



COMMUNICATION I/O MODULES

95630, Rev 05

November 20, 2025

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REVISION

Revision	Date	Author	Description
00	04/20/2018	DS	Initial Release
01	05/16/2018	DS	Updated Information
02	02/05/2019	DS	Updated Section 2.3
03	08/04/2023	TM	Revised for new IO pass thru
04	2/29/2024	TM	Updated to current spec.
05	11/20/25	TM	Updated See ECR TMAA-DNLJ6Y

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1 PRECAUTIONS

This manual contains important information that needs to be observed in order to guarantee safety and avoid material damage.

This information is specially marked and illustrated as follows:



READ MANUAL

Do not start, operate, or service a machine until you read and understand the operator's manual. Failure to do so could result in serious injury.



HAND CRUSH NOTICE

Indicates the possibility for a crush force between components during coupling of the Robot and Tool Adaptor.



Indicates Immediate danger

Failure to observe this warning involves an imminent risk of death or serious injuries.



Indicates Possible danger

Failure to observe this warning can lead to death or serious injuries.



Indicates Low Risk danger

Failure to observe this warning can lead to mild to moderate injuries.



Indicates Possible material damage

Failure to observe the warning may cause damage to the device and/or the system.



NOTE

Other technical information and notes of Effecto.



RECOMMENDATION

Notes with this symbol are recommendations of Effecto.

IGNORING INFORMATION ABOUT POTENTIAL HAZARDS CAN LEAD TO SERIOUS HARM TO PERSONNEL AND/OR DAMAGE TO THE EQUIPMENT, AND MAY RESULT IN THE NULLIFICATION OF THE MANUFACTURER'S EQUIPMENT WARRANTY.

2 DESIGNATED USE

Read this manual carefully before starting the equipment and keep it in a place that is accessible at any time for all users.

The products described in this manual were developed, manufactured, tested, and documented, under strict compliance with strict safety standards. The equipment poses no danger to operating personnel or material if the handling instructions are complied with.



Communication I/O modules are not safety devices conforming to the relevant standards. Do not use the OFF state of the outputs to implement safety-related requirements of the system/machine.

The products are designed for use in industrial environments. A characteristic of the industrial environment is that the consumers are not directly connected to the public low voltage system. Additional precautions are required for use in residential, business, and commercial applications.

Trouble-free and safe functioning of the product can only be assured through proper transportation, storage, installation, assembly, and operation with proper care and attention.

The designated operation of the equipment is only guaranteed with complete installation of the housing.



NOTE

Good resistance to chemicals and oil. When using aggressive mediums, material resistance based on application must be checked.

**NOTE**

The Communication I/O modules are very robust and due to the high protection class IP65 when mated they are protected from dust, dirt, and most liquids without an additional housing. Communication I/O modules are specially designed for harsh industrial applications directly in machines and systems. The Communication I/O modules are not suitable for outdoor use, continuous operation in liquids or high-pressure wash downs.

The power supply must meet the SELV (Separated or safety extra-low voltage) standards. Power supplies according to EN 61558-2-6 (transformer) or EN 60950-1 (switch mode power supply) meet these requirements.

System configuration, installation, startup, maintenance, and testing of devices may only be performed by an accredited, trained electrician familiar with automation technology standards.

Current safety and accident prevention laws valid for a specific application must be observed in the configuration, installation, setup, maintenance, and testing of the equipment.

Only cables and accessories are allowed that meet the requirements and regulations for safety, electro-magnetic compatibility, temperature resistance and, where applicable, telecommunication transmission equipment and specifications.

Information regarding which cables and accessories are approved for the installation can be obtained from Effecto Group Companies and may also be found in this manual.

3 QUALIFIED PERSONNEL

Requirements to be met by qualified personnel are based on qualification profiles described in international electrical and electronic guidelines.

Only qualified electricians that are familiar with the contents of this manual may install and service the products.

These are specialists who are capable of assessing the work to be done and the possible dangers on account of their technical training, knowledge, experience, and knowledge of the relevant standards; or who have an identical level of knowledge equivalent to technical training since they have worked in the same area for many years.

Modification of this equipment, if not described in this manual, may only be carried out by Effecto technicians.



Any unapproved modification of this product, or disregard of the warnings given in this manual, may result in personal injury or serious damage to property.

4 CONFIGURATION

4.1 POWER SUPPLY

Communication I/O modules require direct-voltage power supply of typically 24 VDC (SELV) which must comply with the regulations of conventional industrial power-utility companies.



NOTE

In the Communication I/O modules galvanic isolation of voltage circuits is present. To optimize the noise immunity is recommended to use separate power supplies for sensors and actuators. The supply should be via primary-switched or regulated power supplies.



In any case, it must be ensured that the system voltage does not drop below 18 V DC viewed from the system power supplies and measured at the remotest tool. System response becomes unspecific if sensor and bus power supply drop below 18 V DC.



NOTE

Primary switched-mode power supply units normally permit an increase in output voltage to the amount of the rated voltage to compensate for any power losses.

Modules with digital inputs support the direct connection of commercially available sensors. A separate power passthrough may be necessary for the sensors if the total power required is high due to the number of tools or a high-power draw of the sensors.

4.2 RECOMMENDED POWER SUPPLY UNITS

Primary switched-mode power supply units specially designed to power automation systems are recommended.

4.3 CABLE CROSS SECTIONS

Review the Effecto drawings and schematics for proper cable selection.

4.4 ELECTROMAGNETIC COMPATIBILITY (EMC)

These devices meet the requirements of EC Directive 2004/108/EC “Electromagnetic Compatibility”.



The devices are Class A equipment. It may cause radio-frequency interferences in residential areas. In this case, the operator may be required to implement adequate countermeasures.

The devices described in this manual each meet the relevant standards for electromagnetic compatibility. However, this does not mean that their electromagnetic compatibility is still guaranteed when installed in a plant or machine.

For this reason, we urgently advise you to comply with the instructions on installation in accordance with EMC requirements below. Only then can you assume that the overall system complies with EMC requirements, provided CE-marked components are used exclusively.

4.5 PROTECTION AGAINST ELECTROSTATIC DISCHARGE

The products described in this manual contain complex semiconductor components which may be destroyed or damaged by electrostatic discharge (ESD).

Damage does not necessarily lead to immediate, detectable failure, or malfunction. These states may even be delayed or occur sporadically.

The generally accepted safety precautions for ESD sensitive devices must be observed when handling the devices. The following precautions must be taken:



Never plug or unplug connectors while the equipment is under power.

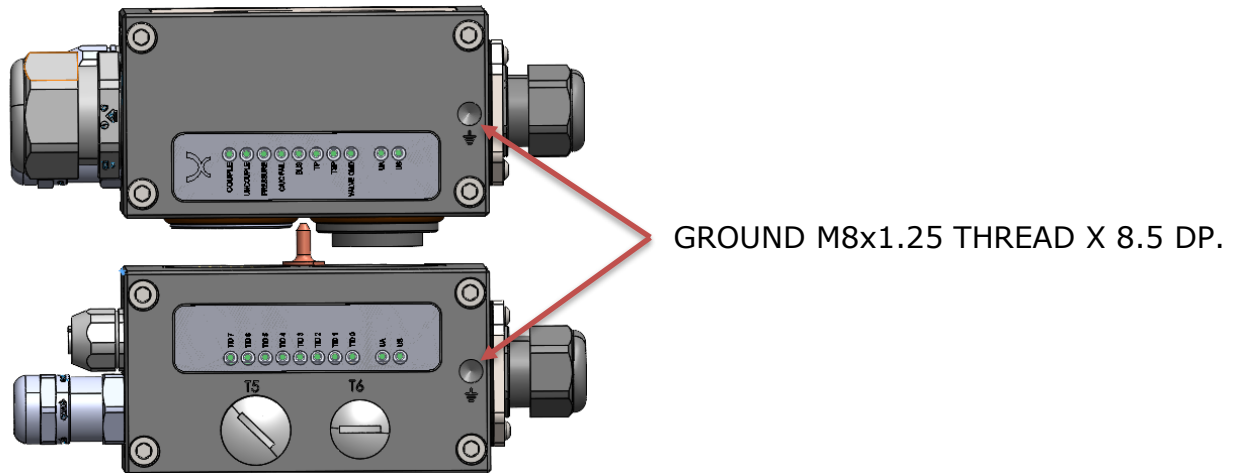
This may result in an accidental discharge of static electricity you may be carrying just before you touch the equipment. For example, you can touch a grounded part of the machine, or wear an ESD discharge strap that is permanently connected to the ground.

4.6 GROUNDING

A short (as short as possible), low-impedance connection between the grounding point and the reference ground is essential to divert interference voltages running between the device and reference ground.

The inductivity of standard FE conductors is a high impedance for high-frequency interference voltages.

For this reason, the use of grounding straps is advisable. If this is not possible, a fine-wire FE conductor should be selected with the largest possible cross section, and the connection to ground should be kept as short as possible.



4.7 CABLE ROUTING

You can avoid EMC problems by observing elementary basic rules of cable routing.

- Route data lines as far as possible away from power lines.
- Route data lines and power lines at least 10 cm apart.
- Intersect data and power lines at right angles only.
- Route data and power lines in separate, shielded compartments.
- Remember the interference potential of other devices or lines when routing the cables.
- Place frequency converters, motor lines, and other devices and lines that emit high-frequency interference at the greatest possible distance.

4.8 OTHER MEASURES AND LIMITS

In some system configurations, the requirements for interference emission and immunity from interference can only be met with additional measures, or even not at all. In these cases, the EMC within the system is also dependent on the single components of other manufacturers.

- Mains filters are a suitable means of reducing line-conducted interference.
- Various manufacturers offer optical-fiber converters. This data transmission technology is basically immune to EMC interferences. However, this does not apply to the electronic conversion circuits. For this reason, the use of optical fibers does not solve all EMC problems.

5 SYSTEM DESCRIPTION

The Communication I/O Module is an electrical pass-through that mounts directly to Position 3 of the APPLIED ROBOTICS Tool Changer. The module can also be mounted on other positions of the APPLIED ROBOTICS Tool Changer: in this case, please check the need for the C/UC status signals and bring these signals into the module with a dedicated wiring.

The Communication I/O Module contains two mating halves, one mounted on the Robot Side and one mounted on the Tool Side. The Communication I/O Module has multiple connections for passing power, bus communication and additional digital or analog signals (for instance for gun feedback) as well as communicating Tool Changer I/O.

Communication I/O Module – The Communication I/O Module is self-contained and has a variety of connections that interface with an integrated IO field bus system that can communicate Tool Changer I/O to the controller (see an example in Table 4.8-1). The Communication I/O Module can be configured to any field bus including DeviceNet, Ethernet/IP, Interbus, RS485, Modbus-RTU, Profibus, and Profinet. The module contains LEDs for function status, two circuits named “Live Power Managers” that prevents probe arcing and short-circuits, also an option for additional IO signals as, for example, gun feed-back signals. To connect the cables to a bus I/O module refer to your specific top-level Integrated Tool Changer assembly drawing for Cable Diagram drawing number.

Please refer to your specific Communication I/O Module Electrical schematic for proper wiring of the cable kit if necessary to replace cables in the module. This electrical schematic is listed on the Communication I/O Module assembly drawing.

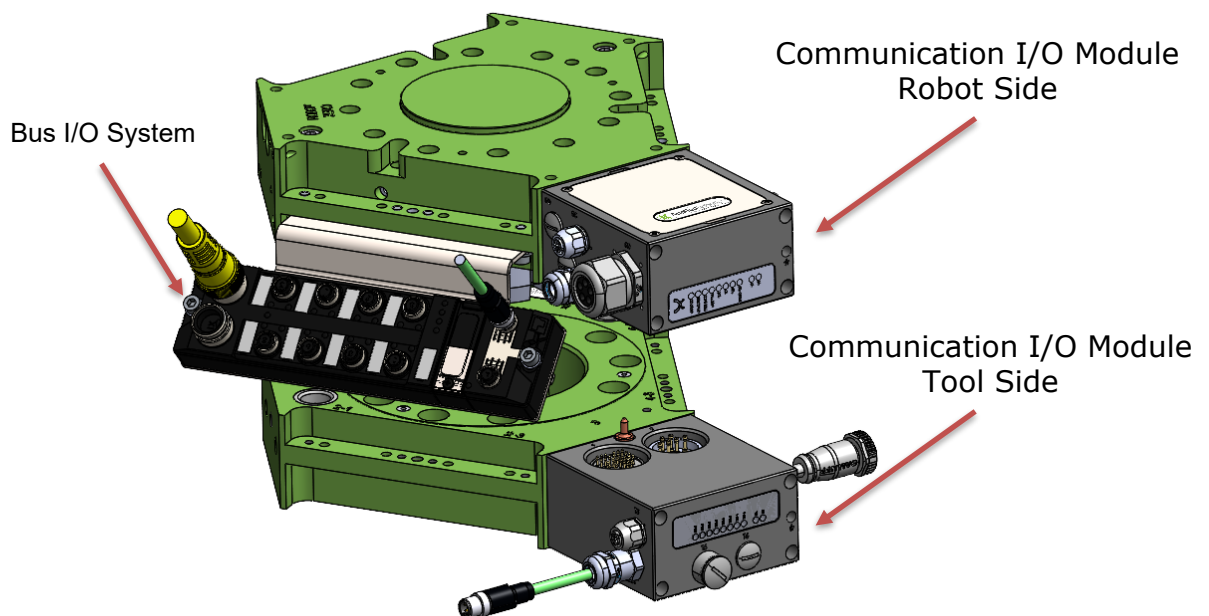
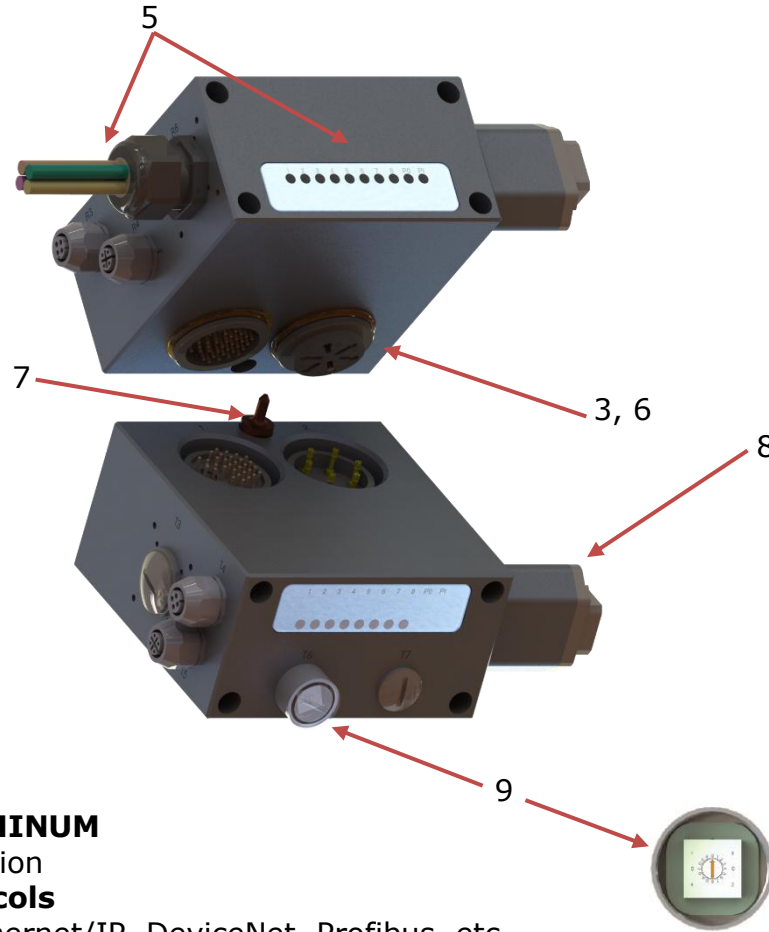


Figure 4.8-1. Communication I/O Module

Table 4.8-1. Example of Mapping of Tool Changer I/O for Bus Communication

Bit ID	Input (DI)	Output (DO)
0	Coupled	Uncouple 1
1	Uncoupled	Reserved
2	Tool Stand Present	Reserved
3	Tool Present	Reserved
4	Tool ID Bit 0	Reserved
5	Tool ID Bit 1	Reserved
6	Tool ID Bit 2	Reserved
7	Tool ID Bit 3 (Optional)	Reserved

6 ROBOT SIDE MODULE FEATURES



1. Material: ALUMINUM

- EMC Protection

2. Multiple Protocols

- Profinet, Ethernet/IP, DeviceNet, Profibus, etc.

3. IP Rating: **IP65** (When coupled)

4. Couple/Uncouple Interface

5. Tool Changer Status Signals (Dependent on Configuration)

- Couple/Uncouple, Tool Present, In Tool Stand Present, Tool Identification
- Visualized via LED's

6. Gold Plated Spring Probe Contacts

- Low Maintenance and Low MTTR
- IP2x (Finger Protection) on Robot Side Power Contacts

7. Functional Earth

- (FE) Connection and Pass Through with M8 Lug Provision

8. Additional I/O or Weld Gun Feedback via Optional Connection

- Push/Pull, M23, Mil-Spec (MS), Souriau, etc.

9. Tool Identification

- 4-Bit Tool ID Rotary Selector (15 Tools)

10. Live Power Manager (LPM)

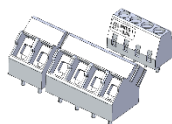
- Arc Prevention during docking and undocking.
- Short Circuit Protection both during Operation and at Startup
- Current limitation for US1 (10A Nominal) and for US2 (16A Nominal)

where:

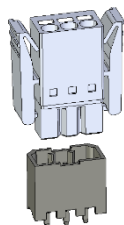
US1 = US = voltage supply for logic and sensors (inputs)

US2 = UA = voltage supply for actuators (outputs)

- 11. Integrated PCB** for clean wiring and easy maintenance
- 12. Galvanic Insulation** Between US and UA
- 13. Optional: Automatic Resistor Termination** for DeviceNet and Profibus
- 14.** Board terminals for power wires and bus wires

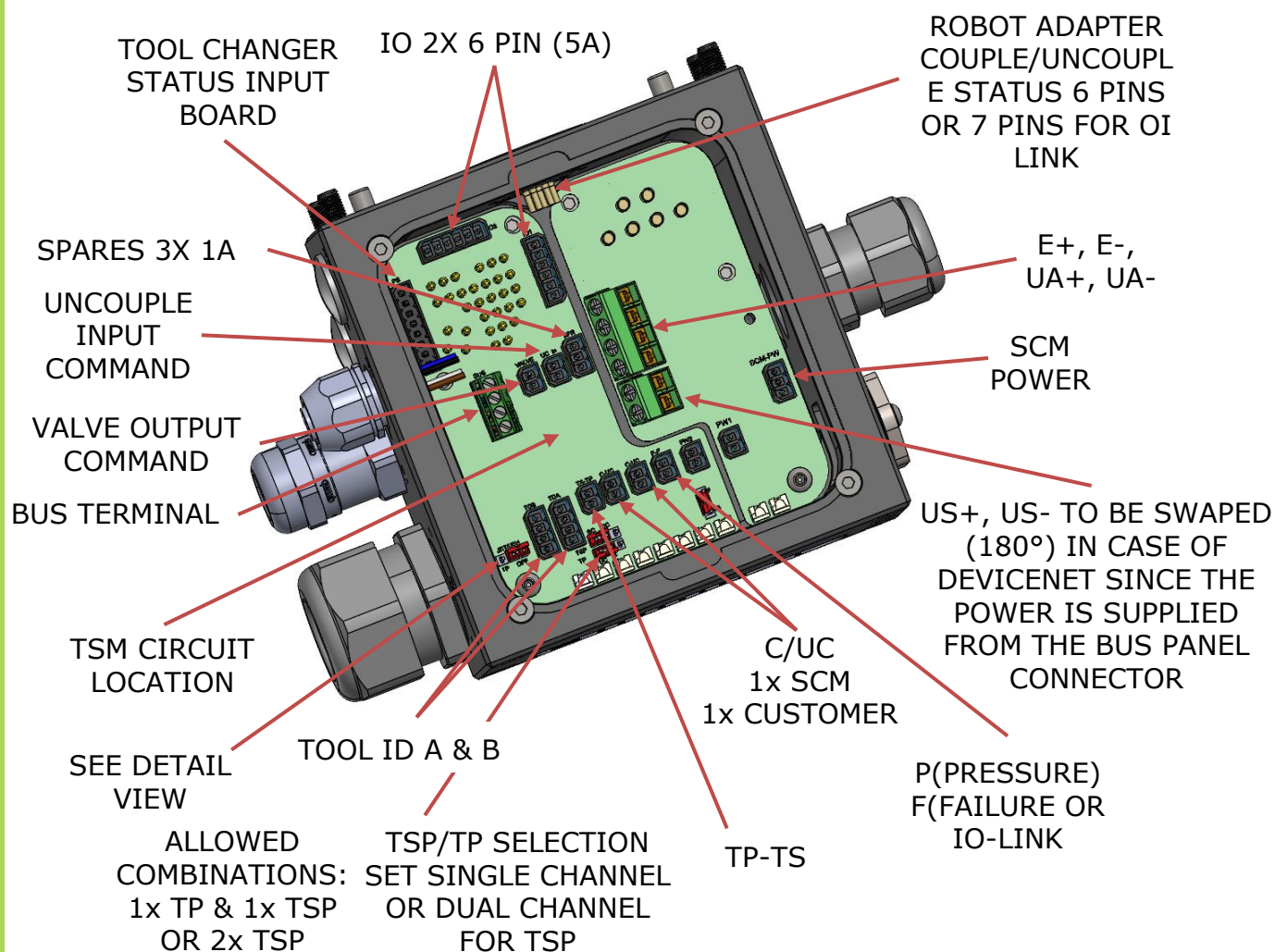


- 15.** Board male connectors for IO signals that mates with female push-in connectors.

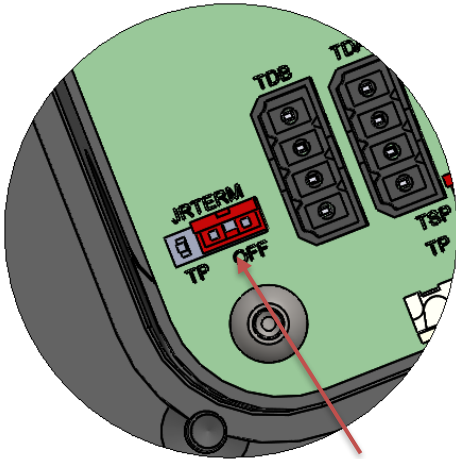


Note: QC testing includes bus transmission certification

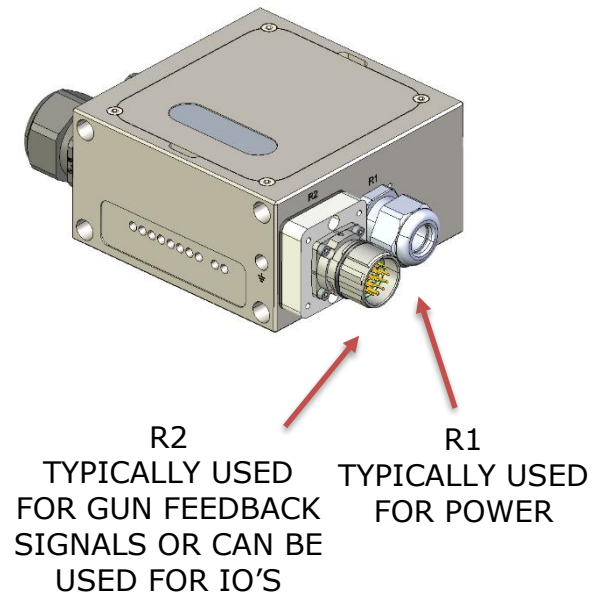
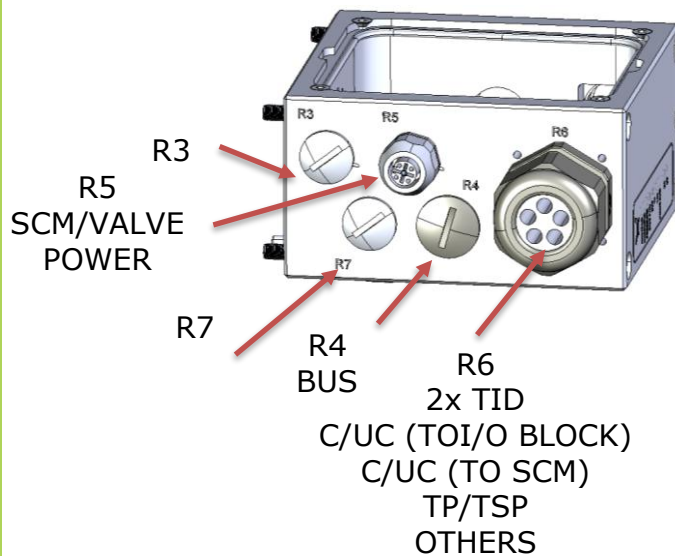
ROBOT SIDE MODULE



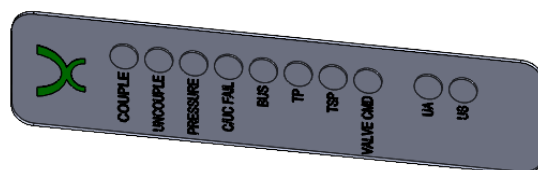
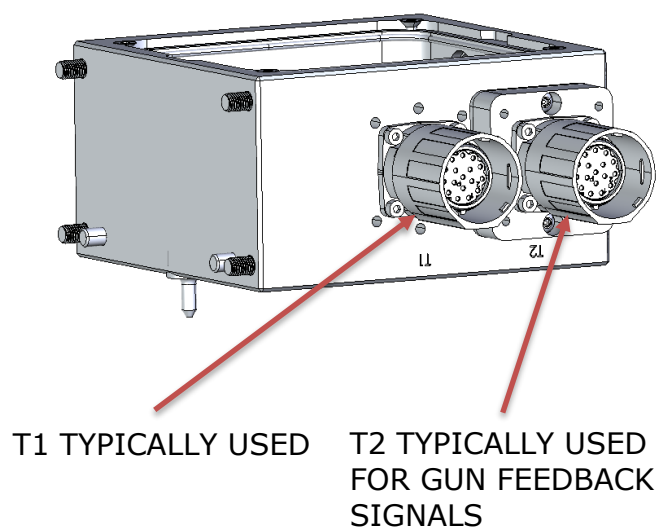
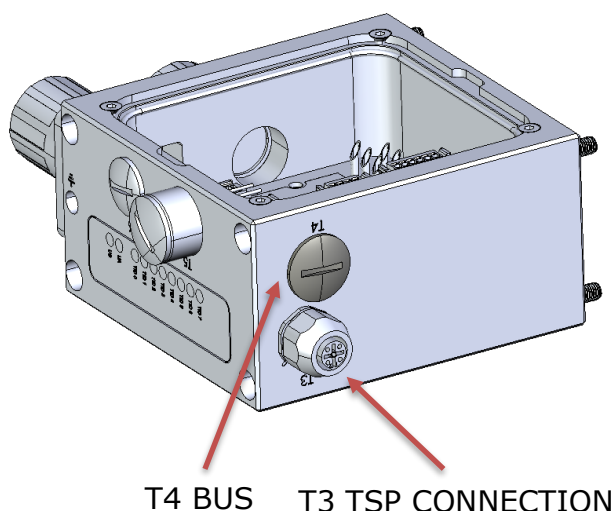
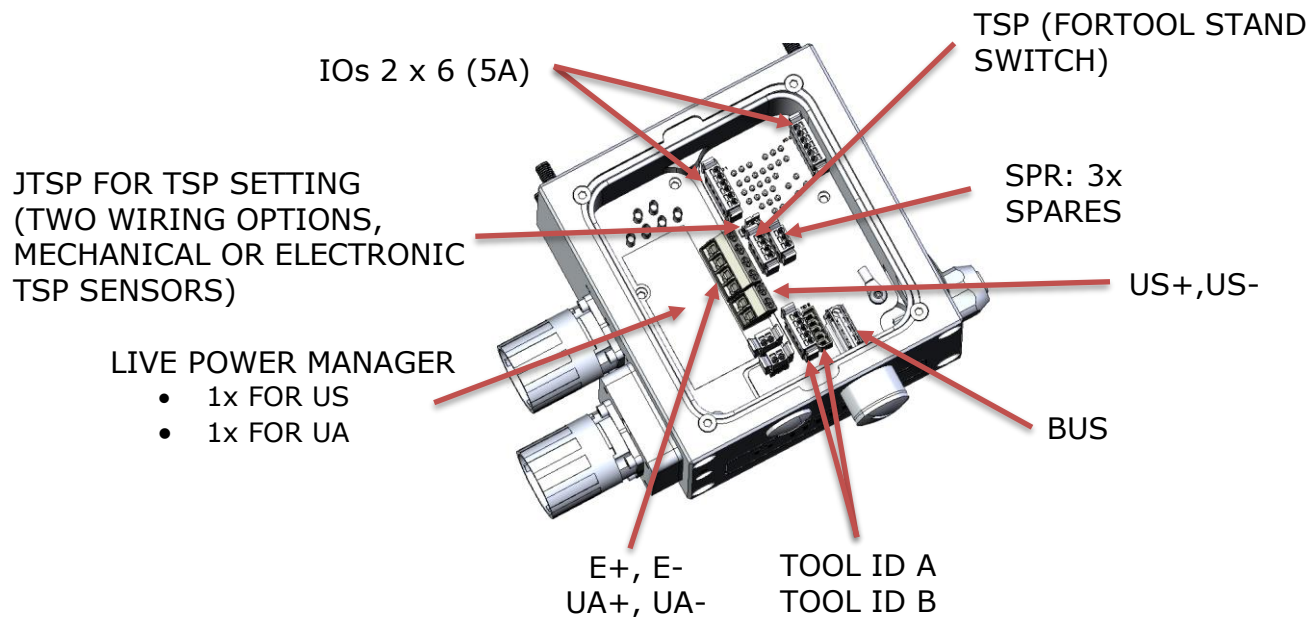
Detail view

**BUS AUTOMATIC RESISTOR TERMINATION JUMPER**

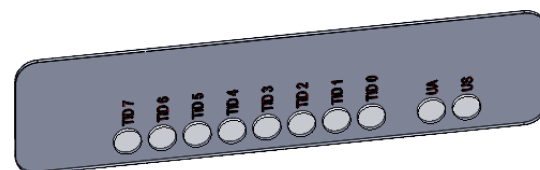
- Jumper JR TERM to OFF: circuit not active
- Jumper JR TERM to TP: circuit active → depending on the bus (DN or Profibus or RS485)



7 TOOL SIDE MODULE FEATURES



LED LABEL ROBOT SIDE



LED LABEL TOOL SIDE

8 FEATURE DETAILS

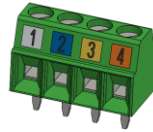
8.1 BUS LINE

The bus cable coming from the robot controller, or from the IO bus module system, or going to the customer's tool can be connected via

- a M12 D-coded connector, or
- a metallic strain relief with 360° EMC connection, that puts the metallic braid of the bus cable (shield) in contact with the module's block.

Please refer to the assembly drawings of the Communication I/O modules to identify the bus connection.

A bus wire terminal of four positions is installed on each signal board, robot or tool. The terminal Satisfies CAT5 requirements in accordance with EN 50173 and ISO/IEC 11801, as well as the requirements of the "Guideline for PROFINET".



Four bus lines rated 5 A are built in the boards according to industrial Ethernet standards and CAT5 requirement.

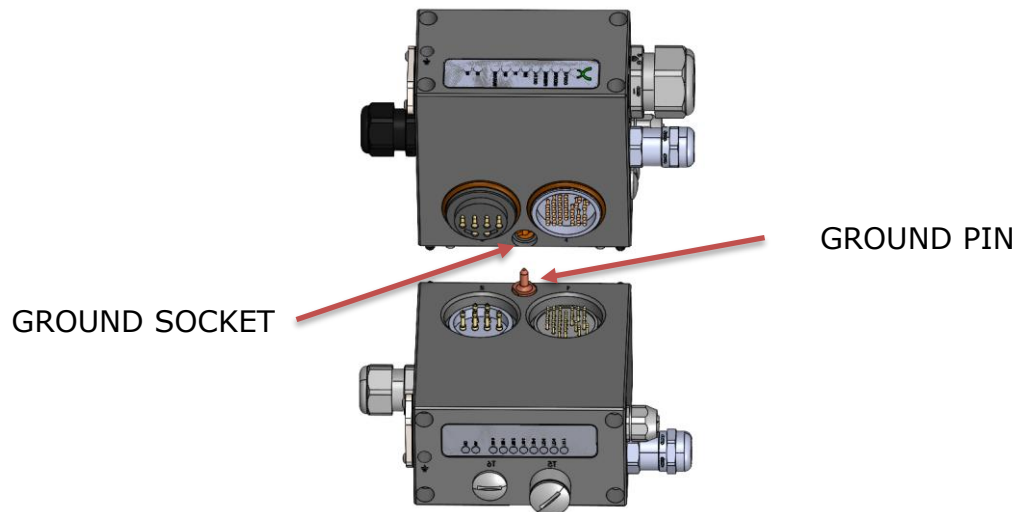
A FE (Functional Earth) connection point is provided by means of a screw hole M8 for a M8 lug in the Robot Module and in the Tool Module blocks.

A lamella spring socket pin in the Robot Module and a silver-plated copper pin in the Tool Module allow the passthrough of the Functional Earth.



NOTE

Please ensure that the pin is mounted in the Tool Module before operating any bus thru the modules. The pin could be supplied in a separate bag to avoid damage during shipment.



8.2 POWER SUPPLY



NOTE

In the Communication I/O modules galvanic isolation of voltage circuits is present. To optimize the noise immunity is recommended to use separated power supplies for sensors (US or US1) and actuators (UA or US2).

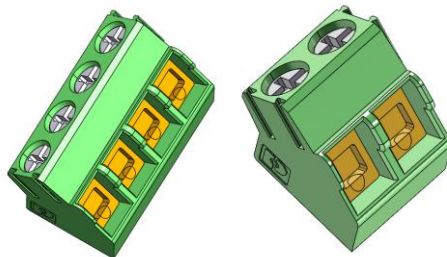
The supply should be via primary-switched or regulated power supplies.

However, the Communication I/O module works even if a single power supply is used for both sensors and actuators (not recommended).

The power supply must meet the SELV (Separated or safety extra-low voltage) standards. Power supplies according to EN 61558-2-6 (trans-former) or EN 60950-1 (switch mode power supply) meet these requirements.

The power board of the Communication I/O modules provides

- a terminal of two positions for US (or V+/V- in case of DeviceNet), and
- a terminal of four position for UA and E+/E-, where E is an auxiliary power supply.



The power supply on the module is needed for multiple functions of the Tool Changer and of the Communication I/O modules. These include the voltage supply of Tool Changer's sensing, TSM circuit, TP digital signal, Tool ID and the supply of the TSP sensor or switch sensors.

The electronic system of the Communication I/O modules is supplied with power via the sensor power supply (US).



NOTE

The sensor power supply (US) must not have a switchable design.

It supplies the module electronics with power. If the US power supply is switched off, only the passthrough function of signal and power is maintained.

The design of the circuit protects the robot side signal board against polarity inversion. However, see notice at 12.2.

8.3 TOOL STAND MONITORING CIRCUIT

The Tool Stand Monitoring (TSM) circuit is a single channel relay circuit used to control the uncouple command signal sent to the Valve Module, which controls the Couple and Uncouple actuation of the Tool Changer. The TSM monitors the status of three conditions; whether power is present on the TSM, Tool Presence, and Tool Stand Presence (See Section **Error! No bookmark name given.**13.1).



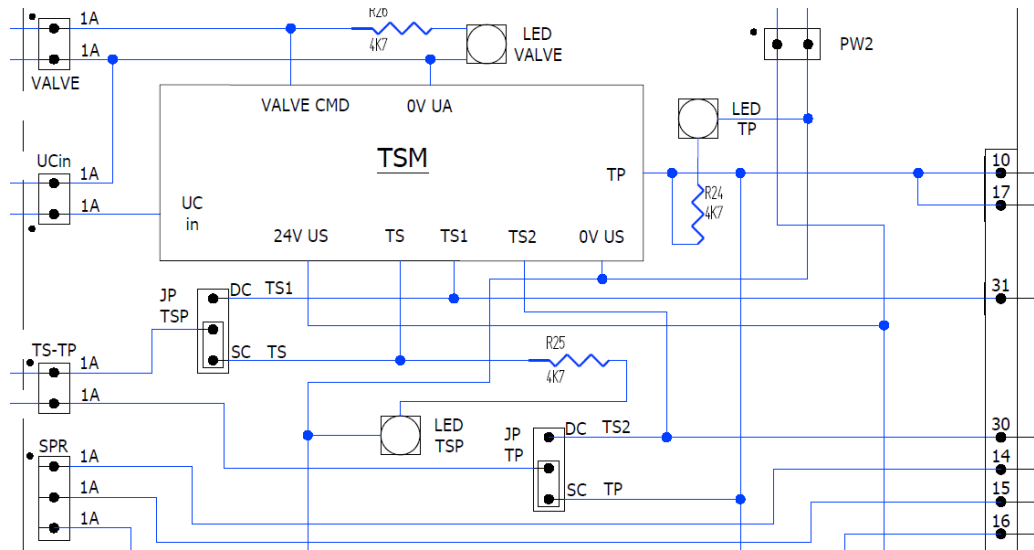
THE TOOL STAND MONITORING CIRCUIT IS NOT A SAFETY CONTROL CIRCUIT CONFORMING TO THE RELEVANT SAFETY STANDARDS. THE ROBOTIC SYSTEM INTEGRATOR AND THE END USER MUST PROVIDE A CONTROL SYSTEM FOR THE ROBOTIC SYSTEM INCLUDING THE TOOL CHANGER, CONFORMING TO THE RELEVANT SAFETY STANDARDS. EFFECTO'S SCM IS A CONFORM SAFETY CONTROL FOR TOOL CHANGER. PLEASE CONTACT EFFECTO SALES DEPARTMENT

The inputs of the TSM circuit are:

- UC command from the robot controller: 24 V digital signal, powered by UA;
- TSP (or Tool Stand Present) = AND of two 24V digital signals coming from a safety rated switch or sensor (at least cat 3, PI-d), powered by US;
- TP (or Tool Present) = OR of two 24V digital signals from a pair of spring probes, powered by US.

The outputs of the TSM circuit are:

- Valve command: 24 V digital signal, powered by UA;
- Optional monitoring signal: TP (Tool Present), 24 V digital signal, powered by US.
- Optional monitoring signal: TS (Tool stand Present), 24 V digital signal, powered by US(AND of TS1 and TS2).



TS1, TS2, TS and TP signals are also made available to user by means of dedicated connectors (one connector, two poles, for TS1 and TS2, and one connector, two poles, for the output signals of the TSM circuit, TS and TP).

The design of the TSM circuit features protection against polarity inversion of the UC command. However, see notice at 12.2.

8.4 AUTOMATIC RESISTOR TERMINATION

Some field buses require the termination of the bus line at the last node of the bus line.

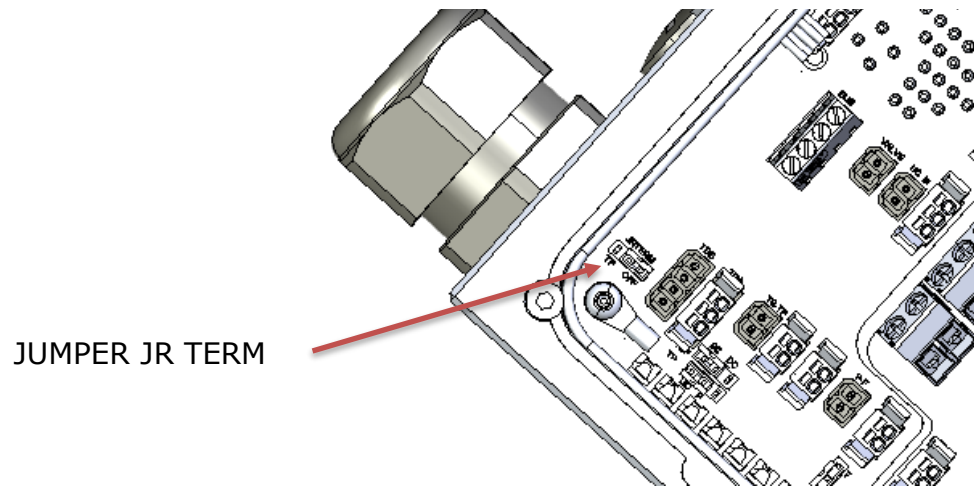
For example, RS485 or Modbus-RTU requires a termination resistor of 120 Ohm. DeviceNet requires a termination resistor of 121 Ohm. Also, Profibus requires termination resistors.

The Robot Module is equipped with a special circuit that allows the automatic insertion of a resistor in the bus line when the TP (Tool Present) signal is OFF.

The resistor is automatically excluded when the TP signal is ON.

Please contact Effecto sales department if you need to passthrough any of these fieldbuses in your application, so that the specific value resistor is mounted into the Robot Module board.

- Jumper JR TERM to OFF: circuit not active
- Jumper JR TERM to TP: circuit active → depending on the bus (DN or Profibus or RS485) we must equip the board with a specific value resistor.



8.5 IO-LINK PASSTHRU

The Robot Module allows to pass the IO-Link signal coming from the Effecto pressure sensing system of the Robot adapter.

In this case a flashing LED of the Robot Module will show the operation of the IO-Link communication.

8.6 DIGITAL AND ANALOG SIGNAL PASSTHRU

The modules allow the passthrough of

- 12 analog or digital signals of a maximum current of 5 A
- 3 spare signals of a maximum current of 1 A.

The twelve signals rated 5 A could be used for example for welding gun feedback.



NOTE

For the sensors we recommend keeping to a cable diameter of min. 0.34 mm² to ensure rapid switch-off in case of a short-circuit.

8.7 VALVE CONNECTION

The Communication I/O Module contains a single electrical connection for the Uncouple output command to the Valve Module via a M12 5 PIN FEMALE connector than can also be used for the SCM power (See Section 18 for Pin Out) on the side of the Communication I/O Module position R5 (See Figure 8.7-1).

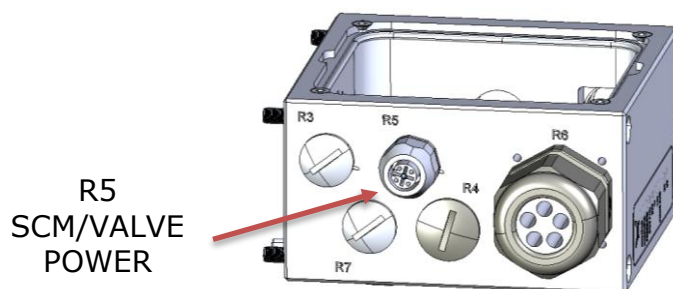


Figure 8.7-2. Communication I/O Module Valve Connection

8.8 TOOL ID

A rotary dip switch is used to handle Tool ID. The shunt being used with the rotary dip switch has four bits, allowing for use of B_0 , B_1 , B_2 and B_3 . The rotary dip switch is a manual dial with options of 0 through 15. Tool ID 0 is left unused because it is "0, 0, 0", which is equivalent to no power being applied to the switch at all or not tool module coupled with the robot module. Table 8.8-1 displays the Tool ID bitmapping.

Table 8.8-1. Tool ID Bitmapping

D I A L	REAL CODE	Common (C) connected to terminals indicated			
		1	2	4	8
0	0				
1	1	●			
2	2		●		
3	3	●	●		
4	4			●	
5	5	●		●	
6	6		●	●	
7	7	●	●	●	
8	8				●
9	9	●			●
A	10		●		●
B	11	●	●		●
C	12			●	●
D	13	●		●	●
E	14		●	●	●
F	15	●	●	●	●
	C	1	2	4	8
	B	W	B	B	G
	R	H	L	L	R
	N	T	U	K	Y

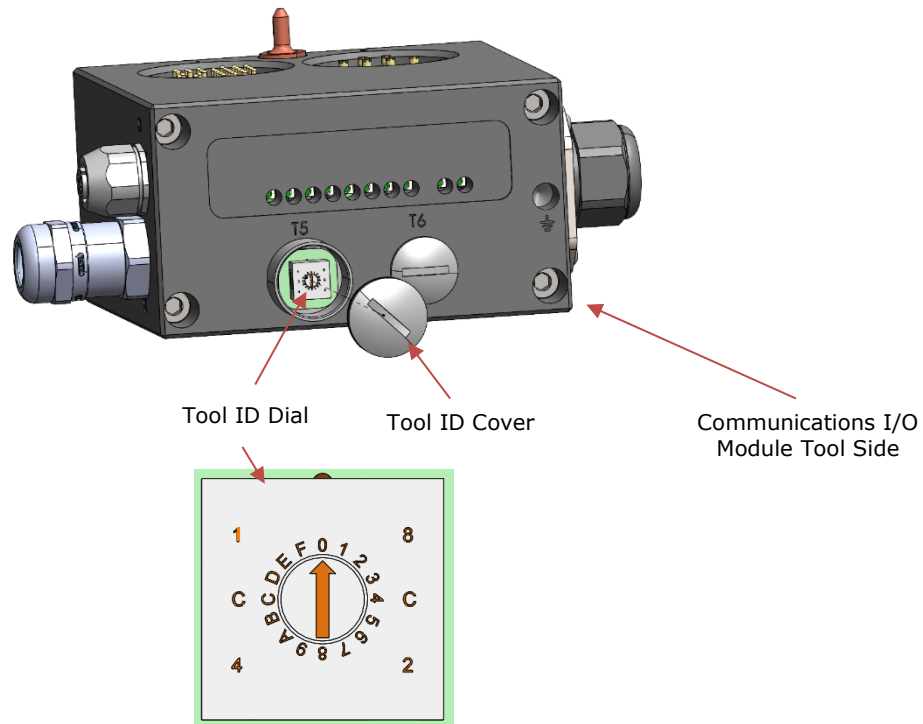


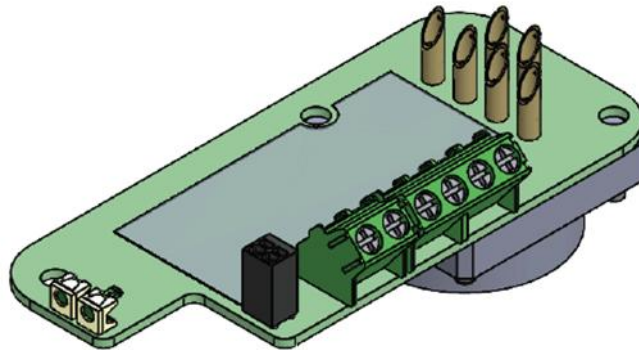
Figure 8.8-1. TOOL ID (ARI PART NO. 1900004A)

The Tool Module provides the possibility to mount two Tool ID switches to achieve a Tool ID coding by means of eight bits instead of four bits.

We call:

- The first TID switch "TIDA"
- The eventual second TID switch "TIDB"

8.9 LIVE POWER MANAGERS



The Communication I/O modules contain two Live Power Manager circuits to provides intelligent control of power supply connections during insertion and removal of tool sides from a live robot system or other hot power sources:

- LPM-T-24VDC/10A live power manager for the US (or US1 or UB) power supply
- LPM-T-24VDC/16A live power manager for the UA (or US2) power supply

The LPM provides inrush current control to limit system voltage drop and transients, controlled load turn-on and power feed protection.

Main features of LPM

- Current-limited connection of DC24V components with high input capacities (max 25.000µF).
- Eliminates electrical contact wear due to arcs or contact sticking by using the control voltage.
- Prevents a high voltage drop on the feeding supply line through the inrush current peak would be caused.
- Power MOSFET switching output DC24V / nominal 10A or 16 A
- Inrush current limitation typ. 12.6 A (10A version) and 19.2 A (16A version)
- Switch-on resistance typ. 6mΩ.
- Automatic operation (no need of a control voltage).
- Integrated short circuit protection.
- LED signaling of "Power good".
- Undervoltage Lockout at 18V.
- LPM latches off after a fault detection.
- Suitable for installation in tool changers, or any swapping device.

The main differences from the previous current limiter module CL-001-DC24V-5A are:

- The LPM actively controls the inrush current with a linear increase of the output voltage; if the output voltage has not reached the input voltage at the end of the transient, the device shuts the output off and protects the circuit. The previous module CL-001, instead, after a transient of 500ms it closes the circuit even if the inrush current has not lowered within its limit.
- Protection from short circuit either during operation or at start-up or at load connection.
- The LPM eliminates the need of any electronic circuit breaker or fuse, needed for the CL-001
- No need of a control voltage: automatic operation by the tool side.

NOTICE

According to the standard practices of electrical circuits, please make sure that the current absorption of load connected to each output of the module is lower than the capability of the correspondent power supply.

Incorrect sizing of the power supply to the load could cause permanent damage to the LPM circuit.

Technical Data (T ambient = 25 ° C, US = DC 24V, UA = DC 24V)

LMP circuit	US: LPM-T-24VDC/10A	UA: LPM-T-24VDC/16A
Operating voltage U (U input / U-GND)	DC 18 to 27.6 V (+15%)	
Rated current I _N	Max. 10 A	Max. 16 A
Current consumption I ₀	Max. 10 mA	
Ripple for all tensions	Max. 5%	
Reverse polarity protection U	Integrated in the device	
Load output (voltage-output)	Power MOSFET switching output (positive switching)	
Maximum data of the load	DC24V / 10A (no load reduction over the entire temperature range)	DC24V / 16A (no load reduction over the entire temperature range)
Permitted load types (US1-output)	Ohmic load, inductive load, lamp load, capacitive load max. 25.000µF	
Switch-on resistance RON	About 6mΩ	
Rise time of the Load current at 24V (10% - 90%)	Typ. 170ms at capacitive load	Typ. 320ms at capacitive load
Limiting time t _{limit} for inrush at 24V	Max. 200ms at 25.000µF	Max. 400ms at 25.000µF
Inrush current limitation	Typ. 12.6 A, max. 14.1 A	Typ. 19.2 A, max. 21.5 A
Freewheeling circuit	Bidirectional suppressor diode	
Short circuit shut-off time	About 1ms	About 1ms
Undervoltage Lockout	18V	
LED for "power good" signal	Green	Green
Overvoltage protection	Bidirectional Suppressor diodes in the U input and U output	
Ambient temperature	0 ... 50°C (without condensation)	
Storage temperature	-20 ... + 70 ° C	
Connections	2 spring probes of nominal current 25 A at the input + 2 terminal contacts nominal current: 17.5 A, rated voltage (III/2): 400 V at the output	2 spring probes of nominal current 25 A at the input + 2 terminal contacts rated nominal current: 17.5 A, rated voltage (III/2): 400 V at the output

Housing	PCB encapsulated by epoxy resin
Dimensions (W x H x D)	See dimensions of the tool power board
Weight	See weight of the tool power board
Mounting option	See mounting features of the tool power board

**NOTE**

The power outputs switch off when an overload or a short-circuit is detected. They remain switched-off even after the error is rectified. Consequently, Power LEDs of the Tool Module turn OFF.

To clear the short-circuit memory, switch off the power supply or disconnect it from the Robot Module.

The Robot Power Board mating with the Tool Power Board is equipped with capacitors to limit the effect of high inductances of cables on the robot side. However, long cables or cables not sized according to the standard practices of electrical circuits could increase the inductive load on the robot side and cause damage to the LPM circuits and/or to the customer equipment.

NOTICE

If the Communication I/O module is used in combination with an IO bus module, and this is installed on the Tool Changer Robot Adapter, the length of the power cable on the robot side supplied by us will be short. In this case a 5-pole power cable with 1.5 mm² cross section wires is sufficient.

Otherwise, we always recommend a 5-pole power cable with 2.5 mm² cross section wires. Please consider additional measures in case of long cables on the robot side.

For the output of the Tool Module, we always recommend a 5-pole power cable with 2.5 mm² cross section wires, unless the cable is short and/or the electrical load of the customer tool is really limited.

8.10 TOOL STAND PRESENT INFORMATION

The Tool Module signal board allows the connection of Tool Stand Present Sensors or Switches.

**NOTE**

The switches or sensors used for the Tool Stand Present information must have two normally open contacts.



IN ORDER TO ACHIEVE A SAFETY CONTROL CIRCUIT CONFORMING TO THE RELEVANT SAFETY STANDARDS, SAFETY SENSORS OR SWITCHES MUST BE RATED AT LEAST CATEGORY 3 (DOUBLE CHANNEL ARCHITECTURE) AND PL-D. SAFETY EVALUATION IS IN ANY CASE RESPONSIBILITY OF THE INTEGRATOR OR END-CUSTOMER.



THE ADOPTION OF A KEY OR TONGUE INTERLOCK SWITCH FOR THE TOOL STAND PRESENT INFORMATION IMPLIES SAFETY MEASURES TO PREVENT A MECHANICAL FAILURE OF THE SWITCH AND/OR ITS ACTUATOR, INCLUDING FOR EXAMPLE, BUT NOT LIMITED TO, A GUIDING SYSTEM IN ORDER TO ENSURE THE ALIGNEMENT OF SWITCH AND ACTUATOR, ALIGNMENT THAT MUST BE VERIFIED EVERY WEEK.

**NOTE**

Effecto recommends adopting contactless safety sensors for the Tool Stand Present information.

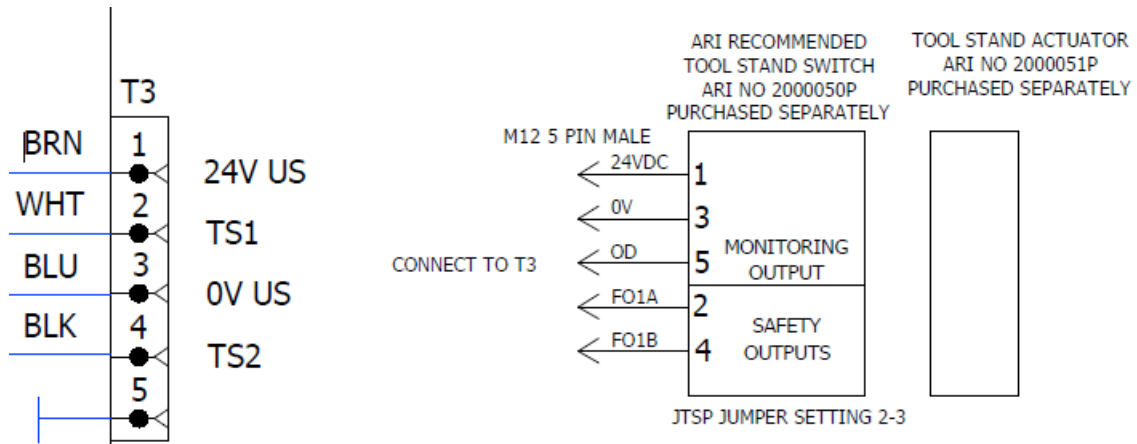
The Tool Signal Board allows to use different safety sensors or switches with two NO contacts.

The wiring configuration for the sensor or the switch can be accommodated by means of the JTSP jumper.

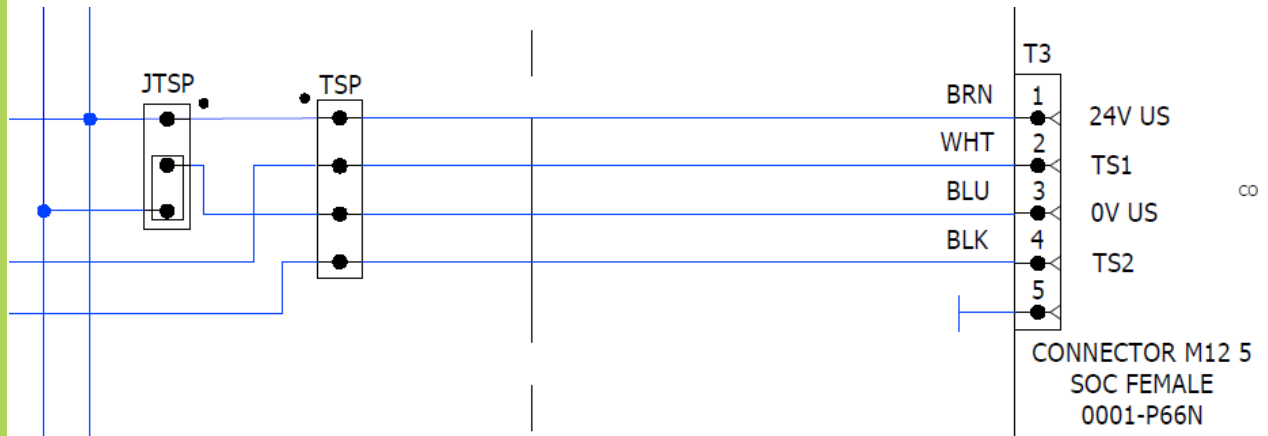
- JSTP jumper to pin 1 (24 V US): for mechanical switches, 24 V is sent to each contact of the switch.
- JSTP Jumper to pin 3 (0V US): for electronic switches.

**NOTE**

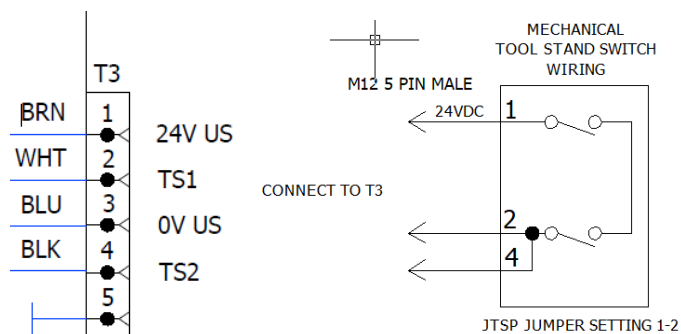
Effecto recommends using our tool stand switch ARI part no. 2000050P with actuator 2000051P with the JTSP jumper setting of 2-3.



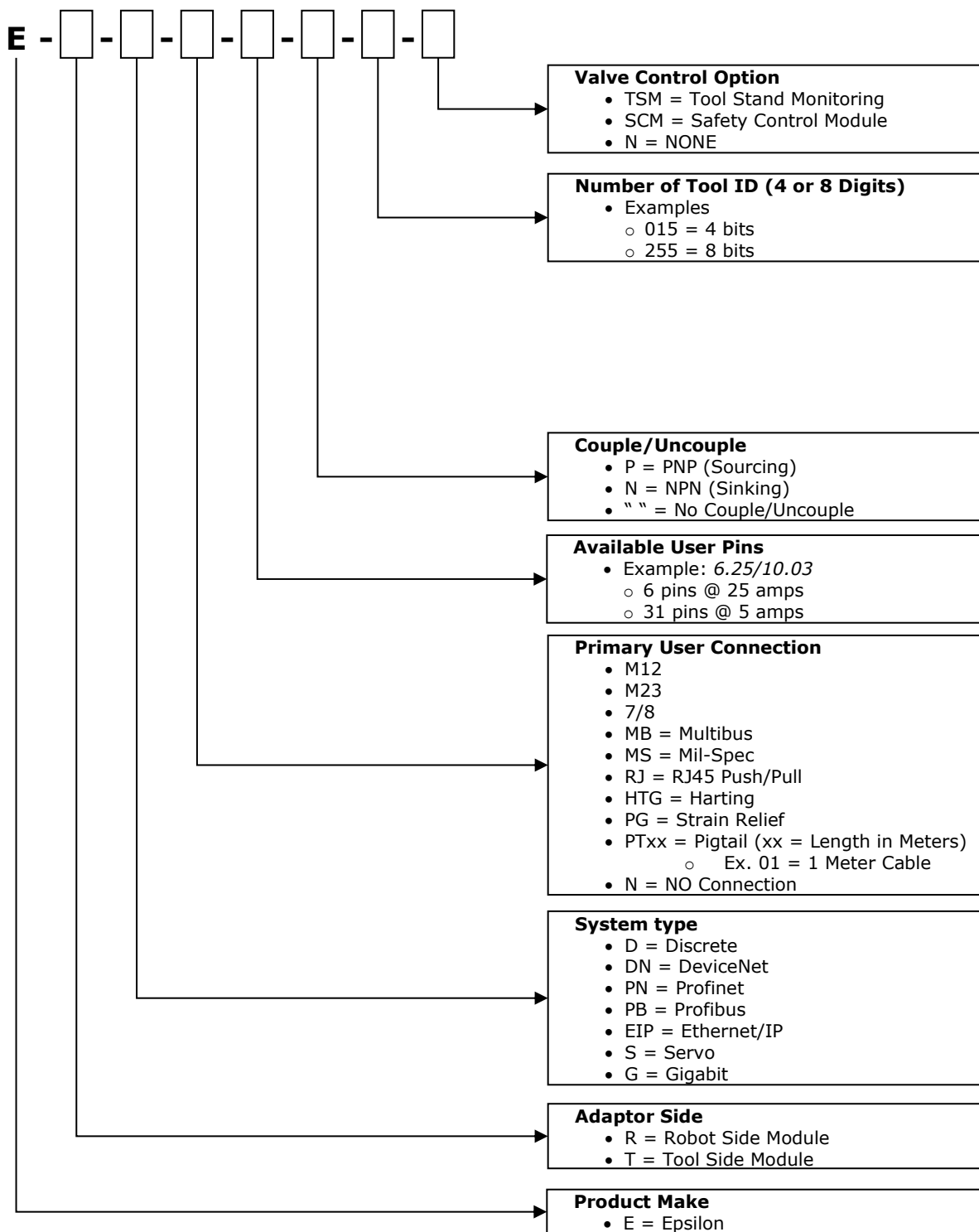
If the customer chooses to use a mechanical tool stand switch use a JTSP jumper setting of 1-2.



In case of mechanical switches with a switching delay between the two contacts we recommend wiring it according to the below picture.



9 COMMUNICATION I/O MODULE (E125, E160, ES160, & ES200)



Custom/Special: E-[]-[]-S###

Note: If " " (blank) is chosen, remove "-"- (dash) if that is the only input between dashes.

See below some examples of module's descriptions:

MODULE EXAMPLES		
BUS NETWORK	DRAWING NUMBER	DESCRIPTION
Ethernet/IP M12 D-Coded/4- Pole 7/8"	2300061A	E-R-EIP-M12-4.25/4.05-P-015-TSM
	2300063A	E-R-EIP-M12-4.25/4.05-P-015-SCM
	2300064A	E-T-EIP-M12-4.25/4.05-015
Ethernet/IP M12 D-Coded/5- Pole 7/8"	2300065A	E-R-EIP-M12-5.25/4.05-P-015-TSM
	2300067A	E-R-EIP-M12-5.25/4.05-P-015-SCM
	2300068A	E-T-EIP-M12-5.25/4.05-015
Profinet Push/Pull	2300069A	E-R-PN-RJ-5.25/4.05-P-015-TSM
	2300071A	E-R-PN-RJ-5.25/4.05-P-015-SCM
	2300072A	E-T-PN-RJ-5.25/4.05-015
Profinet M12 D-Coded/L- Coded	2300073A	E-R-PN-M12-5.25/4.05-P-015-TSM
	2300075A	E-R-PN-M12-5.25/4.05-P-015-SCM
	2300076A	E-T-PN-M12-5.25/4.05-015
DeviceNet M12 D-Coded/4- Pole 7/8"	2300077A	E-R-PN-RJ-5.25/4.05-P-015-TSM
	2300079A	E-R-PN-RJ-5.25/4.05-P-015-SCM
	2300080A	E-T-PN-RJ-5.25/4.05-015

10 TECHNICAL SPECIFICATIONS

Table 10-1. Communication I/O Module Technical Specifications

Specification		Metric	English
Mass / Weight *	Robot	1.12 kg	2.47 lb
	Tool	1.30 kg	2.87 lb
Operating Temperature (DeviceNet)		5 °C to +60 °C	41 °F to 140 °F
Operating Temperature (Ethernet/IP and Profinet)		5 °C to +60 °C	41 °F to 140 °F
Transportation & Storage Temperature (DeviceNet)		-25 °C to +55 °C	-13 °F to 131 °F
Transportation & Storage Temperature (Ethernet/IP and Profinet)		-25 °C to +55 °C	-13 °F to 131 °F
Max Signal Current Rating		5 Amps or 1 A (please see schematic)	
Max Signal Voltage Rating		27,6 VDC	
Max Power Current Rating		US: 10 Amps, UA: 16 Amps	
Max Power Voltage Rating		27,6 VDC	
Enclosure Rating		IP 65 (When coupled)	
Transportation & Storage Humidity		Up to 50%, Maximum Temperature 40 °C (104 °F)	
Noise Emission		<= 70 dB(A) in any direction	
Chemical Resistance		Contact APPLIED ROBOTICS Technical Support	

* Module weight may vary depending on specific configuration.

11 INSTALLATION

The Communication I/O Module is designed to mount directly to APPLIED ROBOTICS' Sigma, Sigma NextGen, and Epsilon (E125, E160, ES160, ES200, & ES315) Tool Change Systems. The Communication I/O Module is primarily installed on Position 3 over the top of the Couple/Uncouple Sensing and Air Pressure Monitoring. There are four types of connections: Power, Communications, I/O, and Valve (or SCM).

To install the Communication I/O Module, place the supplied O-ring into the spot face of the Communication I/O Module. Locate the Communication I/O Module using the two installed M5 dowels and fasten the Communications I/O Module to the mounting position using the four M5 socket head cap screws, supplied with the Communication I/O Module (See Figure 11-1).

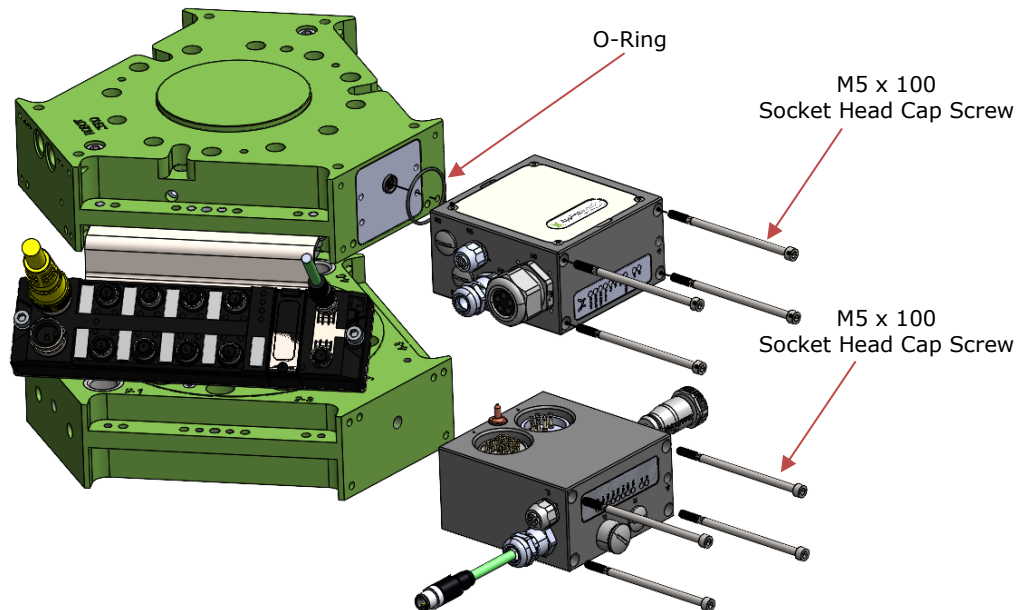


Figure 11-1. Communication I/O Module Installation
Robot & Tool Sides



CAUTION

Before attaching the module, it must be assured that the mounting surface is smooth and flat to prevent mechanical stress in the module housing.

12 CONNECTIONS

The Communication I/O Module contains multiple electrical connections to the I/O Module bus system. There are Power, Bus Communication, and I/O connectors on the Communication I/O Module



CAUTION

MAKING CONNECTIONS WHILE UNDER POWER COULD RESULT IN DAMAGE TO THE EQUIPMENT AND/OR UNFORESEEN SITUATIONS. TURN POWER OFF TO THE EQUIPMENT PRIOR TO CONNECTING/DISCONNECTING ANY CABLE.



NOTE

Unused connectors or module's open hole for connectors or strain reliefs must be fitted with blind caps to ensure IP65 protection (when coupled).

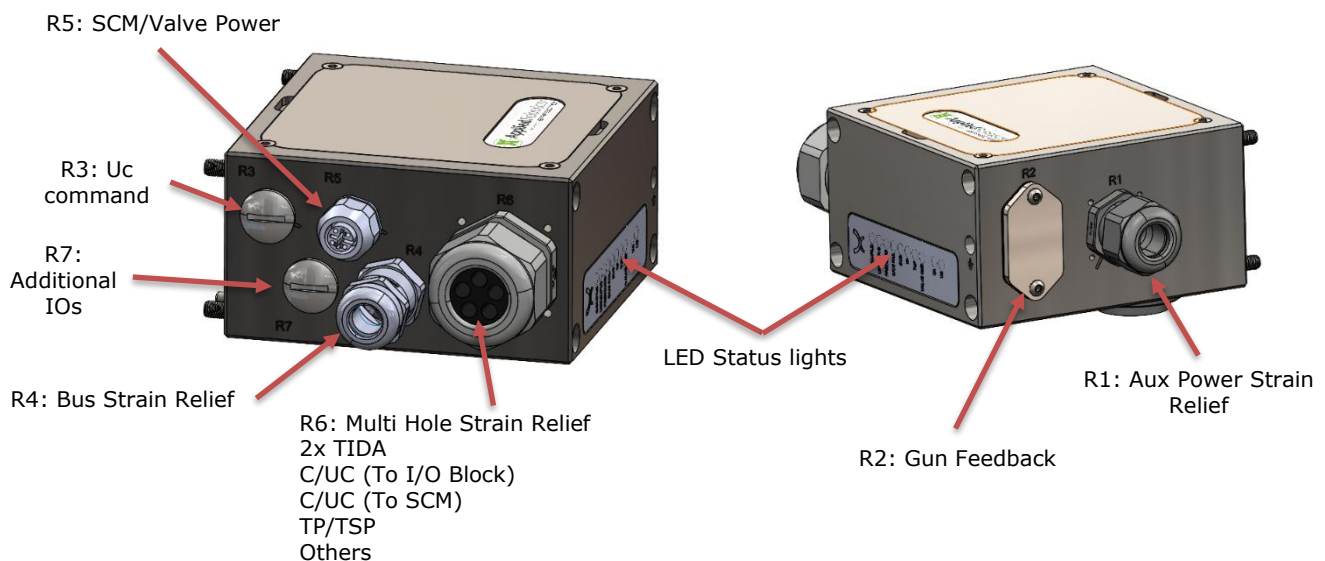


Figure 8.10-1. Communication I/O Module Block Connections

Confirm pin designation with appropriate wiring schematic (See Section 18).

The electrical schematic can be found on APPLIED ROBOTICS Informational Documents (See Section 18) or the system schematic that corresponds to the equipment supplied.

12.1 CONNECTION OF DIGITAL SENSORS AND ACTUATORS



Sensor and actuator cables must only be plugged and removed when power is not supplied to them.



ENSURE THAT THE ROBOT CONTROLLER IS IN PROPER COMMUNICATION WITH I/O BLOCK AND THAT THE STATUS OF ALL OUTPUT SIGNALS ARE KNOWN AND CONFIRMED PRIOR TO CONNECTING ANY ACTUATOR, INCLUDING THE VALVE FOR TOOL CHANGER UNCOUPLING.

12.2 SUPPLY VOLTAGE CONNECTION



If the polarity of the power supply is reversed, the module may be damaged. For this reason, we recommend using pre-assembled cables from Effecto.

12.3 BUS CONNECTION

For correct selection of cables, please refer to your specific Communication I/O Module Electrical schematic. This electrical schematic is listed on the Communication I/O Module assembly drawing.

See below some examples of bus configurations:

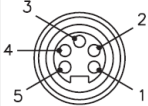
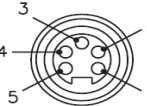
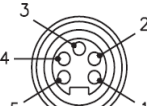
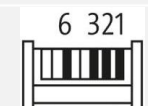
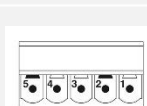
Bus Network	Communications Connection	Power Connection
DeviceNet	5-Pin 7/8"  1 = Shield 2 = US + 3 = US - 4 = CAN_L 5 = CAN_L	4-Pin 7/8"  1 = V_AUX + 2 = Pass thru 3 = Pass thru 4 = V_AUX -
	4-Soc Female D-Coded M12  1 = RD + 2 = TD + 3 = RD - 4 = TD -	5-Pin 7/8"  1 = US- 2 = UA- 3 = FE 4 = US+ 5 = UA+
Ethernet/IP and Profinet	4-Soc Female D-Coded M12  1 = RD + 2 = TD + 3 = RD - 4 = TD -	5-Pin L-Coded M12  1 = US+ 2 = UA- 3 = US- 4 = UA+ 5 = FE
	PUSH PULL RJ45  1 = TD + 2 = TD - 3 = RD + 6 = RD -	POWER PUSH PULL  1 = US+ 2 = US- 3 = UA+ 4 = UA- 5 = FE

Table 12.3-1. Electrical Connections



RECOMMENDATION

We recommend our pre-wired bus cables in order to ensure simple and reliable wiring. Please contact Effecto sales department.

Connecting the bus to Communication I/O modules

- Connect functional earth (GND) to the FE connection on the blocks.



NOTE

Please ensure that the FE pin is mounted in the Tool Module before operating any bus thru the modules. The pin could be supplied in a separate bag to avoid damage during shipment.

- Connect incoming bus cables to the Robot Module bus connection (strain relief + internal terminal or module's connector).
- Connect the tool bus cable to the Tool Module bus connection (strain relief + internal terminal or module's connector).

- or close off the open bus connection with a blind plug.

13 GUIDE TO OPERATION

The two halves of the Communication I/O Module mate when the Robot Side of the Tool Changer goes to dock a tool. The two halves communicate via spring pins when mated, providing tooling information including Tool Present, Tool Stand Present, Tool ID, and tool specific information via downstream nodes. Tool Changer locating pins provide alignment and guidance for contact interface of two halves of Communications I/O Module during docking.

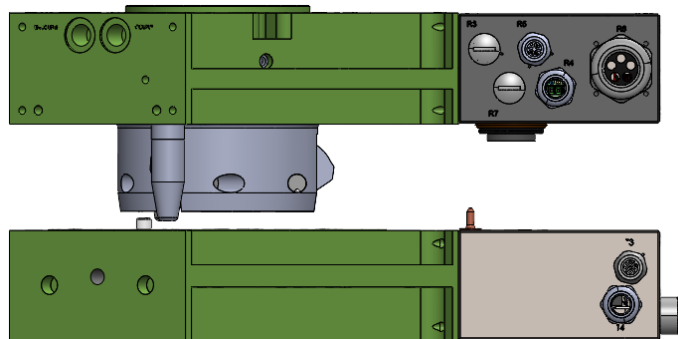


Figure 12.3-1. Tool Changer Undocked

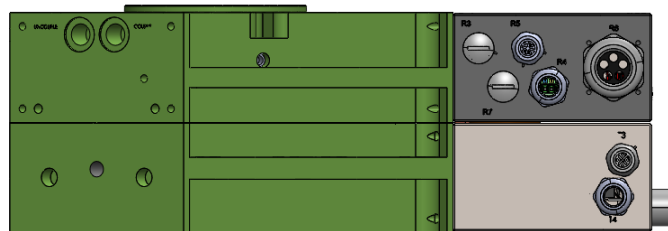


Figure 12.3-2. Tool Changer Docked

NOTICE

The Communication I/O Modules are protected by the Live Power Manager circuits during connect/disconnect.

However, we recommend turning off all downstream outputs during manual connect/disconnect to avoid any damage to the modules or the customer's circuits.

13.1 TSM CIRCUIT OPERATION



THE TOOL STAND MONITORING CIRCUIT IS NOT A SAFETY CONTROL CIRCUIT CONFORMING TO THE RELEVANT SAFETY STANDARDS. THE ROBOTIC SYSTEM INTEGRATOR AND THE END USER MUST PROVIDE A CONTROL SYSTEM FOR THE ROBOTIC SYSTEM INCLUDING THE TOOL CHANGER, CONFORMING TO THE RELEVANT SAFETY STANDARDS. EFFECTO'S SCM IS A CONFORM SAFETY CONTROL FOR TOOL CHANGER. PLEASE CONTACT EFFECTO SALES DEPARTMENT

In case of use of the TSM circuit (single channel), when the robot goes to undock a tool, a Tool Stand Present signal, along with the Tool Present signal, is passed through the same spring pin interface to communicate that the tool is in the tool stand and allows the Uncouple command to be sent to the valve via the TSM circuit.

The TSM requires Power, Tool Stand Present signals, and Tool Present signals. Depending upon the signals received, uncouple may or may not be allowed. Review Figure 13.1-1 to see the TSM logic tree that allows for the Tool Changer to be uncoupled.

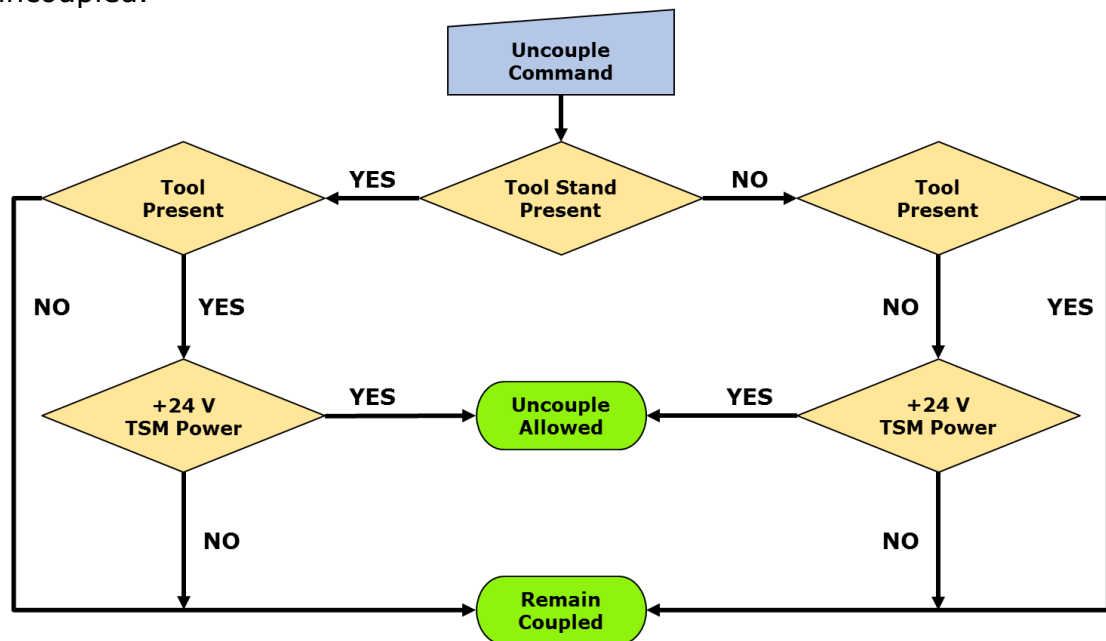


Figure 13.1-1 TSM Logic Tree

14 TROUBLESHOOTING

14.1 TROUBLESHOOTING GUIDE

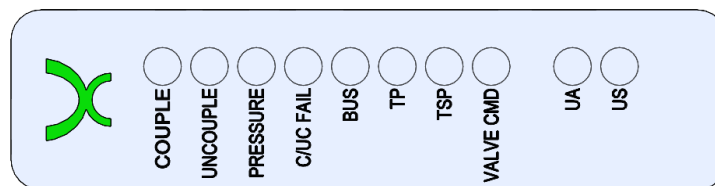
Symptom	Possible Cause	Resolution
Tool Changer Does Not Couple/Uncouple	Valve is not receiving the output signal	Check to see that an output signal is sent to Couple/Uncouple the Tool Changer. If an output signal is being sent, check all cables and connections and that the Valve is receiving the command on Pin 2 of the M12 5 PIN MALE Connector.
	TSM circuit failure	Check TSM signals: Power, Tool Stand Present, and Tool Present.
	Broken/Damaged signal cable	Replace cable. (See Section 17.3)
Tool Not Operating	Broken/Damaged signal cable	Replace cable. (See Section 17.3)
	Broken/Damaged probes	Replace probes. (See Section 17.1)
Loss of Signal	Broken/Damaged signal cable	Replace cable. (See Section 17.3)
	Broken/Damaged probes	Replace probes. (See Section 17.1)
	Loss of power	Confirm power is reaching module. Unplug power cable and check with multimeter.
	TSM circuit failure	Check TSM signals: Power, Tool Stand Present, and Tool Present.
Signal Interrupt	Broken/Damaged signal cable	Replace cable. (See Section 17.3)
	Unterminated grounding	Check and verify that the shield is connected throughout the line and properly grounded.
Loss of power at Tool Module	Overload or short-circuit at the customer's tool	Remove power or disconnect the Tool Module. Check the customer's tool and if everything is fine, connect the Tool Module again.
	Broken/Damaged probes	Replace probes. (See Section 17.1)

14.2 LED INDICATORS LIGHTS ROBOT & TOOL SIDE MODULES

There are ten (10) LEDs on the robot and tool side communication modules that provide the status of various functions. These LEDs help with diagnostics.

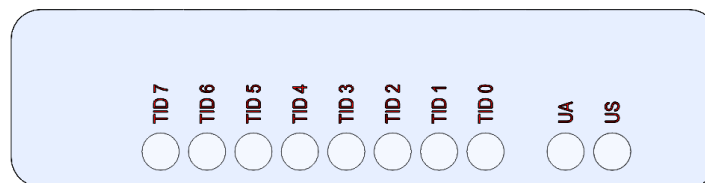
Robot Side LEDs

- **"COUPLE"** – The "Couple" LED provides indication of the piston position of the Robot Adaptor. When this LED is on, the Robot Adaptor is in the Coupled status.
- **"UNCOUPLE"** – The "Uncouple" LED provides indication of the piston position of the Robot Adaptor. When this LED is on, the Robot Adaptor is in the uncoupled status.
- **"PRESSURE"** – available with the four pressure sensor board :the "Pressure" LED provides indication that the robot adapter has a proper air pressure supplied to the valve.
- **"C/UC FAIL"** – available with the four pressure sensor board: the "C/UC FAIL" LED provides indication that the tool changer is not changing states, couple to uncouple or vice versa because of a mechanical issue, or that the pressure sensing electronics has failed.
- **"BUS"** – available with the four pressure sensor board and optional IO-Link : The "BUS" LED provides indication that the IO-Link communication is live and operational to the robot adapter.
- **"TP"** – The "TP" LED provides indication there is a tool present.
- **"TSP"** – The "TSP" LED provides indication that the tool changer is in the tool stand.
- **"VALVE CMD"** – The "VALVE CMD" LED provides indication that the tool changer has received the output command to uncouple from the robot controller and the TSM circuit has enabled the output to the valve.
- **"UA"** – The "UA" LED provides indication that the actuator power (UA) is present in the communication module.
- **"US"** – The "UA" LED provides indication that the sensor and logic power (US) is present in the communication module.



Tool Side LEDs

- **"TID 0-7"** – The "TID 0-7" LED shows the binary ID of the specific tool that the set in the tool module by user (see table 8.8-1).
- **"UA"** – The "UA" LED provides indication that there is actuator power present in the tool side communication module. If the LED is OFF, power could be OFF, or an overload or a short-circuit happened at the customer's tool. Please remove the power to reset the LPM circuit.
- **"US"** – The "UA" LED provides indication that there is sensor power present in the tool side communication module. If the LED is OFF, power could be OFF, or an overload or a short-circuit happened at the customer's tool. Please remove the power to reset the LPM circuit.



14.3 TECHNICAL SUPPORT

If you require assistance, contact APPLIED ROBOTICS or Effecto Technical Support Department at:

US Phone: +1 518 384 1000
US E-mail: techsupport@appliedrobotics.com

Europe Phone: +39 0322 96142
Europe E-mail: info@effecto.com

15 MAINTENANCE

NOTICE

FAILURE TO FOLLOW THE MAINTENANCE SCHEDULE DESCRIBED IN THIS SECTION COULD ALTER OR VOID THE WARRANTY PROVIDED BY APPLIED ROBOTICS, INC.

Communications I/O Module is a low maintenance component. (See Table 15-1.)

Table 15-1. Communications I/O Module Maintenance Schedule

Frequency of Maintenance				
Every 2 Weeks	250,000 Cycles	500,000 Cycles	750,000 Cycles	1,000,000 Cycles
Visual Checks	Visual Checks & Surface Inspection			Visual Checks & Surface Inspection & Check for Damaged Parts

15.1 PREVENTIVE MAINTENANCE

Inspect the cables for any cuts or abrasions and connectors for tightness. Inspect spring probes for excessive dirt, pitting, bending, or burning. If bending, burning, or excessive pitting is observed, replace the probe (See Figure 15.1-1). Ensure spring probes are free to move inside their receptacle. If spring probes do not move freely, replace them (See Section 17.1).

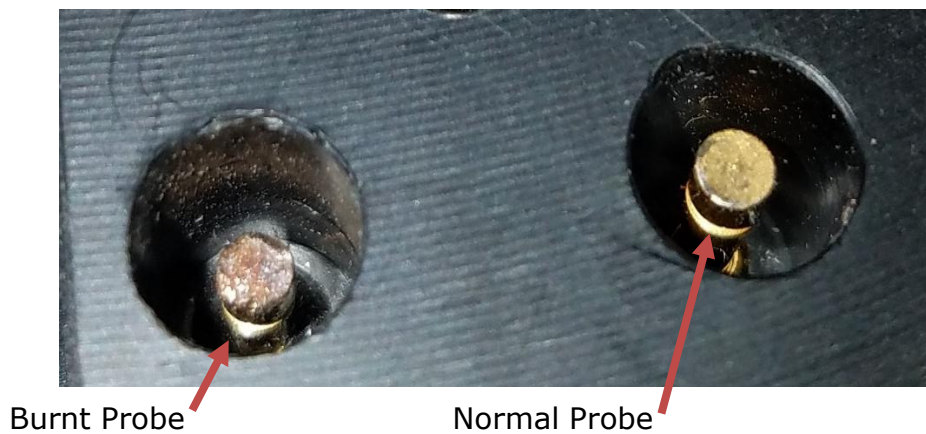
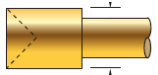


Figure 15.1-1. Normal and Burnt Probes

16 SPARE PARTS

The spare parts listed below are recommended to be maintained in stock for the life of the Communications I/O Module. These quantities are based on a single unit. If higher quantities are purchased, please contact the Technical Support Department at +1 518 384 1000 or techsupport@appliedrobotics.com to determine the quantity of spares recommended for the size of your installation.

Robot COMMUNICATION MODULE

DESCRIPTION	PART NUMBER	QTY	KIT PART NUMBER	
PROBE, FEMALE HSS120302230A3002	1308-P90N	6	2300546X Qty.50	
PROBE, FEMALE UH SPRING GOLD PLATED	98508-P1052	31	2100649X Qty.51	
PROBE, SPRING PIN QA TECH	96504-P1023	7	97500-B1000A Qty.18 97507-X1011A Qty.24 2100651X Qty.50	
O-RING, 1.364 ID X .07 70 BUNA (P)	0106-P18N	1		
SEAL, PROFINET PASSTHRU	1500-P50N	2		
SOCKET, ODU 4MM	1303-P85N	1		

Tool COMMUNICATION MODULE

DESCRIPTION	PART NUMBER	QTY	KIT PART NUMBER	
PROBE, MALE UH SPRING FORCE GOLD	0007-P65N	31	2100650X Qty.51	
PROBE, MALE HSS120306230A3002	2000938P	6	2300547X Qty.50	
4MM OD, M7 THREAD	1304-B11N	1		

CABLE KITS		
BUS NETWORK	DRAWING NUMBER	DESCRIPTION
Ethernet/IP	2300113A	CABLE KIT 1: M12 D-Coded, 4-Pole 7/8", POS 3-2
Ethernet/IP	2300114A	CABLE KIT 2: M12 D-Coded, 5-Pole 7/8", POS 3-2
Profinet	2300115A	CABLE KIT 3: RJ45 Push/Pull, 5-Pole Push/Pull, POS 3-2
Profinet	2300116A	CABLE KIT 4: M12 D-Coded, M12 L-Coded, POS 3-2
Ethernet/IP	2300117A	CABLE KIT 5: M12 D-Coded, 4-Pole 7/8", POS 3-1
Ethernet/IP	2300118A	CABLE KIT 6: M12 D-Coded, 5-Pole 7/8", POS 3-1
Profinet	2300119A	CABLE KIT 7: RJ45 Push/Pull, 5-Pole Push/Pull, POS 3-1
Profinet	2300120A	CABLE KIT 8: M12 D-Coded, M12 L-Coded, POS 3-1
Ethernet/IP	2300303A	CABLE KIT 9: M12 D-Coded, 4-Pole 7/8", POS 3-2, E125
Ethernet/IP	2300359A	CABLE KIT 16: M12 D-Coded, 4-Pole 7/8", POS 3-1, E125
Devicenet	2300330A	CABLE KIT 10: DN 4 PIN 7/8", 5-Pole 7/8", POS 3-2
Ethernet/IP	2300338A	CABLE KIT 11: M12 D-Coded, 4-Pole 7/8", POS 3-2, SCM
Ethernet/IP	2300339A	CABLE KIT 12: M12 D-Coded, 5-Pole 7/8", POS 3-2, SCM
Profinet	2300340A	CABLE KIT 13: RJ45 Push/Pull, 5-Pole Push/Pull, POS 3-2, SCM
Profinet	2300341A	CABLE KIT 14: M12 D-Coded, M12 L-Coded, POS 3-2, SCM
Ethernet/IP	2300342A	CABLE KIT 15: M12 D-Coded, 4-Pole 7/8", POS 3-1, SCM

GUN STATUS TOOL CABLE KITS	
DRAWING NUMBER	DESCRIPTION
2300126A	CABLE KIT GUN STATUS PUSH/PULL 10-POLE
2300127A	CABLE KIT GUN STATUS M23 17-POLE
2300128A	CABLE KIT GUN STATUS M23 19-POLE
2300129A	CABLE KIT GUN STATUS MS

17 SPARE PARTS REPLACEMENT

The following procedures explain the correct method for removing and replacing the recommended spare parts listed in Section 16 of this manual.

17.1 PROBES

**DANGER**

**TURN OFF AND DISCONNECT ALL POWER
BEFORE REPLACING PROBES.**

1. Place the tip of a small screwdriver under the edge of the contact surface of the spring probe and apply a force to push the spring probe straight out of its receptacle.
2. Install the new spring probe by simply pushing it into the probe receptacle until it stops moving. The surface of the new spring probes contact surface should be even with the rest of the spring probes.

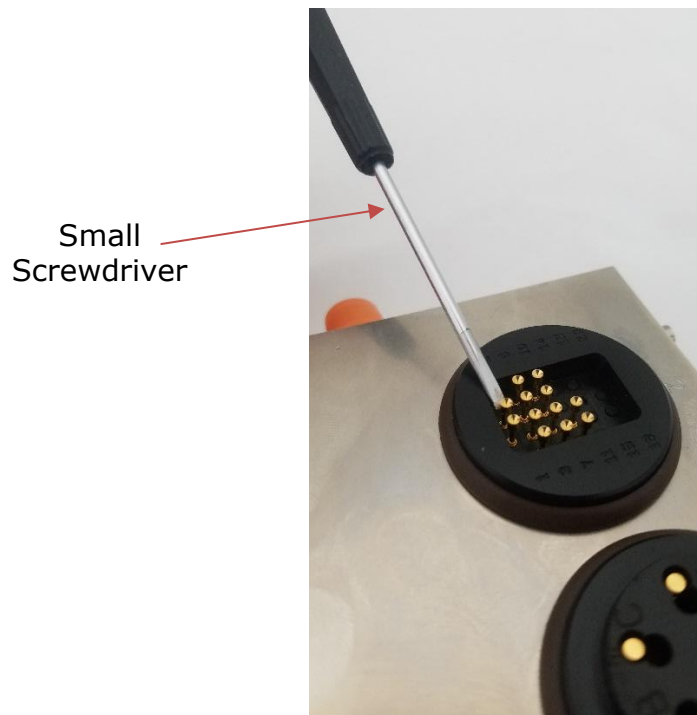


Figure 17.1-1. Probe Replacement

17.2 COUPLE/UNCOUPLE INTERFACE O-RING

1. Remove the M5 socket head cap screws holding the Communications I/O Module to the Robot Adaptor using a 4mm Allen wrench.
2. Remove the Communications I/O Module from the face of the Tool Changer and discard the O-ring.
3. Install replacement O-ring into the counterbored pockets on the Communications I/O Module.

4. Apply Loctite 242, or equivalent, to the threads of the socket head cap screws before installing.
5. Install the Communications I/O Module onto Position 3 of the Tool Changer using the M5 socket head cap screws.

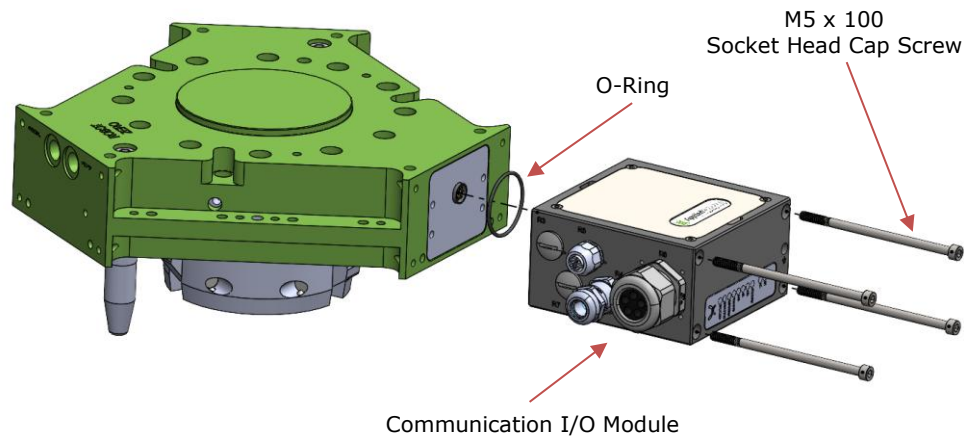


Figure 17.2-1. O-Ring Replacement

17.3 MATING INTERFACE SEALS

The interface seals can be removed while the Communications I/O Module is still on the Robot Adaptor.

1. Remove and discard the seal. A small screwdriver may be needed. Install replacement seal. Verify that the seal is flat against the Communications I/O Module and that it is pressed down into the groove.

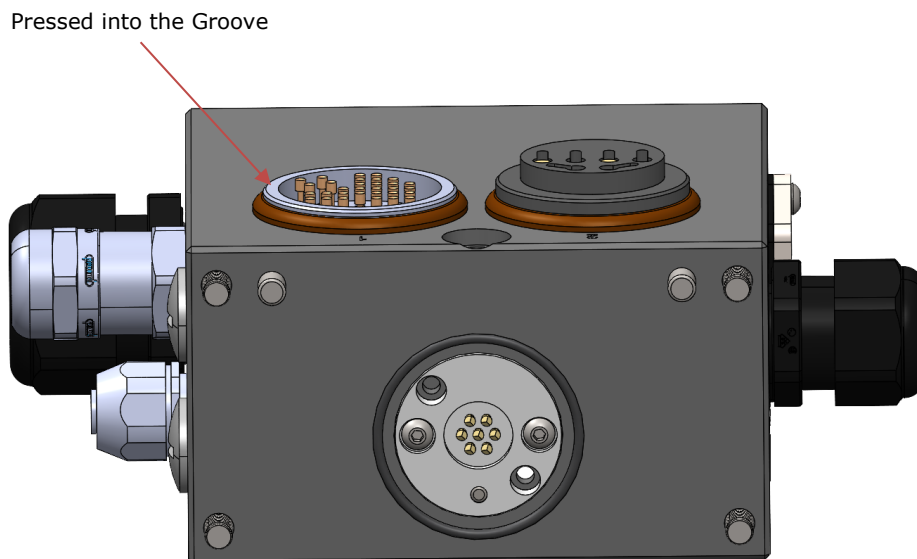
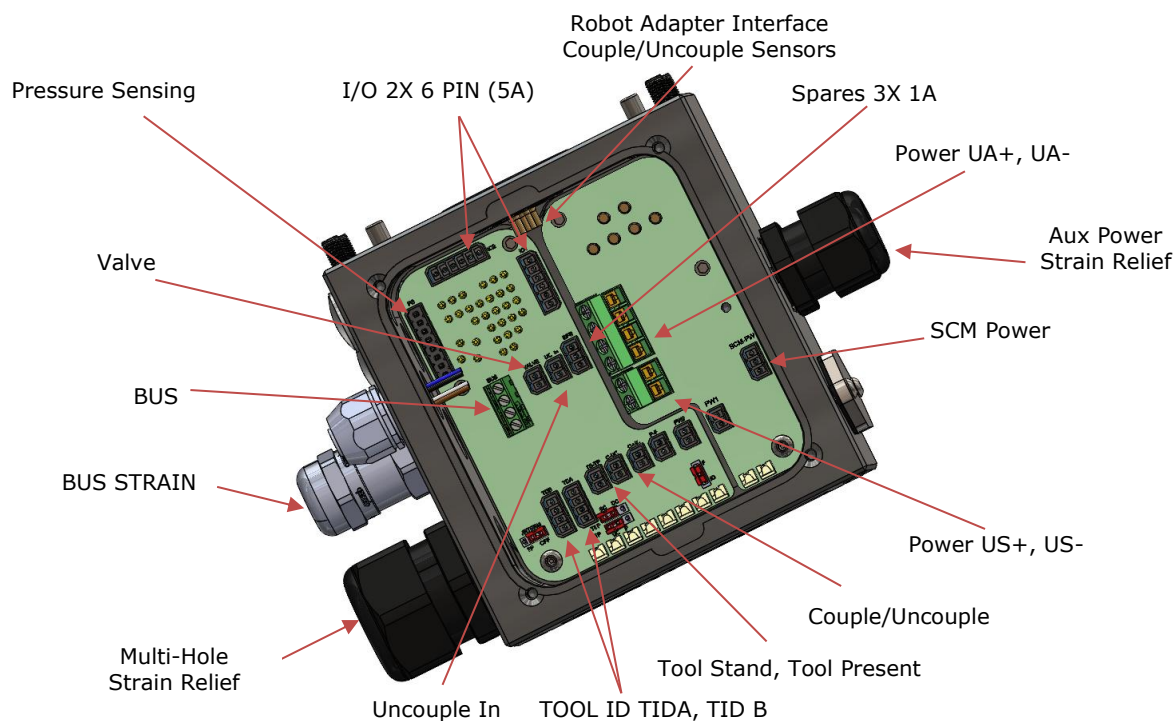


Figure 17.3-1. Seal Replacement**17.4 CABLE & CIRCUIT BOARD CONNECTOR REPLACEMENT**

1. Remove and discard the broken/damaged cable and circuit board connector.
2. Install replacement cable. Select the matching cable length from the Cable Kit. Refer to the Communications I/O Module assembly drawing for the proper Cable Kit part number.

**Figure 17.4-1. Cable Replacement Terminals (Robot Side)**

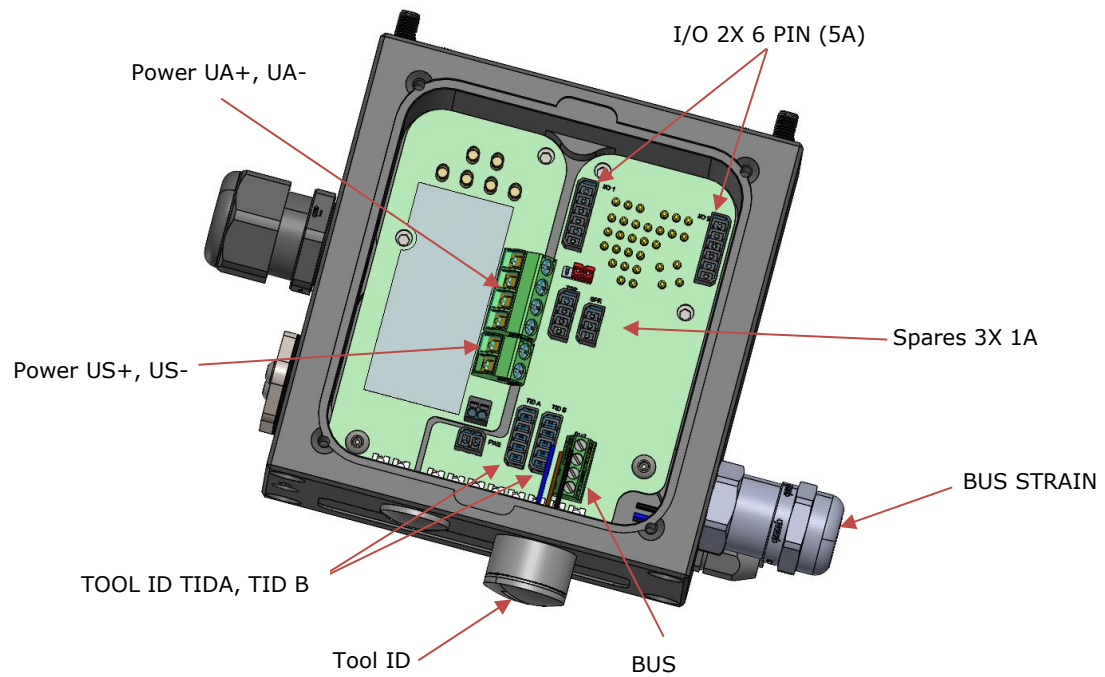


Figure 17.4-2. Cable Replacement Terminals (Tool Side)

SIGNAL WIRE FEMALE CONNECTORS (from 2 to 8 contacts)

Here below the specs of the conductors allowed by the female connectors or plugs:

Interlock

Locking type	Snap-in locking
Mounting flange	Self-locking flange

Conductor connection

Connection method	Push-in spring connection
Conductor/PCB connection direction	0 °
Conductor cross section rigid	0.14 mm ² ... 0.5 mm ²
Conductor cross section flexible	0.2 mm ² ... 0.5 mm ² (up to 0.75 mm ² supported, with a stripping length of 7.5 mm and a rated insulation voltage of 32 V at III/2)
Conductor cross section AWG	24 ... 20
Conductor cross section flexible, with ferrule without plastic	0.25 mm ² ... 0.5 mm ²

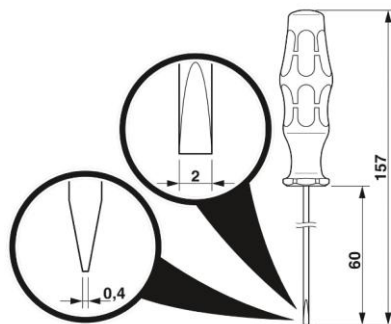
sleeve	
Conductor cross section, flexible, with ferrule, with plastic sleeve	0.25 mm ² ... 0.34 mm ²
Cylindrical gauge a x b / diameter	- / 1.2 mm
Stripping length	6 mm

Install the female (plug) connector on the cable wires.



- PUSH THE SCREWDRIVER IN TO THE RECTANGULAR SLOT
- INSTALL WIRE
- REMOVE SCREWDRIVER

For the female plugs (from 2 to 8 contacts), it is recommended to use a micro screwdriver, bladed, size: 0.4 x 2.0 x 60 mm (for instance Phoenix Contact SZS 0,4X2,0 1205202) to release the spring contact in the connector.



POWER WIRE TERMINALS

For the Power terminals, please follow the specifications of the table below



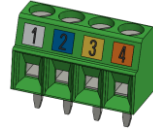
Conductor connection

Connection method	Screw connection with wire protector
Conductor cross section rigid	0.14 mm ² ... 2.5 mm ²
Conductor cross section flexible	0.14 mm ² ... 2.5 mm ²
Conductor cross section AWG	26 ... 14
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm ² ... 1.5 mm ²
Conductor cross section, flexible, with ferrule, with plastic sleeve	0.25 mm ² ... 1.5 mm ²
2 conductors with same cross section, solid	0.14 mm ² ... 1 mm ²
2 conductors with same cross section, flexible	0.14 mm ² ... 0.75 mm ²
2 conductors with same cross section, flexible, with ferrule without plastic sleeve	0.25 mm ² ... 0.34 mm ²
2 conductors with the same cross section, flexible, with TWIN	0.25 mm ² ... 0.75 mm ²
ferrule with plastic sleeve	
Stripping length	5 mm
Tightening torque	0.35 Nm ... 0.4 Nm

The suggested screwdriver for the power terminals is bladed, 0.6X3.5.

BUS WIRE TERMINAL

For the bus terminal, please follow the specifications in the table below

**Conductor connection**

Connection method	Screw connection with tension sleeve
Conductor cross section rigid	0.14 mm ² ... 1.5 mm ²
Conductor cross section flexible	0.14 mm ² ... 1.5 mm ²
Conductor cross section AWG	26 ... 16
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm ² ... 0.5 mm ²
Conductor cross section, flexible, with ferrule, with plastic sleeve	0.25 mm ² ... 0.5 mm ²
2 conductors with same cross section, solid	0.14 mm ² ... 0.5 mm ²
2 conductors with same cross section, flexible	0.14 mm ² ... 0.34 mm ²
Stripping length	5 mm
Tightening torque	0.22 Nm ... 0.25 Nm

The suggested screwdriver for the bus terminal is bladed, 0.4X2.5

STRAIN RELIEF INFORMATION

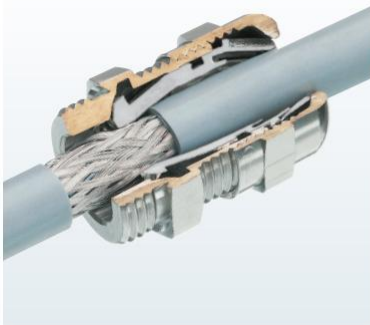
NOTICE

FOLLOW THE RECOMMENDED TORQUE SPECIFICATIONS IN THE TABLE BELOW

Strain Relief Torque Specifications

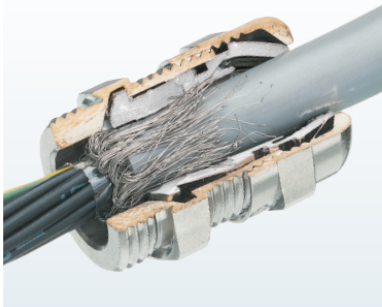
Function	ARI Part Number	Torque
Bus	2100527P	11 Nm (97 lb-in)
Aux	1900250P	4.5 Nm (40 lb-in)
Multi-Hole	2000857P	5 Nm (44 lb-in)

Bus strain relief 2100527P, cable diameter range 5 to 10 mm, below a picture that shows how to wire a bus cable into it.



Option 1 – Feed-through of cable and shield (braided or foil)

- // Expose shield approximately 7/16" (10 mm)
- // Insert cable into fitting until the shield reaches the contact position
- // Tighten dome nut



Option 3 – Termination of the braided shield in the fitting

- // Strip cable jacket and braided shield to different lengths
- // For small diameter cables fold the braided shield back over the cable jacket
- // Insert cable into fitting until the shield reaches the contact position
- // Tighten dome nut

Aux strain relief 1900250P, cable diameter range 6 to 12 mm.

Multi-Hole strain relief 2000857P, 5X Ø4mm holes.

18 INFORMATIONAL DOCUMENTS

The documents in this section can assist with installation, use, and identification of replacement parts for the Communications I/O Module. Please contact **APPLIED ROBOTICS Technical Support** at (518)-384-1000 or email us at techsupport@appliedrobotics.com if you have any questions.

DECLARATIONS
• Declaration of Incorporation for Partly Completed Machinery