PNEUMATIC MODULES

CONTENTS OF THIS CHAPTER

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**
	PAL-P12	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 ½" push-to-connect tubing port that is the primary air supply to all solenoid valves. In the out-of-the-box state, the ½" 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:
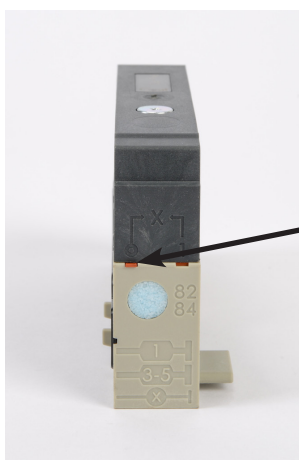

**PAL-P12 as delivered
with top half removed**

**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.
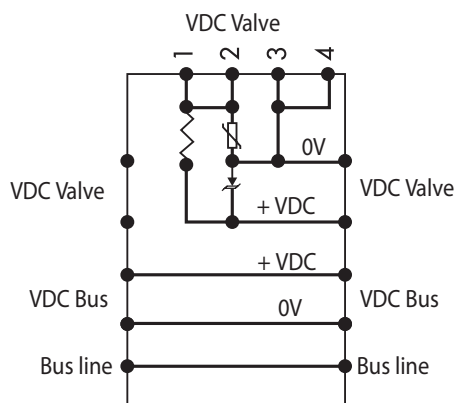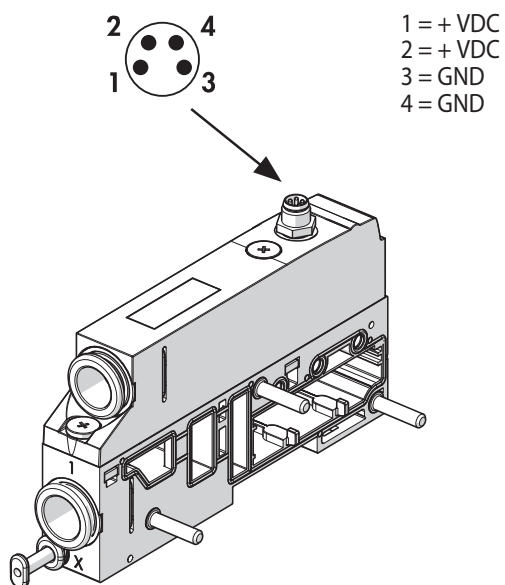
INTERMEDIATE AIR MODULES

PAL System - Intermediate Air Connection Modules		
Item	*Part No.*	*Description*
	PAL-M12	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.
	PAL-M12P	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 and 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

VDC Valve

1 2 3 4

0V

VDC Valve   VDC Valve

+ VDC

+ VDC

VDC Bus   VDC Bus
            0V

Bus line   Bus line

MODULAR VALVE BASES

PAL System - Valve Bases		
Item	*Part No.*	*Description*
	PAL-B3314	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.
	PAL-B3614	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.
	PAL-B4414	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.
	PAL-B4814	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 ¼" 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.
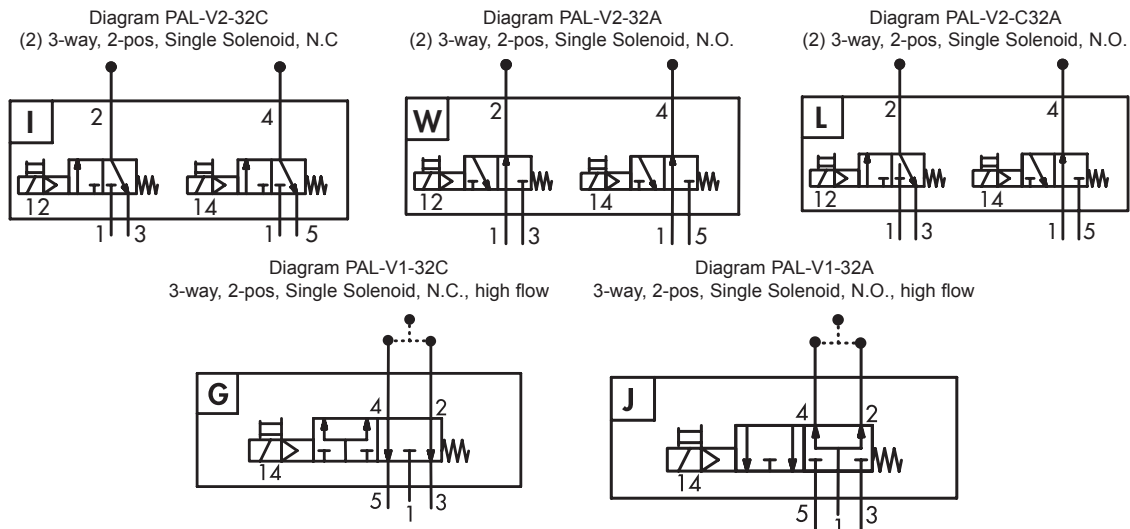
VALVE COMPONENTS AND MATERIALS OF CONTRUCTION
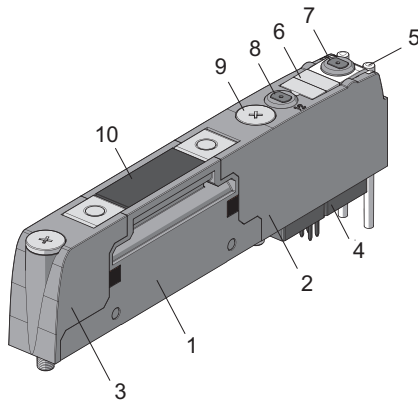
1) BODY: technopolymer
2) CONTROL: technopolymer
3) BASE: technopolymer
4) SOLENOID PILOT
5) DISPLAY: LED light and optical tester in technopolymer
6) TAG: removable
7) MANUAL CONTROL 14, for port 4: locking, brass
8) MANUAL CONTROL 12, for port 2: locking, brass
9) SCREW FOR MOUNTING TO THE BASE: M4 with PH 1 Phillips-head, galvanized steel. Max. torque: 1.2 Nm
10) TAG: technopolymer with laser-etched wording

3-WAY VALVES

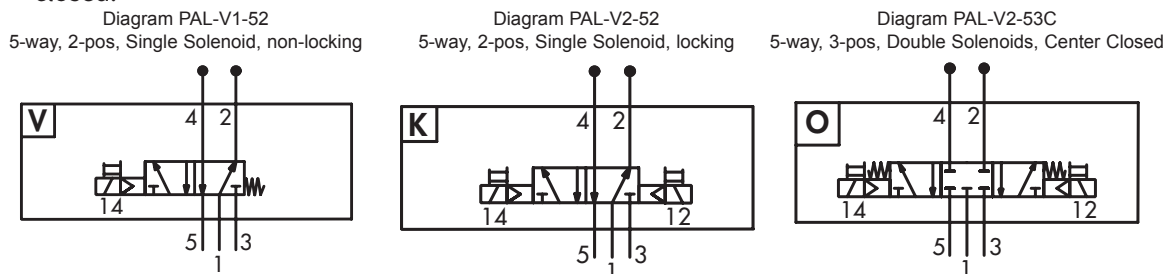| PAL System - 3-way Solenoid Valves		
Item	**Part No.**	**Description**
	PAL-V2-32C	NITRA solenoid valve, 3-way, 2-position, 2 N.C., single solenoid spring return, reinforced technopolymer body, IP65, locking manual override, Cv=0.64, 12-24 VDC.
	PAL-V2-32A	NITRA solenoid valve, 3-way, 2-position, 2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

Diagram PAL-V2-32C
(2) 3-way, 2-pos, Single Solenoid, N.C

Diagram PAL-V2-32A
(2) 3-way, 2-pos, Single Solenoid, N.O.

Diagram PAL-V2-C32A
(2) 3-way, 2-pos, Single Solenoid, N.O.

Diagram PAL-V1-32C
3-way, 2-pos, Single Solenoid, N.C., high flow

Diagram PAL-V1-32A
3-way, 2-pos, Single Solenoid, N.O., high flow

5-WAY VALVES

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

Diagram PAL-V1-52
5-way, 2-pos, Single Solenoid, non-locking

Diagram PAL-V2-52
5-way, 2-pos, Single Solenoid, locking

Diagram PAL-V2-53C
5-way, 3-pos, Double Solenoids, Center Closed

SPECIAL PURPOSE VALVE

PAL System - Special Purpose Solenoid Valve		
Item	*Part No.*	*Description*
	PAL-V1-SR	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. This valve needs pilot pressure to function so the system it is installed on must be configured for external pilot pressure. This would be configured on the PAL-P12 or the standalone base.

Diagram PAL-V1-SR
Shut-off Valve
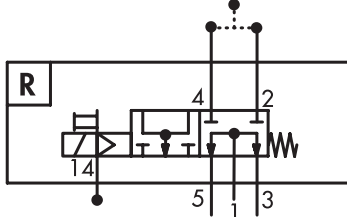
VALVE FLOW RATES

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"**
3-way/2-position	12.4	21.2	24.7	21.2	44.1
5-way/2-position	12.4	23.0	28.3	23.0	44.1 - 49.4
5-way/3-position	12.4	16.2	17.7	16.2	35.3 - 44.1
PAL-V1-SR	-	-	-	-	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
Fail Safe	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

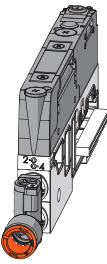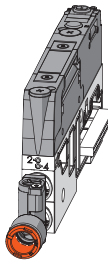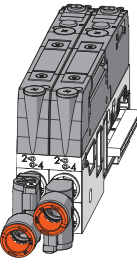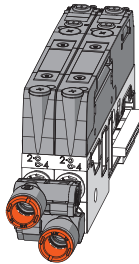| PAL System - PAL-Y38		
Item	*Part No.*	*Description*
	PAL-Y38	NITRA pneumatic push-to-connect fitting, Y, reinforced technopolymer body, (2) 5/16in (8mm) plug-in to 3/8in push-to-connect.
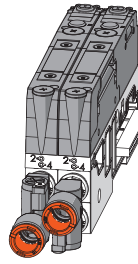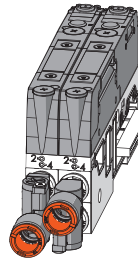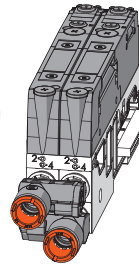
The PAL-Y38 fitting is designed to connect two adjoining 5/16" (8mm) base connectors to a single 3/8" push-to-connect tubing connection. There are a number of very useful applications of this fitting shown in the following diagram.

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.

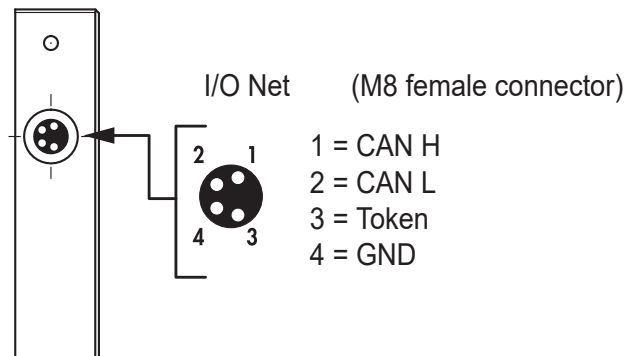| Pneumatic function	3/2 NC Part No. PAL-V1-32C	3/2 NO Part No. PAL-V1-32A	5/2 Momentary Part No. PAL-V1-32C PAL-V1-32A	5/2 * Maintained Part No. PAL-V2-52 PAL-V2-52	5/3 OC (Open Center) Part No. PAL-V1-32C PAL-V1-32C	5/3 PC (Pressure Center) Part No. PAL-V1-32A PAL-V1-32A	5/3 CC * (Closed Center) Part No. PAL-V2-53C PAL-V2-53C
Flow rate at 6.3 ∆P 1 bar [SCFM]	44.1	44.1	44.1	49.4	44.1	44.1	35.3

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

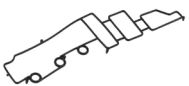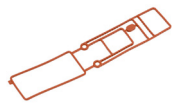| PAL System - End Plates		
Item	*Part No.*	*Description*
	PAL-C2	NITRA closed end plate, IP65. For use with PAL series single fieldbus assemblies.
	PAL-C3	NITRA closed end plate, IP65. For use with PAL series fieldbus assemblies and expansion. Requires PAL series expansion cable or PAL-ACC18 M8 terminator.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

I/O Net   (M8 female connector)

1 = CAN H
2 = CAN L
3 = Token
4 = GND

LOCAL EXPANSION CABLES
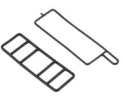
PAL System - Local Expansion Cables		
Item	*Part No.*	*Description*
	PAL-ACC10	NITRA expansion cable, 4-pin M8 axial male to 4-pin M8 axial male, IP65, 3.2ft/1m cable length. For use with PAL series bus expansion coupler.
	PAL-ACC11	NITRA expansion cable, 4-pin M8 axial male to 4-pin M8 axial male, IP65, 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**
	PAL-PC12	NITRA pneumatic push-to-connect cartridge, replacement, 1/2in tubing. Package of 2. For use with PAL-P12 compressed air supply module.
	PAL-ACC13	NITRA pneumatic exhaust silencer, replacement. For use with PAL-P12 compressed air supply module.
	PAL-ACC14	NITRA gasket, replacement. Package of 10. For use with PAL series base interface between valve bases.
	PAL-ACC15	NITRA gasket, replacement. Package of 10. For use with PAL-P12 or PAL-SPC lower/upper body.

VALVE BASE ACCESORIES AND REPLACEMENT PART

PAL System - Valve Base Accessories		
Item	**Part No.**	**Description**
	PAL-PC04M	NITRA pneumatic push-to-connect cartridge, 5/32in (4mm) tubing. Package of 10. For use with PAL series valve bases.
	PAL-PC06M	NITRA pneumatic push-to-connect cartridge, 6mm tubing. Package of 10. For use with PAL series valve bases.
	PAL-PC08M	NITRA pneumatic push-to-connect cartridge, 5/16in (8mm) tubing. Package of 10. For use with PAL series valve bases.
	PAL-PC14	NITRA pneumatic push-to-connect cartridge, replacement, 1/4in tubing. Package of 10. For use with PAL series valve bases.
	PAL-ACC16	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**
	PAL-ACC18	NITRA M8 terminator, for use with PAL-C3 end plate.

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