## **JobMaster® Training Station Pneumatics**



USER MANUAL

Catalog #34-8000-0003 Rev. A







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## 1. Safety and Maintenance

## 1.1. SAFETY

For your personal safety, make sure you observe the following safety guidelines:

- Always wear safety glasses and protective clothing when working with the JMTS pneumatics system.
- Before activating the system, make sure the bolts which attach components to the panel are securely fastened.
- Ensure that the pressure shut-off valve is shut before connecting or disconnecting a hose or coupler.
- When working with electro-pneumatic systems, ensure that the power supply module is off when connecting or disconnecting an electrical connector.

### **1.2. MAINTENANCE**

The JMTS pneumatics system requires little or no maintenance. However, to ensure safe and proper operation, make sure you comply with the following:

- Check hoses regularly for twisting, cracking, splitting, or leakage. Replace any hose which shows signs of damage.
- The lubrication unit of the conditioning unit should be filled with light oil. Do not exceed the level indicated on the lubrication unit's gauge.
- The cap of the condensation trap on the conditioning unit should be periodically removed to drain any water which has accumulated. Press the valve at the bottom of the cap to release the water.





# 2. Installation

One of the chief purposes of the JobMaster Training Station (JMTS) mounting panel is for the assembly of pneumatic circuits and systems. The station, in tandem with the pneumatic components, can be used to teach the fundamentals of pneumatics at both basic and advanced levels.

The components can easily be repositioned, coupled, and uncoupled to form a variety of pneumatic or electropneumatic circuits. An example pneumatic system on the JMTS mounting panel is shown here:



- 1. JMTS Mounting Panel
- 2. Electrical modules
- 3. Electrical connectors (wires)
- 4. Pneumatic and electro-pneumatic components
- 5. Pneumatic connectors (hoses or pipes)

2 Installation





## **2.1. ATTACHING COMPONENTS TO PANEL**

Pneumatic components are easily attached to the JMTS mounting panel.

The components are mounted on special plates that can be attached to the panel. Do not remove the components from these plates.

The plates have pairs of bolts and nuts. The nuts are mounted in black plastic casings which allow them to be tightened and loosened by hand and then further tightened with a hex wrench. The heads of the bolts are shaped to fit into the slots of the panel.

Note: There are two types of slots on the panel. Mount the components by inserting their bolts into the thinner slots.







#### To attach a component to the panel:

- 1. Unscrew the bolts on the mounting plate about two-thirds of the way.
- **2.** Push the bolt head all the way into the slot at a horizontal position (1), and turn the bolt until the bolt head is positioned vertically (2).



- 3. Tighten the bolt by turning it clockwise until the component is held securely.
- 4. Optionally, tighten the component further using the included hex driver.







## **2.2. CONNECTING COMPONENTS**

Pneumatic components are connected by means of flexible  $\emptyset$ 5mm hoses and push-in fittings (quick connectors).

- **③** *Note:* Make sure the pressure shut-off value is shut before connecting or disconnecting a hose.
- To connect an air hose to a push-in fitting (port), place the end of the hose into the female connector and firmly push it in.



• To disconnect components, press the ring inwards and simultaneously pull away the hose.







## **2.3. CONNECTING THE AIR SUPPLY**

The pneumatics components are designed to work in an industrial environment using standard pressure (6–7 bar). However, since the pistons are not loaded, an air pressure setting of 4 bar is recommended.

- **1.** Attach the conditioning unit (Catalog #025310) to the JMTS mounting panel. This unit is mounted on a plate with bolts which slide into the slots on the panel, like all other pneumatic components.
- 2. Connect the air supply quick coupler (Catalog #025321) to an available pressurized air supply outlet.
- 3. Connect the air supply quick coupler to the conditioning unit shut-off valve (left-side port).
- **4.** Connect the conditioning unit outlet to panel components. Manifolds and T-connectors can be used to distribute the air supply.
- **(1)** *Note*: Other than the conditioning unit, do not connect the components directly to the pressurized air supply.





## 2.4. BUILDING ELECTRO-PNEUMATIC SYSTEMS

These instructions are for Electro-pneumatic systems only.

The electro-hydraulic components and modules (Modules are not included in P1, P2 or P3 hardware packages.) require a power supply, supplied by the **JMTS Power Supply Module**. Power from the power supply module can be further transferred and controlled via the toggle and button switches on the **JMTS Operational Module**. These two modules, shown below, should be mounted onto the JMTS panel.



Before you make any connections, make sure the voltage rating of the power supply module matches your power supply.

All connections are by means of cables with banana plugs. The banana plugs can be stacked one into another, as shown here:







#### 2.4.1. Wiring Connections

Wiring connections are performed by first connecting the power supply module to a grounded AC power supply outlet. The power supply module is then connected to the operational via the 24 V (red) and 0V (blue) sockets.



Connections are then made to the electro-pneumatic components from the operational module's 24V (red), 0V (blue) and/or switch (black) sockets.

#### 2.4.1.1. 5/2 Sol-Sol Valve Connections

To power a 5/2 sol-sol valve:

- 1. Connect the blue socket on the valve directly to a OV (blue) socket on the operational panel (or the power supply module).
- Connect the red sockets on the valve to 24V (red) sockets on the operational panel (or the power supply module). These connections should not be direct connections. Rather, they should be made via switches on the operational module or via other switching devices such as the relay module.
- (1) Note: Avoid powering both solenoids simultaneously.

#### 2.4.1.2. Inductive Proximity Sensor Connections

To connect the proximity sensors to the electrical modules:

- 1. Connect the blue socket on the sensor directly to a OV (blue) socket on the operational panel (or the power supply module).
- 2. Connect the red socket on the sensor directly to a 24V (red) socket on the operational panel or the power supply module.
- **3.** Connect the black socket to an input socket of a PLC module.





#### 2.4.1.3. Magnetic Sensor/Switch Connections

#### 2.4.1.3.1. Overview

The pair of magnetic sensors that are intended to be attached to a double-acting cylinder are actually switches. Each switch has normally open contacts only, and thus acts similar to a push button switch on the operational module. The main difference is that on the operation module, the switch requires that the push button be pressed for the contacts to close. The switches on the cylinder require that the cylinder's magnet be adjacent to the magnetic sensor.



- In Note: You may have to adjust the sensors by moving them along the slot in order to find the exact location of the magnet when the cylinder is completely extended or retracted.
- In Note: If a sensor locks (i.e., the NO contacts remain closed even when the cylinder's magnet is no longer adjacent to the sensor) remove it from its slot and tap it gently with your finger. If the problem persists, the sensor should be replaced.





#### 2.4.1.3.2. Sensor/Switch Assembly

To attach the magnetic sensors/switches:

Refer to the image below.



**4.** Insert the M4 nut into the sensor slot alongside the cylinder. You can use a Phillips-head screw driver to insert or position the nut.







5. Fit the M4 screw through the bore in the (black) sensor housing, and attach it to the M4 nut in the slot. Position the sensor as desired (white sensor towards the cylinder), and tighten the screw.



6. Fit the bracket cover onto the sensor socket bracket.



7. Using two Phillips screws, attach the sensor socket bracket to the cylinder's mounting plate.







8. Repeat steps 1 through 4 for the second sensor.



#### 2.4.1.3.3. Connecting the Sensors

To connect the sensor/switch:

- 1. Connect either socket on the switch directly or indirectly to a 24V (red) socket on the operational module (or the power supply module).
- 2. Connect the other socket to a consumer such as a lamp or buzzer, or to a PLC module input socket.





# 3. Components

## **3.1. TERMINOLOGY**

The following are definitions of terms used in this manual as they relate to pneumatics and the JMTS.

Controller	An element which controls a particular function of a device. A controller can be pneumatic, hydraulic, electric, or mechanical, and may be operated manually or by a control signal.
Cylinder	A cylindrical chamber in which a piston moves.
Piston	A disk or round part which fits tightly and moves within a cylinder.
Port	<ul> <li>Openings in pneumatic components which enable air to flow through them. The following codes are generally used to identify ports:</li> <li><b>R</b>, <b>S</b>: Exhaust lines, outlets; port is usually fitted with a silencer.</li> <li><b>P</b>: Pressure. Compressed air input.</li> <li><b>A</b>, <b>B</b>: Supply lines; enable control of device(s), such as cylinders.</li> <li><b>Y</b>, <b>Z</b>: Control lines; enable control of the valve position.</li> </ul>
Position	A defined status of a component or valve.
Pressure	The ratio of a force to the area on which the force is exerted. Pressure is measured in bar or Pascal units.
Solenoid	An electric conductor wound in such a way that a magnetic field is created when electric current flows through the windings. Solenoids can therefore be used for electric control of pneumatic valves. Solenoid is often abbreviated as sol.
Silencers	An element which reduces the noise caused by air being exhausted from pneumatic components.





## **3.2. HARDWARE PACKAGES**

Illustrations and descriptions of the JMTS pneumatics components appear on the following pages. Items which are not designated as belonging to the Basic, Advanced, or Electro-pneumatics packages are optional components which can be purchased separately for use with JMTS.

Basic	<b>Pneumatics:</b>	Package	P1	(Catalog	#00-1904-100	0)
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Qty.	Catalog #	Part Name (Alternate Name)
1	025310	Conditioning Unit
1	025301	5/2 Double Air Pilot Valve (5/2 Air-Air Control Valve)
2	025302	3/2 Mushroom Push Button (3/2 Push Button Valve)
1	025303	3/2 Lever Valve (3/2 Manually Operated Valve, Toggle Valve)
1	025304	3/2 Double Roller Lever Valve (3/2 Roller Valve)
1	025305	3/2 Pneumatic Valve (3/2 Air-Spring Control Valve)
1	025309	AND Gate
1	025307	OR Gate
1	025308	NOT Gate
1	1 025311 Double-Acting Cylinder	
1 025306 Manifold		Manifold
4	324059	T-Connector
4	324060	Connector
1	025321	Quick-Coupler (to air supply)
	324414	Tubing
	324415	
	324416	

#### Advanced Pneumatics: Package P2 (Catalog #00-1905-1000)

Qty.	Catalog #	Part Name (Alternate Name
1	025311	Double-Acting Cylinder
2	025301	5/2 Double Air Pilot Valve (5/2 Air-Air Control Valve)
2	025312	Single Air Pilot Valve
1	025304	3/2 Double Roller Lever Valve (3/2 Roller Valve)
1	025313	Pneumatic Time Delay Valve
1	025306	Manifold





#### Electro-Pneumatics: Package P3 (Catalog #00-1906-1000)

Qty.	Catalog #	Part Name (Alternate Name)	
2	025314	5/2 Double Solenoid Valve (5/2 Sol-Sol Control Valve)	
2	025322	Inductive Proximity Sensor	
1	025323	Magnetic Sensors (Pair)	
		Banana Plug Cables:	
3	411658	Red (200mm)	
3	411659	Blue (200mm)	
2	411661	Red (400mm)	
2	411662	Blue (400mm)	
2	411663	Black (400mm)	
4	411664	Red (600mm)	
4	411665	Blue (600mm)	
4	411666	Black (600mm)	
4	411667	Red (1100mm)	
4	411668	Blue (1100mm)	
4	411669	Black (1100mm)	
	•		





## **3.3. COMPONENTS**

Cat #	Name	Schematic	Description
Cylinders, Driv	es, Actuators		
025311 BASIC	Double-Acting Cylinder		Double-acting cylinder Cam and magnetic piston Ports fitted with 2 one-way flow control valves: forward valve regulates piston extension speed; rear valve regulates piston retraction speed Adjustable knob with locking nut Piston diameter: 25 mm Stroke: 80 mm With one-way flow control valve
Pneumatically	and Electrically Activated Valves		
025305 BASIC	3/2 Air-Spring Valve		3/2 directional control valve Pneumatically actuated, spring return Pressure range: 0-8 bar <b>Example of Use</b> When no pressure is applied to port Z, the valve's position is determined by the spring. In this position, port P is blocked and ports A and R are connected, hence there is no pressure at A. When pressure is applied to Z, the valve's position switches and established air flow from P to A. Exhausting the pressure from port Z allows the spring to return the valve to its initial position.





Cat #	Name	Schematic	Description
025312 ADVANCED	2/2 Single Air Pilot Valve		Pneumatically actuated, one side Pressure range: 2-10 bar This valve converts a continuous pneumatic control signal into a short pulse. The duration of the pulse can be adjusted by means of a screw on the bottom of the valve. This valve can be used to operate valves with low switching forces, and can prevent pressure from being applied simultaneously to both control ports (Y, Z) of a control valve. <b>Example of Use</b> When pressure is applied to the IN port, pressure is briefly applied to the OUT port. After the IN port pressure is exhausted, the valve is reset. If pressure is again applied to the IN port, pressure will again be applied briefly to the OUT port.
025301 BASIC	5/2 Double Air Pilot Valve	R P S	5/2 directional control valve Pneumatically actuated, both sides Directly activated Pressure range: 0-8 bar The valve is controlled by signals which apply pressure to either port Y or port Z. Applying pressure to both control ports will have no effect on the valve position. The valve has no normal state; the position of the valve is determined by the last control signal received and remains unchanged until another signal is received. This valve can be used to control a double- acting cylinder. <b>Example of Use</b> When pressure is applied to Y, air from port P is directed to port B, and air from port A is exhausted through port R. When pressure is applied to Z, air from port P is directed to port A, and air from port B is exhausted through port S. Applying pressure to Y will return the valve to the first position.





Cat #	Name	Schematic	Description
025313 ADVANCED	Pneumatic Time Delay Valve		3/2 valve Spring return Adjustable time delay: 0-30 sec Pressure range: 0-8 bar <b>Example of Use</b> Port 1 is the pressure input. Port 2 is the delayed output. Port 3 is the exhaust port. Port 4 is the control signal input. In the normal position, pressure is applied to P and no pressure is applied to A and Z. When pressure is applied to Z, compressed air flows through the restriction into the capacitor and also through the control line to the 3/2 valve. Pressure from the other side acts against the pressure in the control line, thus blocking the flow from P to A. As air continues to be supplied, pressure builds up behind the restriction. If the force produced by the pressure exceeds the spring force, the 3/2 valve switches over, and thus establishes flow from P to A. The delay is the time it takes for the valve to switch over after pressure has been applied at Z. When pressure is no longer applied to Z, the compressed air escapes from the capacitor. The 3/2 valve returns to its normal position. Line A is exhausted through R.





Cat #	Name	Schematic	Description
025314 ELECTRO	5/2 Double Solenoid Valve	R P S	5/2 directional control valve Solenoid actuated, both sides LED indicators Pressure range: 0-10 bar Ratings: 24 Vdc, 5W Ensure that power is only directed to one solenoid at a time. <b>Example of Use</b> The valve position is determined by the last control signal. In one position, air from port P is directed to port B while air from port A is exhausted through port R. Energizing the proper solenoid changes the valve position, thus redirecting air from port B through port S. Energizing the other solenoid returns the valve to its initial position.
Manually and	Mechanically Activated Valves		
025302 BASIC	3/2 Mushroom Push Button Valve		<ul> <li>3/2 directional control valve</li> <li>Push button actuated, spring return</li> <li>Pressure range: 0-8 bar</li> <li>This valve can be used to control air flow to a cylinder.</li> <li>Example of Use</li> <li>In its normal state, the valve blocks port P and connects ports A and R. When the push button is pressed, it compresses the spring and establishes air flow from port P to port A. When the push button is released, the spring expands, and allows the valve to return to its initial position.</li> </ul>





Cat #	Name	Schematic	Description
025303 BASIC	3/2 Lever Valve		3/2 directional control valve Manual level actuated, manual return Normally closed Pressure range: 0-8 bar <b>Example of Use</b> Position 1 establishes air flow. Position 2 terminates the air flow. When the lever is switched to position 1, the valve allows air to flow from port P to port A. When the lever is switched to position 2, an internal piston moves and blocks the air flow from ports P to A. Air from port A is exhausted through port R.
	3/2 Toggle Valve)		
025304 BASIC	Double 3/2 Roller Lever Valve		Two 3/2 directional control valves Roller lever actuated, spring return Normally closed Pressure range: 0-8 bar This component serves as a limit switch for the outgoing and ingoing strokes of a cylinder: one valve is activated when the head of the piston rod is fully extended and the other valve is activated when the piston is fully retracted. Although it is a 3/2 valve, only ports P and A are accessible to the user since the exhaust port, R, is within the cylinder's working area. When attaching this component to the panel, make sure the cam at the end of the piston rod presses each valve completely.





Cat #	Name	Schematic	Description
Logic Elements	5		
025309	And Gate Valve		AND gate (logic unit)
BASIC			Pressure range: 2-8 bar
025307	Or Gate Valve		OP gate (logic unit)
BASIC		A ≥1 P P	Pressure range: 2-8 bar
025308	Not Gate Valve		NOT gate (logic unit)
BASIC		A A P P X	Pressure range: 2-8 bar Since there can be no pressure at the output if no pressure is applied to the input, the NOT gate operates according to the logic function AND NOT (e.g., when pressure is applied to port X AND NOT applied to port P there will also be pressure at port A.)





Cat #	Name	Schematic	Description
Sensors			
025322 ELECTRO	Inductive Proximity Sensor		Inductive proximity switch NPN type LED indicator Switching distance: 10 mm Operating voltage: 24 Vdc 15mA max. current consumption 200mA max. switching current
025323 ELECTRO	Magnetic Proximity Sensors	S N	Magnetic proximity switch 2 magnetic sensors For attaching to cylinders Max. rated power: 10W (0.4A @ 24V).
Power and Cor	trol Units (Electrical Modules)		
10-2550-1000	Power Supply Module		Converts mains AC to constant 24 V necessary for operating all other modules and electrical components. Input voltage: 110-220 Vac Output voltage: 24 Vdc Output max. current: 4.5A Short circuit, overload and over voltage protected
10-2550-3000	Operational Module		<ul> <li>Provides essential switches and indicators for operating and controlling the system.</li> <li>Contains: <ul> <li>Buzzer (0.7W)</li> <li>3 lamps (LED 1.2W each)</li> <li>2 Momentary push button switches (10A max. resistive load, 1.5A inductive load)</li> <li>1 On-Off push button</li> <li>3 Toggle Switches (Off-On/MOM, 10A max. each)</li> </ul> </li> </ul>





Cat #	Name	Schematic	Description
10-2550-2000	Relay Module		<ul> <li>3 separate relays, each with 4 changeover contacts: 3 NO, 1 NC enabling switching high power loads.</li> <li>Sockets (per relay):</li> <li>2 coil terminals</li> <li>4 contacts (2 sockets each)</li> <li>Operating voltage: 24 Vdc, 5A max per contact</li> </ul>
10-2550-4000	Siemens PLC Module		<ul> <li>Industrial programmable Siemens S7-1200 controller for building and controlling advanced automated exercises and projects, using SIMATIC STEP 7 (TIA Portal) software <ul> <li>8 Digital Inputs (sink wiring)</li> <li>8 Digital Outputs (source wiring, 2A max.)</li> <li>2 Analog Inputs</li> <li>LAN cable for PC connection</li> <li>An additional 6 inputs and 2 outputs can be wired manually.</li> </ul> </li> </ul>
10-2550-5000	HMI Module		<ul> <li>Graphic-based touch screen allows</li> <li>friendly operating, monitoring and</li> <li>controlling of PLC applications.</li> <li>Features:</li> <li>Siemens SIMATIC HMI KTP700</li> <li>7" TFT high resolution touch screen</li> <li>LAN RJ45 Input socket</li> <li>LAN cable for PLC connection</li> </ul>





10-2550-6000       MicroLogix PLC Module         Programmable controller Allen-Bradley MicroLogix 1100 for building and controlling automated exercises and projects.         A/B MicroLogix 1100 (1763-L16DWD)         10 Digital Inputs         6 Digital Outputs (source wiring, 1A Max.)         2 Com Inputs         2 Analog Inputs (0-10Vdc)	Cat #	Name	Schematic	Description
Construction and Alia Construction	10-2550-6000	MicroLogix PLC Module		<ul> <li>Programmable controller Allen-Bradley MicroLogix 1100 for building and controlling automated exercises and projects.</li> <li>A/B MicroLogix 1100 (1763-L16DWD)</li> <li>10 Digital Inputs</li> <li>6 Digital Outputs (source wiring, 1A Max.)</li> <li>2 Com Inputs</li> <li>2 Analog Inputs (0-10Vdc)</li> </ul>







Cat #	Name	Schematic	Description
Tubing and Co	nnectors		
324414	Tubing		
324415			Tubing can be cut to any required length.
324416			The clear tubing is used to connect the air
			supply and the conditioning unit.
BASIC			The blue tubing is used to connect the components on the panel.
025321	Quick Coupler (to air supply)		
			Input Ø ¼" (6.35 mm)
BASIC			Output $\varnothing$ 5 mm
324060	Connector $\varnothing$ 5 mm		
			Straight metal fitting
BASIC			1/8" thread for air tube outer $arnothing$ 5 mm
			Since some components may be too far
			apart to connect with a single hose
			Ø5mm push-in connectors are used to
			join two hoses and extend the length of
			hose between two components.
22/050	T-Connector		
524055	1-connector		T-connector metal fitting.
		$\rightarrow X \rightarrow X \leftarrow$	#324059: for outer $\varnothing$ 5mm tube
BASIC		X	
		ĺ ↑	





Cat #	Name	Schematic	Description
025306 BASIC	Manifold		Manifold, 5 ports Quick couplings Connectors for Ø 5 mm air lines Pressure range: 0-10 bar Port A admits pressurized air. Ports B, C, D, and E are used to direct pressurized air to the components. Each of these ports has a quick coupling female connector, which prevents air flow through the connector when it is not in use.
Didactic			
330212	Hex Wrench		Tool for attaching components to slotted panel.
411658 411659 411661 411662 411663 411664 411665 411666 411667 411668 411669 Electro	Banana Safety Cables with 4mm Stacking Banana Plugs		#411658 Red (200mm) #411659 Blue (200mm) #411661 Red (400mm) #411662 Blue (400mm) #411663 Black (400mm) #411664 Red (600mm) #411665 Blue (600mm) #411666 Black (600mm) #411667 Red (1100mm) #411668 Blue (1100mm) #411669 Black (1100mm)