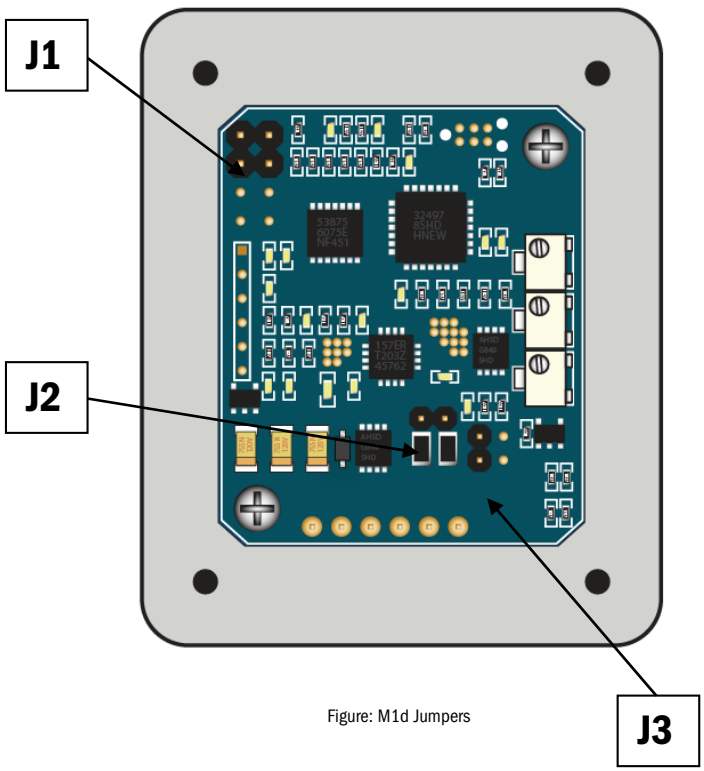
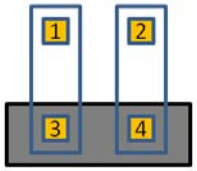
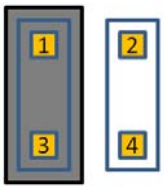
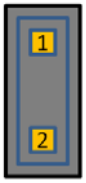
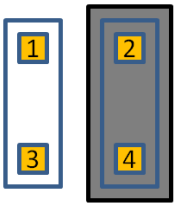
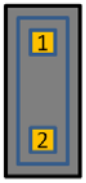


Figure: M1d Jumpers

Command Input	Jumper 1 Setting	Jumper 3 Setting
0-10V (factory default)	 Use J1 to connect pins 1 and 2	 J3 Off
0 – 5V	 Use J1 to connect pins 3 and 4	 J3 Off
0 – 20mA	 Use J1 to connect pins 1 and 3	 Use J3 to connect pins 1 and 2
4 – 20mA	 Use J1 to connect pins 2 and 4	 Use J3 to connect pins 1 and 2
PWM (>2kHz)	Use Setting for 0-10V or 0-5V based on PWM Amplitude	 J3 Off

Indications

The M1d is equipped with two LEDs to indicate that the board is powered as well as any status/faults.

Red LED (Power LED)

a. Under normal conditions, the power is on, the LED is on

b. If the board is not powered the LED will remain off

Green LED (Status and Faults):

Under normal conditions (no faults) the green LED is on when the command is bigger than the dead band (command value at which the driver starts supplying current).

When a fault occurs during operation, the drive stage is disabled, and number of times that the green LED blinks indicates the problem that was detected. There are three different faults that are shown with the LED:

a. Open circuit fault – When the driver is powered on, it tries to drive current to see if a valve is connected. If it does not detect one, an open circuit fault is tripped and is indicated by the green LED blinking twice.

b. Supply voltage fault – The supply voltage is measured at startup and also every 24th interrupt cycle to determine if the supply voltage is staying within the correct operating range of 10 – 14V or 20 – 28V. If it drops out of those ranges at any point during operation, the driver is disabled and the LED will blink 3 times.

c. Driver fault – There is a direct line running from the driver chip to the microprocessor. If the driver chip determines its own fault condition (i.e. under voltage, short circuit, thermal protection, etc.) it will signal the microprocessor and the driver will be disabled and the LED will blink 4 times.

Due to the way in which faults are handled, the power must be cycled to reset the driver after the fault has been corrected.