

SAFETY CONTROL MODULE

95636, Rev 01

May 19, 2021

648 Saratoga Road
Glenville, NY 12302 USA
Phone: +1 518 384 1000
Fax: +1 518 384 1200
www.appliedrobotics.com

REVISION

Revision	Date	Author	Description
00	07/17/2018	DS	Initial Release
01	05/19/2021	SC	Updated Sequence of Operations

All rights reserved. Copyright © 1986—2021 Applied Robotics Inc.

The use of this document is reserved exclusively for the use of Applied Robotics Incorporated customers and personnel. The information and drawings contained herein are the sole property of Applied Robotics Incorporated and shall not be divulged to any third party without the prior written consent of Applied Robotics Inc. The information in this document is subject to change without notice. Applied Robotics makes no warranty of any kind with regard to this user's guide, including but not limited to, implied warranties or fitness for a particular purpose. Applied Robotics Inc. shall not be liable for any errors contained herein or for incidental or consequential damages in connection with the performance or use of this material.

CONTENTS

1	PRECAUTIONS	4
2	SYSTEM DESCRIPTION	5
2.1	DEFINITIONS	5
2.2	SAFETY FUNCTION	6
2.3	FUNCTIONAL DESCRIPTION	6
2.4	DIAGNOSTIC COVERAGE	8
2.5	SAFETY CONTROL MODULE	9
3	TECHNICAL SPECIFICATIONS	10
4	INSTALLATION	11
4.1	ROBOT SIDE MODULE	11
4.1.1	Mounting to Robot Adaptor	11
4.1.2	Robot Module Electrical Connections	11
4.1.3	Connecting the Robot Module Air Supply	12
4.2	TOOL SIDE MODULE	13
4.2.1	Mounting to Tool Adaptor	13
4.2.2	Tool Module Electrical Connections	13
5	GUIDE TO OPERATION	15
5.1	STATE DIAGRAM	18
5.2	MANUAL UNCOUPLE	19
5.3	LED STATUS INDICATORS	19
6	TROUBLESHOOTING	21
6.1	TROUBLESHOOTING GUIDE	21
6.2	TECHNICAL SUPPORT	22
7	MAINTENANCE	23
7.1	PREVENTIVE MAINTENANCE	23
8	SPARE PARTS	24
9	SPARE PARTS REPLACEMENT	25
9.1	PROBES	25
9.2	COUPLE/UNCOUPLE INTERFACE O-RINGS	25
9.3	INTERFACE O-RING	26
10	INFORMATIONAL DOCUMENTS	27

1 PRECAUTIONS



READ MANUAL

Do not start, operate or service machine until you read and understand 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 a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



Indicates a situation which, if not avoided, could result in equipment damage and voiding the manufacturer's equipment warranty.

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.

HEED ALL PRECAUTION NOTICES

2 SYSTEM DESCRIPTION

THE SCM IS A “CONTROL SYSTEM WITH SAFETY FUNCTIONS” ACCORDING TO UNI EN ISO 13849-1, AND MEETS ALL NECESSARY CONDITIONS FOR SAFE OPERATION IF INSTALLED ACCORDING TO MANUFACTURER’S INSTRUCTIONS. ACCESS OF THE MODULE FOR REPAIR OR MODIFICATION IS PROHIBITED, UNLESS BY A CERTIFIED APPLIED ROBOTICS REPRESENTATIVE.

NOTICE

ANY MODIFICATIONS OR REPAIRS MADE WITHOUT THE EXPRESS AUTHORIZATION OF APPLIED ROBOTICS CAN LEAD TO FATAL INJURIES TO PERSONNEL AND RELEASES APPLIED ROBOTICS OF ANY PRODUCT LIABILITY, AS WELL AS MAKING ANY PRODUCT WARRANTY VOID.

2.1 DEFINITIONS

SCM – Safety Control Module

Tool – A device that may be attached to a Tool Changer to perform a specific function.

Tool Changer – A device consisting of two adaptors, one attached to a robot and one attached to a tool, that mechanically Couples the robot to a tool. After the task is complete, the robot can return to the tool stand to Uncouple the tool from the robot. As a result, a single robot can perform multiple functions.

Tool Stand – A device that holds a tool mounted to a Tool Adaptor for later use as the robot performs other tasks. A Tool Stand is a safe area for the Tool Changer to Couple and Uncouple tools.

Couple – The action of moving the cams outward on the Tool Changer so a tool will become connected. See Figure 2.1-1.

Uncouple – The action of moving the cams inward on the Tool Changer so a tool will become disconnected. See Figure 2.1-2.

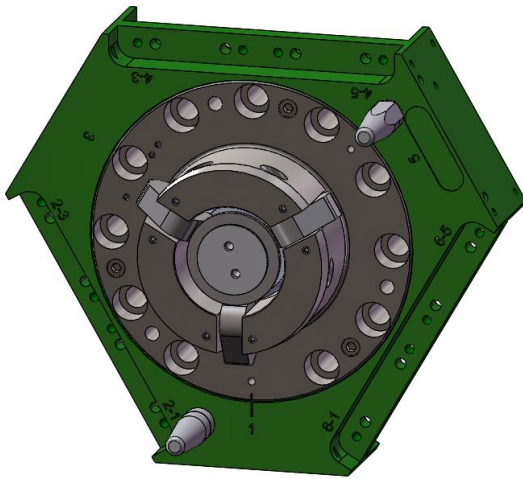


Figure 2.1-1. Robot Adaptor Coupled (Cams Extended)

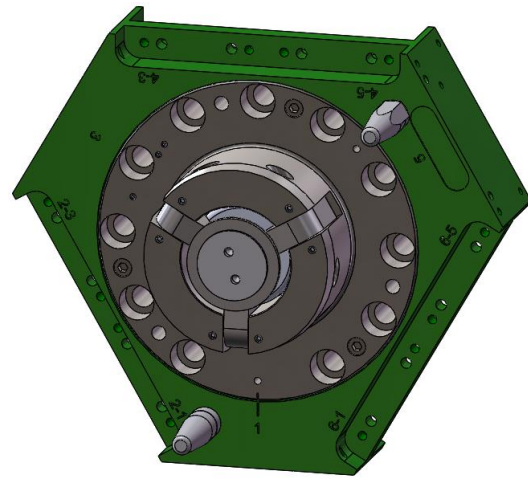


Figure 2.1-2. Robot Adaptor Uncoupled (Cams Retracted)

Docked – The state of which a Robot Adaptor is in position to Couple with a Tool Adaptor. This does not require the Tool Changer to be Coupled though.

Undocked – The state of which a Robot Adaptor is not in position to Couple with a Tool Adaptor.



Figure 2.1-3. Tool Changer Docked

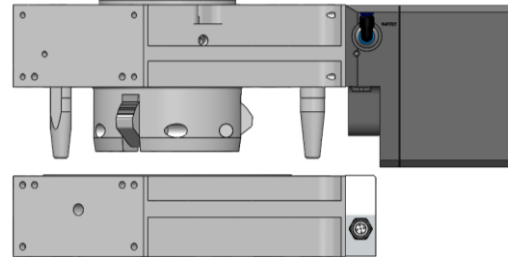


Figure 2.1-4. Tool Changer Undocked

2.2 SAFETY FUNCTION

The reason for a SCM is to prevent a Tool Changer from Uncoupling while it is not in a safe condition. A safe condition is defined as a Tool Changer engaged in a tool stand or in movement without a tool (Tool Adaptor) attached to the Robot Adaptor. To Uncouple, a pneumatic piston drives cams in the Robot Adaptor. If not performed under safe conditions, it's this action that can cause injuries.

2.3 FUNCTIONAL DESCRIPTION

With air on and the Tool Changer not in a tool stand while a tool is present (or a tool is not absent), the robot may be moved around to perform tasks. If air is lost to the valves, the Tool Adaptor will remain Coupled to the Robot Adaptor, as mechanical safety mechanisms in the Robot Adaptor prevent uncoupling. The Tool Changer should never be operated without air supplied.

When the Tool Changer needs to be Uncoupled, a double Uncouple command must be sent to two valves, and both valves must actuate in order to complete the Uncouple process. Both Uncouple commands must pass through a set of contacts: tool stand present and tool absent. Tool stand present is connected to a safety interlock switch, which is a safety rated switch, with a set of normally open contacts feeding two forcibly guided relays. When the tool stand present switch is actuated, it is safe to Couple and Uncouple, because this indicates that the tool has been docked in the tool stand. Different safety switches for tool stand presence can be adapted, from mechanical keyed switches to non-contact switches, provided that any adopted switch is rated Category-3 and have a consistent MTTFd. In case of mechanical keyed switch, a guidance system for tool Coupling and mechanical sensor's actuator insertion shall be provided in order to exclude the fault due to a fracture of the actuator.

Tool absent is to show if a tool is not in proximity to the Robot Adaptor through the use of a dual output safety proximity switch. A Tool Changer is free to Couple and Uncouple at any point if a tool is absent. A dual channel safety rated proximity device on the robot side, with two outputs each, connects to a relay coil indicating a tool is present (or absent) by coming within the correct distance of the Tool Adaptor when the robot and Tool Adaptors come together.

The double Uncouple command is fed through two channels. One channel will have a set of tool stand present contacts, one normally closed and one normally open running in parallel. A set of tool absent contacts, one normally closed and one normally open, will be run in series to the tool stand present contacts. The second channel will have the same logic as the first channel.

Both valves driving the cylinder are piloted and spring return. When a command is not being provided to the valve, they are both in a state that will allow one side of the cylinder to vent, while applying pressure to the other side forcing the Tool Changer to Couple. The valves are interlocked, forcing the cylinder to pressurize and vent through both valves to achieve an Uncoupled state. This way a command has to be applied to both valves and no combination of one valve being off and the other on will cause an uncoupling to take place.

As the tool stand present and tool absent sensors may not actuate at exactly the same time when the two halves (adaptors) separate, it is necessary that in this step, the Tool Changer doesn't Couple again due to a relay synchronization issue. Therefore, another relay with a normally open contact is installed in parallel with the tool absent and tool stand present relay contacts. The coil of this relay is energized by an Uncouple command being applied in a safe state. After the coil is energized, the Uncouple command is latched, and will remain this way regardless of the tool absent and tool stand present relay states. That is until an Uncouple command is no longer applied, at this point the Tool Changer will Couple, and a safe state needs to be achieved again in order to obtain uncoupling. This allows the Tool Changer not to Couple as the two halves (adaptors) separate.

2.4 DIAGNOSTIC COVERAGE

The diagnostic coverage monitors the status of the tool stand present, tool absent, latching relays, and the piston position through a set of normally open and normally closed contacts. In order for proper operation of the system, all dual channel devices need to operate simultaneously. A resistor/capacitor combination is such that the **enable signal shall remain present approximately 1 second after initial loss of signal**. This is to ensure there are no nuisance trips while the switches, relays, and piston change state.

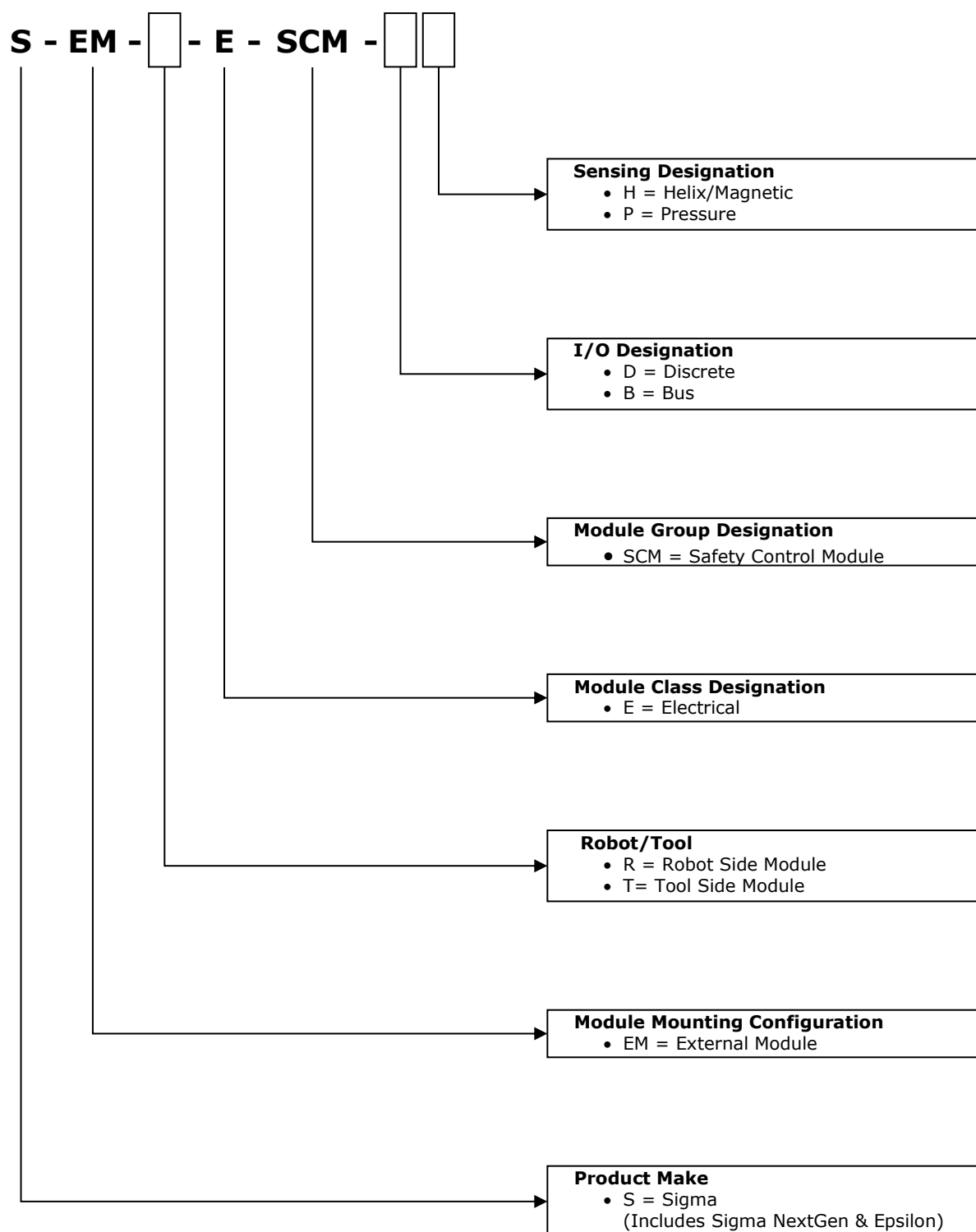
This resistor/capacitor combination is used to power a relay coil (relay X1). If any single channel fails to operate within about 1 second of its complimentary channel, a loss of monitoring signal occurs. Two normally open contacts from this relay are in series with both Uncouple commands and are before any Uncouple ability logic stated above. This allows that, when a loss of any channel in the diagnostic coverage occurs, the Tool Changer safety module becomes locked out and no Uncouple commands may be applied to the valves.

Another normally closed contact from this relay (X1) is placed in series with another relay (XR), that is used to reset the diagnostic coverage, and before the resistor/capacitor combination. In order to reset this locking relay XR, the customer is required to remove both Uncouple commands so that XR coil drops out and the normally close contact of XR can power the X1 relay coil again. In the case that all faults have been cleared, X1 stays on and so the Uncouple commands have the possibility to operate the valves.

The sensing of the piston position (Couple/Uncouple) is provided via a pressure sensor circuit on Side 3 of the Robot Adaptor and indicates if the Tool Changer is in a Coupled or Uncoupled state, thus if both valves have completed actuation. The Uncouple signal is inverted and when both channels are HIGH ("1"), indicating "Coupled Air", the Tool Changer is in the Coupled position. When both channels are LOW ("0"), indicating no "Coupled Air", the Tool Changer is in the Uncoupled position. The 1 second delay on the monitor signal ("Monitor Point"/"SCM OK") prevents nuisance trips while the Tool Changer is changing states.

The customer is given two redundant output signals to monitor ("Monitor Point"/"SCM OK") that all safety conditions are met. The customer also has the option to supply a monitoring signal to power the diagnostic coverage instead of using the internal power of the control module.

2.5 SAFETY CONTROL MODULE



Custom/Special: S-EM--E-SCM--S####

3 TECHNICAL SPECIFICATIONS

Table 3-1. Safety Control Module Technical Specifications

Specification		Metric	English
Mass / Weight *	Robot	1.75 kg	3.86 lb
	Tool	0.16 kg	0.35 lb
Operating Temperature		5 °C to 60 °C	41 °F to 140 °F
Transportation & Storage Temperature		-25 °C to +55 °C	-13 °F to 131 °F
Transportation & Storage Humidity		Up to 50%, Maximum Temperature 40 °C (104 °F)	
Max Supply Pressure		7 bar	101 psig
Max Current Rating		0.4 Amps	
Max Voltage Rating		30 VDC	
Enclosure Rating		IP 65 (When Coupled)	
Noise Emission		<= 70 dB(A) in any direction	
Probability of Dangerous Failures per Hour (PFHd)		8.46E-8	
Minimum Safety Classification **		Category 3, Performance Level – e According to UNI EN ISO 13849-1	
Chemical Resistance		Contact APPLIED ROBOTICS Technical Support	

* Module weight may vary depending on specific configuration.

** Performance Level calculated based on an operating life of 24 hours/day, 281 days/year, for 8 years and a tool change every 30 seconds (6,474,240 cycles).

4 INSTALLATION

4.1 ROBOT SIDE MODULE

4.1.1 Mounting to Robot Adaptor

The robot side SCM is designed to be directly mounted to Side 1 of the Robot Adaptor. To mount the module to the Robot Adaptor, locate the module on Side 1 via two (2) M5 dowels and secure with four (4) M5 socket head cap screws.

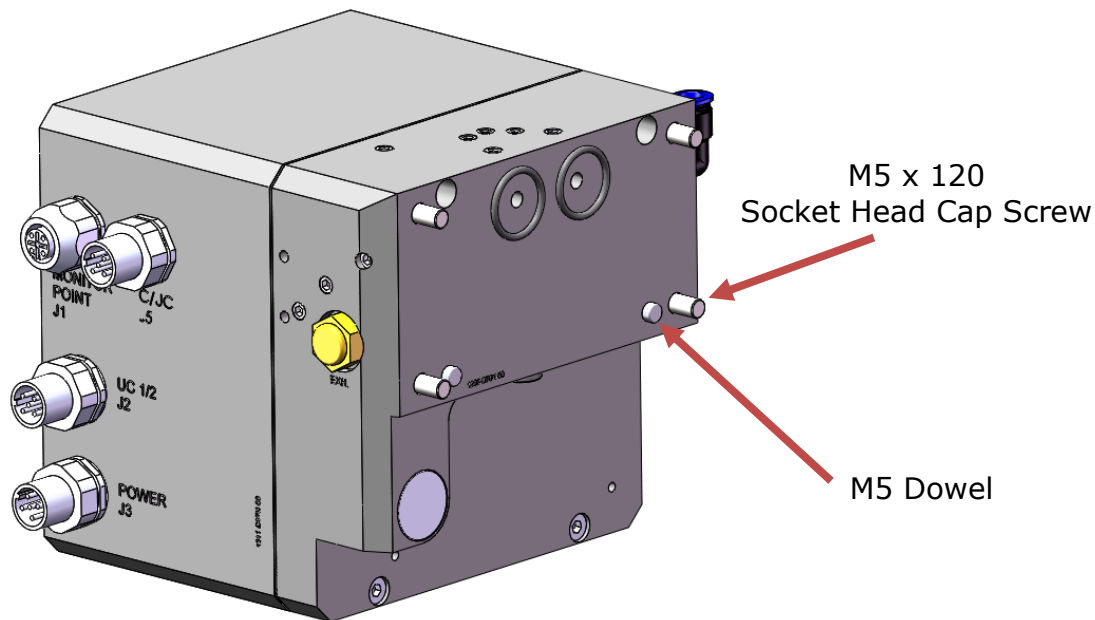


Figure 4.1-1. Mounting Information for Robot Side SCM

4.1.2 Robot Module Electrical Connections

The robot side SCM contains four (4) electrical connections.

NOTICE

MAKING CONNECTIONS WHILE UNDER POWER COULD RESULT IN DAMAGE TO THE EQUIPMENT. TO AVOID DAMAGING EQUIPMENT, CONNECT CABLES IN THE ORDER LISTED BELOW. DISCONNECT IN REVERSE ORDER.

1. **"Monitor Point" (J1)** – A dual channel output of opposing pairs (two channels of opposite polarity) indicating that all safety conditions are met. Power for the Monitor Point (diagnostic coverage) can be supplied by either the SCM internal power or separately by the customer.
2. **"C/UC" (J5)** – Piston position (Couple/Uncouple) signals from sensors located on side 3 of the Robot Adaptor.
3. **"Power" (J3)** – SCM power supply (See Table 3-1 for power requirements).

4. **"UC 1/2" (J2)** – Two (2) Uncouple commands are required to properly operate the SCM.



ENSURE THAT AN UNCOUPLE COMMAND IS NOT BEING SUPPLIED ON THE CABLE BEING CONNECTED TO J2. THIS COULD CAUSE THE ROBOT ADAPTOR TO UNCOUPLE INADVERTENTLY. MAKE SURE ALL OBJECTS AND FINGERS ARE CLEAR OF THE CAMS WHEN CONNECTING J2.

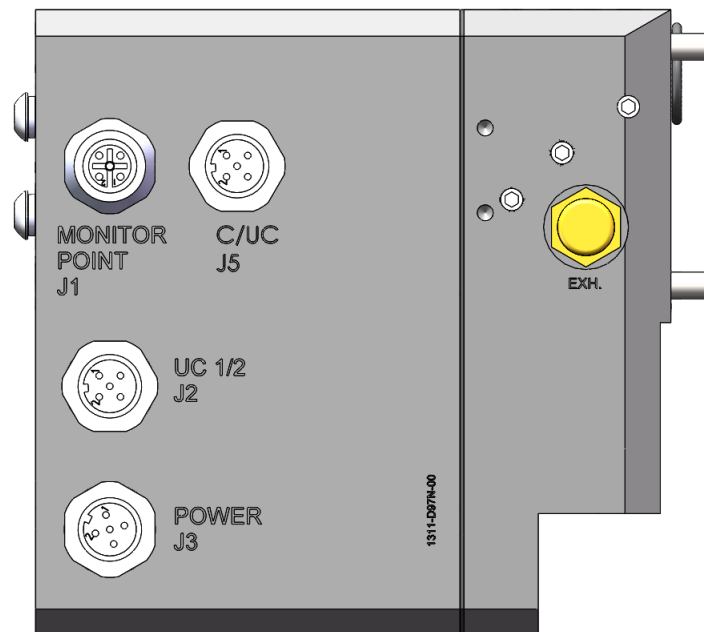


Figure 4.1-2. Electrical Connections for Robot Side SCM

4.1.3 Connecting the Robot Module Air Supply

The pneumatic supply for the SCM can be supplied via the appropriate universal module or through a separate supply line coming down the robot arm.



UPON SUPPLYING AIR TO THE SCM, THE ROBOT ADAPTOR WILL BE FORCED COUPLED. MAKE SURE THE TOOL ADAPTOR IS NOT WITHIN RANGE OF THE ROBOT SIDE CAMS TO CAUSE AN UNDESIRED COUPLE. MAKE SURE ALL OBJECTS AND FINGERS ARE CLEAR OF THE CAMS AND MATING SURFACES WHEN AIR IS SUPPLIED.

NOTICE

THE SCM IS SUPPLIED WITH BUILT-IN PRESSURE REGULATION THAT LIMITS THE PRESSURE TO THE VALVES TO 6 BAR (87 PSIG). MAXIMUM INLET PRESSURE SHOULD NOT EXCEED 7 BAR (101 PSIG).

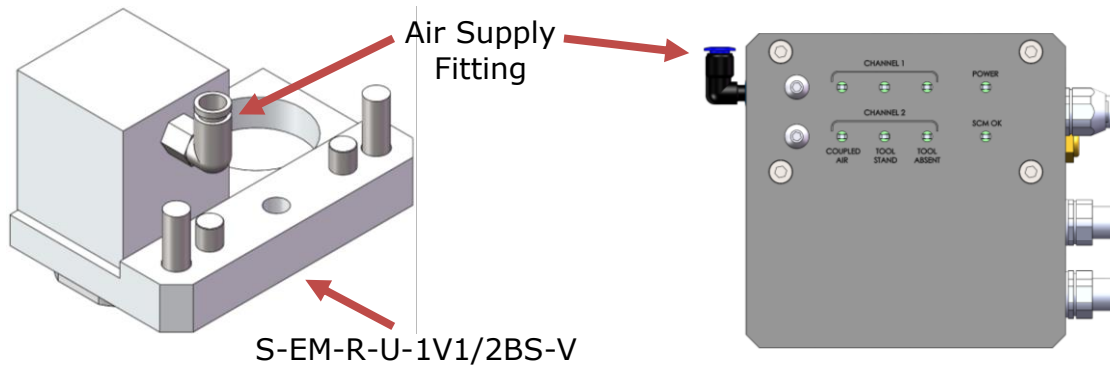


Figure 4.1-3. Air Supply Fittings

4.2 TOOL SIDE MODULE

4.2.1 Mounting to Tool Adaptor

The tool side SCM is designed to be directly mounted to Side 1 of the Tool Adaptor. To mount the module to the Tool Adaptor, locate the module on Side 1 via two (2) M10 dowels and secure with one (1) M10 flat head socket cap screw.

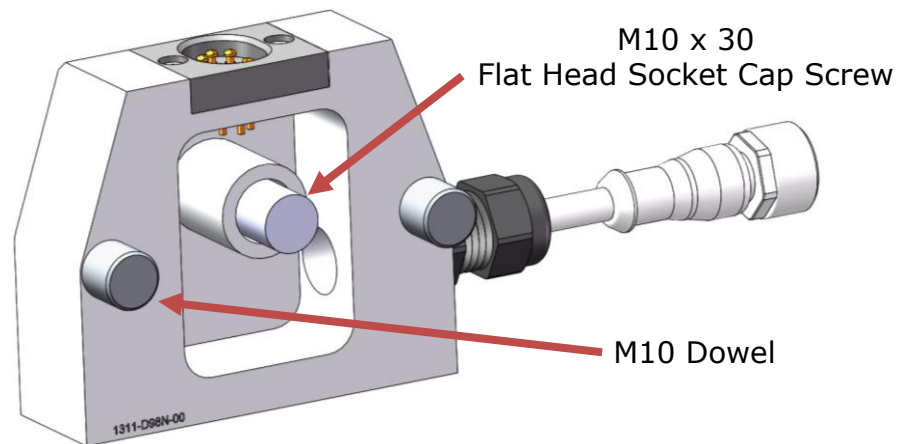


Figure 4.2-1. Mounting Information for Tool Side SCM

4.2.2 Tool Module Electrical Connections

The tool side SCM contains one (1) electrical connection wired for tool stand safety switch:

- **"Tool Stand Safety Switch" (T1)** – Connection for an approved tool stand present safety switch (See Section 10).

NOTICE

REFER TO MANUFACTURER'S TOOL STAND CONNECTION MANUAL FOR INSTRUCTIONS ON HOW TO INSTALL THE TOOL STAND PRESENT SWITCH.

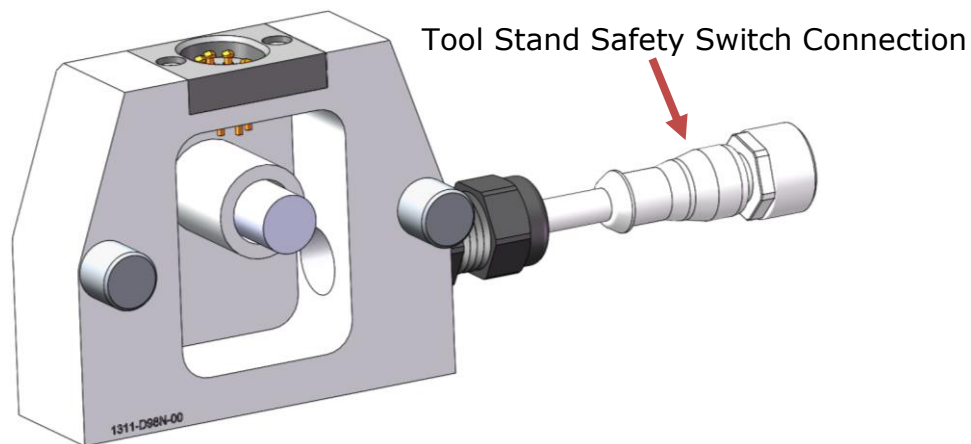


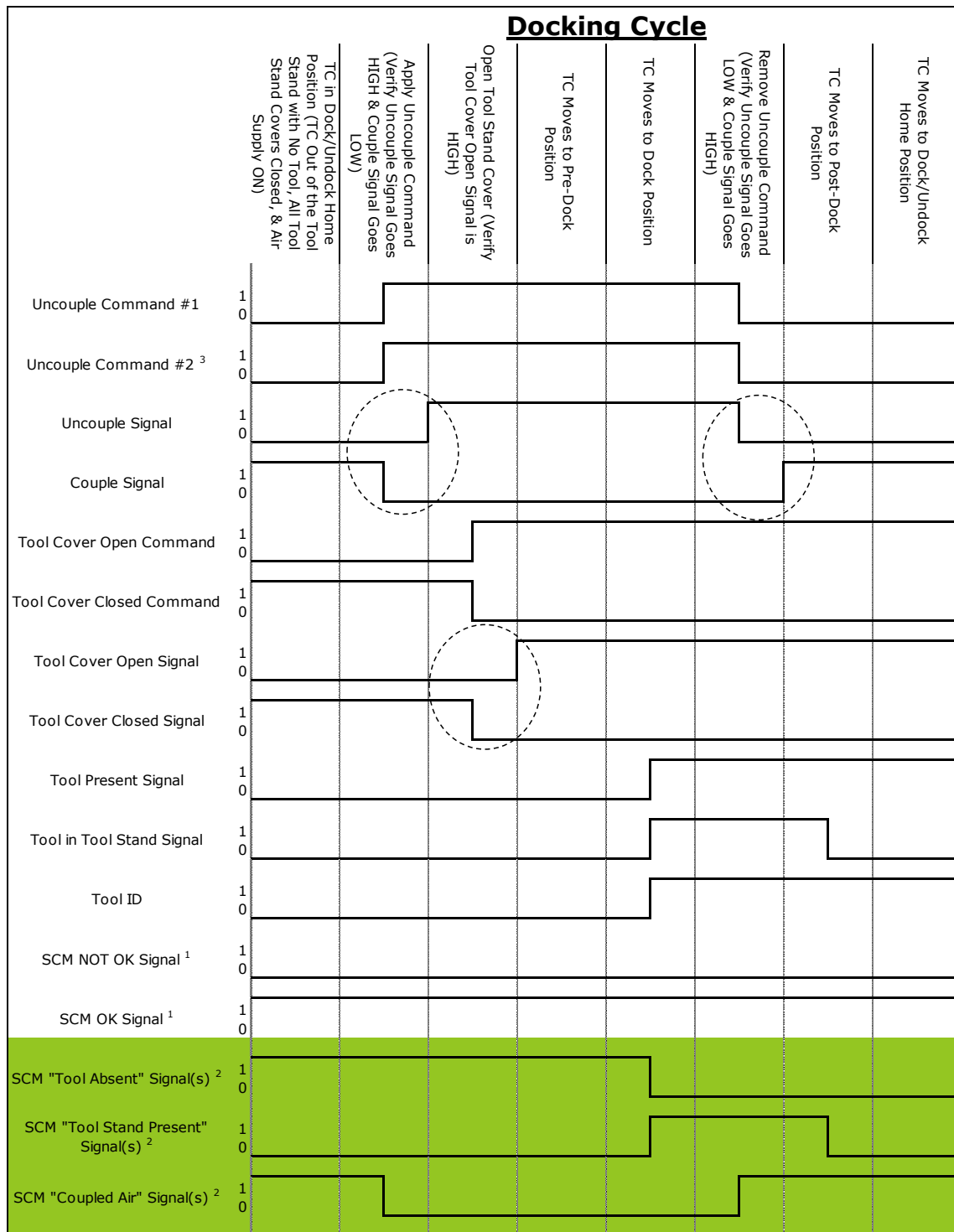
Figure 4.2-2. Tool Stand Safety Switch Connection

5 GUIDE TO OPERATION

The two halves of the SCM mate when the Robot Side of the Tool Changer goes to dock a tool. The two halves communicate via spring pins when mated, providing Tool Stand Present. When the robot goes to undock a tool, a Tool Stand 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. Tool Changer locating pins provide alignment and guidance for contact interface of two halves of SCM during docking.



**TURN OFF ALL DOWNSTREAM OUTPUTS
DURING CONNECT/DISCONNECT TO
AVOID ARCING AND SHORTS.**



¹ Customer is required to continuously monitor the SCM Status Signal throughout the entire operation. The SCM Status Signal is dual channels of opposing input pairs (two channels of opposite polarity) eliminating the need for pulse testing.

² Signals (dual channel) are only available via LED's on ARI's Safety Control Module (SCM). Not available for monitoring by the robot controller.

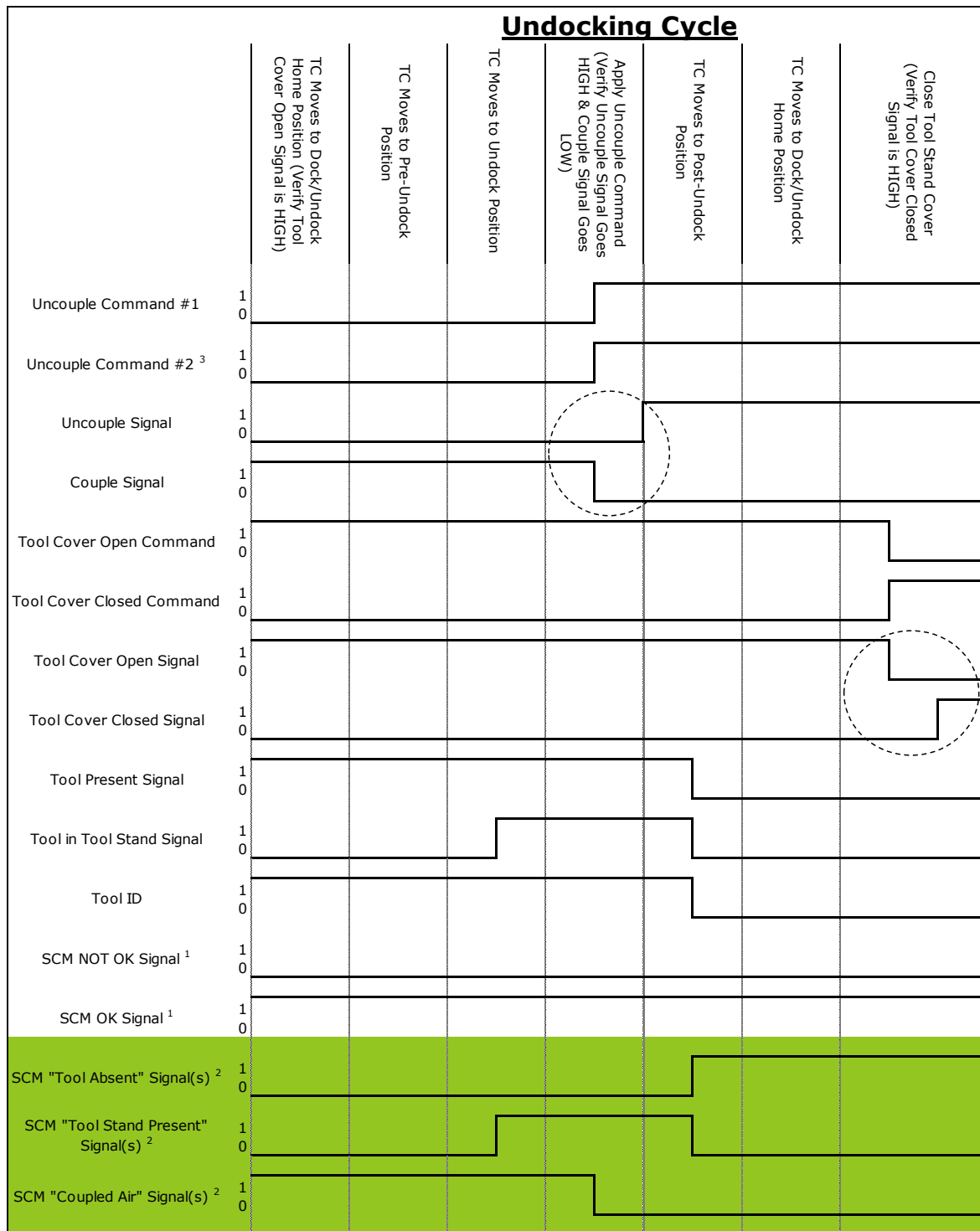
³ Second Uncouple Command is required when using ARI's Safety Control Module (SCM) and should be applied simultaneously with the first Uncouple Command.

- Verify the status of all signals before proceeding to the next step.

- Input/Output HIGH = 1, LOW = 0

- Dotted circles indicate a intermediate state of an actuating cylinder when neither "Open" or "Close" signal is present.

Figure 4.2-1. Sequence of Operations Diagram – Docking Cycle



¹ Customer is required to continuously monitor the SCM Status Signal throughout the entire operation. The SCM Status Signal is dual channels of opposing input pairs (two channels of opposite polarity) eliminating the need for pulse testing.

² Signals (dual channel) are only available via LED's on ARI's Safety Control Module (SCM). Not available for monitoring by the robot controller.

³ Second Uncouple Command is required when using ARI's Safety Control Module (SCM) and should be applied simultaneously with the first Uncouple Command.

- Verify the status of all signals before proceeding to the next step.

- Input/Output HIGH = 1, LOW = 0

- Dotted circles indicate a intermediate state of an actuating cylinder when neither "Open" or "Close" signal is present.

Figure 4.2-2. Sequence of Operations Diagram – Undocking Cycle

5.1 STATE DIAGRAM

The State Diagram below shows the status of each individual sensor/switch that makes up the Safety Function and Diagnostic Coverage. The Tool Absent Status Switch is normally closed and will show a "1" when no tool is present. The Tool Stand Present Status Switch is normally open and will show a "1" when there is the tool stand is present. The Coupled Air Status monitors the Couple/Uncouple position and air supply. It shows a "1" when the Tool Changer is in the Coupled position and air is supplied. The LEDs shown in Figure 5.3-1 will correspond to this diagram by being ON when the listed condition shows a "1". All status signals represented in the diagram below indicate BOTH channels at a given state. If either channel is non-coincident with the other, then the "SCM OK" (Monitor Point) signal will turn LOW, preventing the ability to Uncouple due to the X1 relay, and all operations should stop immediately.

Condition of Tool Changer	Tool Absent Status	Tool Stand Status	Coupled Air Status	Uncouple Ability	Operation Condition, Safety Action
Tool Changer Coupled No Tool Stand Tool Absent	1	0	1	Yes	Normal Operation Uncouple Allowed
Tool Changer Coupled No Tool Stand No Tool Absent (Tool Present)	0	0	1	No	Normal Operation Forced Couple
Tool Changer Coupled In Tool Stand Tool Absent	1	1	1	No	Abnormal Operation* Forced Couple
Tool Changer Coupled In Tool Stand No Tool Absent (Tool Present)	0	1	1	Yes	Normal Operation Uncouple Allowed
Tool Changer Uncoupled No Tool Stand Tool Absent	1	0	0	Yes	Normal Operation Uncouple Allowed
Tool Changer Uncoupled No Tool Stand No Tool Absent (Tool Present)	0	0	0	No	Abnormal Operation* Forced Couple
Tool Changer Uncoupled In Tool Stand Tool Absent	1	1	0	No	Abnormal Operation* Forced Couple
Tool Changer Uncoupled In Tool Stand No Tool Absent (Tool Present)	0	1	0	Yes	Normal Operation Uncouple Allowed

* Abnormal Operation describes a condition not expected during Normal Operation. The result is always a safe condition being met.

5.2 MANUAL UNCOUPLE

During initial programming or if an undesired or abnormal state is achieved, the two (2) M5 screws may be removed from the face of the cover to manually actuate the valves to Uncouple. To manually Uncouple, air will need to be supplied to the module and both valves will need to be actuated with a small flat head screwdriver (approx. 3.5mm). This is done by inserting the flat head screw driver into the slot and turning it 90 degrees clockwise, locking it in position.

**DANGER**

NEVER PERFORM THIS OPERATION WHILE A TOOL IS PRESENT AND NOT FULLY SUPPORTED (I.E., OUT OF A TOOL STAND/STORAGE). OPERATING THE MANUAL UNCOUPLE WITH A TOOL PRESENT AND NOT SUPPORTED MAY RESULT IN SERIOUS INJURY OR DEATH.

**DANGER**

ONLY USE MANUAL UNCOUPLE WITH AIR BEING SUPPLIED TO THE TOOL CHANGER.

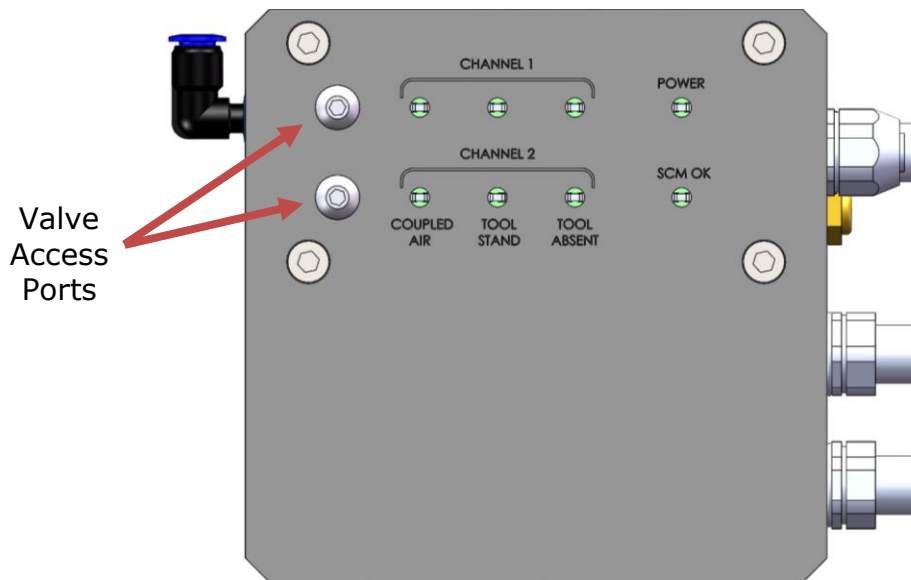


Figure 5.2-1. Manual Uncouple Valve Access Ports

5.3 LED STATUS INDICATORS

Eight (8) LEDs on the robot side SCM provide the status of each diagnostic channel along with indications for Power and SCM OK ("Monitor Point").

- **"COUPLED AIR"** – The "Coupled Air" LEDs provide indication of the piston position of the Robot Adaptor. When both channels are ON, the Robot Adaptor is in the Coupled position. When both channels are OFF, the Robot Adaptor is in the Uncoupled position.

- **"TOOL STAND"** – The "Tool Stand" LEDs provide feedback from the Tool Stand Present Safety Switch. When both channels are ON, the Robot Adaptor is receiving a signal that the Tool Adaptor/Tool is in the tool stand. When both channels are OFF, the Robot Adaptor is not receiving a signal, indicating that the Tool Adaptor/Tool is not in the tool stand.
- **"TOOL ABSENT"** – The "Tool Absent" LEDs provide feedback from the Tool Absent Switch. When both channels are ON, the Robot Adaptor is in proximity of the Tool Adaptor. When both channels are OFF, the Robot Adaptor is not in proximity of the Tool Adaptor.
- **"POWER"** – The "Power" LED indicates that the SCM has power. When the Power LED is ON, the module has power. When the Power LED is OFF, the module does not have power.
- **"SCM OK"** – The "SCM OK" LED provides the single point monitoring of the status of the SCM indicating that all safety conditions are met. When the SCM OK LED is ON, all diagnostic channels are in-sync and operational. When the SCM OK LED is OFF, a single channel is out of sync or non-operational. **Potential causes for the SCM OK LED to go OFF include loss of air, single channel fault in one of the switches, the diagnostic coverage has not been reset after a fault (removing both Uncouple Commands).**

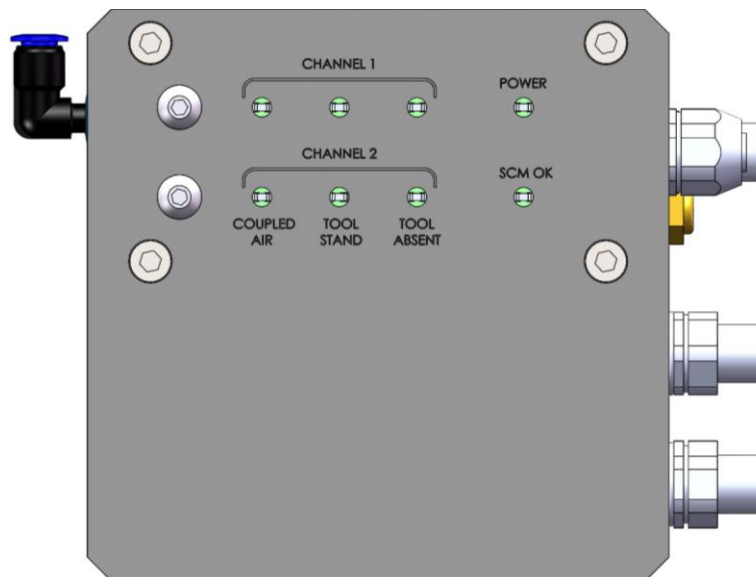
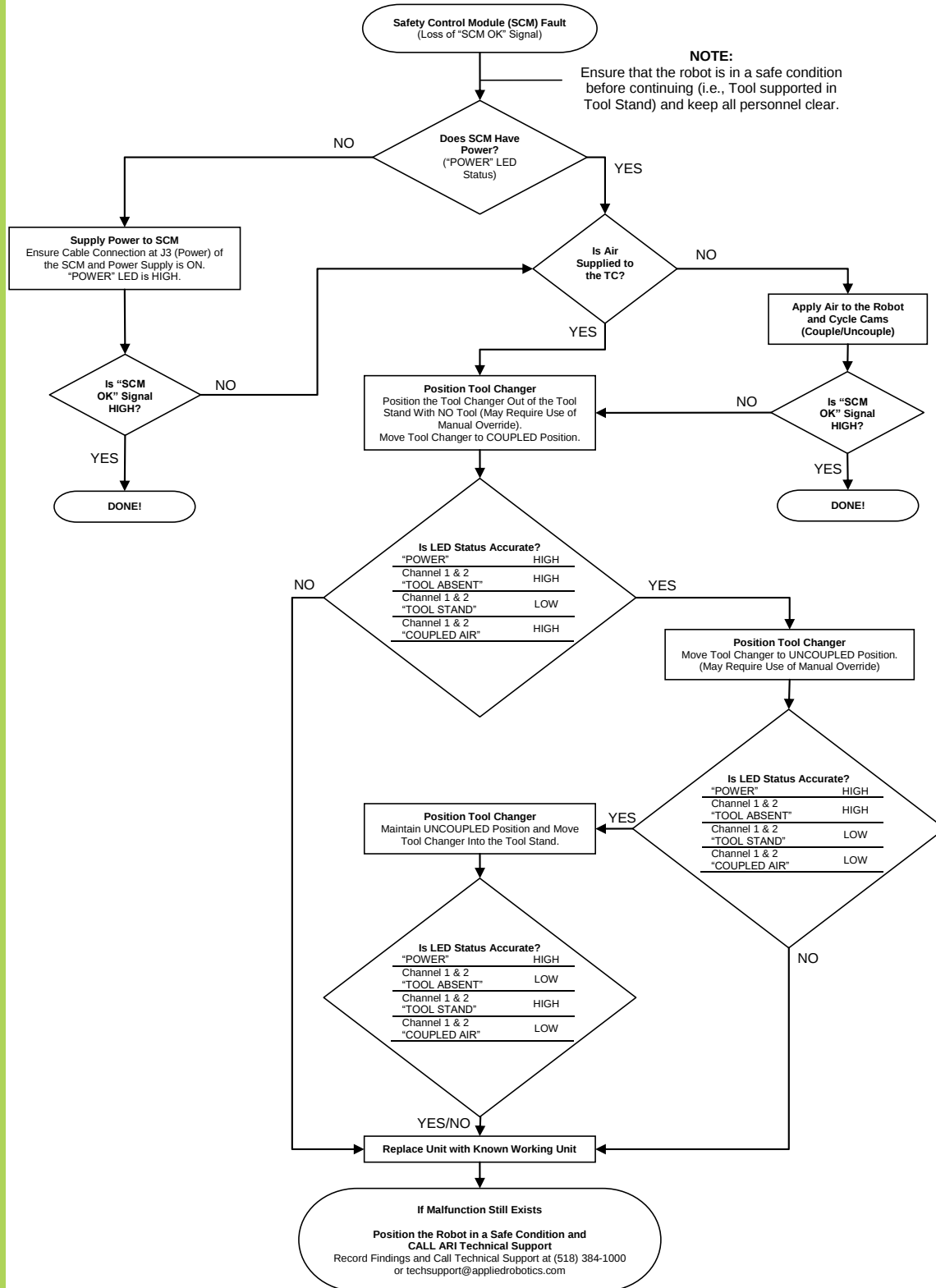


Figure 5.3-1. LED Status Indicators

6 TROUBLESHOOTING

6.1 TROUBLESHOOTING GUIDE

The fault tree below provides guidance for troubleshooting the SCM.



6.2 TECHNICAL SUPPORT

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

Phone: +1 518 384 1000

E-mail: techsupport@appliedrobotics.com

7 MAINTENANCE

NOTICE

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

SCM is a low maintenance component. (See Table 7-1.)

Table 7-1. Safety Control Module Maintenance Schedule

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

7.1 PREVENTIVE MAINTENANCE

1. Inspect the cables for any cuts or abrasions and connectors for tightness.
2. Inspect spring probes for excessive dirt, pitting, bending, or burning. If bending, burning or excessive pitting is observed, replace the probe (See Figure 7.1-1).
3. Ensure spring probes are free to move inside their receptacle. If spring probes do not move freely, replace them (See Section 9.1).



Figure 7.1-1. Normal and Burnt Probes

¹ Continue Visual Checks and inspecting for wear/damaged parts every 250,000 Cycles.

8 SPARE PARTS

The spare parts listed below are recommended to be maintained in stock for the life of the SCM. 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.

Safety Control Module – ROBOT SIDE (PER MODULE)		
Description	Part Number	Quantity
PROBE, SPRING LOADED CUP POINT	95505-P1087	6
O-RING, .426 ID X .07 75 VITON (P)	97508-P1039	1
O-RING, .614 ID X .07 70 BUNA (P)	89501-P1064	2

Safety Control Module – TOOL SIDE (PER MODULE)		
Description	Part Number	Quantity
PROBE, SPRING PIN QA TECH.	96504-P1023	6

9 SPARE PARTS REPLACEMENT

The following procedures explain the correct method for removing and replacing the recommended spare parts listed in Section 8 of this manual.

9.1 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.



Small
Screwdriver

Figure 9.1-1. Probe Replacement

9.2 COUPLE/UNCUPLE INTERFACE O-RINGS

1. Remove the M5 socket head cap screws holding the SCM to the Robot Adaptor using a 4mm Allen wrench.
2. Remove SCM from the face of the Robot Adaptor and discard the O-rings.
3. Install replacement O-rings into the counterbored pockets on the Robot Adaptor.
4. Apply Loctite 242, or equivalent, to the threads of the socket head cap screws before installing.
5. Install the SCM onto Position 1 of the Robot Adaptor using the M5 socket head cap screws.

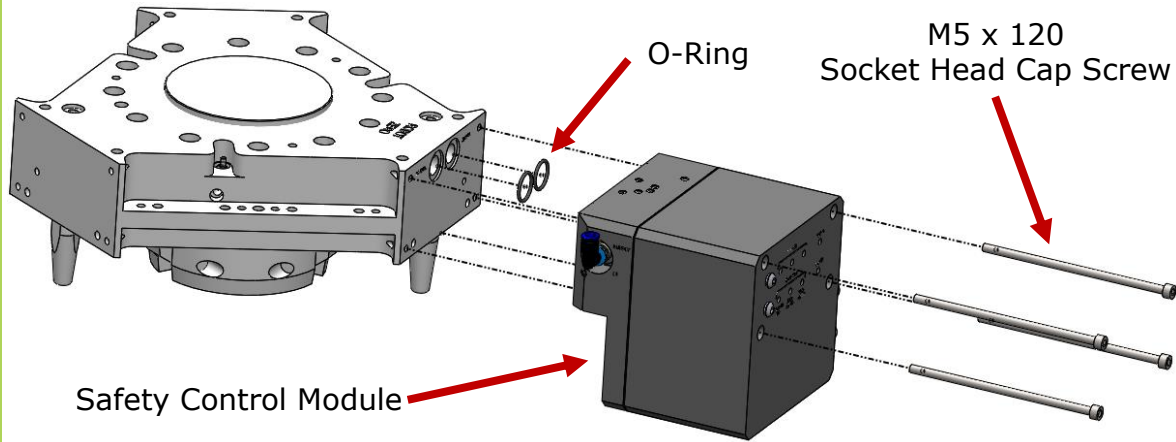


Figure 9.2-1. O-Ring Replacement

9.3 INTERFACE O-RING

The interface O-ring can be removed while the SCM is still on the Robot Adaptor.

1. Remove and discard the O-ring. A small screwdriver may be needed.
2. Install replacement O-ring. Verify that the O-ring is flat against the SCM.



Figure 9.3-1. O-Ring Replacement

10 INFORMATIONAL DOCUMENTS

The documents in this section can assist with installation, use, and identification of replacement parts for the SCM. Please contact **APPLIED ROBOTICS Technical Support** if you have any questions.

DECLARATIONS	
Declaration of Incorporation for Partly Completed Machinery	

DRAWINGS	
DRAWING NUMBER	DESCRIPTION
1700466A	S-EM-R-E-SCM-BP SAFETY CONTROL MODULE
1504-D51A	S-EM-T-E-SCM-DH
1800096S	SCHEM, ELECT S-EM-R-E-SCM-BP

Declaration of Incorporation of Partly Completed Machinery (Annex II 1 B of EC Machinery Directive 2006/42/EC)

Description and identification of the partly completed machinery:

XChange – EPSILON Series Tool Changers & Utility Modules

Fulfills the following function:

Allows industrial robots (and other automated equipment) to automatically change their end of arm tooling under programmed control without the need of human intervention. These products are intended to be incorporated into machinery supplied by others.

The following essential requirements of EC Machinery Directive 2006/42/EC (Annex I) have been applied and fulfilled:

Section 1.1.2.	Principles of safety integration
Section 1.1.3.	Materials and products
Section 1.1.5.	Design of machinery to facilitate its handling
Section 1.2.1.	Safety and reliability of control systems
Section 1.2.6.	Failure of the power supply
Section 1.3.2	Risk of break-up during operation
Section 1.3.3.	Risks due to falling or ejected objects
Section 1.3.4.	Risks due to surfaces, edges or angles
Section 1.3.7.	Risks related to moving parts
Section 1.3.9.	Risks of uncontrolled movements
Section 1.5.1.	Risks due to electricity supply
Section 1.5.3.	Risks due to energy supply other than electricity (air pressure)
Section 1.5.8.	Risks due to noise
Section 1.5.10.	Risks due to non-ionizing radiation
Section 1.6.4.	Operator intervention
Section 1.7.1.	Information and warnings on the machinery
Section 1.7.2.	Warning of residual risks
Section 1.7.3.	Marking of machinery
Section 1.7.4.	Instructions.

The partly completed machinery has been designed and manufactured according to the following harmonized standards:

EN ISO 12100-1	Safety of machinery - Basic concepts, general principles for design Part 1: Basic terminology, methodology
EN ISO 12100-2	Safety of machinery - Basic concepts, general principles for design Part 2: technical principles

EN ISO 10218-2	Robots and robotic devices — Safety requirements for industrial robots — Part 2: Robot systems and integration
EN ISO 60204-1	Safety of machinery. Electrical equipment of machines. General requirements
EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic standards. Immunity for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments
EN 61000-4-2	Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test
EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use -- Part 1: General requirements

The relevant technical documentation has been compiled in accordance with Annex VII, Part B of EC Machinery Directive 2006/42/EC. We undertake, in response to a reasoned request, to supply it in electronic form to the market surveillance authorities within a reasonable period.

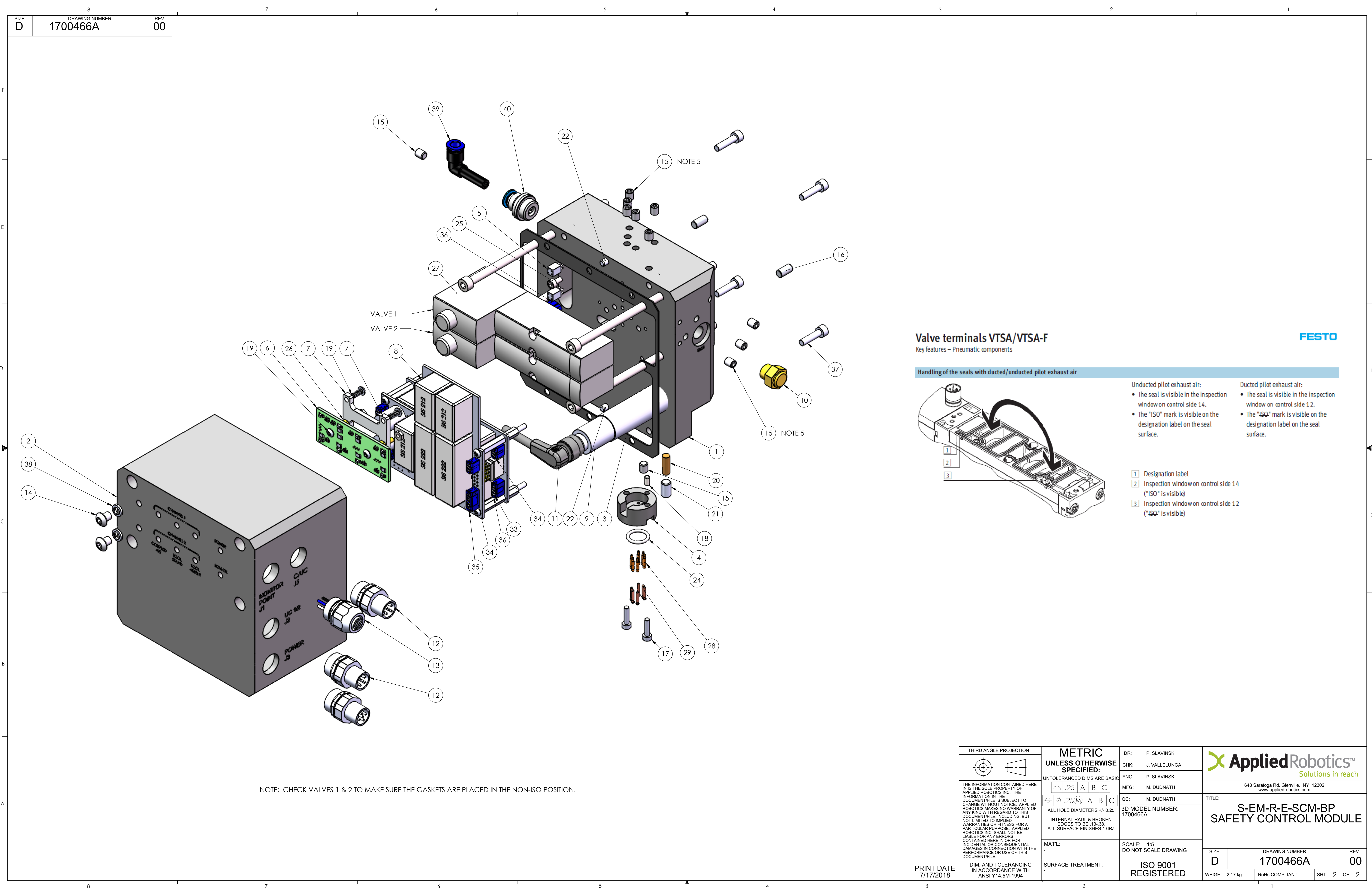
The party authorized to compile the technical documentation is:

Giovanni Patrini, at Effecto Group SpA

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of the Machinery Directive.


Stefan Casey
Vice President, Engineering

APRIL 20, 2018
Date



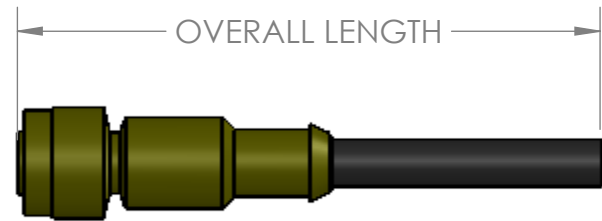
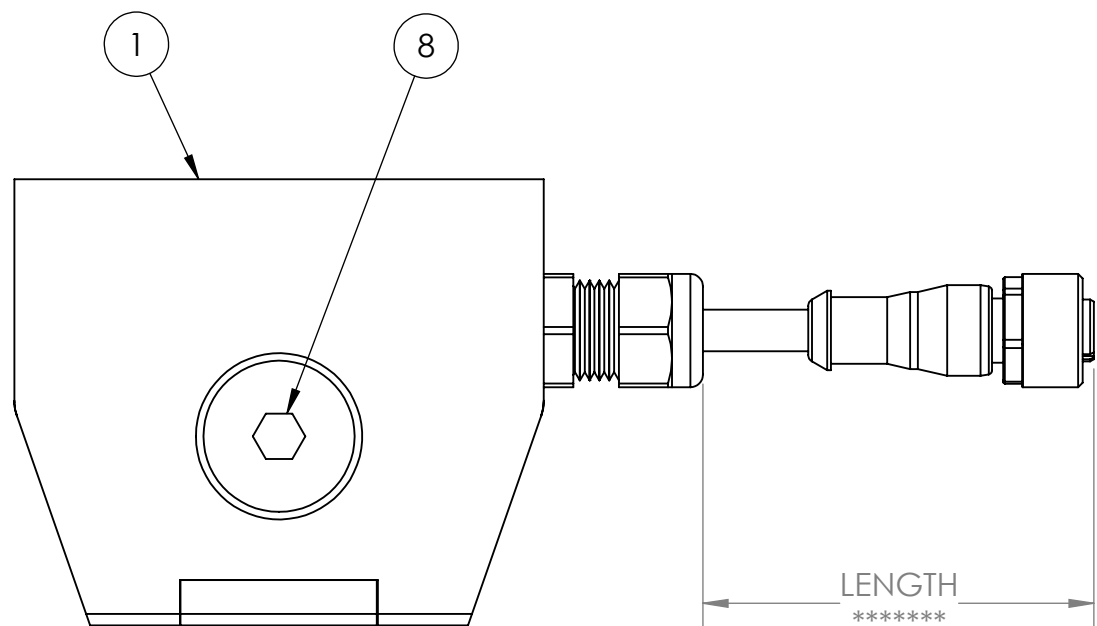
NOTE: CHECK VALVES 1 & 2 TO MAKE SURE THE GASKETS ARE PLACED IN THE NON-ISO POSITION.

PRINT DATE
7/17/2018

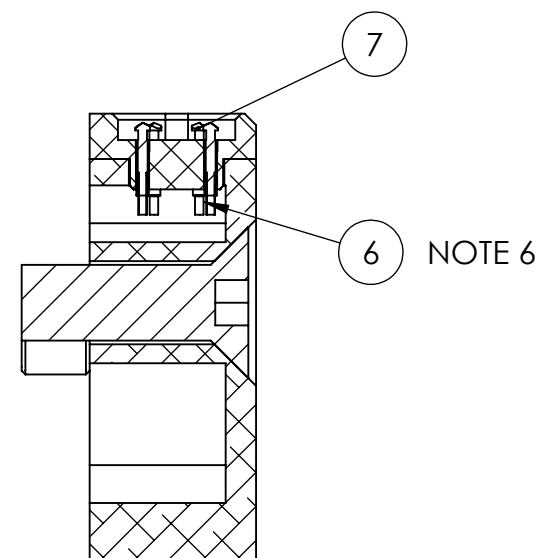
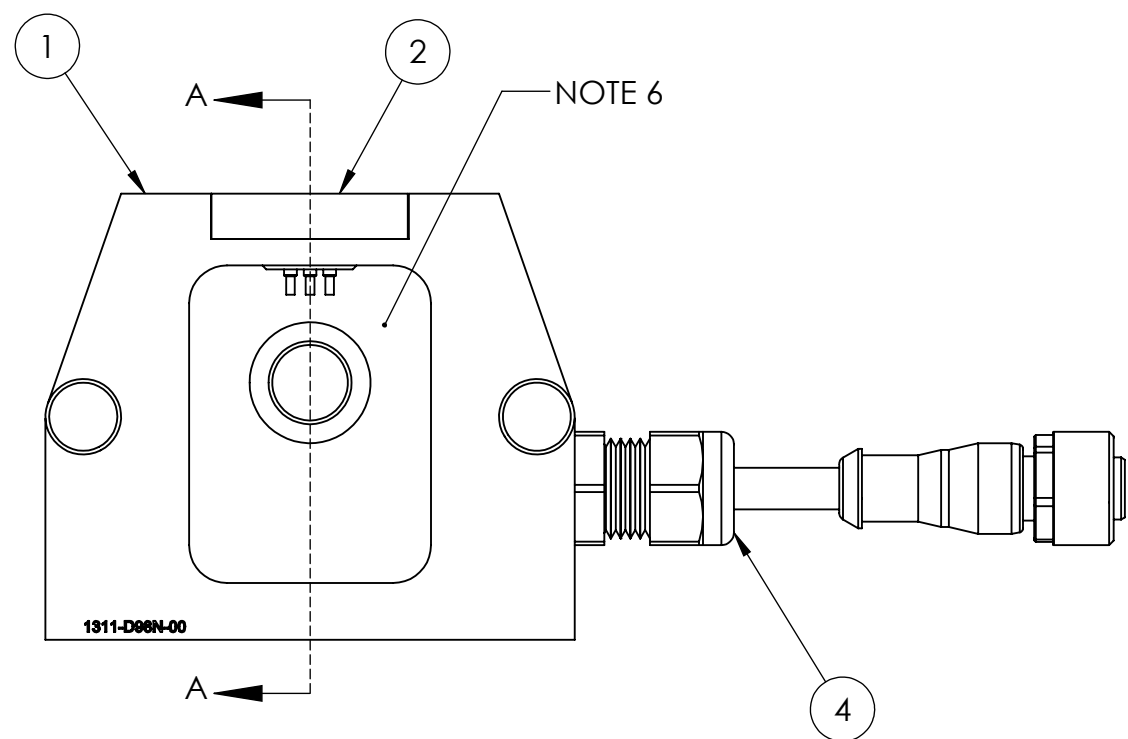
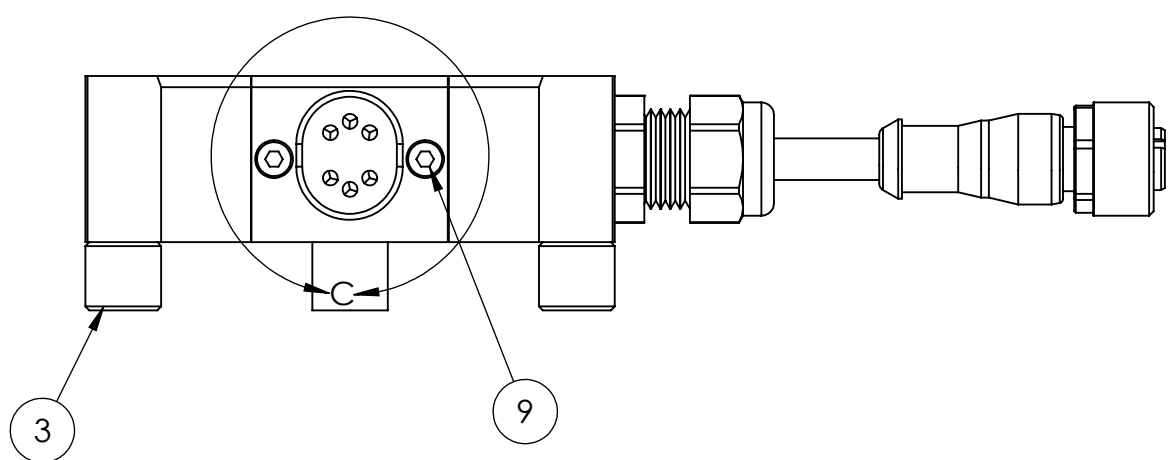
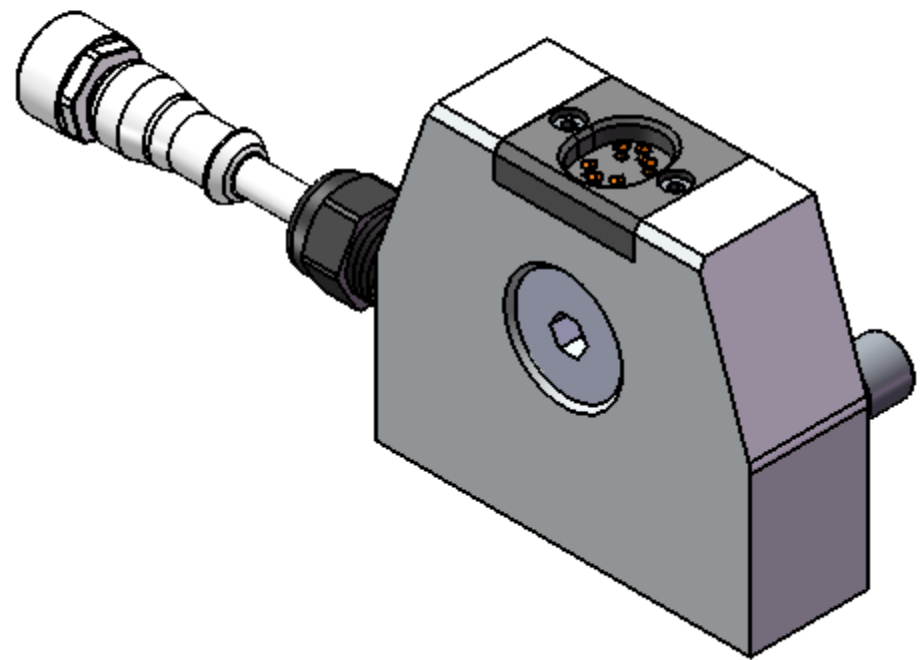
THIRD ANGLE PROJECTION		METRIC	DR: P. SLAVINSKI	 Applied Robotics™ Solutions in reach	648 Saratoga Rd. Glenville, NY 12302 www.appliedrobotics.com	TITLE: S-EM-R-E-SCM-BP SAFETY CONTROL MODULE
		UNLESS OTHERWISE SPECIFIED:	CHK: J. VALLELUNGA			
UNTOLERANCED DIMS ARE BASIC	ENG: P. SLAVINSKI	MFG: M. DUDNATH	3D MODEL NUMBER: 1700466A			
THE INFORMATION CONTAINED HERE IN IS THE SOLE PROPERTY OF APPLIED ROBOTICS INC. THE INFORMATION IN THE DOCUMENT/FILE IS SUBJECT TO CHANGE WITHOUT NOTICE. APPLIED ROBOTICS MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS DOCUMENT/FILE, INCLUDING, BUT NOT LIMITED TO IMPLIED WARRANTIES OR FITNESS FOR A PARTICULAR PURPOSE. APPLIED ROBOTICS INC. SHALL NOT BE LIABLE FOR ANY ERRORS CONTAINED HEREIN OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH THE PERFORMANCE OR USE OF THIS DOCUMENT/FILE.	 .25 A B C	QC: M. DUDNATH				
	 .25M A B C	ISO 9001 REGISTERED				
	ALL HOLE DIAMETERS +/- .025	SURFACE TREATMENT: -				
	INTERNAL RADII & BROKEN EDGES TO BE .13-.38					
	ALL SURFACE FINISHES 1.6Ra					
MAT'L: -				SIZE D	DRAWING NUMBER 1700466A	REV 00
DIM. AND TOLERANCING IN ACCORDANCE WITH ANSI Y14.5M-1994				WEIGHT: 2.17 kg	RoHS COMPLIANT: -	SHT. 2 OF 2

SIZE D	DRAWING NUMBER 1504-D51A	REV 00
-----------	-----------------------------	-----------

REVISIONS						
ZONE	REV	DESCRIPTION	DR	CHK	DATE	ECR/ESR NO.
	00	RELEASED FOR MANUFACTURING	PS	JV	08/10/2015	WJON-9XYGFG



ARI PART NO.	LENGTH *****	OVERALL LENGTH	COMMENTS
1405-P08N	750mm (29.53")	825mm (32.48")	CUT, WIRE IN, TIGHTEN STRAIN RELIEF, THEN POT



SECTION A-A

- ## NOTES
1. ALL ITEMS TO RECEIVE LOCTITE ARE TO BE THOROUGHLY CLEANED FROM GREASE AND OIL, USE PRIMER "N" BEFORE APPLYING ANY LOCTITE THREAD LOCKERS.
 2. APPLY LABEL NP ARI #90144L.
 3. FOR ELECTRICAL SCHEMATIC SEE ARI #1504-D52A.
 4. APPLY LOCTITE 222 ARI #86005-P1020 TO M5 AND SMALLER SCREWS.
 5. APPLY LOCTITE 242 ARI #50106 TO M6 - M18 SCREWS.
 6. WIRE IN CABLE, ACCORDING TO WIRING SCHEMATIC, USE HEAT SHRINK AROUND CONNECTIONS, TIGHTEN STRAIN RELIEF, THEN FILL CAVITY WITH POTTING COMPOUND E-60NC ARI #25400). FILL UNTIL FLUSH WITH OUTSIDE OF HOUSING.

9	2	48007	SCR, SOC HD CAP M2.5 X 6 (SS)
8	1	49037	SCR, FLAT HD SOC CAP M10 X 30
7	6	96504-P1023	PROBE, SPRING PIN QA TECH.
6	6	87515-P2047	RECEPTACLE, CRIMP 100-SDNO50N
5	1	1405-P08N	CABLE, M12 5-PIN FEMALE STR PUR
4	1	1303-P63N	STRAIN RELIEF PG7 CABLE RANGE 3-6.5MM
3	2	1312-C06N	PIN, ADAPTER
2	1	1311-C99N	PUCK, S.1-EM-T-V-ISO 13849-SCM-AL
1	1	1311-D98N	BLOCK, HOUSING TOOL

ITEM NO.	QTY.	PART NO.	DESCRIPTION		
THIRD ANGLE PROJECTION		METRIC UNLESS OTHERWISE SPECIFIED: UNTOLERANCED DIMS ARE BASIC			

PRINT DATE
8/10/2015

DETAIL C
SCALE 2:1

