



## NITRA PNEUMATIC AUTOMATION LINK USER MANUAL

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# USER MANUAL REVISION HISTORY



**PLEASE INCLUDE THE MANUAL NUMBER AND THE MANUAL ISSUE, BOTH SHOWN BELOW, WHEN COMMUNICATING WITH TECHNICAL SUPPORT REGARDING THIS PUBLICATION.**

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1st Ed. Rev. B	05/2021	Updated firmware notes
1st Ed. Rev. C	05/2021	Revised PAL-EIP note
1st Ed. Rev. D	05/2022	Added additional stand-alone valve information
1st Ed. Rev. E	05/2022	Added PAL-S04 analog data input table
1st Ed. Rev. F	09/2023	Added additional PAL-EIP notes Chapter 3

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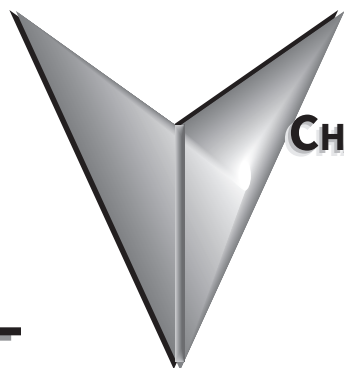
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# GETTING STARTED

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## CHAPTER

# 1

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## MANUAL OVERVIEW

### OVERVIEW OF THIS PUBLICATION

The NITRA Pneumatic Automation Link (PAL) User Manual describes the installation, configuration, and methods of operation of the NITRA Pneumatic Automation Link (PAL) system.

### WHO SHOULD READ THIS MANUAL

This manual contains important information for those who will install, maintain, and/or operate the NITRA Pneumatic Automation Link (PAL) system.

### SUPPLEMENTAL PUBLICATIONS

Additional PAL system documentation can be downloaded at [www.automationdirect.com](http://www.automationdirect.com). For information about using the PAL Configuration Software, refer to the online help file available in the software.

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- On the Web: [www.automationdirect.com](http://www.automationdirect.com)

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### SPECIAL SYMBOLS



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*WARNING: WHEN YOU SEE THE “EXCLAMATION MARK” ICON IN THE LEFT-HAND MARGIN, THE PARAGRAPH TO ITS IMMEDIATE RIGHT WILL BE A WARNING. THIS INFORMATION COULD PREVENT INJURY, LOSS OF PROPERTY, OR EVEN DEATH (IN EXTREME CASES).*

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## PAL SYSTEM INTRODUCTION

### OVERVIEW OF THE SYSTEM

The NITRA Pneumatic Automation Link (PAL) system is a highly versatile electro-pneumatic system for industrial automation applications. A full range of high-performance compact solenoid valves can be combined with configurable input and output (I/O) modules into a robust assembly with an IP65 rating. The assembly communicates with a PLC or other controller through an EtherNet/IP fieldbus connection. Simpler systems without I/O can be directly wired.

The system is powered by 12 or 24 VDC and can be mounted on DIN rail or surface mounted using optional adapters. Fieldbus systems can support up to 128 solenoids, 128 digital inputs, 128 digital outputs\*, 16 analog inputs, 16 analog outputs and 16 temperature inputs. Wired systems support either 4, 8, 21 or 38 solenoids depending on the unit.

Solenoid valve bases come with 1/4" push-to-connect tubing connections. If needed, each connector can be changed out to either 4mm(5/32"), 6mm, or 8mm(5/16") tubing sizes using optional replacement connectors. Solenoid valve options include 3-way, 2-position (2 valves per body) either (2) normally closed, (2) normally open, or one of each. 5-way valves are available in 2-position, single or double solenoid and 3-position, center closed.

8-point Digital Input and Output Modules have 3-pin M8 connections. The Analog Inputs, Outputs, and Temperature Modules have 4-pin M8 connections. Optional caps seal any unused connections. For systems that do not need the IP65 rating, there are digital input and output modules with 16 points per module and an IP40 rating. All I/O modules are configured using the PAL Configuration Software.

Fieldbus systems support local expansion and can be separated into smaller assemblies which all share one IP address and are configured as a single system in software. This allow valves and I/O to be located as needed on a machine.

To assist with the selection of your components for your PAL system, we recommend you use our online selector tool located at this link. [www.automationdirect.com/selectors/pal](http://www.automationdirect.com/selectors/pal)



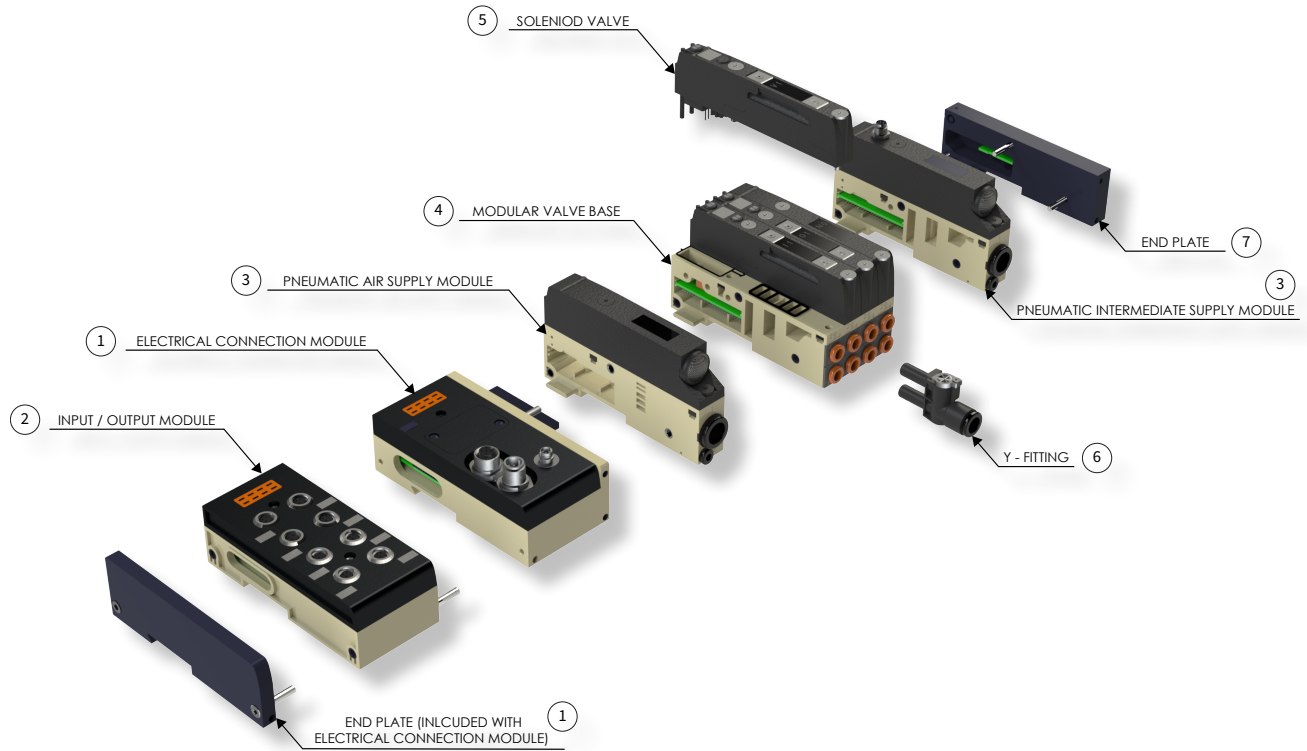
**NOTE:** The total number of Digital Outputs is 128, unless the assembly is using all 22 possible 6-point Digital Output modules, in which case the total count is 132.



**GENERAL SPECIFICATIONS**

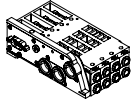
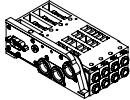
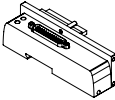
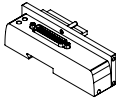
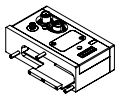
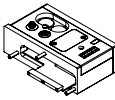
PAL System - General Specifications			
<b>Nominal Supply Voltage</b>	12 or 24 VDC		
<b>Minimum Operating Voltage</b>	10.8 V *		
<b>Maximum Operating Voltage</b>	31.2 V		
<b>Maximum Admissible Voltage</b>	32V **		
<b>Power for Each Controlled Pilot</b>	3W for 15ms, then holding 0.3 W		
<b>Drive (for multi-pole)</b>	PNP or NPN		
<b>Solenoid Rating</b>	100% ED		
<b>Protection</b>	Overload and short-circuit protected solenoid pilot Output		
<b>Maximum Number of Solenoid Pilots</b>	21 or 38 multi-pole connection; field bus 128		
<b>Ambient Temperature</b>	-10°C to + 50°C (at 8 bar) 14°F to 122°F (at 8 bar)		
<b>Operating Pressure</b>			5/2 and 5/3
	Common supply	Port 1	3 to 8 bar (43 to 116 psi)
	Separate pilot supply	Assisted valves	Vacuum to 10 bar (Vacuum to 145psi)
		Pilot pressure	3 to 8 bar (43 to 116 psi)
<b>Actuation Response Time (TRA) / Reset Response Time (TRR) at 6 bar</b>	TRA/TRR valve 2/2 and 3/2		14 / 28 ms
	TRA/TRR valves 5/2 monostable and shut-off valve		12 / 45 ms
	TRA/TRR valve 5/2 bistable		12 / 14 ms
	TRA/TRR valve 5/3		15 / 45 ms
	TRA/TRR valve 3/2 high flow		13 / 36 ms
<b>Fluid</b>	Unlubricated air		
<b>Air Quality Required</b>	ISO 8573-1 class 4-7-3		
<b>Degree of Protection</b>	IP65 (with connectors connected or plugged if not used)		
<b>Agency Approvals</b>	CE, cURus		
* Minimum voltage 10.8V required at solenoid pilots.			
** IMPORTANT! Voltage greater than 32VDC will damage the system irreparably.			

COMPONENTS OVERVIEW



1 ELECTRICAL CONNECTION MODULES

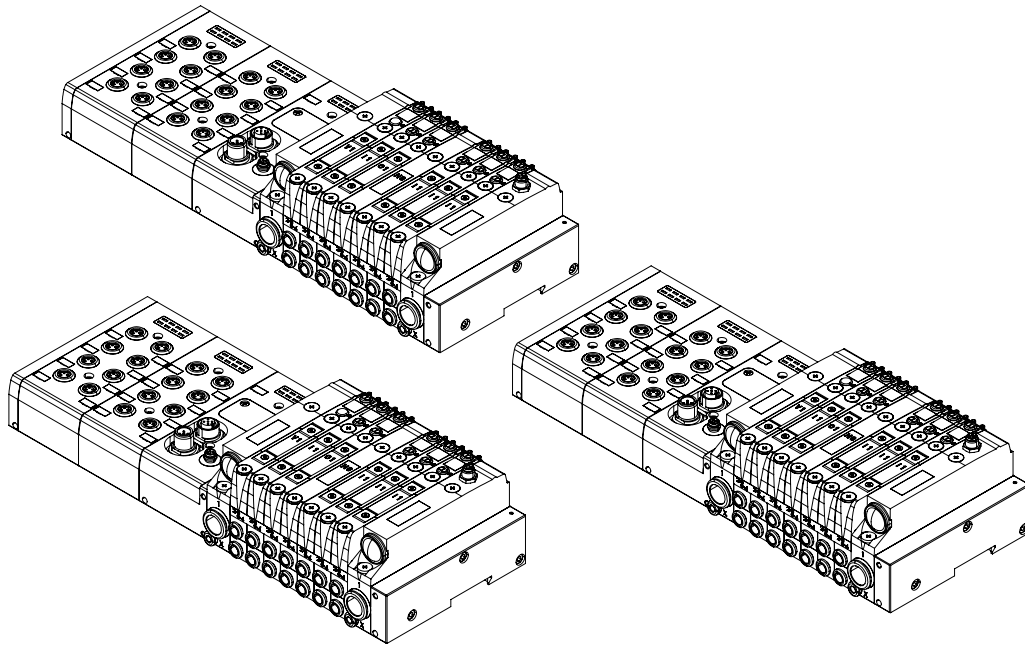
There are three different types of electrical connection modules available for use with the PAL system. PAL-EIP supports EtherNet/IP protocol at 10/100 Mbps. PAL-EAD is used to physically separate PAL assemblies while using a common IP address. For pneumatic only systems, with no I/O, PAL-E25 or PAL-E44 may be used. PAL-CB4414 and PAL-CB4814 are 4-position electro-pneumatic manifold bases for PAL valves with 4 or 8 controls for solenoid pilots. Up to 4 valves with one solenoid pilot can be installed on PAL-CB4414, and up to 4 valves with one or two solenoid pilots can be installed on PAL-CB4814.

ELECTRICAL CONNECTION MODULES					
PAL-CB4414	PAL-CB4814	PAL-E25	PAL-E44	PAL-EIP	PAL-EAD
					
Stand-alone, 4-solenoids, 4-stations, 1- female NPT inlet, 8-outlets, 2-exhausts	Stand-alone, 8-solenoids, 4-stations, 1- female NPT inlet, 8-outlets, 2-exhausts	25-pin electrical connection	44-pin electrical connection	EtherNet/IP electrical connection EtherNet/IP	Additional electrical connection

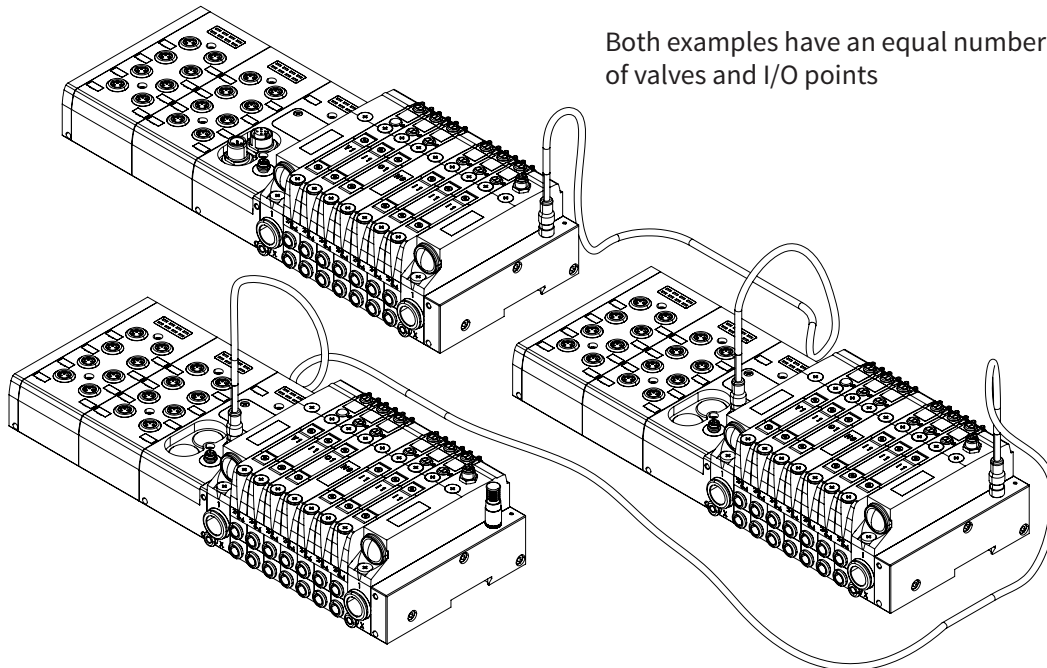
***PAL-EAD Application***

In larger systems, it is often desirable to locate valves and I/O modules close to their respective machine components. There are two main ways that this can be done with the PAL system. Smaller subassemblies of valves and I/O can be assembled using a PAL-EIP bus coupler and PAL-C2 end plate for each subassembly. These subassemblies will each be assigned separate IP addresses and treated as independent units by the PLC. The second option is to use local expansion. One PAL-EIP bus coupler and PAL-C3 end plate is joined by an expansion cable with a second subassembly with a PAL-EAD local expansion coupler. Subassemblies can be “daisy chained” in this manner up to the limits of I/O points and solenoids. The end plate on the last subassembly should be a PAL-C2 unless the possibility of future expansion is desired. If so, a PAL-C3 end plate with a PAL-ACC18 terminator can be used. When using local expansion, the overall system has one IP address and is treated as a single assembly by the configuration software tool and by the PLC.

**(3) Independent PAL Systems**

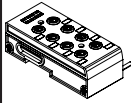
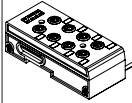
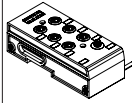
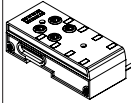
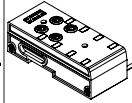
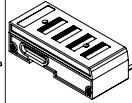
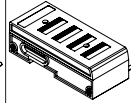
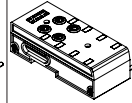


**(3) Daisy chained PAL assemblies acting as (1) PAL system**



2 **INPUT / OUTPUT MODULES**

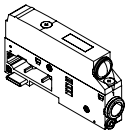
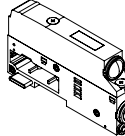
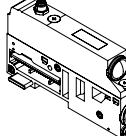
The PAL system can be configured with a variety of input or output signal modules, which can be mounted on systems with fieldbus electrical connection and no additional systems. The signal modules can be added at any time. You only need to unscrew the aluminium plate to the left side of the electrical connection module and install the signal modules (ready fitted with fixing tie rods) and retighten the end plate to the left. There is a small button under the access panel of the PAL-EIP that has to be depressed during power up to discover initial assembly or when modules have been added or removed. See PAL Configuration Software help topic PAL004 for further details.

INPUT / OUTPUT MODULES							
PAL-S01	PAL-S02	PAL-S03	PAL-S04	PAL-S05	PAL-S06	PAL-S07	PAL-S08
							
8 M8 digital inputs	8 M8 digital outputs	6 M8 digital outputs + electrical supply	4 M8 analog inputs	4 M8 analog outputs	16 digital terminal block inputs	16 digital terminal block outputs	4 M8 analog inputs for temperature measurement

3 **COMPRESSED AIR CONNECTION MODULES**

The PAL-P12 compressed air connection module is the primary interface for the compressed air supply and PAL system solenoid valves. It features a 1/2” push-to-connect main supply and 5/32” (4mm) pilot supply. Used in the default configuration, pilot pressure of 3 to 8 bar (43 to 116 psi) is supplied to port X, allowing the main supply to be in the range of vacuum to 10 bar (145 psi). If the total system is operated in the range of 3.5 to 8 bar (51 to 116 psi), the PAL-P12 can be easily converted to require only the single main supply connection for complete operation. See chapter 5 for details on converting the PAL-P12.

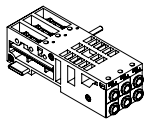
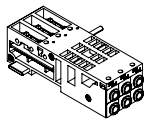
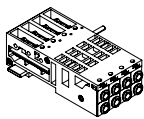
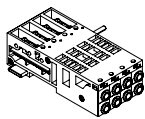
When additional air and/or power is needed that exceeds the capacity of the primary connections, an intermediate module can be installed anywhere in the valve bank. PAL-M12 provides an additional 1/2” push-to-connect inlet and silenced exhaust while the PAL-M12P also include a 4-pin M8 power connection.

PNEUMATIC AIR SUPPLY MODULE	PNEUMATIC INTERMEDIATE SUPPLY MODULE	
PAL-P12	PAL-M12	PAL-M12P
		
Compressed air supply - Silenced relief	Intermediate module - Silenced relief	Intermediate module - Silenced relief w/power



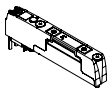
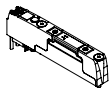
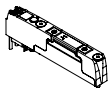
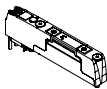
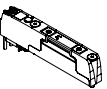
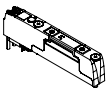
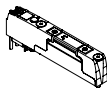
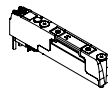
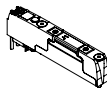
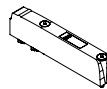
4 **MODULAR VALVE BASES**

PAL modular valve bases are available with 3 or 4 positions. A version is available with an electrical connection for a single control of each position, suitable for 5/2 single solenoid valves or 3/2 high flow valves (physically impossible to install other valves). Another version comes with two electrical connections for each position and is suitable for all types of valves. The electronics in the base controls the signal coming from both the multi-pole connector and the fieldbus, so the base is the same, regardless of the control system of the island. The air delivery ports (ports 2 and 4) are made up of cartridge-type push-in fittings. The cartridge can be replaced, for example when the tube diameter needs to be changed, by pulling out the clip placed under the base.

MODULAR VALVE BASES			
PAL-B3314	PAL-B3614	PAL-B4414	PAL-4814
			
3-solenoids, 3-stations, 6-tubing outlets	6-solenoids, 3-stations, 6-tubing outlets	4-solenoids, 4-stations, 8-tubing outlets	8-solenoids, 4-stations, 8-tubing outlets

5 **SOLENOID VALVES**

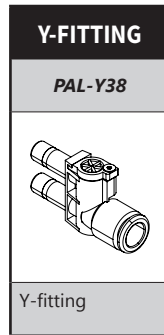
Solenoid valves in the PAL system are designed to ensure high flow while using only one small size valve (14 mm wide), without the need of installing a larger size one, to the benefit of component standardization. Versions are available with all the main air supply diagrams - from 3/2 to 5/3. The valves are secured to the base with two sturdy M4 captive screws. They come with all the accessories that facilitate their use: manual control, LED light, plate with air supply diagram and technical data and white ID tags.

SOLENOID VALVES									
PAL-V2-32C*	PAL-V2-32A*	PAL-V2-32C32A*	PAL-V1-52	PAL-V2-52*	PAL-V2-53C*	PAL-V1-32C	PAL-V1-32A	PAL-V1-SR**	PAL-V0-PLUG
									
2 valves 3/2 NC (valid as 5/3 OC)	2 valves 3/2 NO (valid as 5/3 PC)	3/2 NC + 3/2 NO	1 valve 5/2 spring return	1 valve 5/2 2 solenoids	5/3 center closed 2 solenoids	3/2 NC high flow	3/2 NO high flow	Shut-off valve	Blanking plug
* Requires a base with 2 solenoid connections per station.									
** Requires bank main inlet port to be plugged.									



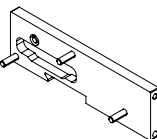
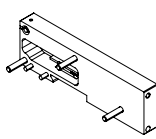
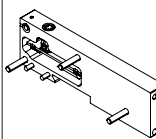
6 **Y-FITTING**

The Y-fitting is a reinforced technopolymer pneumatic fitting used to accomplish various air flow combinations between one or two solenoid valves. See Chapter Five - Pneumatic Modules for further explanation.



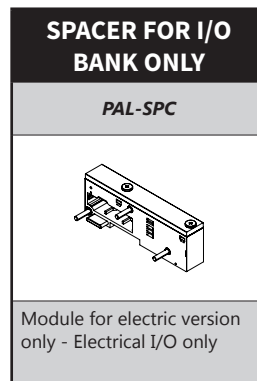
7 **END PLATES**

The closed end-plate is the last element on the right end of each PAL system. A version for banks with multi-pole connector is available. One for banks with fieldbus, containing a small electronic board; one for connection to other additional PAL banks (only for systems with fieldbus). The end plate houses the system for mechanically mounting the base to external supports i.e. DIN rail.

END-PLATES		
PAL-C4	PAL-C2	PAL-C3
		
Closed end-plate for banks with multi-pole connector	Closed end-plate for banks with fieldbus	Closed end-plate for electrical connection of banks with fieldbus to additional banks

**CLOSED END SPACER MODULE (NOT SHOWN IN DIAGRAM)**

To use the PAL system bank without pneumatics this module is needed. Only one module per bank is required.



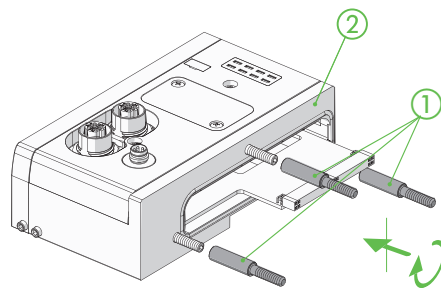
**ASSEMBLY****REQUIRED TOOLS**

When assembling the Pneumatic Automation Link (PAL) system we recommend using the following tools:

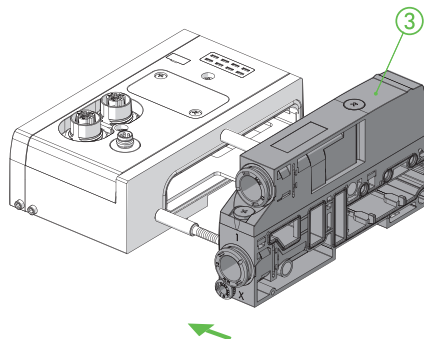
- M4 open end wrench
- PH1 screwdriver
- 4mm hex wrench
- 3mm hex wrench
- 2mm hex wrench
- 3mm slotted screwdriver

**ASSEMBLING THE BANK**

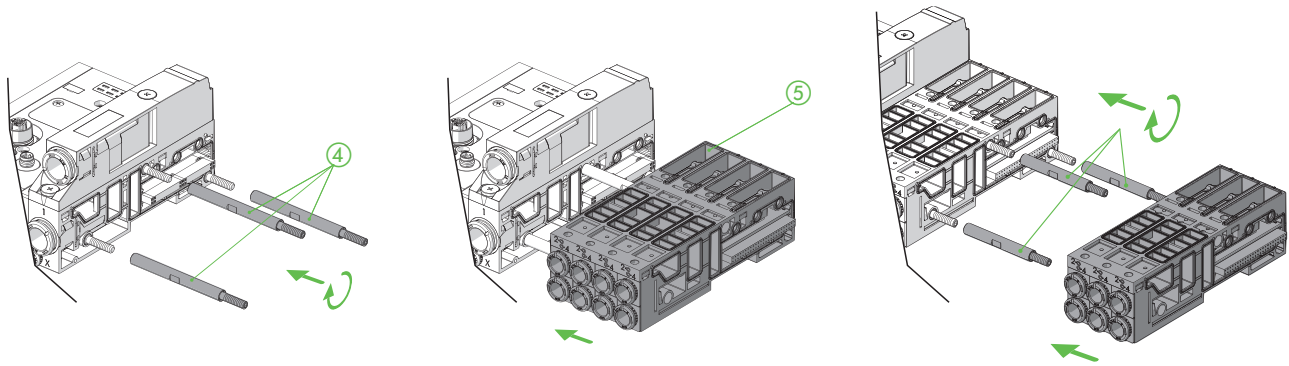
Hand tighten the three tie rods (1) of the compressed air supply input/output module for connection to the bus coupler (2).



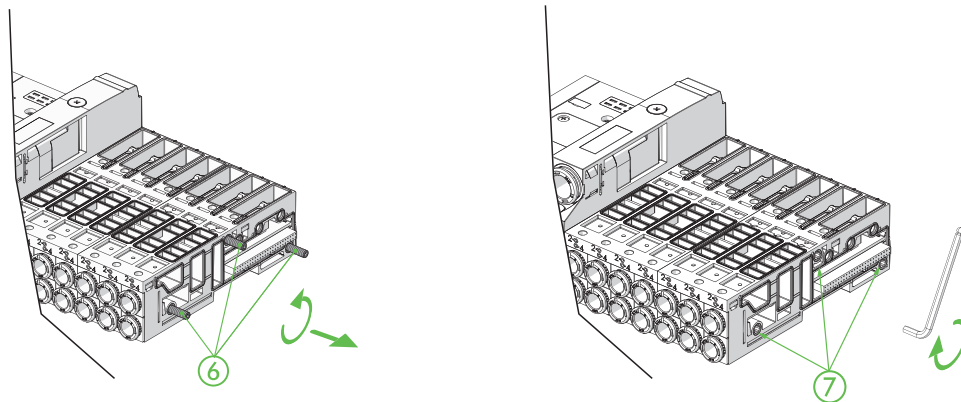
While aligning the tie rods, carefully mate the compressed air module (3) onto the electrical module. Make sure the electronic board fits into the slots provided. **DO NOT FORCE!**



Hand tighten the three tie rods (4) and mate the base (5). Make sure the electronic board is fitted properly. Should there be any binding, gently move the board to facilitate its insertion or gently push the end plate board downwards. Repeat the operation for all the bases.

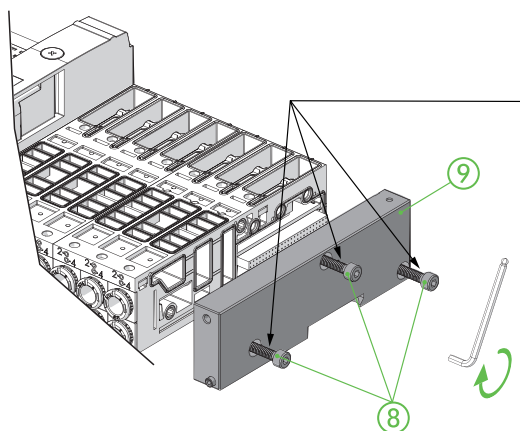


Unscrew the three M4 set screws on the end base (6).  
Tighten the three tie rods (7) using a 4mm hex wrench at a torque of 2Nm [18 lb-in].

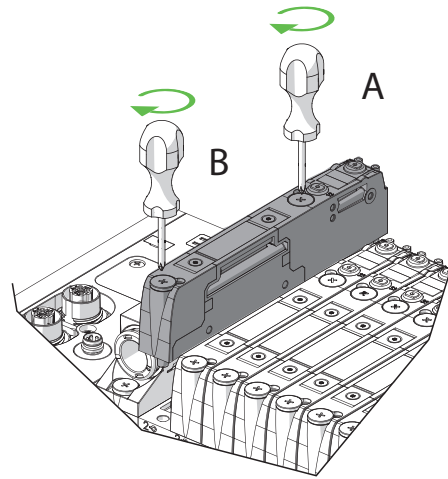


**NOTE:** For the optimal alignment of the boards, it is advisable to install the bases *WITHOUT* the valves assembled.

Place the bank on a flat surface, insert the closed end plate (9) and tighten the three screws (8) using 3mm hex wrench at a torque of 2Nm [18 lb-in]. In the versions with electronic board (PAL-C2 & C3), make sure the boards are properly aligned. **DO NOT FORCE.**

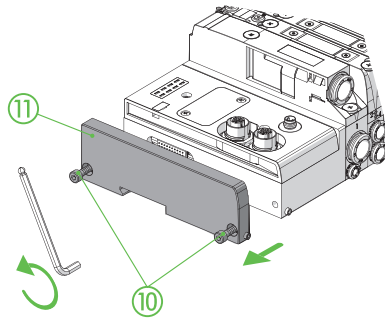


After checking that the seals are positioned properly, install the valves and tighten the Phillips screws with a PH1 driver at a torque of 1.1 - 1.3 Nm [9.7 - 11.5 lb-in]. **First tighten screw A and then screw B.**

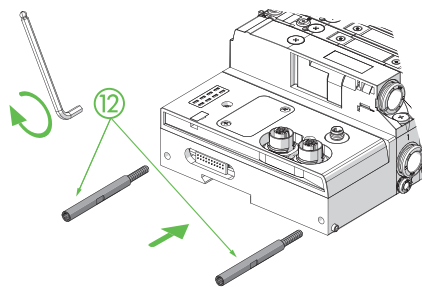


**ASSEMBLING THE I/O MODULES**

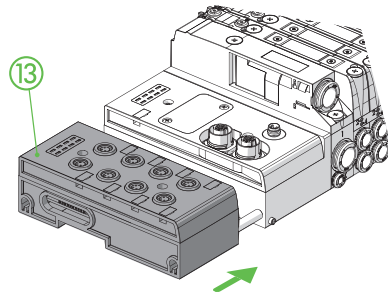
Unscrew the two M4 SHCS (10) on the bus coupler end plate (11) and remove.



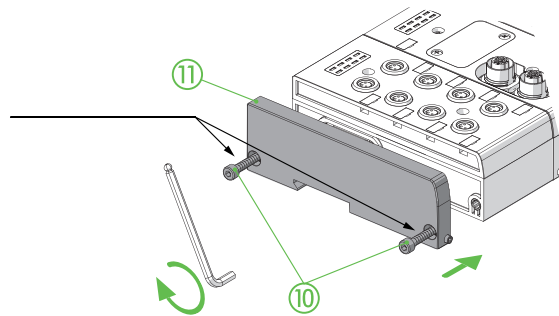
Hand tighten the two tie rods (12) of any I/O module.



Insert the I/O module (13), making sure the electronic board is aligned properly. **DO NOT FORCE.** Repeat the operation for all the I/O modules.

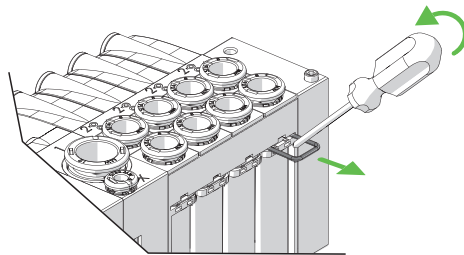


Carefully refit the plate (11), making sure the electronic board is aligned properly. **DO NOT FORCE.** Using a 3mm hex wrench tighten the two M4 SHCS (10) at a torque of 2Nm [18 lb-in].

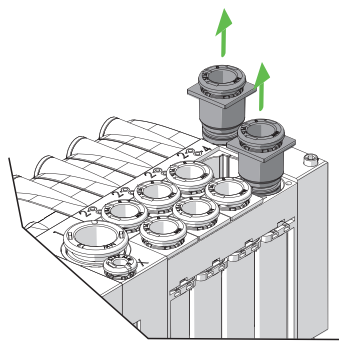


## REPLACING THE FITTINGS

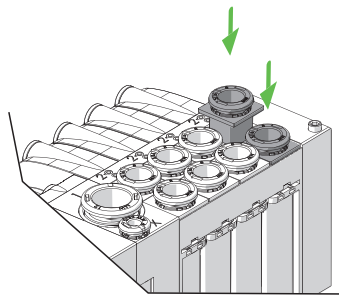
Use a 3mm slotted screwdriver to remove the clips.



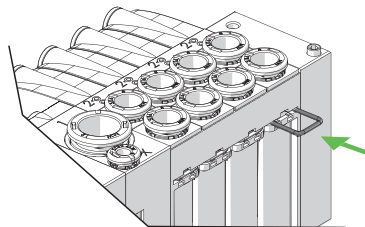
Remove the push-to-connect cartridges.



Insert the new cartridges until they are fully seated into the base.

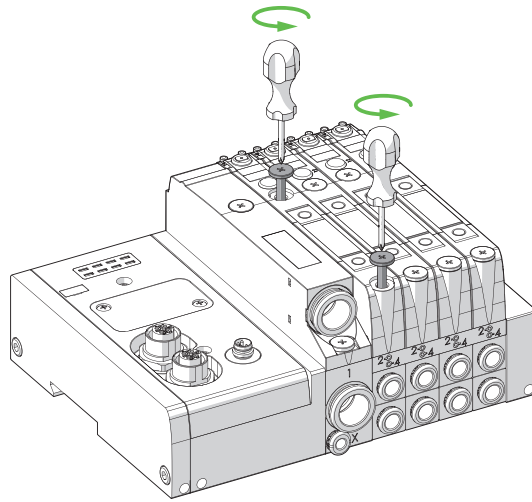


Reinsert the clip completely.

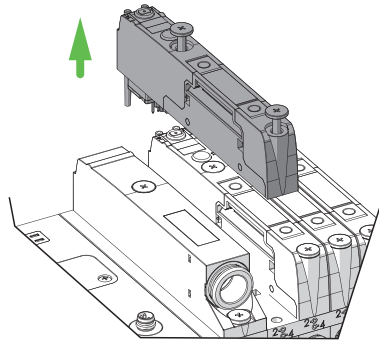


**REPLACING THE VALVES**

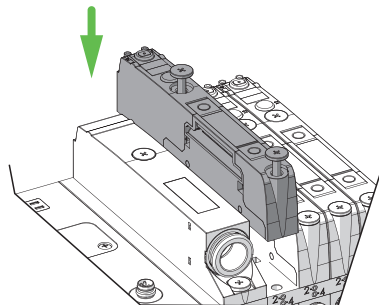
Unscrew the two Phillips head screws using a PH1 driver.



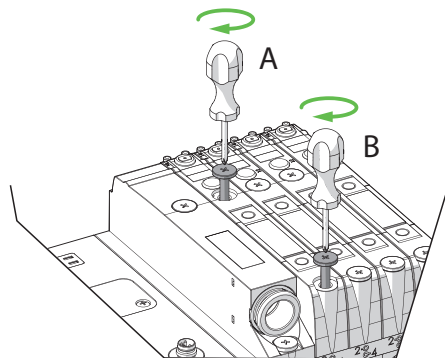
Gently lift the valve, perpendicular to the base, in order to remove the valve.



Check that the seals are positioned properly and lower to insert the new valve.

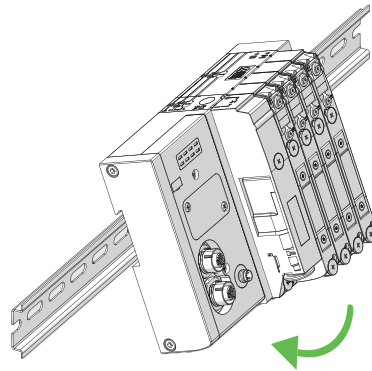


Tighten the two Phillips head screws using a PH1 driver at a torque of 1.1 - 1.3 Nm [9.7 - 11.5 lb-in].  
**First tighten screw A and then screw B.**

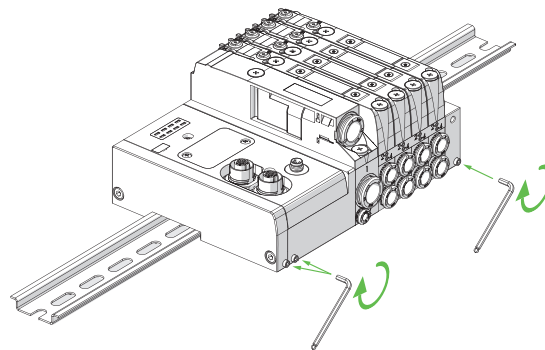


**MOUNTING THE BANK TO DIN RAIL**

Mount the bank to the designated side of the DIN rail dovetail first.



Using a 2mm hex wrench tighten the set screws at a torque of 0.5 Nm [4.4 lb-in].





## ELECTRICAL CONNECTIONS

### POWER WIRING

#### ETHERNET/IP MODULES

An M8 4-pin female connector is used for the power supply. Pin 1 (brown wire) carries power for the main bus of the system. Pin 2 (white wire) is used to power any auxiliary solenoid valves connected to the system. The auxiliary power supply of the valves is separate from the fieldbus, which means that the valves can be powered off while the bus line remains live.

Input voltage range is 12VDC -10% to 24VDC +30% (minimum 10.8, maximum 31.2 VDC)

Choose an appropriate cable to maintain IP65 rating. See AutomationDirect.com for a large selection of M8 IP65 rated cables.



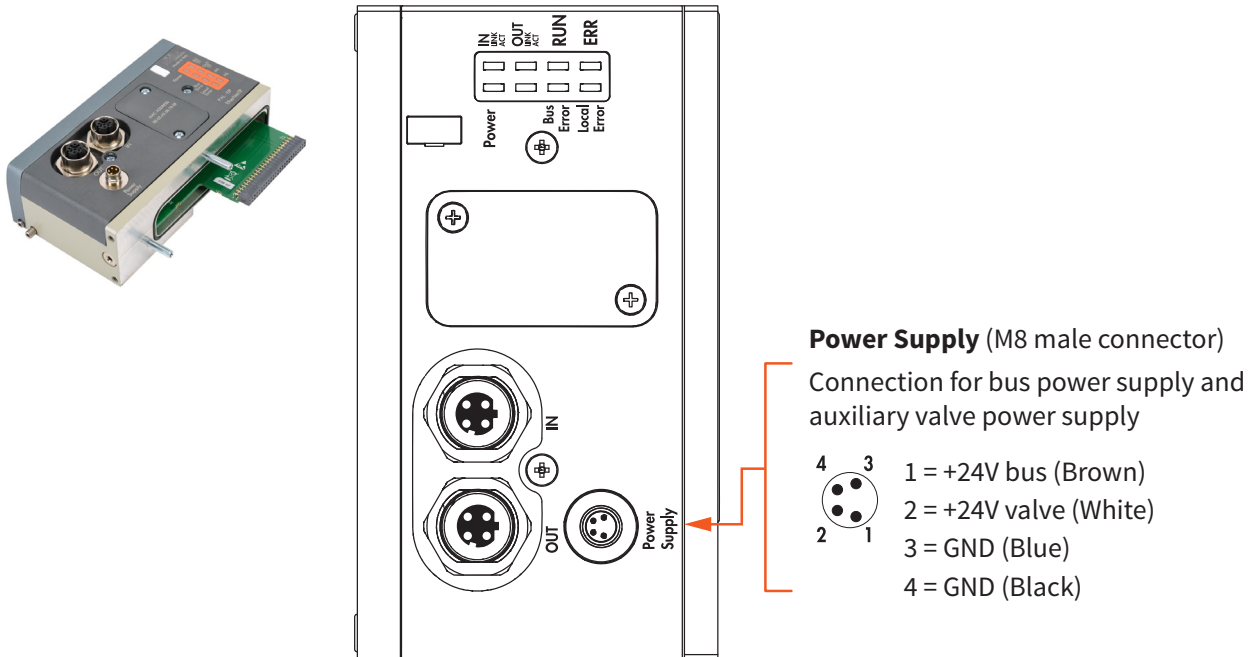
**WARNING:** POWER OFF THE SYSTEM BEFORE PLUGGING OR UNPLUGGING THE CONNECTOR (RISK OF FUNCTIONAL DAMAGE).

USE FULLY ASSEMBLED VALVE UNITS ONLY.

USE AN APPROPRIATE POWER SUPPLY FOR INCOMING POWER THAT COMPLIES WITH IEC 742/EN60742/VDE0551 WITH AT LEAST 4kV INSULATION RESISTANCE (PELV).



**WARNING:** SUPPLY VOLTAGE GREATER THAN 32VDC WILL PERMANENTLY DAMAGE THE PAL SYSTEM.



**NOTE:** The module must be grounded using the end plate connection marked with the Symbol PE  $\perp$ .



**WARNING:** IMPROPER GROUNDING MAY CAUSE DAMAGE TO THE BUS COUPLER. PROPER GROUNDING IS NECESSARY TO MAINTAIN IP65 RATING. UNUSED M12 CONNECTIONS MUST BE COVERED WITH A PROTECTIVE CAP TO MAINTAIN IP65 RATING.

**ELECTRICAL CONNECTION MODULES**

Choose the appropriate Electrical Connection Module power cable for wiring. AutomationDirect part numbers PAL-ACC04, PAL-ACC05 and PAL-ACC06 are for use with Electrical Connection Module PAL-E25. Part numbers PAL-ACC07, PAL-ACC08 and PAL-ACC09 are for use with Electrical Connection Module PAL-E44.

Input voltage range is 12VDC -10% to 24VDC +30% (minimum 10.8, maximum 31.2 VDC)



**WARNING:** POWER OFF THE SYSTEM BEFORE PLUGGING OR UNPLUGGING THE CONNECTOR (RISK OF FUNCTIONAL DAMAGE).

USE FULLY ASSEMBLED VALVE UNITS ONLY.

USE AN APPROPRIATE POWER SUPPLY FOR INCOMING POWER THAT COMPLIES WITH IEC 742/EN60742/VDE0551 WITH AT LEAST 4kV INSULATION RESISTANCE (PELV).



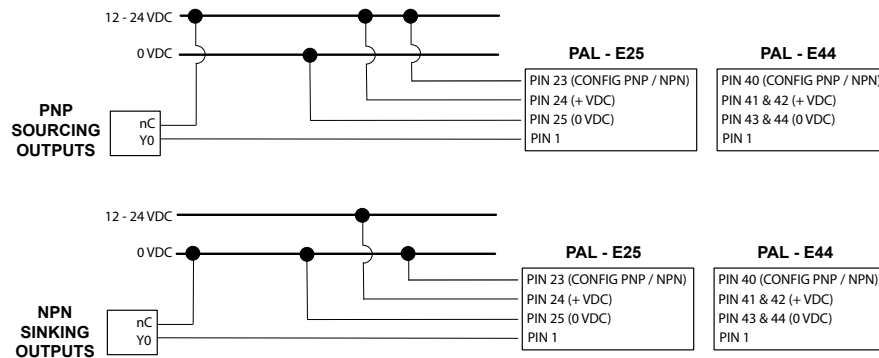
**WARNING:** SUPPLY VOLTAGE GREATER THAN 32VDC WILL PERMANENTLY DAMAGE THE PAL SYSTEM.

**D-SUB 25-PIN CONNECTOR**

PIN	Color of the corresponding wire (DIN 47100)	Function
1	White	1
2	Brown	2
3	Green	3
4	Yellow	4
5	Grey	5
6	Pink	6
7	Blue	7
8	Red	8
9	Black	9
10	Violet	10
11	Grey + Pink ring	11
12	Red + Blue ring	12
13	White + Green ring	13
14	Brown + Green ring	14
15	White + Yellow ring	15
16	Yellow + Brown ring	16
17	White + Grey ring	17
18	Grey + Brown ring	18
19	White + Pink ring	19
20	Pink + Brown ring	20
21	White + Blue ring	21
22	Brown + Blue ring	Fault reporting
23	White + Red ring	* Config. PNP/NPN
24	Brown + Red ring	+VDC
25	White + Black ring	0VDC

**D-SUB 44-PIN CONNECTOR**

PIN	Color of the corresponding wire (DIN 47100)	Function
1	White	1
2	Brown	2
3	Green	3
4	Yellow	4
5	Grey	5
6	Pink	6
7	Blue	7
8	Red	8
9	Black	9
10	Violet	10
11	Grey + Pink ring	11
12	Red + Blue ring	12
13	White + Green ring	13
14	Brown + Green ring	14
15	White + Yellow ring	15
16	Yellow + Brown ring	16
17	White + Grey ring	17
18	Grey + Brown ring	18
19	White + Pink ring	19
20	Pink + Brown ring	20
21	White + Blue ring	21
22	Brown + Blue ring	22
23	White + Red ring	23
24	Brown + Red ring	24
25	White + Black ring	25
26	Brown + Black ring	26
27	Grey + Green ring	27
28	Yellow + Grey ring	28
29	Pink + Green ring	29
30	Yellow + Pink ring	30
31	Green + Blue ring	31
32	Yellow + Blue ring	32
33	Green + Red ring	33
34	Yellow + Red ring	34
35	Green + Black ring	35
36	Yellow + Black ring	36
37	Grey + Blue ring	37
38	Pink + Blue ring	38
39	Grey + Red ring	Fault reporting
40	Pink + Red ring	* Config. PNP/NPN
41	Grey + Black ring	+VDC
42	Pink + Black ring	+VDC
43	Blue + Black ring	0VDC
44	Red + Black ring	0VDC



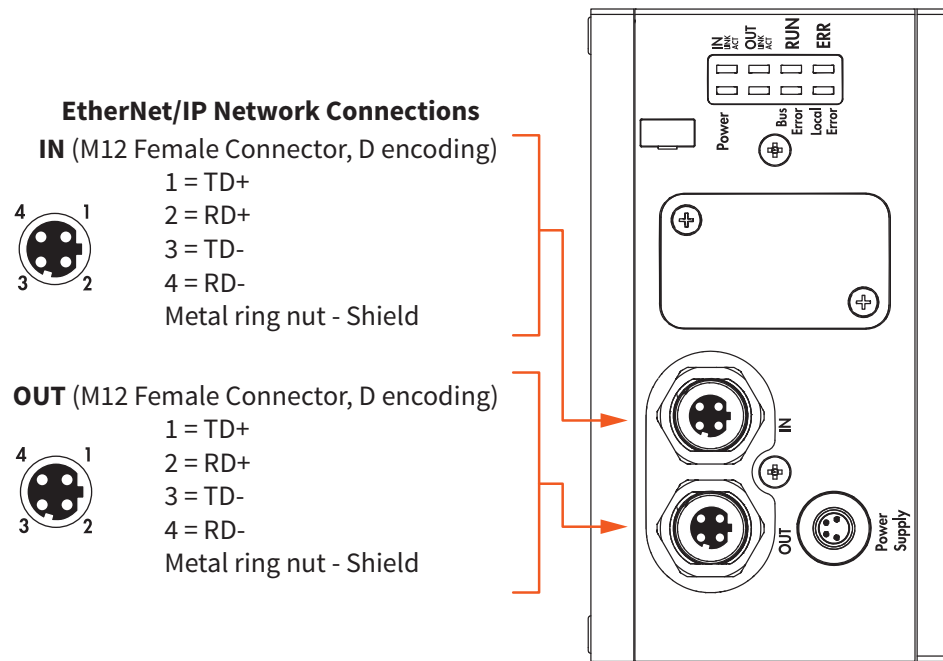
**NOTE:** The module must be grounded using the end plate connection marked with the Symbol PE  $\perp$ .



**WARNING:** IMPROPER GROUNDING MAY CAUSE DAMAGE TO THE BUS COUPLER. PROPER GROUNDING IS NECESSARY TO MAINTAIN IP65 RATING.

**PAL-EIP CONNECTIONS**

The network connectors on the PAL-EIP are M12 female D-coded for Ethernet. Pre-wired Ethernet Cat5e cables with M12 male D-coded connector or field-wireable connectors such as AutomationDirect part numbers 7000-14581-0000000 or 7000-14521-0000000 are recommended for connecting the PAL system to the network.



**WARNING:** IMPROPER GROUNDING MAY CAUSE DAMAGE TO THE BUS COUPLER. PROPER GROUNDING IS NECESSARY TO MAINTAIN IP65 RATING. UNUSED M12 CONNECTIONS MUST BE COVERED WITH A PROTECTIVE CAP TO MAINTAIN IP65 RATING.

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# CONVENTIONAL ELECTRICAL MODULES

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**CHAPTER**



**2**

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### CONVENTIONAL ELECTRICAL MODULES

For pneumatic only systems, with no I/O, a conventional electrical module may be used. PAL-E25 supports up to 21 solenoids and PAL-E44 supports up to 38 solenoids. The cables listed below were designed to fit the electrical connection modules and maintain IP65 protection.

PAL System - Conventional Electrical Modules			
Item	Part No.	Description	Electrical Cables
	<b>PAL-E25</b>	NITRA electrical connection module, 12-24 VDC, (21) solenoid(s), IP65. For use with PAL series. Requires PAL series 25-pin male D-sub control cable.	Listed below
	<b>PAL-E44</b>	NITRA electrical connection module, 12-24 VDC, (38) solenoid(s), IP65. For use with PAL series. Requires PAL series 44-pin male D-sub control cable.	

### CABLES

Electrical Module Power Cables			
Item	Part No.	Description	Length
	<b>PAL-ACC04</b>	NITRA control cable, 25-pin D-sub right-angle female to pigtail, IP65, 3.2ft/1m cable length. For use with PAL-E25 electrical connection module.	3.2 ft (1m)
	<b>PAL-ACC05</b>	NITRA control cable, 25-pin D-sub right-angle female to pigtail, IP65, 8.2ft/2.5m cable length. For use with PAL-E25 electrical connection module.	8.2 ft (2.5 m)
	<b>PAL-ACC06</b>	NITRA control cable, 25-pin D-sub right-angle female to pigtail, IP65, 16.4ft/5m cable length. For use with PAL-E25 electrical connection module.	16.4 ft (5m)
	<b>PAL-ACC07</b>	NITRA control cable, 44-pin D-sub right-angle female to pigtail, IP65, 3.2ft/1m cable length. For use with PAL-E44 electrical connection module.	3.2 ft (1m)
	<b>PAL-ACC08</b>	NITRA control cable, 44-pin D-sub right-angle female to pigtail, IP65, 8.2ft/2.5m cable length. For use with PAL-E44 electrical connection module.	8.2 ft (2.5 m)
	<b>PAL-ACC09</b>	NITRA control cable, 44-pin D-sub right-angle female to pigtail, IP65, 16.4ft/5m cable length. For use with PAL-E44 electrical connection module.	16.4 ft (5m)

**SPECIFICATIONS**

Conventional Electrical Module Specifications	
<b>Maximum Admissible Current (PAL-E25, PAL-E44)</b>	With multi-pole connection 6A continuous, 9A instantaneous With fieldbus connection 4A continuous, 6A instantaneous for valve supply; 4A continuous, 6A instantaneous for bus and signal supply
<b>Protection</b>	Overload and short-circuit protected solenoid pilot Output
<b>Diagnostics</b>	LED signal on valve, LED on electrical connection and software message regarding: short-circuited solenoid pilot; solenoid pilot with coil failure; voltage out of range (undervoltage and overvoltage); module communication control; on switching, configuration other than that stored
<b>Maximum Number of Solenoid Pilots</b>	128
<b>Maximum number of simultaneously controllable solenoid pilots to actuate a greater number of solenoid pilots at the same time, add "Intermediate module PAL-M12P" with electrical connection</b>	38
<b>Maximum Number of I/O</b>	128 digital inputs, 128 digital outputs, 16 analog inputs, 16 analog outputs
<b>Maximum Number of Modules</b>	40 Bases for valves + 16 digital inputs + 16 digital outputs + 4 analog inputs + 4 analog outputs

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# ETHERNET/IP MODULES

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**OVERVIEW**

Control interface with the PAL system is through either an EtherNet/IP module or conventional electrical module. If I/O modules are to be used, the PAL-EIP bus coupler is required and EtherNet/IP protocol is used. For pneumatic only systems, one of the conventional electrical connection modules can be used.

**ETHERNET/IP MODULES**

PAL System - EtherNet/IP Modules			
Item	Part No.	Description	Electrical Cables
	<b>PAL-EIP</b>	NITRA bus coupler, 12-24 VDC, (2) Ethernet 10/100Base-T (M12) port(s), EtherNet/IP, 10/100 Mbps, (128) solenoid(s) per system, IP65. For use with PAL series. Requires 4-pin M8 power cable.	Power: 4-Pole Pico (M8) cable EtherNet: M12 4-Pole, D-Coded cable
	<b>PAL-EAD</b>	NITRA local expansion coupler, 12-24 VDC, (1) 4-pin M8 quick-disconnect port(s), CAN, up to 100 Mbps, number of solenoid(s) inclusive of main system, IP65. For use with PAL series. Requires 4-pin M8 power cable. Used for local expansion.	

The full capabilities of the NITRA PAL system can be realized when the EtherNet/IP module is used for control and communication interface with a PLC. The PAL-EIP bus coupler is required for systems that utilize I/O modules either with or without solenoid valves. Free downloadable configuration software allows easy setup of the PAL system’s IP address and then configuration of each input and output point and each solenoid valve. I/O and valves can be assembled into sub-units yet treated as a single IP address with the use of the PAL-C3 end plate, PAL-EAD expansion module and the appropriate extension cable.?

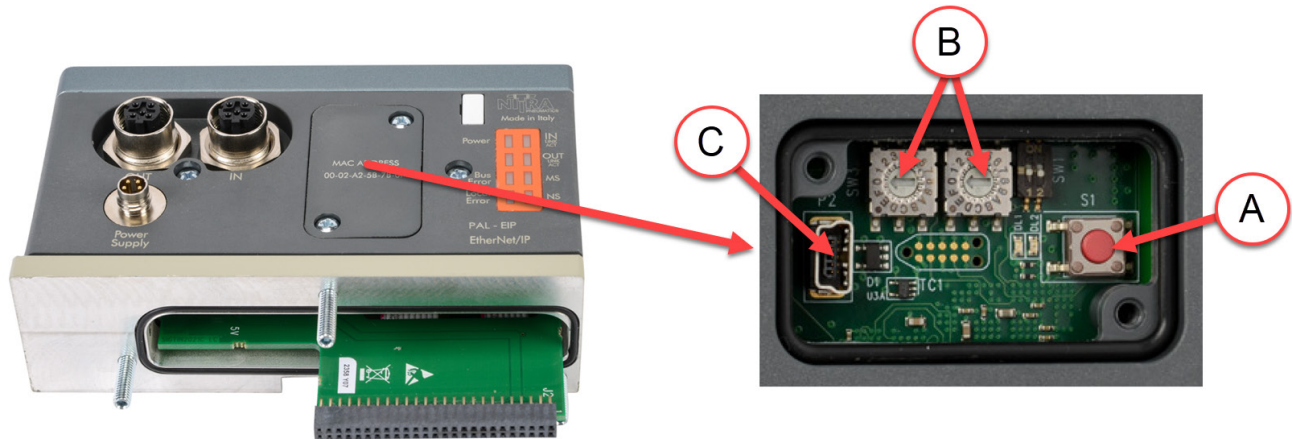
**SPECIFICATIONS**

PAL System - EtherNet/IP Module Specifications	
<b>Maximum Admissible Current (PAL-EIP, PAL-EAD)</b>	4A continuous, 6A instantaneous for valve supply 4A continuous, 6A instantaneous for bus and signal supply
<b>Protection</b>	Overload and short-circuit protected solenoid pilot Output
<b>Diagnostics</b>	LED signal on valve, LED on electrical connection and software message regarding: short-circuited solenoid pilot; solenoid pilot with coil failure; voltage out of range (undervoltage and overvoltage); module communication control; on switching, configuration other than that stored
<b>Maximum Number of Solenoid Pilots</b>	128
<b>Maximum number of simultaneously controllable solenoid pilots to actuate a greater number of solenoid pilots at the same time, add "Intermediate module PAL-M12P" with electrical connection</b>	38
<b>Maximum Number of I/O</b>	128 digital inputs, 128 digital outputs, 16 analog inputs, 16 analog outputs
<b>Maximum Number of Modules</b>	40 Bases for valves + 16 digital inputs + 16 digital outputs + 4 analog inputs + 4 analog outputs
<b>Maximum Number of Class 1 Input Only/ Listen Only Connections</b>	8
<b>Maximum Number of Class 3 Connections</b>	8
<b>Maximum Number of Concurrent TCP Connections (thinking of resources for Unconnected Explicit Messaging)</b>	30

## SYSTEM SETUP FOR ETHERNET/IP ASSEMBLIES

### INITIAL HARDWARE CONFIGURATION

Before the PAL controller can be connected to an EtherNet/IP scanner and update the I/O, the physical configuration must be verified. This is to allow the diagnostics to report if a problem has occurred with the hardware.



- A) To set the hardware configuration, remove the small access panel on the PAL controller. With all the I/O and Solenoid valves installed, power up the unit WHILE pressing the **A** button until all the indicators light up temporarily on the controller, the solenoid valve bases, and the I/O modules. Any time a change is made to the configuration by adding or removing modules or their order, you must repeat this procedure.



**NOTE:** If a 6-point digital output + power supply module is present in the configuration, power must be applied when following the procedure above in order for that module to be recognized properly.

- B) The IP addressing of the module can be configured to a static IP using the EIP Configuration tool discussed in Configuring the PAL Network Settings shown below. But the rotary switches indicated above can be used to either set the network settings to DHCP or to reset the network settings to factory default. To set the network interface to DHCP, set the rotary switches to FF. To change the interface to factory default, set the rotary switches to FF and then back to 00. A power cycle is not required. The default IP address is: 192.168.192.32 with a subnet mask of 255.255.255.0.

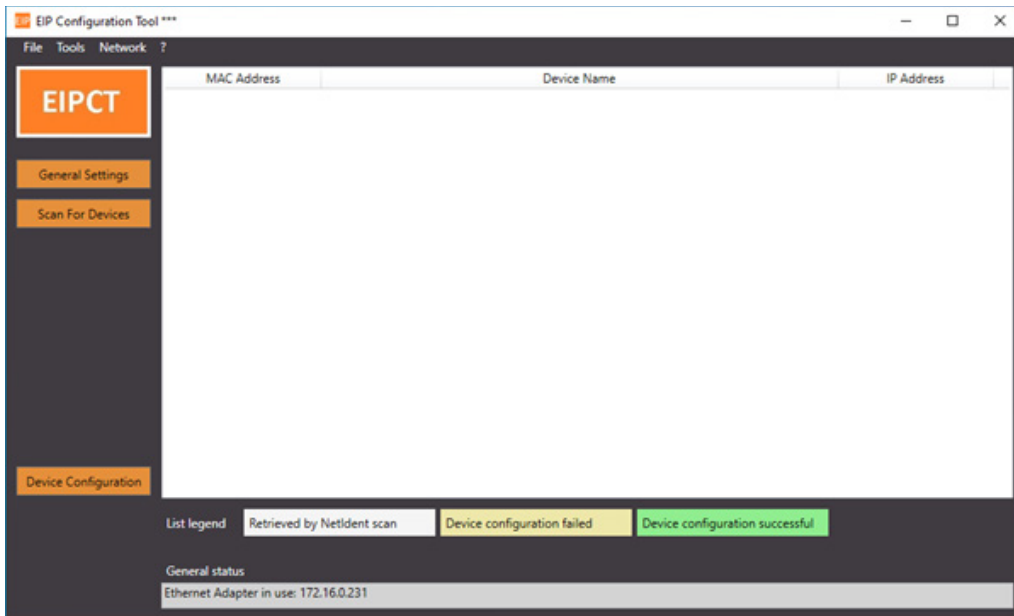
### CONFIGURING THE PAL NETWORK SETTINGS

In order to configure the PAL Network Settings, the software utility EIPConfiguration Tool is required. The download for the EIPConfiguration Tool can be found here:

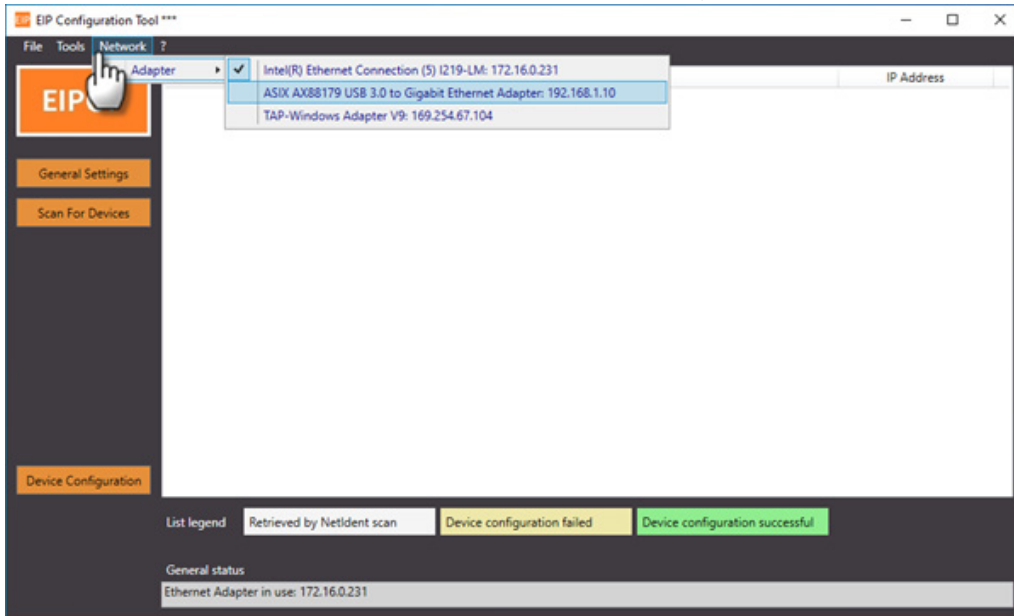
<https://support.automationdirect.com/products/nitra.html>

The EIPConfiguration Tool is a software utility that will scan and discover any NITRA PAL Controllers connected to the network (as well as any EtherNet/IP-capable NITRA CMV modular plates). With the EIPConfiguration Tool, the user can configure the network settings (IP address, subnet mask, default gateway) of their device.

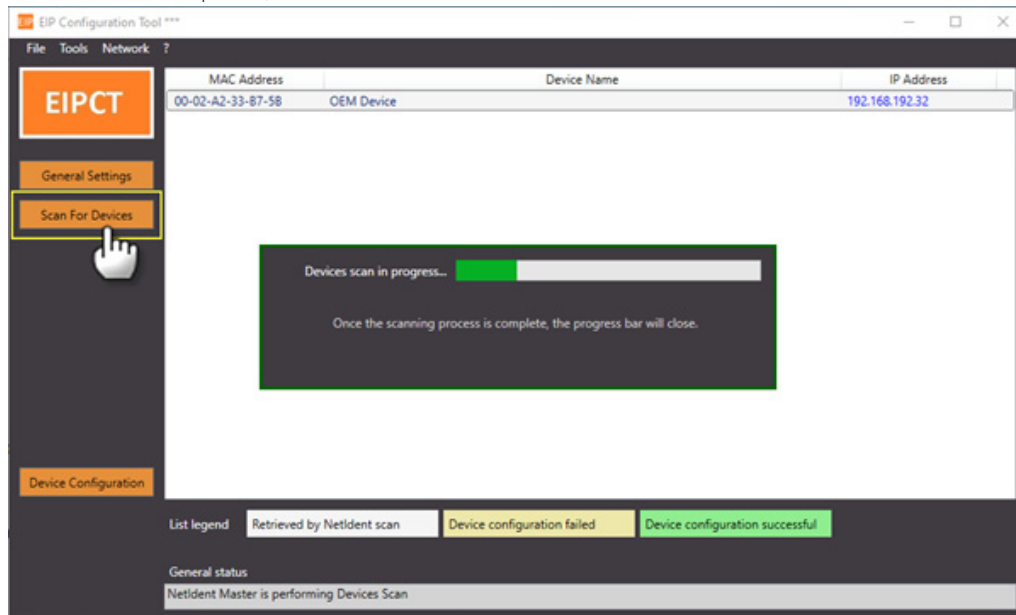
Upon opening the EIPConfiguration Tool, the PC's default network adapter will be displayed in the General Status field. If the PC being used has multiple network adapters and an adapter other than the default is needed, follow the steps listed next.



1) From the menu bar, click the Network menu and select Adapter.



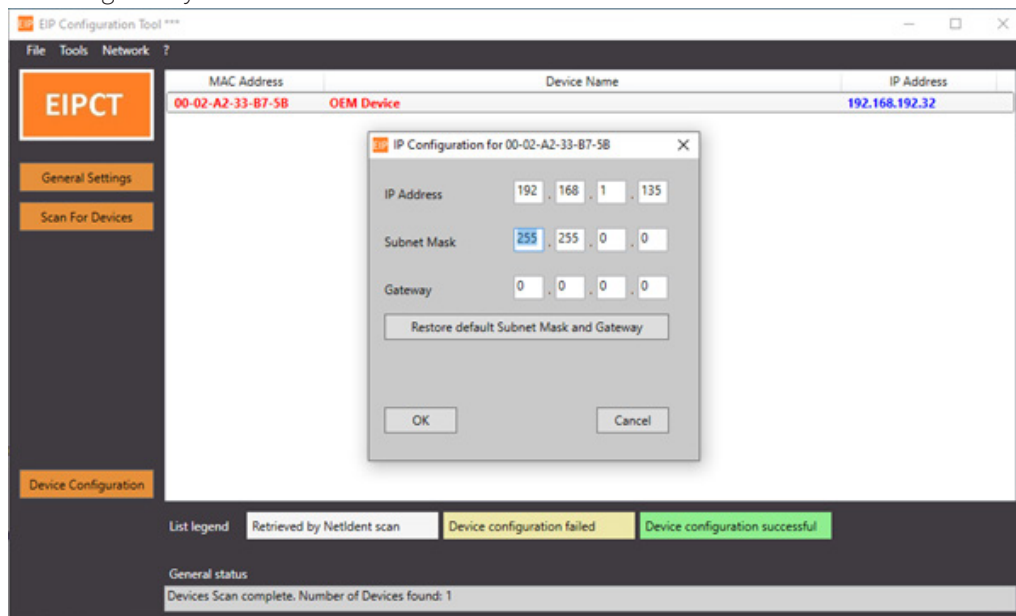
- 2) Select the PC's network adapter that is connected to the same network as the NITRA PAL Controller. The EIPConfiguration Tool will automatically scan the network. When no change of network adapter selection is required, the user can click the Scan for Devices button to also scan the network.



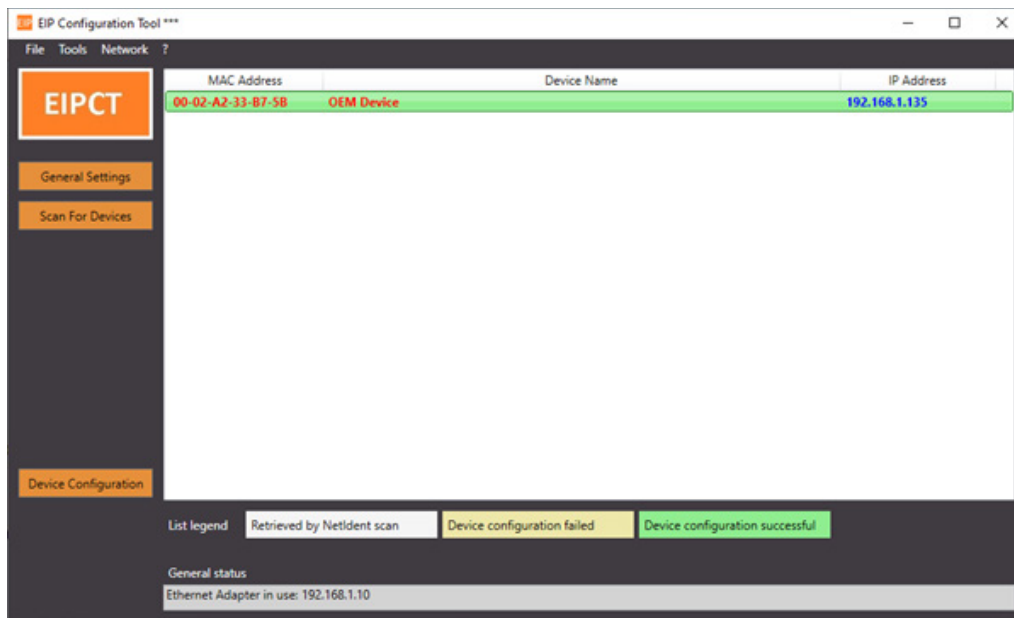
Any discovered NITRA PAL Controller will be listed in the utility window.

**ENTERING THE STATIC IP ADDRESS, SUBNET MASK AND DEFAULT GATEWAY**

With the discovered device selected, click the Device Configuration button or double-click the selected device to open the network settings window. Here the user can enter the static IP address, subnet mask, and default gateway needed for the device.



Once the parameters are set, click OK. The new network parameters are written to the device and the network is rescanned. The device should once again be discovered, only now showing the new IP address.



### NITRA PNEUMATIC AUTOMATION LINK (PAL) CONFIGURATION SOFTWARE

The NITRA Pneumatic Automation Link (PAL) Configuration Software is used to configure the PAL system for proper operation. Refer to the help file included with the configuration software for more in-depth explanation. The software is available for download at

<https://support.automationdirect.com/products/nitra.html>

## ETHERNET/IP CONNECTIONS AND DATA MAPPING

The PAL EtherNet/IP interface supports EtherNet/IP in the following methods:

- Class 1 I/O Messaging (also called "Implicit Messaging")
- Class 3 Explicit Messaging
- Unconnected Explicit Messaging

### EDS FILE

To assist in an EtherNet/IP Scanner side setup for establishing communication and facilitating the exchange of I/O Messaging data with the NITRA PAL EtherNet/IP Adapter, an EDS file for the NITRA PAL is available. See <https://support.automationdirect.com/products/nitrapal.html>

### CLASS 1 I/O MESSAGING

- Input Connection Point = 101 (0x65)
- Input Data Size = 146 bytes
- Output Connection Point = 100 (0x64)
- Output Data Size = 102 bytes
- Configuration Connection Point = 3\*
- Configuration Data Size = 0\*
- Run/Idle header should be enabled for Output (O->T) connection
- Supports Unicast or Multicast for Input (T->O) data.



*\*NOTE: Configuration Data from the EtherNet/IP Scanner is not required by the PAL-EIP. If the Scanner (Client) setup requires a Configuration Connection Point to be specified, use these values.*

### CLASS 3 EXPLICIT OR UNCONNECTED EXPLICIT

- Input Data:
  - Service = Get Single Attribute = 14 (0x0E)
  - Class = 4
  - Instance = 101 (0x65)
  - Attribute = 3
  - Size = 146 bytes
- Output Data:
  - Service = Set Single Attribute = 16 (0x10)
  - Class = 4
  - Instance = 100 (0x64)
  - Attribute = 3
  - Size = 102 bytes
- Enable/Disable Unconnected Explicit Updates:
  - Services: Set Single Attribute = 16 (0x10) and Get Single Attribute = 14 (0x0E)
  - Class = 4
  - Instance = 104 (0x68)
  - Attribute = 3
  - Size = 1 byte
  - Value: Disable = 0; Enable = 1



*\*NOTE: For the PAL-EIP unit to accept Unconnected Explicit writes to the Output Assembly Instance 100:*

- A Class 1 (implicit) or Class 3 (connected explicit) connection to Assembly Instance 100 must NOT exist.
- Attribute 3 of Assembly Instance 104 must be transitioned from 0 to 1. Without this transition, the physical outputs will not engage.

*Additionally, for the PAL-EIP to update the input data image of Input Assembly Instance 101 for Unconnected Explicit Messaging: Attribute 3 of Assembly Instance 104 must be transitioned from 0 to 1. Without this transition, the input data image will not be updated for Unconnected Explicit Messaging.*

**EIP DATA MAPPING**

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>Diagnostic Data</b>	0	1		
<b>8 pt. Digital Input (PAL-S01) Module 1</b>	1	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 2</b>	2	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 3</b>	3	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 4</b>	4	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 5</b>	5	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				



Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Input (PAL-S01) Module 6</b>	6	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 7</b>	7	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 8</b>	8	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 9</b>	9	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 10</b>	10	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Input (PAL-S01) Module 11</b>	11	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 12</b>	12	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 13</b>	13	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 14</b>	14	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Input (PAL-S01) Module 15</b>	15	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Input (PAL-S01) Module 16</b>	16	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>4 ch. Analog Input (PAL-S04) Module 1</b>	17	8		1 High
	18			1 Low
	19			2 High
	20			2 Low
	21			3 High
	22			3 Low
	23			4 High
	24			4 Low
<b>4 ch. Analog Input (PAL-S04) Module 2</b>	25	8		1 High
	26			1 Low
	27			2 High
	28			2 Low
	29			3 High
	30			3 Low
	31			4 High
	32			4 Low
<b>4 ch. Analog Input (PAL-S04) Module 3</b>	33	8		1 High
	34			1 Low
	35			2 High
	36			2 Low
	37			3 High
	38			3 Low
	39			4 High
	40			4 Low
<b>4 ch. Analog Input (PAL-S04) Module 4</b>	41	8		1 High
	42			1 Low
	43			2 High
	44			2 Low
	45			3 High
	46			3 Low
	47			4 High
	48			4 Low
<b>&lt;reserved&gt;</b>	49	48		

(table continued on next page)

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Input (PAL-S06) Module 1</b>	97	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Input (PAL-S06) Module 2</b>	99	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

*(table continued on next page)*

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Input (PAL-S06) Module 3</b>	101	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Input (PAL-S06) Module 4</b>	103	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

*(table continued on next page)*

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Input (PAL-S06) Module 5</b>	105	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Input (PAL-S06) Module 6</b>	107	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

(table continued on next page)

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Input (PAL-S06) Module 7</b>	109	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Input (PAL-S06) Module 8</b>	111	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>4 ch. Temp Input (PAL-S08) Module 1</b>	113	2		Ch 1
	115	2		Ch 2
	117	2		Ch 3
	119	2		Ch 4
<b>4 ch. Temp Input (PAL-S08) Module 2</b>	121	2		Ch 1
	123	2		Ch 2
	125	2		Ch 3
	127	2		Ch 4
<b>4 ch. Temp Input (PAL-S08) Module 3</b>	129	2		Ch 1
	131	2		Ch 2
	133	2		Ch 3
	135	2		Ch 4

(table continued on next page)

Input Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>4 ch. Temp Input (PAL-S08) Module 4</b>	137	2		Ch 1
	139	2		Ch 2
	141	2		Ch 3
	143	2		Ch 4
<reserved>	145	1		

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>Valves 1 - 8</b>	0	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 9 - 16</b>	1	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 17 - 24</b>	2	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 25 - 32</b>	3	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	

(table continued on next page)



Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>Valves 33 - 40</b>	4	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 41 - 48</b>	5	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 49 - 56</b>	6	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 57 - 64</b>	7	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 65 - 72</b>	8	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>Valves 73 - 80</b>	9	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 81 - 88</b>	10	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 89 - 96</b>	11	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 97 - 104</b>	12	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 105 - 112</b>	13	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>Valves 113 - 120</b>	14	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>Valves 121 - 128</b>	15	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 1</b>	16	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 2</b>	17	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 3</b>	18	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Output (PAL-S02) Module 4</b>	19	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 5</b>	20	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 6</b>	21	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 7</b>	22	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 8</b>	23	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	

(table continued on next page)

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Output (PAL-S02) Module 9</b>	24	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 10</b>	25	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 11</b>	26	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 12</b>	27	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 13</b>	28	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>8 pt. Digital Output (PAL-S02) Module 14</b>	29	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 15</b>	30	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>8 pt. Digital Output (PAL-S02) Module 16</b>	31	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 1</b>	32	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 2</b>	33	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	

(table continued on next page)

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>6 pt. Digital Output (PAL-S03) Module 3</b>	34	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 4</b>	35	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 5</b>	36	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 6</b>	37	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 7</b>	38	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>6 pt. Digital Output (PAL-S03) Module 8</b>	39	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 9</b>	40	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 10</b>	41	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 11</b>	42	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 12</b>	43	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	

(table continued on next page)



Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>6 pt. Digital Output (PAL-S03) Module 13</b>	44	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 14</b>	45	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 15</b>	46	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 16</b>	47	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 17</b>	48	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<i>(table continued on next page)</i>				

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>6 pt. Digital Output (PAL-S03) Module 18</b>	49	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 19</b>	50	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 20</b>	51	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 21</b>	52	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>6 pt. Digital Output (PAL-S03) Module 22</b>	53	1	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
<b>4 ch. Analog Output (PAL-S05) Module 1</b>	54	2		Ch 1
	56	2		Ch 2
	58	2		Ch 3
	60	2		Ch 4

(table continued on next page)

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>4 ch. Analog Output (PAL-S05) Module 2</b>	62	2		Ch 1
	64	2		Ch 2
	66	2		Ch 3
	68	2		Ch 4
<b>4 ch. Analog Output (PAL-S05) Module 3</b>	70	2		Ch 1
	72	2		Ch 2
	74	2		Ch 3
	76	2		Ch 4
<b>4 ch. Analog Output (PAL-S05) Module 4</b>	78	2		Ch 1
	80	2		Ch 2
	82	2		Ch 3
	84	2		Ch 4
<b>16 pt. Digital Output (PAL-S07) Module 1</b>	86	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Output (PAL-S07) Module 2</b>	88	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

(table continued on next page)

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Output (PAL-S07) Module 3</b>	90	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Output (PAL-S07) Module 4</b>	92	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

(table continued on next page)

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Output (PAL-S07) Module 5</b>	94	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Output (PAL-S07) Module 6</b>	96	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	

*(table continued on next page)*

Output Data				
Definition	Byte #	Byte Size	Bit #	Ch
<b>16 pt. Digital Output (PAL-S07) Module 7</b>	98	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	
<b>16 pt. Digital Output (PAL-S07) Module 8</b>	100	2	0	
			1	
			2	
			3	
			4	
			5	
			6	
			7	
			8	
			9	
			10	
			11	
			12	
			13	
			14	
			15	



# I/O MODULES



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**OVERVIEW**

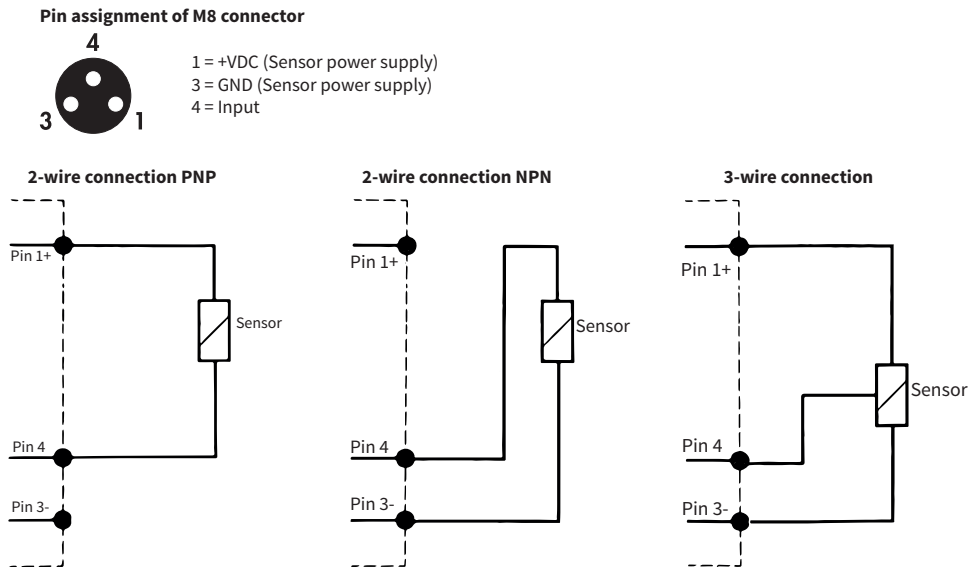
The PAL system has eight input and output modules that are highly configurable by the user during setup. A single PAL system using EtherNet/IP can have up to 128 digital inputs, 128 digital outputs, 16 analog inputs and 16 analog outputs. Each input / output module is protected internally from short-circuit. This chapter will cover each I/O module in detail.

**PAL-S01 8-POINT DISCRETE INPUT**

PAL System - Discrete Input Module		
Item	Part No.	Description
	<b>PAL-S01</b>	NITRA discrete input module, 8-point, 12-24 VDC, PNP/NPN, 1 common(s), 8 point(s) per common, IP65. For use with PAL series. Mounting hardware included. Requires PAL-EIP bus coupler.

The PAL-S01 has eight 3-pole M8 connectors for discrete inputs. Each input point is separately configured for polarity, operating state, signal persistence and input filter time. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

**WIRING DIAGRAM**



**PARAMETER CONFIGURATION**


Use the information in the table below to configure the parameters for the PAL-S01 8-point digital input module.

Setting	Options	How It Works	Setting Description
<b>Polarity</b>	PNP (+VDC) (default)	Determines whether the Input becomes true with +VDC or 0VDC.	Input is ON when signal pin has +VDC present.
	NPN (0VDC)		Input is ON when signal pin has 0VDC present.
<b>Operating State</b>	Normally Open (default)	Determines whether the digital value of the Input is true when the signal is present or true when the signal is not present.	Input is ON when point is enabled.
	Normally Closed		Input is ON when point is not enabled.
<b>Signal Persistence</b>	Filter Off (default)	Ensures that the EtherNet/IP scanner sees the digital value by keeping the digital value on for the specified amount of time regardless of whether or not the actual signal is still present.	Ensures the EtherNet/IP Scanner will see the Input data indicate true if the signal becomes true by leaving the Input data ON for the time period specified. Filter Off means that Input data only indicates true while signal is true.
	15 ms		Input data indicates true for at least 15 ms when signal becomes true.
	50 ms		Input data indicates true for at least 50 ms when signal becomes true.
	100 ms		Input data indicates true for at least 100 ms when signal becomes true.
<b>Input Filter</b>	Filter Off	This option will only indicate the digital value as true if the signal is on for the specified amount of time to eliminate spurious or noisy signals.	Filters out spurious Input signals. Filter Off means that Input data only indicates true while signal is true.
	3 ms (default)		Input data indicates true if signal is on for at least 3 ms.
	10 ms		Input data indicates true if signal is on for at least 10 ms.
	20 ms		Input data indicates true if signal is on for at least 20 ms.

**SPECIFICATIONS**

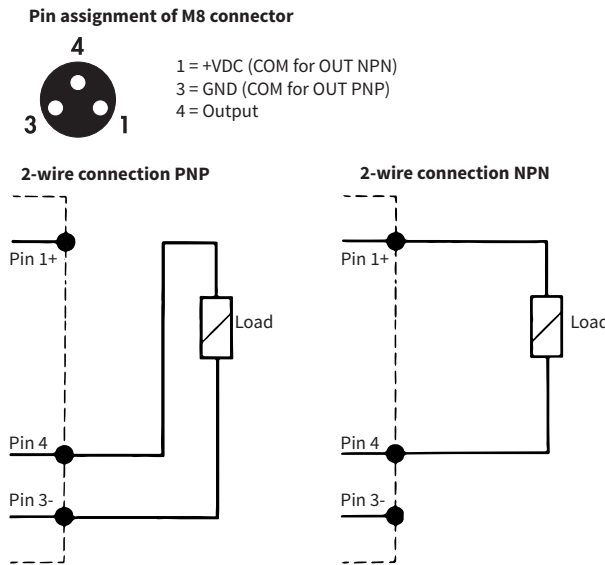
PAL System - Discrete Input Module Specifications	
<b>Sensors Supply Voltage</b>	Corresponding to the supply voltage
<b>Current for Each Connector</b>	200mA max
<b>Current for Each Module</b>	500mA max
<b>Input Impedance</b>	3.9 kΩ
<b>Type of Input</b>	Software-configurable PNP/NPN
<b>Protection</b>	Overload and short-circuit protected inputs
<b>Connections</b>	8 M8 3-pole female connectors
<b>Input Active Signals</b>	One LED for each input

### PAL-S02 8-POINT DISCRETE OUTPUT

PAL System - Discrete Output Module		
Item	Part No.	Description
	<b>PAL-S02</b>	NITRA discrete output module, 8-point, 12-24 VDC, PNP/NPN, 1 common(s), 8 point(s) per common, 1A/point, 4A/common, short circuit and overload protection, IP65. Mounting hardware included. Requires PAL-EIP bus coupler.

The PAL-S02 has eight 3-pole M8 connectors for discrete outputs. Each output point is separately configured for polarity, operating state and fail safe operation. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

#### WIRING DIAGRAM




#### PARAMETER CONFIGURATION

Use the information in the table below to configure the parameters for the PAL-S02 8-point digital output module.

Setting	Options	How It Works	Setting Description
<b>Polarity</b>	PNP (+VDC) (default)	Determines whether the point outputs + VDC or 0VDC.	Output signal presents +VDC when Output data point is true.
	NPN (0VDC)		Output signal presents 0VDC when Output data point is true.
<b>Operating State</b>	Normally Open (default)	Determines whether the Output signal is present when the digital value is true or if the Output signal is present when the digital value is false.	Output signal is present when Output data point is true.
	Normally Closed		Output signal is present when Output data point is false.
<b>Fail Safe</b>	Hold Last State	Specifies the behavior of the Outputs when the connection to the EtherNet/IP scanner is lost. Note that the "Fail Safe" byte of the PAL Controller options must be set to 'Fault Mode' for this option to work.	Output signal will remain at last state when EtherNet/IP connection is lost.
	Reset Output (default)		Output signal will disable when EtherNet/IP connection is lost.
	Set Output		Output signal will enable when EtherNet/IP connection is lost.

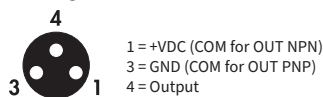
**PAL-S03 6-POINT DISCRETE OUTPUT + ADDITIONAL POWER CONNECTION**

PAL System - Discrete Output Module		
Item	Part No.	Description
	<b>PAL-S03</b>	NITRA discrete output module, 6-point, 12-24 VDC, PNP/NPN, 1 common(s), 6 point(s) per common, 1A/point, 4A/common, short circuit and overload protection, IP65. Mounting hardware included. Requires PAL-EIP bus coupler and power cable.

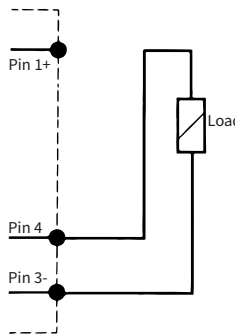
The PAL-S03 has six 3-pole M8 connectors for discrete outputs and one 4-pole power connection to add additional capacity to the electrical bus. This makes it possible to increase the current supplied by the module and system. A PAL-S03 digital output with additional power connection should be used when the current required for the I/O modules will exceed the rated 4A continuous / 6A instantaneous available at the PAL-EIP or PAL-EAD coupler. Each output point is separately configured for polarity, operating state and fail safe operation. The current supplied is the sum of all currents supplied by the PAL-S03 module plus that supplied by all the output modules connected to the left hand side up to another PAL-S03 module with power supply. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

**WIRING DIAGRAM**

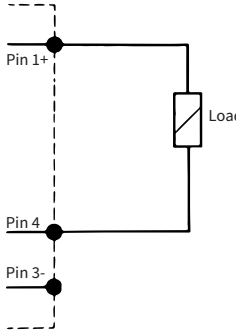
Pin assignment of M8 connector



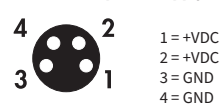
2-wire connection PNP



2-wire connection NPN



Pin assignment of M8 connector for electrical power supply



**PARAMETER CONFIGURATION**


Use the information in the table below to configure the parameters for the PAL-S03 6-point digital output module.

Setting	Options	How It Works	Setting Description
<b>Polarity</b>	PNP (+VDC) (default)	Determines whether the point outputs + VDC or 0VDC.	Output signal presents +VDC when Output data point is true.
	NPN (0VDC)		Output signal presents 0VDC when Output data point is true.
<b>Operating State</b>	Normally Open (default)	Determines whether the Output signal is present when the digital value is true or if the Output signal is present when the digital value is false.	Output signal is present when Output data point is true.
	Normally Closed		Output signal is present when Output data point is false.
<b>Fail Safe</b>	Hold Last State	Specifies the behavior of the Outputs when the connection to the EtherNet/IP scanner is lost. Note that the "Fail Safe" byte of the PAL Controller options must be set to 'Fault Mode' for this option to work.	Output signal will remain at last state when EtherNet/IP connection is lost.
	Reset Output (default)		Output signal will disable when EtherNet/IP connection is lost.
	Set Output		Output signal will enable when EtherNet/IP connection is lost.

**SPECIFICATIONS**

PAL System - Discrete Output Module Specifications		
	PAL-S02	PAL-S03
<b>Supply Voltage Range</b>	N/A	12V -10% 24V +30%
<b>Minimum Operating Voltage</b>	N/A	10.8 V*
<b>Maximum Operating Voltage</b>	N/A	31.2 V
<b>Maximum Admissible Voltage</b>	N/A	32V **
<b>Output Voltage</b>	Corresponding to the supply voltage	
<b>Current for Each Connector</b>	500mA max	1000mA max
<b>Current for Each Module</b>	3000mA max	4000mA max
<b>Type of Output</b>	Software-configurable PNP/NPN	
<b>Protection</b>	Overload and short-circuit protected inputs	
<b>Connections</b>	8 M8 3-pole female connectors	6 M8 3-pole female connectors for Signals 1 M8 4-pole male connector for Supply
<b>Status Indicator</b>	One LED for each output	
* Minimum voltage 10.8V required at solenoid pilots.		
** IMPORTANT! Voltage greater than 32VDC will damage the system irreparably.		

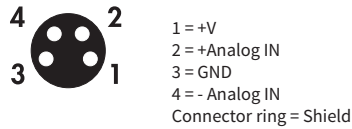
**PAL-S04 4-POINT ANALOG INPUT**

PAL System - Analog Input Module		
Item	Part No.	Description
	<b>PAL-S04</b>	NITRA analog input module, 4-channel, current/voltage, 15-bit, input current signal range(s) of 0-20 mA, 4-20 mA, input voltage signal range(s) of 0-5 VDC, 0-10 VDC, +/- 5 VDC, +/- 10 VDC, IP65.

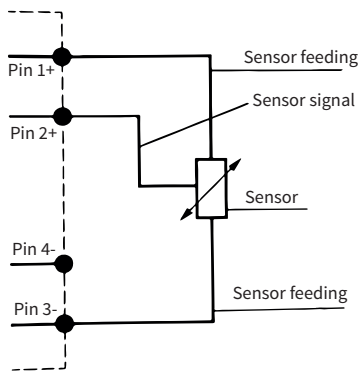
The PAL-S04 has four 4-pole M8 connectors for analog inputs. Each input point is separately configured for signal range and filtering. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

**WIRING DIAGRAM**

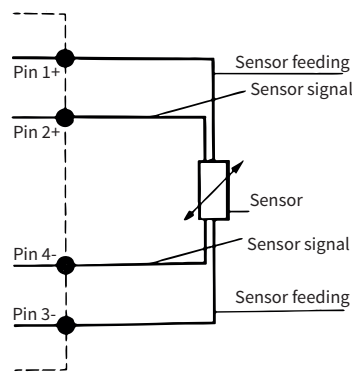
Pin assignment of M8 connector



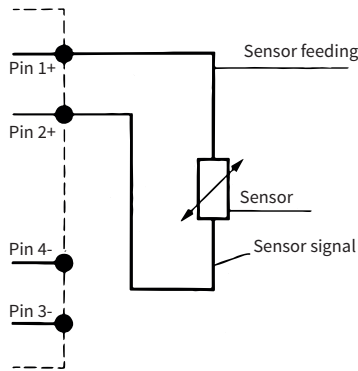
**3-wire voltage sensors**



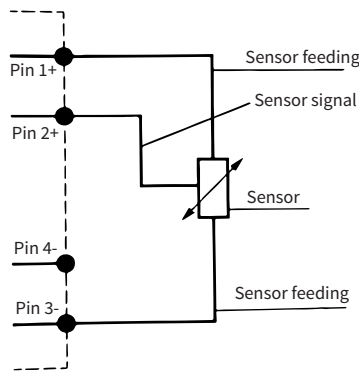
**4-wire voltage sensors (differential)**



**2-wire current sensors**



**3-wire current sensors**



**PARAMETER CONFIGURATION**


Use the information in the table below to configure the parameters for the PAL-S04 4-Channel Analog Input module.

Setting	Options	How It Works	Setting Description
<b>Signal Type</b>	Off (default)	Determines the type of signal being provided to the Analog input channel. A value of 0 disables the channel and is recommended for unused channels to save processing time.	Determines the signal read by the Analog Input channel (configurable for each individual channel). Any channel not being used should be set to Off to save on processing time for the module.
	0 to 10V		
	-10 to 10V		
	0 to 5V		
	-5 to 5V		
	1 to 5V		
	0 to 20mA		
	-20 to 20mA		
<b>Filter</b>	No filter	Averages the values specified to give a 'steadier' digital value. The higher the value, the steadier the result but the slower the update.	Input filter. The channel value is averaged by the number of readings specified. Configuring this option to No filter will deliver a faster update but with less stability.
	2 values		
	4 values		
	8 values (default)		
	16 values		
	32 values		
	64 values		

**ANALOG INPUT DATA FORMAT**

Input Type	Analog Value	Digital Value	State
<b>-10 V to +10 V</b>	+11.7 V	32767	Overflow
	+10 V	28095	Nominal Range
	-10 V	-28095	
	-11.7 V	-32768	Underflow
<b>-5 V to +5 V</b>	+5.8 V	32767	Overflow
	+5 V	28095	Nominal Range
	-5 V	-28095	
	-5.8 V	-32768	Underflow
<b>+1 V to +5 V</b>	+5.8 V	32767	Overflow
	+5 V	28095	Nominal Range
	0 V	0	Underflow
<b>-20 mA to +20 mA</b>	+23 mA	32767	Overflow
	+20 mA	28095	Nominal Range
	-20 mA	-28095	
	-23 mA	-32768	Underflow
<b>+4 mA to +20 mA</b>	+23 mA	32767	Overflow
	+20 mA	28095	Nominal Range
	4 mA	5513	
	0 mA	0	Underflow

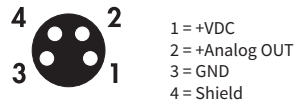
**PAL-S05 4-POINT ANALOG OUTPUT**

PAL System - Analog Output Module		
Item	Part No.	Description
	<b>PAL-S05</b>	NITRA analog output module, 4-channel, current/voltage, 15-bit, output current signal range(s) of 0-20 mA and 4-20 mA, output voltage signal range(s) of 0-5 VDC, +/- 5 VDC, 0-10 VDC and +/- 10 VDC, IP65.

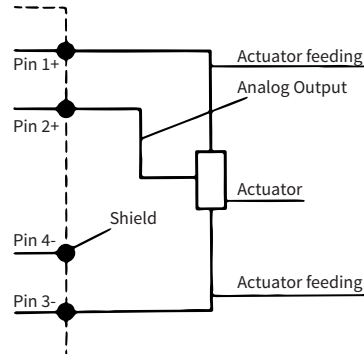
The PAL-S05 has four 4-pole M8 connectors for analog outputs. Each output point is separately configured for signal range, min/max monitoring, fail safe operation and fault mode. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

**WIRING DIAGRAM**

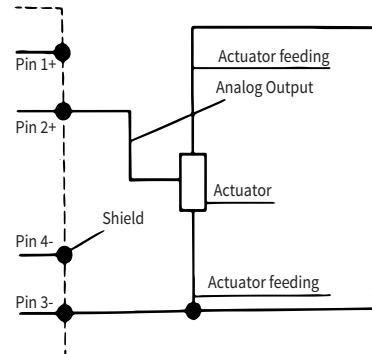
Pin assignment of M8 connector



Analog actuator with internal power supply



Analog actuator with external power supply



**PARAMETER CONFIGURATION**

Use the information in the table below to configure the parameters for the PAL-S05 4-Channel Analog Output module.

Setting	Options	How It Works	Setting Description
<b>Signal Monitor / Fail Safe</b>	<b>Signal:</b>	Determines what kind of signal the analog module channels will output.	This option configures the signal for each output. Any channel not being used should be set to Off to save on processing.
	Off (default)		
	0 to 10V		
	-10V to 10V		
	0 to 5V		
	-5V to 5V		
	0 to 20mA		
	4 to 20mA		
	<b>Max Monitor:</b>	These 2 options (Max Monitor and Min Monitor) enable Maximum value and minimum value output limiting. Enabling these bits requires specifying the minimum and maximum values in the fields described below.	This option enables the Maximum and Minimum Output option value feature. Each channel can be enabled independently. When enabled, the module will limit the analog output values to the values specified for each channel in the Minimum and Maximum Value Monitor configuration settings.
	Disable (default)		
Enable			
<b>Min Monitor:</b>			
Disable (default)			
Enable			
<b>Fail Safe:</b>	This option allows a value to be specified for the analog module to output in case the connection is lost between the controllers and the EtherNet/IP scanner module.	When this setting is enabled, the module will output the value specified in Fault Mode Value settings in case of EtherNet/IP communication loss.	
Hold last value (default)			
Fault Mode value			
<b>Minimum Value Monitor</b>	Valid range for each channel: -32768 to 32767 Default: 384	If the Minimum value monitor is enabled, this is the lower limit value that the module will output.	If this feature is enabled, the firmware will limit the output value to the minimum specified in this field.
<b>Maximum Value Monitor</b>	Valid range for each channel: -32768 to 32767 Default: 32767	If the Maximum value monitor is enabled, this is the upper limit value that the module will output.	If this feature is enabled, the firmware will limit the output value to the maximum specified in this field.
<b>Fault Mode Value</b>	Valid range for each channel: -32768 to 32767 Default: 0	If the Fail Safe option is enabled, this is the value that the module will output if the connection is lost to the EtherNet/IP scanner. Note that the Fail Safe byte of the PAL Controller options must be set to Fault Mode for this option to work.	If this feature is enabled, the firmware will output this value upon loss of EtherNet/IP connectivity with the client.




*\*NOTE: The Nitra PAL has fail-safe behavior options of the physical outputs when a Class 1 Implicit connection or Class 3 Explicit connection is established with the PAL-EIP unit. The fail-safe behavior is dependent upon the CIP connection. Since Unconnected Explicit Messaging does not establish or maintain a CIP connection, the fail-safe features are not applicable when using an Unconnected Explicit Message.*



**SPECIFICATIONS**

PAL System - Analog Module Specifications		
	PAL-S04	PAL-S05
<b>Supply Voltage Range</b>	Corresponding to the supply voltage	
<b>Current for Each Connector</b>	200mA max	
<b>Current for Each Module</b>	650mA max	
<b>Type of Input</b>	Software configurable: 0/10 V; 0/5 V; +/-10 V; +/-5 V; 4/20 mA; 0/20 mA	N/A
<b>Type of Output</b>	N/A	Software configurable: 0/10 V; 0/5 V; +/-10 V; +/-5 V; 4/20 mA; 0/20 mA
<b>Protection</b>	Overload and short-circuit protected inputs	
<b>Connections</b>	4 M8 4-pin female connectors	
<b>Signal Indicator</b>	One LED for each input or output	
<b>Digital Convert Resolution</b>	15 bit + prefix	

**PAL-S06 16-POINT DISCRETE INPUT**

PAL System - Wired Discrete Input Module		
Item	Part No.	Description
	<b>PAL-S06</b>	NITRA discrete input module, 16-point, 12-24 VDC, PNP/NPN, 1 common(s), 16 point(s) per common, IP40. For use with PAL series. Mounting hardware included. Requires PAL-EIP bus coupler.

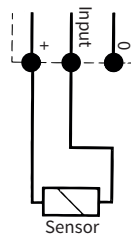
The PAL-S06 has 16 3-pole spring terminals for discrete inputs. Each input point is separately configured for polarity, operating state, signal persistence and input filter time.

**WIRING DIAGRAM**

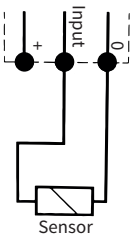
Pin assignment of terminal board connectors

Input X1 - X5 - X9 - X13			Input X2 - X6 - X10 - X14			Input X3 - X7 - X11 - X15			Input X4 - X8 - X12 - X16		
+	Input	0	+	Input	0	+	Input	0	+	Input	0

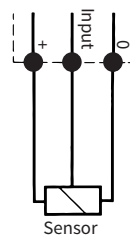
2-wire connection PNP



2-wire connection NPN



3-wire connection




**PARAMETER CONFIGURATION**

Use the information in the table below to configure the parameters for the PAL-S06 16-point input module.

Setting	Options	How It Works	Setting Description
<b>Polarity</b>	PNP (+VDC) (default)	Determines whether the Input becomes true with +VDC or 0VDC.	Input is ON when signal pin has +VDC present.
	NPN (0VDC)		Input is ON when signal pin has 0VDC present.
<b>Operating State</b>	Normally Open (default)	Determines whether the digital value of the Input is true when the signal is present or true when the signal is not present.	Input is ON when point is enabled.
	Normally Closed		Input is ON when point is not enabled.
<b>Signal Persistence</b>	Filter Off (default)	Ensures that the EtherNet/IP scanner sees the digital value by keeping the digital value on for the specified amount of time regardless of whether the actual signal is still present or not.	Ensures the EtherNet/IP Scanner will see the Input data indicate true if the signal becomes true by leaving the Input data ON for the time period specified. The (Filter Off) setting disables this feature (Input data only indicates true while signal is true). The other values will ensure that the Input data is indicated for the value specified.
	15 ms		
	50 ms		
	100 ms		
<b>Input Filter</b>	Filter Off	Only indicates the digital value as true if the signal is on for the specified amount of time to eliminate spurious or noisy signals.	Filters out spurious Input signals. The (Filter Off) setting disables filter (Input Data only indicates true while signal is true). The other values will filter out input signals shorter than the value specified.
	3 ms (default)		
	10 ms		
	20 ms		

### PAL-S07 16-POINT DISCRETE OUTPUT

PAL System - Wired Discrete Output Module		
Item	Part No.	Description
	<b>PAL-S07</b>	NITRA discrete output module, 16-point, 12-24 VDC, PNP/NPN, 1 common(s), 16 point(s) per common, 0.5A/point, 3A/common, short circuit and overload protection, IP40. Mounting hardware included. Requires PAL-EIP bus coupler.

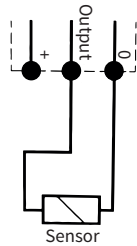
The PAL-S07 has 16 3-pole spring terminals for discrete outputs. Each output point is separately configured for polarity, operating state and fail safe operation.

#### WIRING DIAGRAM

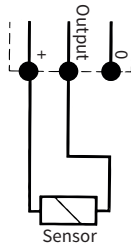
Pin assignment of terminal board connectors

Input X1 - X5 - X9 - X13		Input X2 - X6 - X10 - X14		Input X3 - X7 - X11 - X15		Input X4 - X8 - X12 - X16	
+	Output 0	+	Output 0	+	Input 0	+	Output 0

2-wire connection PNP



2-wire connection NPN



#### PARAMETER CONFIGURATION


Use the information in the table below to configure the parameters for the PAL-S07 16-point digital output module.

Setting	Options	How It Works	Setting Description
<b>Polarity</b>	PNP (+VDC) (default)	Determines whether the point outputs +VDC or 0VDC.	Output signal presents +VDC when Output data point is true.
	NPN (0VDC)		Output signal presents 0VDC when Output data point is true.
<b>Operating State</b>	Normally Open (default)	Determines whether the Output signal is present when the digital value is true or if the Output signal is present when the digital value is false.	Output signal is present when Output data point is true.
	Normally Closed		Output signal is present when Output data point is false.
<b>Fail Safe</b>	Hold last state	Specifies the behavior of the Outputs when the connection to the EtherNet/IP scanner is lost. Note that the Fail Safe byte of the PAL Controller options must be set to Fault Mode for this option to work.	Output signal will remain at last state when EtherNet/IP connection is lost.
	Reset Output (default)		Output signal will disable when EtherNet/IP connection is lost.
	Set Output		Output signal will enable when EtherNet/IP connection is lost.

**SPECIFICATIONS**

PAL System - Wired Discrete Module Specifications		
	PAL-S06	PAL-S07
<b>Supply Voltage Range</b>	Corresponding to the supply voltage	N/A
<b>Output Voltage</b>	N/A	Corresponding to the supply voltage
<b>Current for Each Connector</b>	200mA max	500mA max
<b>Current for Each Module</b>	500mA max	3000mA max*
<b>Input Impedance</b>	3.9 kΩ	N/A
<b>Type of Input</b>	Software-configurable PNP/NPN	N/A
<b>Type of Output</b>	N/A	Software-configurable PNP/NPN
<b>Protection</b>	Overload and short-circuit protected inputs	
<b>Connections</b>	4 12-pin connectors with spring clamping	
<b>Maximum Wire Size</b>	20 AWG (0.5 mm <sup>2</sup> )	
<b>Status Indicator</b>	One LED for each input or output	
<b>Degree of Protection</b>	IP40	
* <b>IMPORTANT:</b> the module is powered via the fieldbus. Check that the total current of connected outputs is not greater than 3.5 A.		

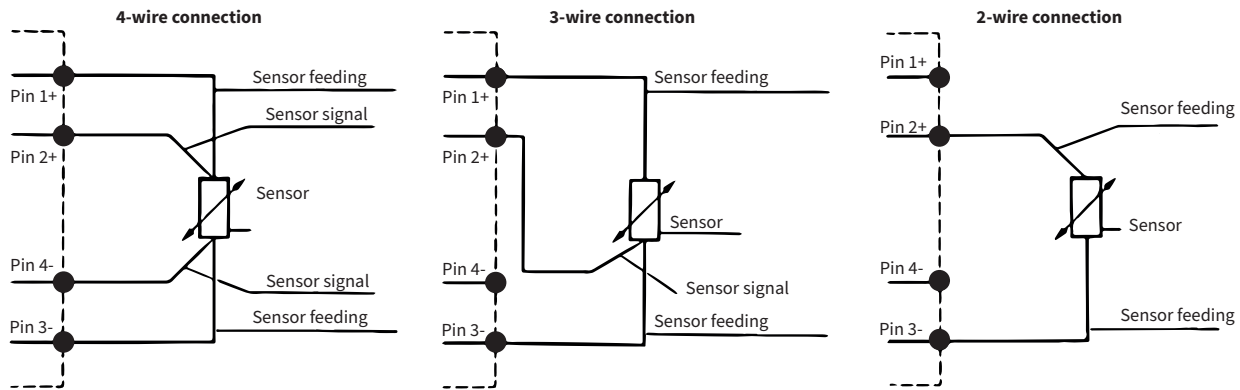
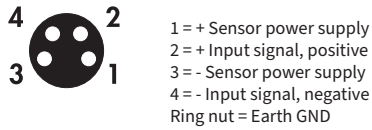
## PAL-S08 4-POINT ANALOG TEMPERATURE INPUT

PAL System - Temperature Input Module		
Item	Part No.	Description
	<b>PAL-S08</b>	NITRA temperature input module, RTD/ thermocouple, 4-channel, 15-bit resolution, IP65. Mounting hardware included. Requires PAL-EIP bus coupler.

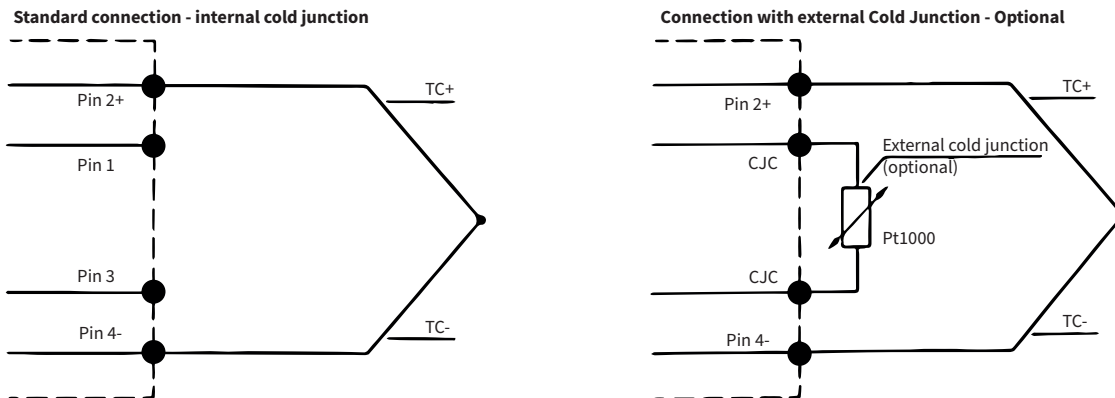
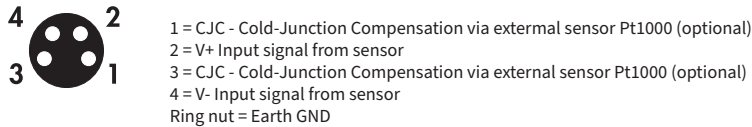
The PAL-S08 has four 3-pole M8 connectors for analog temperature inputs. Each input point is separately configured for the type of RTD or thermocouple, number of wires, resolution, filtering, min/max monitoring and short or open circuit handling. Any unused points should be capped with PAL-ACC02 M8 caps available separately.

### WIRING DIAGRAM

#### Pin assignment of Temperature Sensors (PT and NI Series)



#### Pin assignment of Temperature Sensors (Thermocouples)



**PARAMETER CONFIGURATION**

Use the information in the table below to configure the parameters for the PAL-S08 temperature input module.

Setting	Options	How It Works	Setting Description
<b>Unit of Measurement</b>	Celsius (default)	Select between Celsius and Fahrenheit as the temperature format for the module.	Module setting for temperature format.
	Fahrenheit		
<b>Noise Suppression</b>	50Hz (default)	This is a module setting to choose between better filtering or faster update.	Suppresses noise generated by main electrical supply. 50/60Hz slow delivers a high level of filtering, but updates the channels more slowly. 50/60Hz fast delivers less filtering, but updates the channels faster.
	60Hz		
	50/60Hz slow		
	50/60Hz fast		
<b>Sensor Type</b>	No sensor (default)	Choose between the different available RTD and Thermocouple types. Choose 0 to disable the channel. It is recommended to disable unused channels to save on processing time.	Types of sensors and thermocouples the module supports. Set all unused channels to No sensor to save on processing time.
	Pt100 (TK=0.00385)		
	Pt200 (TK=0.00385)		
	Pt500 (TK=0.00385)		
	Pt1000 (TK=0.00385)		
	Pt100 (TK=0.00391)		
	Pt200 (TK=0.00391)		
	Pt500 (TK=0.00391)		
	Pt1000 (TK=0.00391)		
	Ni100 (TK=0.00617)		
	Ni200 (TK=0.00617)		
	Ni500 (TK=0.00617)		
	Ni1000 (TK=0.00617)		
	TC Type E		
	TC Type J		
	TC Type T		
TC Type K			
TC Type N			
TC Type S			
TC Type B			
TC Type R			
<b>Resolution Parameters</b>	<b>CJC Compensation:</b>	There is an internal CJC provided with the module, but in some applications with some sensor types an external CJC (such as with the Pt1000) may work better.	There is an internal Cold Junction Compensation but it may be better to use an external CJC (such as a Pt1000) for cases where sudden temperature changes occur.
	External (default)		
	Internal		
	<b>Resolution:</b>	Determines the resolution of the temperature reading and only applies to RTD sensors with temperature reading range of +/- 327 C.	Choose the resolution of temperature display. This only applies to RTD sensors with temperature reading range of +/- 327 C.
	0.1 (default)		
	0.01		
<b>Filter:</b>	This digital filter setting works in conjunction with the module Noise Suppression filter. Sync4 provides greater filtering than Sync3, but has slower updates.	The digital filter setting that works in conjunction with the Noise Suppression filter. Sync4 provides greater filtering but slower updates than Sync3.	
Sync 3 (default)			
Sync 4			

(table continued on next page)


Setting	Options	How It Works	Setting Description
<b>Filter Diagnostic Parameters</b>	Filter setting:	This option determines the number of samples that are averaged. The greater the value, the steadier the value but the slower the update.	Filter Setting determines the number of samples that are acquired before updating the digital value. The higher the samples, the greater the filtering but slower updates.
	No Filter (default)		
	1 sample		
	2 samples		
	4 samples		
	8 samples		
	16 samples		
	32 samples		
	64 samples		
	<b>Max Value Monitor:</b>	An alarm option to inform the user when the temperature has exceeded a specified value. Enabling this option requires specifying the Maximum temperature value in the field below. If the temperature exceeds the value specified, it will be indicated in Input Byte 0 (status byte). The error data will be between 0xD4 – 0xD7.	Max Value Monitor enables the Max Temperature monitor and will generate an alarm if the value is exceeded. Use the Max Temperature value setting if enabling this option.
	Disabled (default)		
	Enabled		
<b>Min Value Monitor:</b>	An alarm option to inform the user when the temperature has dropped below a specified value. Enabling this option requires specifying the Minimum temperature value in the field below. If the temperature is below the value specified, it will be indicated in Input Byte 0 (status byte). The error data will be between 0xD4 – 0xD7.	Min Value Monitor enables the Min Temperature monitor and will generate an alarm if the value is exceeded. Use the Min Temperature value setting if enabling this option.	
Disabled (default)			
Enabled			
<b>Short Circuit detect:</b>	An alarm option to inform the user that a channel has short circuited. If a short circuit is detected, it will be indicated in Input Byte 0 (status byte). The error data will be between 0xD4 – 0xD7.	This option enables Short circuit detection for the channel. An alarm is generated if a short circuit is detected.	
Disabled (default)			
Enabled			
<b>Filter Diagnostic Parameters (cont'd)</b>	<b>Open Circuit detect:</b>	An alarm option to inform the user that a channel has an open circuit. If an open circuit is detected, it will be indicated in Input Byte 0 (status byte). The error data will be between 0xD4 – 0xD7.	This bit enables Open circuit detection for the channel. An alarm is generated if an open circuit is detected.
	Disabled (default)		
	Enabled		
<b>Minimum Temperature</b>	Valid range for each channel: -32768 to 32767 Default: 1	This value is used in conjunction with the Min Value Monitor to signal an alarm when the temperature has dropped below the value specified in this field. Valid range is -32768 to 32767.	Minimum Temperature value used for the Minimum Temperature detection function.
<b>Maximum Temperature</b>	Valid range for each channel: -32768 to 32767 Default: 127	This value is used in conjunction with the Max Value Monitor to signal an alarm when the temperature has risen above the value specified in this field. Valid range is -32768 to 32767.	Maximum Temperature value used for the Maximum Temperature detection function.

**SPECIFICATIONS**

<b>PAL System - Temperature Input Module Specifications</b>	
<b>Sensors Supply Voltage</b>	Corresponding to the supply voltage
<b>Maximum Input Voltage</b>	30VDC
<b>Sensor Type (RTD)</b>	Platinum (-200 to +850°C): Pt100, Pt200, Pt500, Pt1000 (TK = 0.00385 and TK = 0.00391) Nickel (-60 to +180°C): Ni100, Ni120, Ni500, Ni1000 (TK = 0.00618)
<b>Connections Type (RTD)</b>	2, 3 or 4-wire
<b>Type of Thermocouple (TC)</b>	J, E, T, K, N, S, B, R
<b>Cold Junction Compensation for Thermocouples</b>	Internal: With internal electronic sensor included External (recommended in case of sudden changes in the ambient temperature): PT1000 sensor for connection with the M8 thermocouple connector
<b>Temperature Range</b>	-200 to + 800 °C (-328 to + 1472 °F)
<b>Digital Convert Resolution</b>	15 bit + prefix
<b>Max Error Compared to Ambient Temperature</b>	±0.5% (TC) ±0.06% (RTD)
<b>Max. Basic Error (Ambient T 25°C)</b>	±0.6 °C (with 4-wire RTD with 0.1 resolution) ±0.2 °C (with 4-wire RTD with 0.01 resolution)
<b>Repeatability (Ambient T 25°C)</b>	±0.03%
<b>Address Employment</b>	2 bytes for each input - 8 bytes per module
<b>Cycle time (Module)</b>	240ms
<b>Software Linearization</b>	For RTD: Piecewise linear approximation For TC: NIST (National Institute of Standards and Technology) Linearization based on ITS-90 scale (International Temperature Scale of 1990) for the thermocouple linearization
<b>Maximum Length of Shielded Cable for the Connection</b>	< 30m
<b>Status Indicator</b>	One LED for each input and reporting to the Master



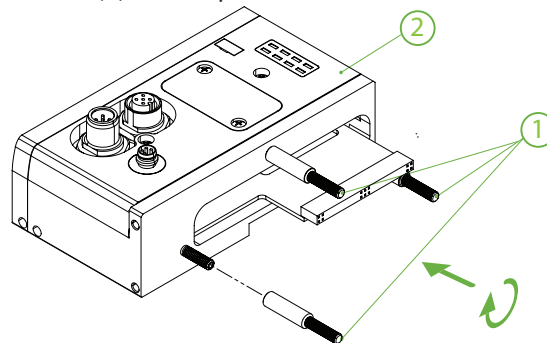
**CLOSED END SPACER MODULE**

PAL System - Closed End Spacer Module		
Item	Part No.	Description
	<b>PAL-SPC</b>	NITRA closed end spacer, IP65. For use with PAL series assemblies without pneumatics.

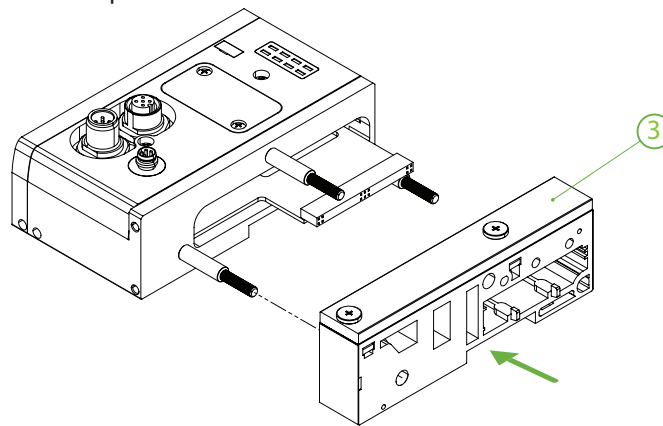
To use the PAL system bank without pneumatics the closed end spacer module is needed. Only one module per bank required.

**INSTALLATION**

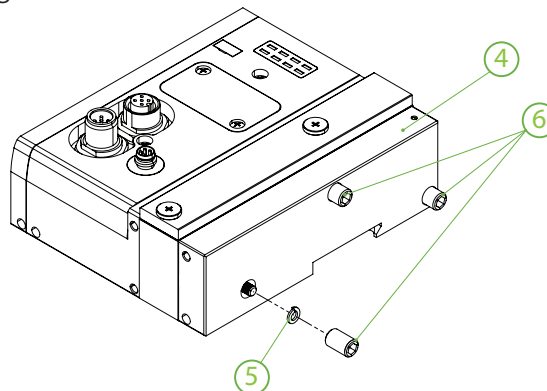
Hand tighten the three tie rods (1) of the spacer module for connection to the bus coupler (2).



While aligning the tie rods, carefully mate the spacer module (3) onto the electrical module. Make sure the board fits into the slots provided. **DO NOT FORCE!**



Place the assembly on a flat surface, insert the closed end plate (4), three lock washers (5) and tighten the three nuts (6) using a 4mm hex wrench at a torque of 2Nm [18 lb-in]. Make sure the electronic boards are properly aligned. **DO NOT FORCE!**



# PNEUMATIC MODULES

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## CHAPTER

# 5


### CONTENTS OF THIS CHAPTER

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**OVERVIEW**

The pneumatic portion of the PAL system consists of a primary supply/exhaust module, intermediate supply/exhaust modules as needed, bases for solenoid valves, solenoid valves, valve bank end plate and a Y-fitting that is used for certain special applications. This chapter will cover each of these items in detail.

**PRIMARY AIR INLET / EXHAUST MODULE**

PAL System - Compressed Air Connection Module		
Item	Part No.	Description
	<b>PAL-P12</b>	NITRA pneumatic compressed air module, left supply/exhaust, Cv=3.76, 1/2in push-to-connect tubing inlet(s), silenced exhaust(s), 5/32in (4mm) push-to-connect tubing pilot(s), IP65. For use with PAL series.

The PAL-P12 primary air inlet / exhaust module is installed just to the right of the electrical connection or bus coupler module. There is a 1/2” push-to-connect tubing port that is the primary air supply to all solenoid valves. In the out-of-the-box state, the 1/2” port supplies system pressure (vacuum to 145 psi) while port X (5/32” push-to-connect) supplies pilot pressure to the valves. Pilot pressure is 43 to 116 psi if all valves are 5/2 or 5/3 but if any 3/2 valves are used, pilot minimum pilot pressure varies from 43 psi (system pressure 0 psi) to 67 psi (system pressure 145 psi). If the system operating pressure is between 51 and 116 psi, port X can easily be disabled to allow system and pilot pressure to all come from the main inlet (port 1) by making a simple adjustment to the mid-body orange gasket. Loosen the two Phillips head screws and separate the upper and lower portions of the module. Remove the orange gasket, flip over, and replace the gasket. Refer to the diagrams below:

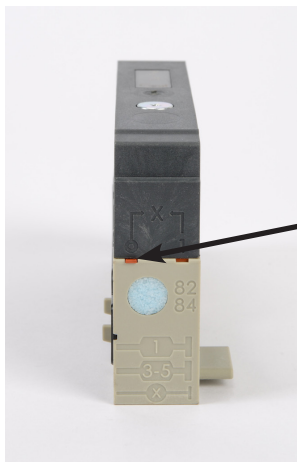


**PAL-P12 as delivered with top half removed**



**PAL-P12 with orange gasket reversed**

Reassemble the top half onto the bottom and torques the screws to 1.1 to 1.3 N-m [9.7 to 11.5 lb-in]. System operation will no longer require a pilot air supply. System pressure must be 51 to 116 psi at port 1 (1/2” push-to-connect).



The position of the orange gasket can be seen from the back of the PAL-P12.

Orange tab under “0” = Port X enabled (port 1 pressure vacuum to 145 psi, port X pressure 43 to 116 psi)

Orange tab under “1” = Port X disabled (port 1 pressure 51 to 116 psi)



Port X is enabled in this photo



On PAL-P12, PAL-M12 and PAL-M12P, this metal clip can be removed and the exhaust silencer can be removed for cleaning or to be replaced with push to connect fitting PAL-PC12.

It is easiest to remove this clip by pushing from the opposite side with a small tool to get it started before removing.

### INTERMEDIATE AIR MODULES

PAL System - Intermediate Air Connection Modules		
Item	Part No.	Description
	<b>PAL-M12</b>	NITRA pneumatic air module, intermediate through, Cv=3.76, 1/2in push-to-connect tubing inlet(s), 5/32in (4mm) push-to-connect tubing pilot(s), IP65. For use with PAL series. Without additional power connection.
	<b>PAL-M12P</b>	NITRA pneumatic air module, intermediate through, Cv=3.76, 1/2in push-to-connect tubing inlet(s), 5/32in (4mm) push-to-connect tubing pilot(s), IP65. For use with PAL series. Requires power cable. With additional power connection.

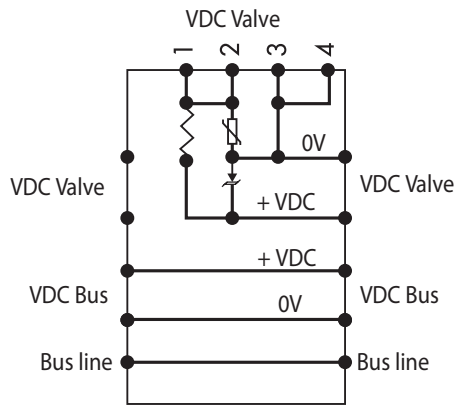
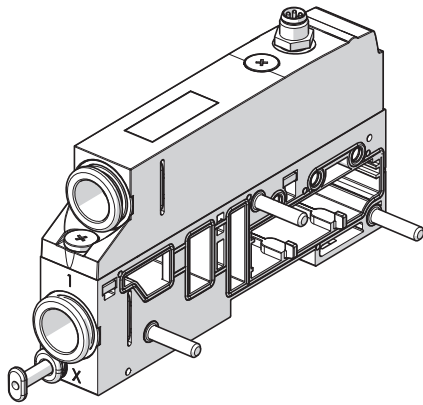
PAL-M12 and PAL-M12P intermediate air modules are required when the air budget for all valves in the system exceeds the capacity of the primary inlet. Intermediate modules can be installed anywhere to the right of the primary air module and are full flow through in both directions. The PAL-M12P module also includes an additional M8 power connection that can be used to increase the available power both the I/O and solenoid buses.

**PAL-M12P WIRING**





M8 male connector



- 1 = + VDC
- 2 = + VDC
- 3 = GND
- 4 = GND



MODULAR VALVE BASES

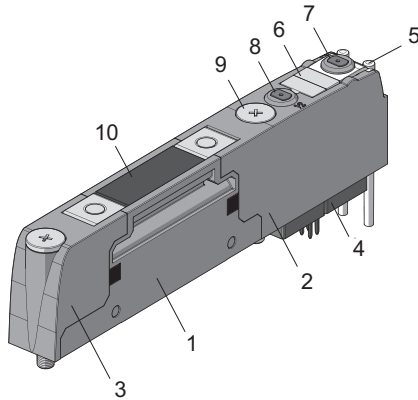
PAL System - Valve Bases		
Item	Part No.	Description
	<b>PAL-B3314</b>	NITRA pneumatic modular valve base, fiberglass-reinforced thermoplastic, (3) solenoid(s), (3) stations, (6) 1/4in push-to-connect tubing outlet(s), IP65. For use with PAL series.
	<b>PAL-B3614</b>	NITRA pneumatic modular valve base, fiberglass-reinforced thermoplastic, (6) solenoid(s), (3) stations, (6) 1/4in push-to-connect tubing outlet(s), IP65. For use with PAL series.
	<b>PAL-B4414</b>	NITRA pneumatic modular valve base, fiberglass-reinforced thermoplastic, (4) solenoid(s), (4) stations, (8) 1/4in push-to-connect tubing outlet(s), IP65. For use with PAL series.
	<b>PAL-B4814</b>	NITRA pneumatic modular valve base, fiberglass-reinforced thermoplastic, (8) solenoid(s), (4) stations, (8) 1/4in push-to-connect tubing outlet(s), IP65. For use with PAL series.

Modular valve bases are available in either 3-station or 4-station models, but with either one or two solenoid connections per station. This is necessary because some solenoid valves have one solenoid per station and some have two. Using a base with two solenoids per station but with double solenoid valves will function, but each station will use up two of the maximum 128 solenoid budget. Double solenoid valves installed on bases with only one solenoid connection will not function properly and should not be used. All valve bases are supplied with 1/4" push-to-connect tubing connections for both output ports. Each port connector can be easily changed to any available size of 5/32"(4mm), 6mm or 5/16"(8mm) as needed.

**SOLENOID VALVES**

There are eight different directional control solenoid valves and one special purpose supply and dump solenoid valve available in the NITRA PAL system.

**VALVE COMPONENTS AND MATERIALS OF CONSTRUCTION**

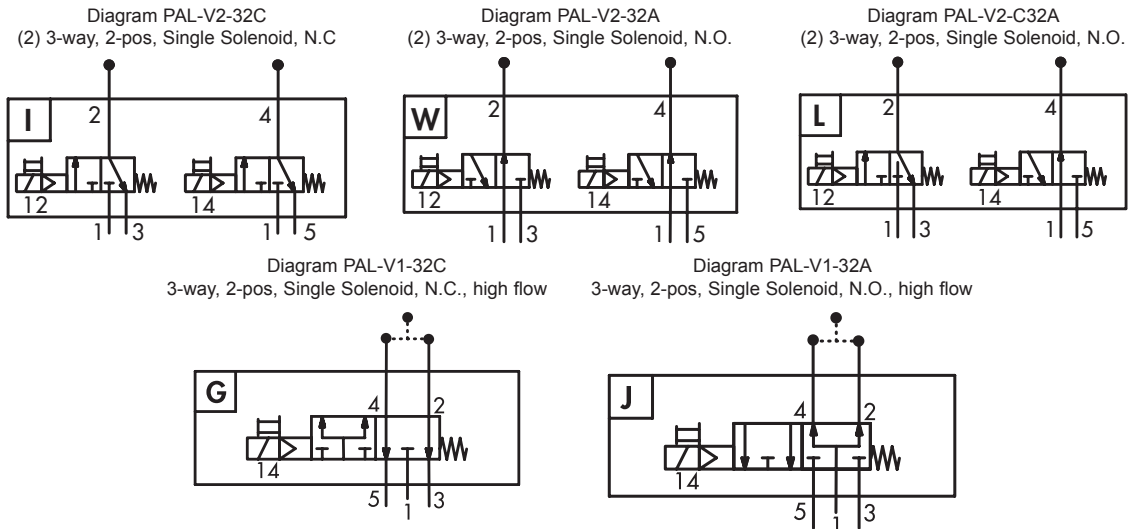


- 1) BODY: technopolymer
- 2) CONTROL: technopolymer
- 3) BASE: technopolymer
- 4) SOLENOID PILOT
- 5) DISPLAY: LED light and optical tester in technopolymer
- 6) TAG: removable
- 7) MANUAL CONTROL 14, for port 4: locking, brass
- 8) MANUAL CONTROL 12, for port 2: locking, brass
- 9) SCREW FOR MOUNTING TO THE BASE: M4 with PH 1 Phillips-head, galvanized steel. Max. torque: 1.2 Nm
- 10) TAG: technopolymer with laser-etched wording




**3-WAY VALVES**

PAL System - 3-way Solenoid Valves		
Item	Part No.	Description
	<b>PAL-V2-32C</b>	NITRA solenoid valve, 3-way, 2-position, 2 N.C., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=0.64, 12-24 VDC.
	<b>PAL-V2-32A</b>	NITRA solenoid valve, 3-way, 2-position, 2 N.O., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=0.64, 12-24 VDC.
	<b>PAL-V2-32C32A</b>	NITRA solenoid valve, 3-way, 2-position, 1 N.C. / 1 N.O., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=0.64, 12-24 VDC.
	<b>PAL-V1-32C</b>	NITRA solenoid valve, 3-way, 2-position, 1 high-flow N.C., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=1.28, 12-24 VDC.
	<b>PAL-V1-32A</b>	NITRA solenoid valve, 3-way, 2-position, 1 high-flow N.O., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=1.28, 12-24 VDC.

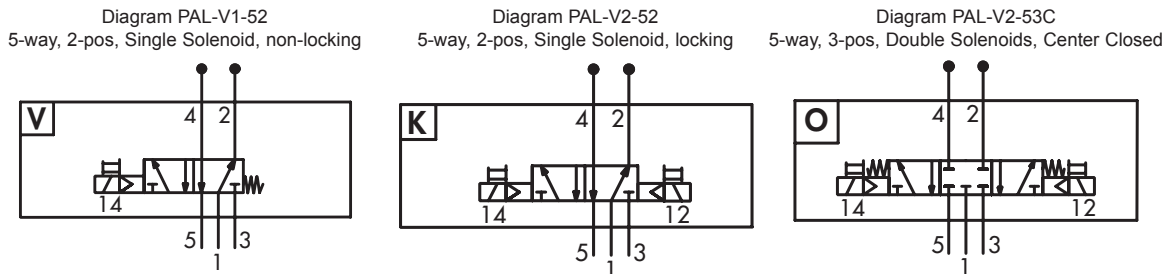
Since 3-way valves have only one outlet, each valve station can support two 3-way valves. Available valves include: (2) normally closed (NC), (2) normally open (NO), (1) NC + (1) NO, (1) high flow NC and (1) high flow normally open. The high flow valves are actually two valves operated by a single solenoid. They require changing the out connectors to 5/16" (8mm) the installation the PAL-Y38 fitting to give a single 3/8" outlet.



5-WAY VALVES


PAL System - 5-way Solenoid Valves		
Item	Part No.	Description
	<b>PAL-V1-52</b>	NITRA solenoid valve, 5-way, 2-position, single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=0.7, 12-24 VDC.
	<b>PAL-V2-52</b>	NITRA solenoid valve, 5-way, 2-position, double solenoid, reinforced technopolymer body, IP65, locking manual override, Cv=0.7, 12-24 VDC.
	<b>PAL-V2-53C</b>	NITRA solenoid valve, 5-way, 3-position, center closed, double solenoid, reinforced technopolymer body, IP65, locking manual override, Cv=0.49, 12-24 VDC.

5-way valves are available in 2-position with either single or double solenoid, or in 3-position, center closed.



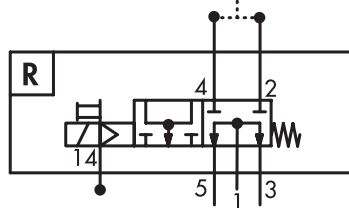


**SPECIAL PURPOSE VALVE**

PAL System - Special Purpose Solenoid Valve		
Item	Part No.	Description
	<b>PAL-V1-SR</b>	NITRA solenoid bank shut-off pressure relief valve, 5-way, 2-position, single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=1.07, 12-24 VDC.

The PAL-V1-SR is a special purpose solenoid valve that can be used as an alternate primary air supply that will switch air on to all valves or dump the air from all valves when de-energized. Use of the PAL-V1-SR requires plugging the ½” air inlet on the PAL-P12 as well as changing the base ports to 5/16” (8mm) and installing a PAL-Y38 fitting. The valve can be installed in any station on any valve base.

Diagram PAL-V1-SR  
Shut-off Valve



**VALVE FLOW RATES**

Valve Flow Rate (scfm) @ 91.4 psi (6.3 bar) ΔP 14.5 psi (1 bar)					
Valve	Ø 4mm (5/32")	Ø 6mm	Ø 8mm (5/16")	Ø 1/4" (Default)	Ø 3/8"*
<b>3-way/2-position</b>	12.4	21.2	24.7	21.2	44.1
<b>5-way/2-position</b>	12.4	23.0	28.3	23.0	44.1 - 49.4
<b>5-way/3-position</b>	12.4	16.2	17.7	16.2	35.3 - 44.1
<b>PAL-V1-SR</b>	-	-	-	-	35.3


\* Using high-flow valves or connected valves with PAL-Y38

**SOLENOID VALVES SOFTWARE CONFIGURATION SETTINGS**

The following solenoid valve configuration needs to be set in the NITRA Pneumatic Automation Link (PAL) Configuration Software. See Chapter 3 for software download information and the software configuration help file for solenoid configuration instruction.

Setting	Options	How It Works	Setting Description
<b>Fail Safe</b>	Hold last state	Determines the behavior of the solenoid when the communication with the Client device is interrupted.	The solenoid maintains the state it held at the point communication was interrupted.
	Reset (default)		The solenoid is disabled when communication is interrupted.
	Set		The solenoid activates when communication is interrupted.

### PAL-Y38 FITTING

PAL System - PAL-Y38		
Item	Part No.	Description
	<b>PAL-Y38</b>	NITRA pneumatic push-to-connect fitting, Y, reinforced technopolymer body, (2) 5/16in (8mm) plug-in to 3/8in push-to-connect.

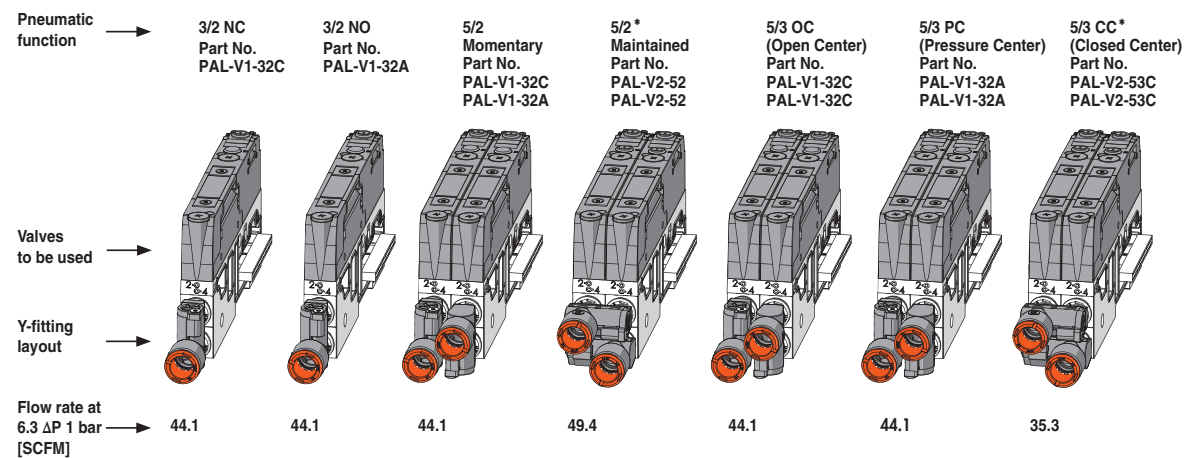
The PAL-Y38 fitting is designed to connect two adjoining 5/16” (8mm) base connectors to a single 3/8” push-to-connect tubing connection. There are a number of very useful applications of this fitting shown in the following diagram.

#### HOW TO GET HIGH-FLOW RATE FOR EACH PNEUMATIC FUNCTION

Note: The two cartridges on the base (2 and 4) must fit the Ø 8mm pipe.

Outputs 2 and 4 must be connected one to the other. To do this, you can use the special PAL-Y38 fitting.




When connecting one or more valves using the PAL-Y38 fitting, the pneumatic system functions must be configured according to the following diagram.



In order to get 5/2 momentary, 5/2 maintained and 5/3 CC high flow, use two parallel valves, by energizing the solenoids simultaneously.

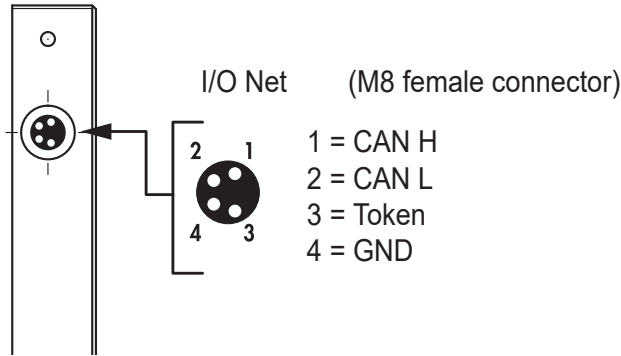
\* The PAL-Y38 fittings of this valve must be installed longitudinally with one PAL-Y38 fitting connecting the two outputs (2) and the other the two outputs (4). The solenoid pilots must be operated simultaneously.

END PLATES




PAL System - End Plates		
Item	Part No.	Description
	<b>PAL-C2</b>	NITRA closed end plate, IP65. For use with PAL series single fieldbus assemblies.
	<b>PAL-C3</b>	NITRA closed end plate, IP65. For use with PAL series fieldbus assemblies and expansion. Requires PAL series expansion cable or PAL-ACC18 M8 terminator. Used for local expansion.
	<b>PAL-C4</b>	NITRA closed end plate, IP65. For use with PAL series wired assemblies.

Every PAL system will require a right end plate to complete the assembly. For wired systems without I/O, the PAL-C4 is used. For systems using I/O and EtherNet/IP, PAL-C2 is used for a single system while PAL-C3 is used when the system is separated into smaller subassemblies. The PAL-C3 has an M8 bus connector that uses a cable (PAL-ACC10, 11 or 12) to connect to the PAL-EAD module on the second subassembly. Any PAL-C3 that is not connected to a PAL-EAD must have a PAL-ACC18 terminator plug installed.

**PAL-C3 WIRING**




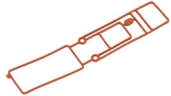


**LOCAL EXPANSION CABLES**






PAL System - Local Expansion Cables		
Item	Part No.	Description
	PAL-ACC10	NITRA expansion cable, 4-pin M8 axial male to 4-pin M8 axial male, IP65, 3.2ft/1m cable length. For use with PAL series bus expansion coupler.
	PAL-ACC11	NITRA expansion cable, 4-pin M8 axial male to 4-pin M8 axial male, IP65, 16.4ft/5m cable length. For use with PAL series bus expansion coupler.
	PAL-ACC12	NITRA expansion cable, 4-pin M8 axial male to 4-pin M8 axial male, IP65, 32.8ft/10m cable length. For use with PAL series bus expansion coupler.

**ACCESSORIES AND REPLACEMENT PARTS**


**AIR CONNECTION MODULES ACCESSORIES AND REPLACEMENT PARTS**

PAL System - Air Connection Modules Accessories		
Item	Part No.	Description
	<b>PAL-PC12</b>	NITRA pneumatic push-to-connect cartridge, replacement, 1/2in tubing. Package of 2. For use with PAL-P12 compressed air supply module.
	<b>PAL-ACC13</b>	NITRA pneumatic exhaust silencer, replacement. For use with PAL-P12 compressed air supply module.
	<b>PAL-ACC14</b>	NITRA gasket, replacement. Package of 10. For use with PAL series base interface between valve bases.
	<b>PAL-ACC15</b>	NITRA gasket, replacement. Package of 10. For use with PAL-P12 or PAL-SPC lower/upper body.

**VALVE BASE ACCESSORIES AND REPLACEMENT PART**

PAL System - Valve Base Accessories		
Item	Part No.	Description
	<b>PAL-PC04M</b>	NITRA pneumatic push-to-connect cartridge, 5/32in (4mm) tubing. Package of 10. For use with PAL series valve bases.
	<b>PAL-PC06M</b>	NITRA pneumatic push-to-connect cartridge, 6mm tubing. Package of 10. For use with PAL series valve bases.
	<b>PAL-PC08M</b>	NITRA pneumatic push-to-connect cartridge, 5/16in (8mm) tubing. Package of 10. For use with PAL series valve bases.
	<b>PAL-PC14</b>	NITRA pneumatic push-to-connect cartridge, replacement, 1/4in tubing. Package of 10. For use with PAL series valve bases.
	<b>PAL-ACC16</b>	NITRA gasket, replacement. Package of 10. For use with PAL series base and valve.

**END PLATE ACCESSORY**

PAL System - End Plate Accessory		
Item	Part No.	Description
	<b>PAL-ACC18</b>	NITRA M8 terminator, for use with PAL-C3 end plate.

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# STAND-ALONE VALVE BASES

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## CHAPTER



# 6

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OVERVIEW



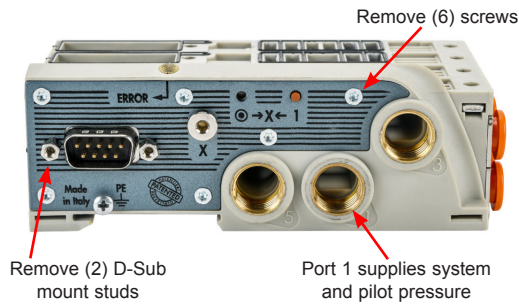
PAL System - Stand-Alone Valve Bases		
Item	Part No.	Description
	<b>PAL-CB4414</b>	NITRA pneumatic stand-alone valve base, fiberglass-reinforced thermoplastic, (4) solenoid(s), (4) stations, (1) 1/4in female NPT inlet(s), (8) 1/4in push-to-connect tubing outlet(s), (2) 1/4in female NPT exhaust(s), IP65. For use with PAL series.
	<b>PAL-CB4814</b>	NITRA pneumatic stand-alone valve base, fiberglass-reinforced thermoplastic, (8) solenoid(s), (4) stations, (1) 1/4in female NPT inlet(s), (8) 1/4in push-to-connect tubing outlet(s), (2) 1/4in female NPT exhaust(s), IP65. For use with PAL series.

PAL-CB4414 and PAL-CB4814 stand alone valve bases offer the performance of PAL solenoid valves in a smaller, less expensive package for basic applications of 4 valves or less. PAL-CB4414 has one solenoid output per station while the PAL-CB4814 has two outputs per station. Pneumatic and electrical connections are all built into the base.

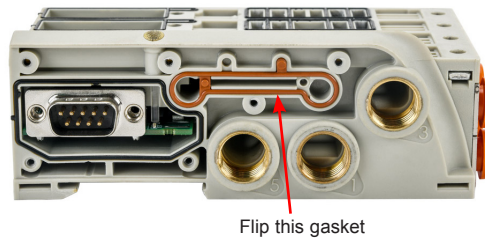
**PORT CONNECTIONS**

Operating pressure range for the stand alone units must be 50 to 120 psi if using a single supply connection at port “1”. A range of -14.5 to 145 psi is possible when using a separate pilot supply connected to port “X”. Pressure at port “X” must be 50 to 120 psi. See instructions below for enabling port “X”:

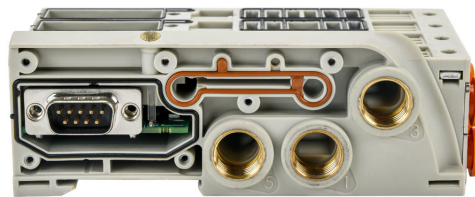
- 1) Out of Box state



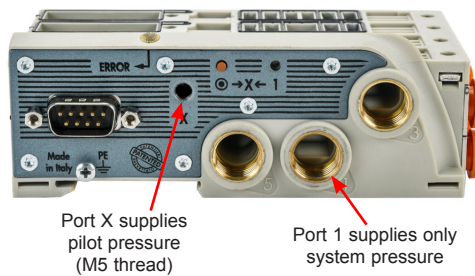
- 2) Out of Box with cover removed



- 3) Port X enabled with cover removed



- 4) Cover replaced





**WIRING**

Choose the appropriate Electrical Connection Module power cable for wiring. AutomationDirect part numbers PAL-ACC19, PAL-ACC20 and PAL-ACC21 are used for wiring Stand-Alone valve bases. Input voltage range is 12VDC -10% to 24VDC +30% (minimum 10.8, maximum 31.2 VDC)



**WARNING:** POWER OFF THE SYSTEM BEFORE PLUGGING OR UNPLUGGING THE CONNECTOR (RISK OF FUNCTIONAL DAMAGE).  
 USE FULLY ASSEMBLED VALVE UNITS ONLY.  
 USE AN APPROPRIATE POWER SUPPLY FOR INCOMING POWER THAT COMPLIES WITH IEC 742/EN60742/VDE0551 WITH AT LEAST 4kV INSULATION RESISTANCE (PELV).

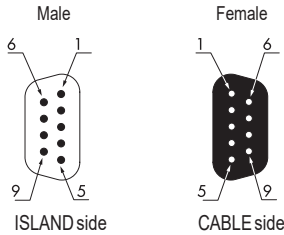


**WARNING:** SUPPLY VOLTAGE GREATER THAN 32VDC WILL PERMANENTLY DAMAGE THE PAL SYSTEM.



**NOTE:** The grounding screw below the D-Sub connector must always be connected to earth ground.

CONNECTOR D-Sub 9 PIN PRE-WIRED



Electric contact position	Color conductor cable	Function	4-position base	8-position base
1	White	1 + VDC	Solenoid pilot 14 valve 1	Solenoid pilot 14 valve 1
2	Brown	2 + VDC	Solenoid pilot 14 valve 2	Solenoid pilot 12 valve 1
3	Green	3 + VDC	Solenoid pilot 14 valve 3	Solenoid pilot 14 valve 2
4	Yellow	4 + VDC	Solenoid pilot 14 valve 4	Solenoid pilot 12 valve 2
5	Grey	5 + VDC	/	Solenoid pilot 14 valve 3
6	Pink	6 + VDC	/	Solenoid pilot 12 valve 3
7	Blue	7 + VDC	/	Solenoid pilot 14 valve 4
8	Red	8 + VDC	/	Solenoid pilot 12 valve 4
9	Black	COM 0VDC	Common	Common

**CONTROL CABLES**

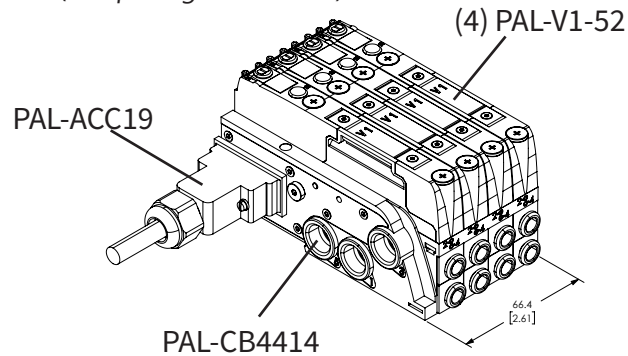
PAL System - Stand-Alone Valve Bases Control Cables		
Item	Part No.	Description
	<b>PAL-ACC19</b>	NITRA control cable, 9-pin D-sub axial female to pigtail, IP65, 3.2ft/1m cable length. For use with PAL series stand-alone valve base.
	<b>PAL-ACC20</b>	NITRA control cable, 9-pin D-sub axial female to pigtail, IP65, 8.2ft/2.5m cable length. For use with PAL series stand-alone valve base.
	<b>PAL-ACC21</b>	NITRA control cable, 9-pin D-sub axial female to pigtail, IP65, 16.4ft/5m cable length. For use with PAL series stand-alone valve base.

## STAND-ALONE VS. PAL ASSEMBLY COMPARISON

### TYPICAL STAND-ALONE BASE CONFIGURATION

List of parts:

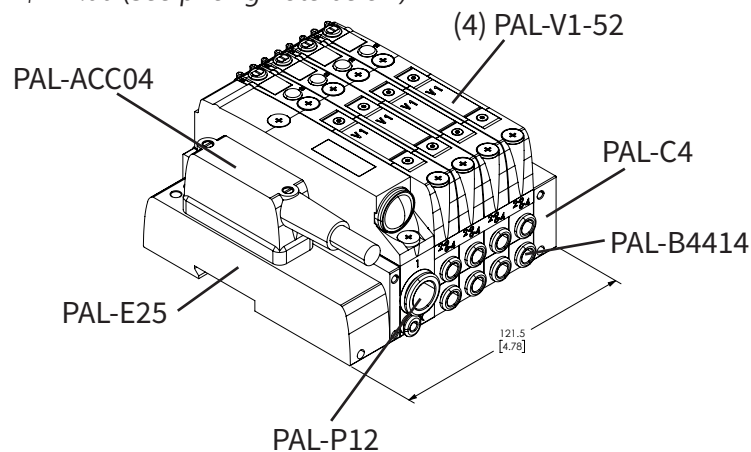
- PAL-CB4414 - Stand-Alone Base
  - (4) PAL-V1-52 - Solenoid Valves
  - PAL-ACC19 - Control Cable
- Total cost = \$259.50 (See pricing note below)



### COMPARABLE PAL ASSEMBLY CONFIGURATION

List of parts:

- PAL-E25 - Electrical Connection Module
  - PAL-P12 - Pneumatic Compressed Air Module
  - PAL-B4414 - Modular Valve Base
  - (4) PAL-V1-52 - Solenoid Valves
  - PAL-C4 - Closed End Plate
  - PAL-ACC04 - Control Cable
- Total cost = \$421.00 (See pricing note below)

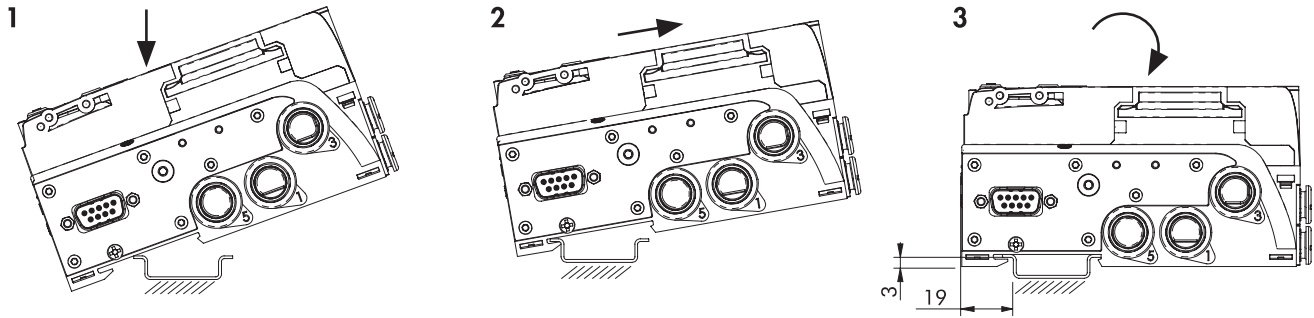


**NOTE:** Current prices as of date of publication. Visit [www.automationdirect.com](http://www.automationdirect.com) for current prices.

**MOUNTING OPTIONS**

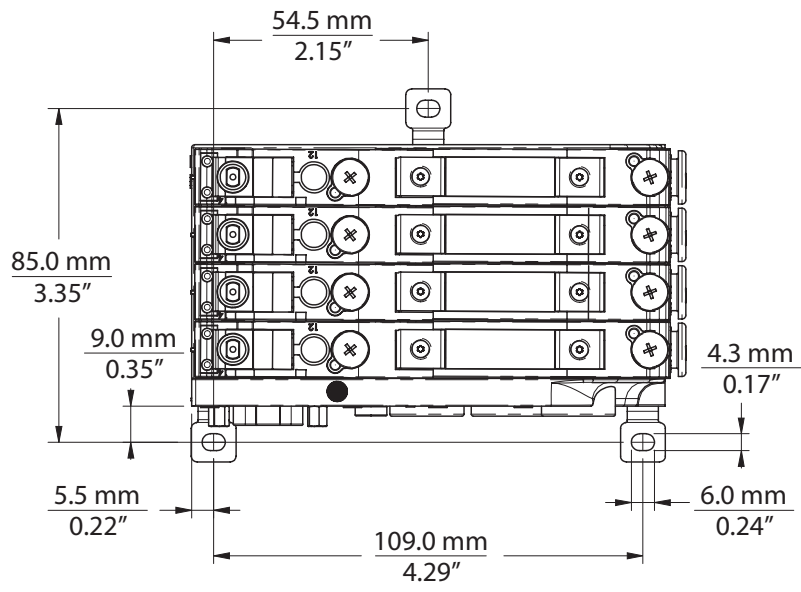
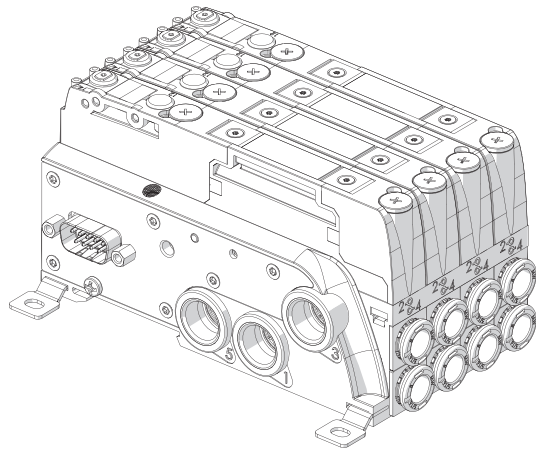
**DIN RAIL MOUNTING**

The base snaps on to DIN rail as shown.













**BRACKET MOUNTING**

Three brackets are included with each PAL stand-alone valve base. Push them firmly into the appropriate seats on the bases until they “click”. Use the appropriate screws to fasten securely to a stable mounting surface.



## LED STATUS LIGHTS AND DIAGNOSTICS

Stand alone valve bases are protected against overload and polarity inversion. A short circuit will damage the circuit board. A flashing red ERROR LED indicates excessive voltage or failed control of a solenoid pilot. An alarm continues as long as the command is active. A steady red ERROR LED indicates that voltage out of range. The stand alone valve may continue to operate but may operate incorrectly.

Solenoid Valve LED Status				Description
LED Status		ERROR (on base)		
Pilots (on valves)				
OFF		OFF		No output control
ON (green)		OFF		The output is working properly
ON (green)		ON (flashing) ON 0.1 sec OFF 1 sec		Solenoid valve failed or missing (blinking plug installed or single pilot valve installed on a base for two pilots)
OFF		ON (flashing) ON 0.4 sec OFF 2 sec		Solenoid valve short circuit
ON (green)		ON (red)		Voltage is out of range: Less than 10.8V or greater than 31.2V. CAUTION: Voltage greater than 32V can damage the system.

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# DIAGNOSTICS / TROUBLESHOOTING

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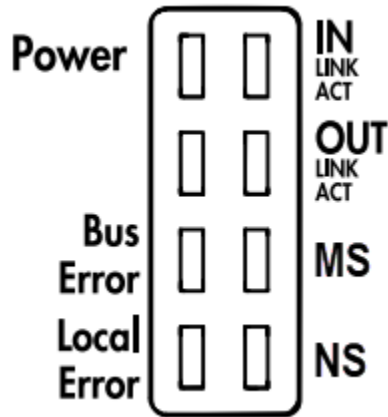
## LED STATUS

Diagnostics of the NITRA PAL Electro-Pneumatic System are reported via the LEDs and a hexadecimal error code. Each Signal Module and Valve in the system will indicate its state through its local LEDs and report any error code to the controller. If more than one error is present, the errors will be reported in order of priority. Byte 0 of the Input Data will show the present error code.



**NODE ERRORS**

Diagnostics of the EtherNet/IP node are reported through the IN, OUT, MS, and NS LEDs.

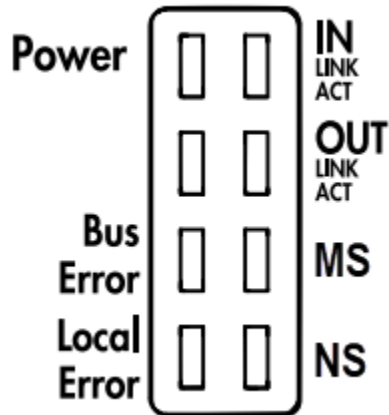


Node Errors			
LED	Status		Description
IN/OUT link / act	OFF		No connection to the EtherNet/IP Scanner.
	ON (green)		The module is connected to the network but there is no data exchange.
	ON (flashing)		The module is communicating correctly with the network.
MS	OFF		No power or communications initializing.
	ON (green)		The module is operating correctly.
	ON (flashing)		The module is connected but not configured correctly on the network..
	ON (flashing)		Auto test when powering on the module.
	ON (flashing)		Error: Configuration error, IP Address assignment error, duplicate IP.
	ON (red)		Module operating fault.
NS	OFF		Incorrect communication initialization or module configuration on the network.
	ON (green)		Good EtherNet/IP connection.
	ON (flashing)		Scanner is not connected to the module.
	ON (flashing)		Auto test when powering on the module.
	ON (flashing)		Connection to the scanner previously existed but is now down. The scanner should reconnect to establish communications.






























**SYSTEM DIAGNOSTICS**

Diagnostics of the NITRA PAL Electro-Pneumatic System as a whole are reported through the Power, Bus Error, and Local Error LEDs. Byte 0 of the Input Data will show the present error code.





















Node Errors									
LED Light State						Hex Value (Byte 0: Diagnostic Data)	Description	Notes	Solution
Power	Bus Error		Local Error						
ON (green)		OFF		ON (red)		0xFF	System limits exceeded, communication buffer overflow.	Number of I/O to check simultaneously is too high or the scan rate (RPI) is too fast.	Reduce the I/O count or increase the RPI time.
ON (green)		OFF		ON (red)		0xD4 - 0xD7	Fault with a temperature analog input module.	Could be sensors not connected or parameters configured incorrectly.	Check the connections and the parameters.
ON (green)		OFF		ON (red)		0xD0 - 0xD3	Analog Input module not calibrated.	---	Replace the module exhibiting this error.
ON (green)		OFF		ON (red)		0xCC - 0xCF	Analog Output module fault or total module current exceeded.	Individual Output fault/ module current exceeded/ Digital to Analog converter error.	Power down and remove the cause of the error.
ON (green)		OFF		ON (red)		0xC8 - 0xCB	Analog Input module fault or total module current exceeded.	Under range, or over range for single input. Over range for module.	Power down and remove the cause of the error.
ON (green)		OFF		ON (red)		0xB0 - 0xC5	Digital output failure or total module current exceeded.	Short circuit of an individual output/module over current.	Power down and remove the cause of the error.
ON (green)		OFF		OFF		0xA0 - 0xAF	Overcurrent of a digital input.	Triggered by 1 input.	Power down and remove the cause of the error.

(table continued on next page)

Node Errors									
LED Light State			Hex Value (Byte 0: Diagnostic Data)	Description	Notes	Solution			
Power	Bus Error						Local Error		
ON (green)		OFF		ON (red)		0x20 - 0x9F *Solenoid valve 1 - 128 fault. *see calculation at the end of the table	Solenoid short circuit or not connected.	Power down and remove the cause of the error.	
ON (flash)		OFF		OFF		0x17	No auxiliary power.	---	Connect auxiliary power.
ON (green)		ON (flash)		OFF		0x16	Address or configuration of a solenoid valve or signal module error.	Solenoid valve or signal module faulty.	Power down and remove the cause of the error.
ON (flash)		OFF		ON (red)		0x15	Power supply out of range (under/over voltage).	---	Correct power input to specified range.
ON (green)		ON (flash)		OFF		0x14	Configuration of a solenoid valve or signal module error.	Current configuration doesn't match the ones stored in the device.	Repeat the hardware configuration procedure using pushbutton A in the controller access panel (see user manual section 1). If error persists, replace the faulty device.
ON (green)		ON (red)		OFF		0x10	Internal base communication fault.	Expansion base is configured but not communicating.	Check the connection cable. Ensure correct end plates are being used. If communications are corrected, the alarm resets automatically after 3 seconds.
ON (green)		OFF		ON (flash)		0x09	Error in the PAL controller parameters.	Check that correct values are being configured.	---
ON (flash)		OFF		ON (flash)		0x08	Number of solenoid valves connected exceeds 128	---	Ensure that connected solenoid valves do not exceed 128.
ON (green)		OFF		ON (flash)		0x07	Mapping error. Number of valve bases exceeds max allowed.	Current configuration doesn't match the ones stored in the device.	Reduce number of valve bases. Ensure end plates are correct.

(table continued on next page)






Node Errors									
LED Light State						Hex Value (Byte 0: Diagnostic Data)	Description	Notes	Solution
Power	Bus Error		Local Error						
ON (green)		OFF		ON (flash)		0x06	Addressing error: type of module not allowed or no valve base/signal module connected.	---	Remove incompatible module or connect valve base/signal module.
ON (flash)		OFF		ON (flash)		0x05	Number of digital input modules connected to the system exceeds 128.	---	Reduce number of digital input modules.
ON (green)		OFF		ON (flash)		0x04	Number of digital output modules connected to the system exceeds 128.	---	Reduce number of digital output modules.
ON (green)		OFF		ON (flash)		0x03	Number of analog input modules connected to the system exceeds 16.	---	Reduce number of analog input modules.
ON (green)		OFF		ON (flash)		0x02	Number of analog output modules connected to the system exceeds 16.	---	Reduce number of analog output modules.
ON (green)		OFF		OFF		0	System is working properly.	---	---

Calculating the specific faulty solenoid valve:  
 Dummy and bypass valves must be considered in the calculation. 0 corresponds to the first solenoid valve in the island.  
 Error code in HEX: 0x20 = n; where n is the faulty solenoid valve  
 Example: Error code 0x3F  
 $0x3F - 0x20 = 0x1F$   
 $0x1F = 31$   
 Solenoid valve 32 has a problem.





## MODULE LED DIAGNOSTICS

Signal Modules and Valves indicate their state through individual LEDs and report any errors to the PAL Controller with a hexadecimal error code. Byte 0 of the Input Data will show the present error code.





### SOLENOID VALVE LED

Solenoid Valve LED Status			
LED Status		Description	Solution
OFF		The solenoid valve is not enabled.	No fault signal.
ON (green)		The solenoid valve is enabled and working.	No fault signal.
ON (flashing) X 2		Indication for each solenoid valve. Solenoid missing, output triggered for dummy valve or missing solenoid on double valve.	Fault signal active. The output resets automatically when error is removed. The power must be cycled to reset Fault signal.
ON (flashing)		Solenoid valve short circuit.	Fault signal active. The output is disabled. Both the fault signal and output can only be reset by power cycle.
ON (flashing) all LEDs		Voltage is out of range: Less than 10.8V or greater than 31.2V. CAUTION: Voltage greater than 32V can damage the system.	Fault signal active. Error will self-reset when voltage is in proper range. Error will take 5 seconds to reset after voltage is within range.






### DIGITAL INPUT MODULE LEDs

Digital Input Module LED Status			
LED Status (X1-X8)		Description	Solution
OFF		Input not active.	---
ON (green)		Input active.	---
ON (red)		Short circuit or overcurrent on input.	Remove the cause of the error.
ON (flashing) all LEDs		Current on module too high.	Remove the cause of the error.










### DIGITAL OUTPUT MODULE LEDs

Digital Output Module LED Status			
LED Status (X1-X8)		Description	Solution
OFF		Output not active.	---
ON (green)		Output active.	---
ON (red)		Short circuit or overcurrent on output.	Remove the cause of the error.
ON (flashing) all LEDs		Current on module too high.	Remove the cause of the error.











### ANALOG INPUT MODULE LEDs

Analog Input Module LED Status			
LED Status (X1-X4)		Description	Solution
OFF		Input not active.	---
ON (green)		Input active and no problems.	---
ON (flashing)		Analog input signal outside of range.	Correct range or replace sensor.
ON (red)		Analog input signal too low or too high.	Correct range or replace sensor.
ON (flashing) all LEDs		Overload or short circuit of module.	Remove the cause of the error.

**ANALOG OUTPUT MODULE LEDs**

Analog Output Module LED Status			
LED Status (X1-X4)		Description	Solution
OFF		Output not active.	---
ON (green)		Output active and no problems.	---
ON (flashing) all LEDs On .2s Off 1s		Power supply outside of permitted range.	Correct power supply range.
ON (flashing) all LEDs On .2s Off .2s		Power supply overload or short circuited.	Correct power supply range.
ON (red)		All LEDs active simultaneously: Internal fault.	Replace the module.
ON (flashing) all LEDs On .6s Off .6s		Output overload or short circuit.	Remove the cause of the error.
ON (flashing) all LEDs On .2s Off .2s		Module over temperature.	Reduce temperature of module.
ON (flashing) all LEDs On .6s Off 1s		Open circuit (4-20ma or 1-5V channels).	Ensure sensor is installed properly or channel is disabled.
ON (flashing) all LEDs On .6s Off .6s		Value sent to output outside of permissible range.	Correct value sent to module. Module must be power cycled to reset.

**TEMPERATURE INPUT MODULE LEDs**

Temperature Input Module LED Status			
LED Status (X1-X4)		Description	Solution
OFF		Input not active.	---
ON (green)		Input active and no problems.	---
ON (flashing) all LEDs On .2s Off 1s	 	Power supply outside of permitted range.	Correct power supply range.
ON (flashing) all LEDs On .2s Off .2s		Input value below configured minimum value or higher than configured maximum value.	Temperature must be within specified range or re-configure minimum and maximum values.
ON (red)		Sensor short circuit.	Remove the cause of the error.
ON (flashing) all LEDs On .5s Off .5s	 	Internal error.	Remove the cause of the error. If error persists, replace module.
ON (flashing) all LEDs On .2s Off .2s		Open circuit on channel.	Connect sensor, replace sensor or disable channel.
ON (flashing) all LEDs On .6s Off .6s		Sensor out of range.	Connect sensor, replace sensor or disable channel.

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