

Sigma Tool Change System

Σ 3.1
 Σ 5.1
 Σ 8.1
 Σ **Modules**

**Users Guide
&
Preventative Maintenance and
Replacement Procedures**

GUIDE: 95000_english Rev 14

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**APPLIED ROBOTICS INCORPORATED
GLENVILLE, NEW YORK
XChange Sigma 3.1, Sigma 5.1, & Sigma 8.1**

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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 MANUFACTURERS' EQUIPMENT WARRANTY.

ILLUSTRATIONS AND DRAWINGS CONTAINED IN THIS MANUAL ARE TYPICAL. CONTACT TECH SUPPORT FOR ACTUAL DETAIL DRAWINGS.

HEED ALL PRECAUTION NOTICES

2 SYSTEM DESCRIPTION

There are two (2) main components in the basic system:

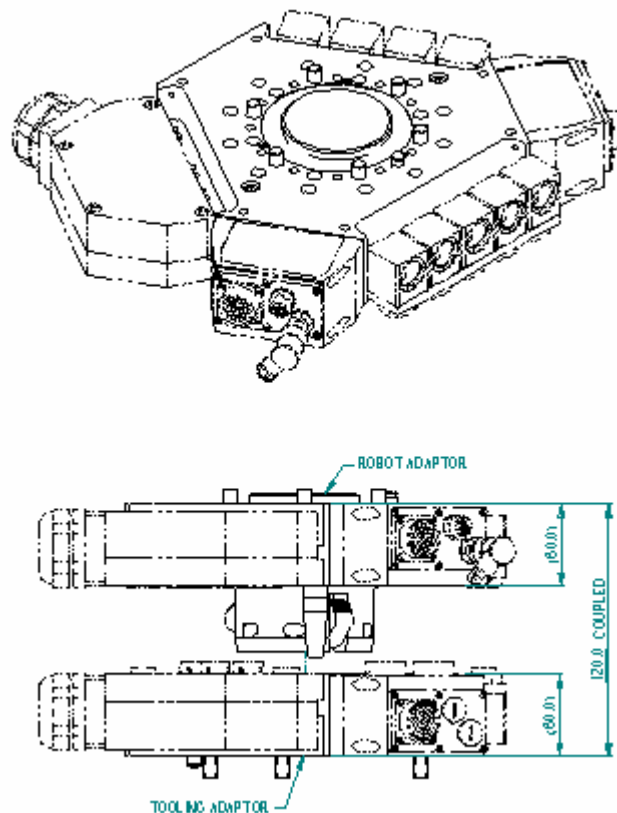
The XChange Robot Assembly

One Robot Adaptor is needed for each manipulator changing tools.

The XChange Tooling Assemblies

One Tooling Adaptor is needed for each tool.

The Sigma 3.1, 5.1, & 8.1 XChange System provides a fast and reliable method for a manipulator to connect to and release a number of Tooling Adaptor Assemblies (each equipped with different tooling). Attachment is through a mechanical linkage. To couple and release a Tooling Adaptor Assembly, air is ported to a double acting cylinder, which drives three cams. As the cams extend and retract, the Tooling Adaptor Assembly is coupled or released from the Robot Assembly, allowing the units to physically connect and disconnect along with any utilities contained in attached modules.



3 INSTALLATION

Please review these instructions thoroughly before installing your **Sigma 3.1, 5.1, OR 8.1 XChange System**.

3.1 Robot Adaptor Installation

3.1.1 Mount the Robot Sigma 3.1 Adaptor Assembly to your robot

ISO Conform Ø 125mm (6 or 10) M10 x 60mm socket head cap screws (property class 12.9)

Or

ISO Conform Ø 160mm (6 or 10) M10 x 60mm socket head cap screws (property class 12.9)

Or

ISO Conform Ø 160mm (11) M12 x 65mm socket head cap screws (property class 12.9)

3.1.2 Mount the Robot Sigma 5.1 Adaptor Assembly to your robot

ISO Conform Ø 160mm (6 or 10) M10 x 60mm socket head cap screws (property class 12.9)

Or

ISO Conform Ø 200mm (6, 10 or 12) M12 x 65mm socket head cap screws (property class 12.9)

Or

ISO Conform Ø 200mm (12) M16 x 70mm socket head cap screws (property class 12.9)

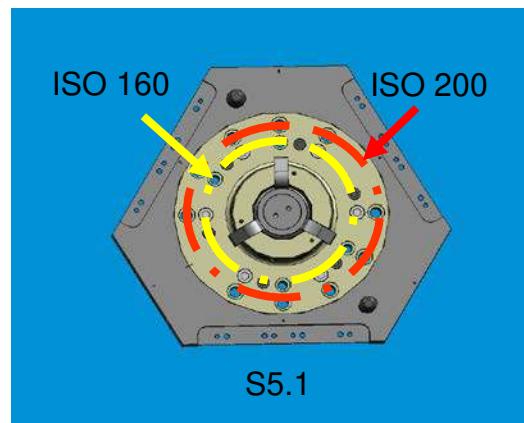
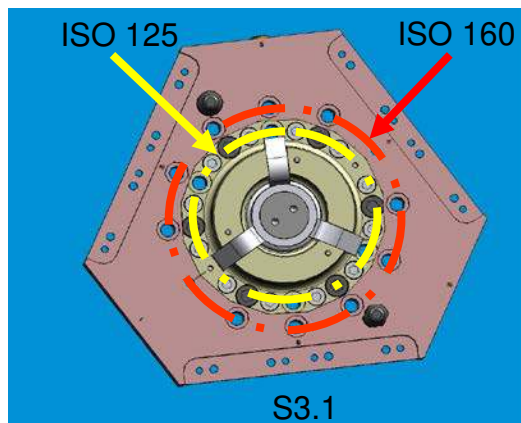
3.1.3 Mount the Robot Sigma 8.1 Adaptor Assembly to your robot

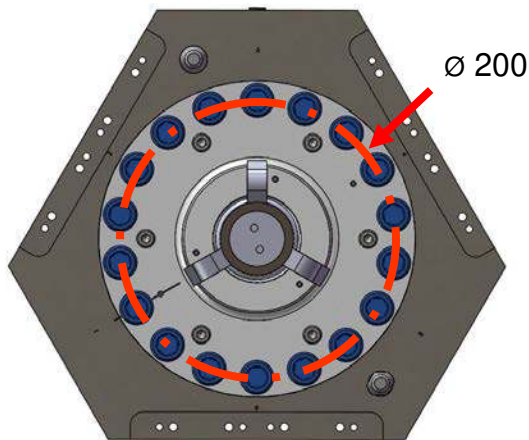
Ø 200mm (16 or 18) M16 x 65mm socket head cap screws (property class 12.9)



TIGHTEN FACEPLATE MOUNTING SCREWS TO ROBOT MANUFACTURER'S SPECIFICATIONS.

If these patterns do not fit your robot, other housings are available. Call the Application Engineering Department for more information.

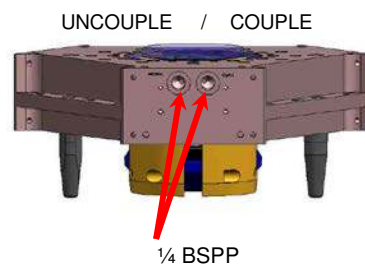




S8.1

3.1.4 Install any electrical and/or pneumatic modules (see section 11.2)

3.1.5 Install air fittings for couple and uncouple (actuation ports supplied by customer)



Both the coupling and uncoupling actuation port lines **must** be installed in order for the XChange System to function properly. Either a **single solenoid spring-return 4-way pneumatic valve** or a **double solenoid 4-way pneumatic valve** can be used to connect air to the couple and uncouple ports on the Robot Adaptor Unit.



DANGER

PNEUMATIC PRESSURE SHOULD NEVER BE SUPPLIED TO THE VALVE UNTIL THE STATE OF THE VALVE (COUPLED OR UNCOUPLED) HAS BEEN CONFIRMED. FAILURE TO DO SO CAN RESULT IN SERIOUS INJURY OR DEATH FROM A DROPPED TOOL. THE ROBOT SHOULD NEVER BE RUN WITHOUT AIR PRESSURE SUPPLIED TO THE TOOL CHANGER. CLEAN, DRY AIR AT A PRESSURE OF AT LEAST 4.9 BAR (72 PSIG) SHALL BE SUPPLIED TO TOOL CHANGER FOR PROPER OPERATION.

The valve module used for the Sigma series of tool changers is a double solenoid 4-way pneumatic valve. This module can only be installed on side 1 so that it is over the couple and uncouple ports of the robot adaptor housing.

The valve module is designed to interface directly and be controlled through the robot electrical module for easy integration.

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

 **WARNING**

IF A SINGLE SOLENOID SPRING-RETURN 4-WAY PNEUMATIC VALVE IS USED, THE FOLLOWING CONDITIONS MUST BE UNDERSTOOD AND ADHERED TO:

- **IN THE DE-ENERGIZED STATE, THE VALVE MUST PROVIDE AIR TO THE COUPLE PORT ONLY.**

 **WARNING**

WHEN THE ARI DOUBLE SOLENOID 4-WAY PNEUMATIC VALVE MODULE IS USED, THE FOLLOWING CONDITIONS MUST BE UNDERSTOOD AND ADHERED TO:

- **THE VALVE WILL REMAIN IN ITS PRESENT POSITION UNTIL ITS POSITION IS CHANGED BY EITHER ENERGIZING THE ALTERNATE SOLENOID OR MANUALLY PRESSING THE ALTERNATE SOLENOID OVERRIDE BUTTON LOCATED ON THE VALVE BODY.**
- **IF THE SOLENOID ON ONE SIDE OF THE VALVE IS ENERGIZED, THE CONDITION OF THE VALVE WILL NOT CHANGE BY ONLY ENERGIZING THE OTHER SOLENOID. YOU MUST ALSO DE-ENERGIZE THE FIRST SOLENOID.**
- **THE VALVE USED IS PILOT-ACTUATED. THE POSITION OF THE VALVE WILL NOT CHANGE UNLESS THERE IS AIR SUPPLY TO THE VALVE.**
- **THE POWER FLOW TO THE UNCOUPLE SOLENOID SHOULD ALWAYS BE ROUTED IN SERIES THROUGH ALL TOOL STORAGE FIXTURE "TOOL PRESENT" SWITCHES.**

 **CAUTION**

COUPLE AND UNCOUPLE SENSOR SIGNALS SHOULD BE CONTINUALLY MONITORED TO VERIFY THAT THE TOOL CHANGER IS IN THE PROPER STATE BEFORE COMMANDING THE ROBOT TO MOVE

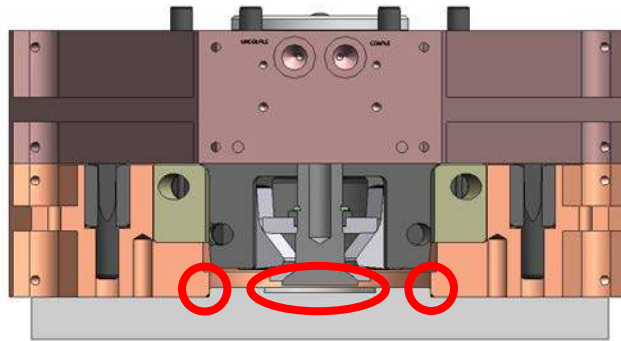
Holding force up to the rated payload of the Robot Adaptor Assembly is provided in the event of all pneumatic pressure loss.

The (3) Coupling Cams should be in the coupled position (extended) when system air is applied and the valve is de-energized.

3.2 Tooling Adaptor Installation

 **CAUTION**

IF A PILOT IS USED TO LOCATE THE TOOL TO THE TOOL ADAPTOR A (50MM FOR SIGMA3.1 / 60MM FOR SIGMA5.1) DIAMETER COUNTERBORE MUST BE MADE INTO THE PILOT TO ALLOW CLEARANCE FOR THE LATCHING MECHANISM. REFER TO THE MOUNTING PATTERN DRAWINGS IN SECTION 12 FOR THE CORRECT DIMENSIONS.



3.2.1 Attach Tooling to the Tooling Adaptor Assemblies

NOTE: Tooling Adaptors can be electrically coded so the Robot Controller can verify acquisition of a specific Tooling Adaptor. By installing a jumper wire between appropriate signal pins (via the mating electrical connector) you can produce a unique binary code for each Tooling Adaptor.

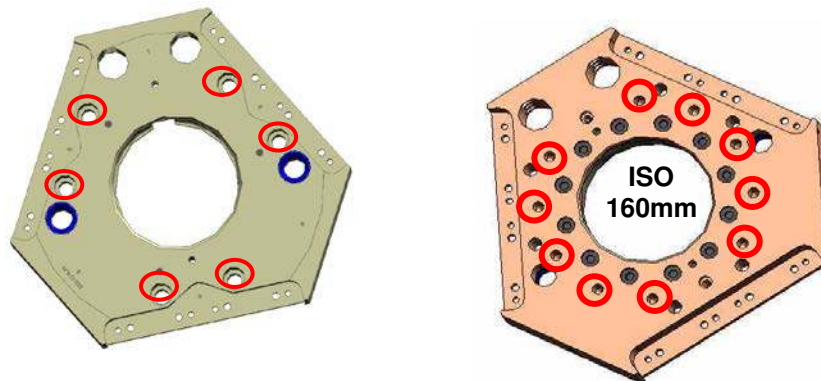
3.2.1.1 Sigma 3.1 Tooling

1. The (6) M10mm counter bored clearance holes shown below to bolt from the top down into the tooling.

(See drawing section for detail). Hardware supplied by the customer.

6 x M10 for 0303-D53A S3.1T-P-000-A-100-A000

6 x M12 for 0305-D13A S3.1T-P-000-B-100-A000



2. Or Bolt up into the (6 or 10) M10 / (6 or 11) M12 tapped holes (hardware supplied by customer) on the ISO 160mm-diameter bolt hole pattern located in the bottom of the Tooling Adaptor Unit. (See drawing section for detail). To use the mounting holes threaded into the Sigma 3.1

3. To use the mounting holes tapped into the Sigma 3.1 tooling use the following Guidelines:

For **Pattern (6x) M10x1.5-6H on 125 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 16 - 19 mm. ARI recommends the use of Grade 8.8 bolts, torque M10 bolts to ISO Specification.

For **Pattern (6x) M12x1.75-6H on 125 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 16 - 19 mm. ARI recommends the use of Grade 8.8 bolts, torque M12 bolts to ISO Specification.

For **Pattern (10x) M10x1.5-6H on 160 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 16 - 19 mm. ARI recommends the use of Grade 8.8 bolts, torque M10 bolts to ISO Specification.

For **Pattern (11x) M12x1.75-6H on 160 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 16 - 19 mm. ARI recommends the use of Grade 8.8 bolts, torque M12 bolts to ISO Specification.

4. Install any electrical and/or pneumatic modules, as the application requires. (see chapter 11.2)

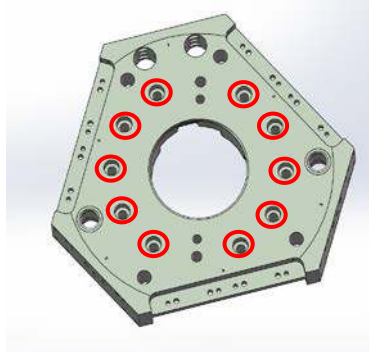
3.2.1.2 Sigma 5.1 Tooling

1. The (10) M10 or (12) M14 counter bored clearance holes shown to bolt from the top down into the tooling.

(See drawing section for detail). Hardware supplied by the customer.

10 x M10 for 0303-E62A S5.1T-P-000-A-125-A000

12 x M14 for 0802-E25A S5.1T-P-000-C-125-A000



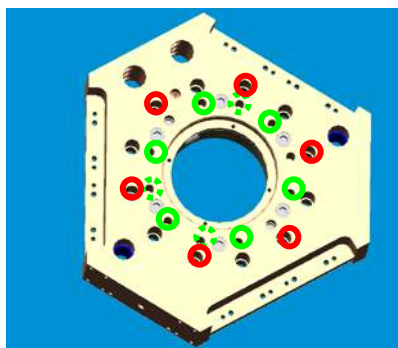
2. Bolt up into the (6 or 10) M10 / (10) M12 tapped holes on the ISO 160mm-diameter bolt hole pattern located in the bottom of the Tooling Adaptor Unit. (See drawing section for detail).
3. Or Bolt up into the (6 or 10) M12 / (12) M16 tapped holes (hardware supplied by customer) on the ISO 200mm-diameter bolt hole pattern located in the bottom of the Tooling Adaptor Unit.
4. To use the mounting holes tapped into the Sigma 5.1 tooling use the following Guidelines.:

For **Pattern (10x) M10x1.5-6H on 160 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 19 - 24 mm. ARI recommends the use of Grade 8.8 bolts, torque M10 bolts to ISO Specification.

For **Pattern (10x) M12x1.75-6H on 160 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 19 - 24 mm. ARI recommends the use of Grade 8.8 bolts, torque M12 bolts to ISO Specification.

For **Pattern (12x) M12x1.75-6H on 200 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 43 - 48 mm. ARI recommends the use of Grade 8.8 bolts, torque M12 bolts to ISO Specification.

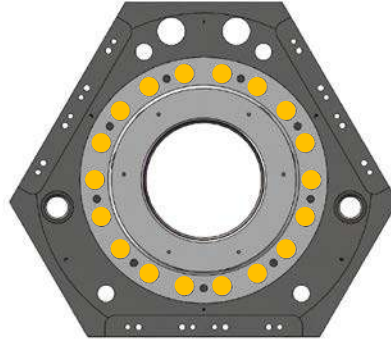
For **Pattern (12x) M16x2.0-6H on 200 mm Bolt Circle**, use all tapped bolt holes in the pattern. The bolt must utilize a Thread Engagement of 43 - 48 mm. ARI recommends the use of Grade 8.8 bolts, torque M16 bolts to ISO Specification.



5. Install any electrical and/or pneumatic modules, as the application requires. (see chapter 11.2)

3.2.1.3 Sigma 8.1 Tooling

The (18) M16 clearance holes shown to bolt from the top down into the tooling.
(See drawing section for detail). Hardware supplied by the customer.
18 x M16 for 0902-E97A S8.1T-P-000-D-160-A000



3.3 OEM Switch Setting

Couple and Uncouple switch signals are preset at the factory to an OEM standard which is derived to produce a calculated engineering safety factor. Adjusting or tampering with the OEM standard switch settings voids all warranty and may lead to catastrophic failure.

NOTICE

Adjusting or tampering with the OEM standard switch settings voids all warranty and may lead to catastrophic failure.

4 INITIAL TESTS

CAUTION

DURING TESTING KEEP YOUR FINGERS CLEAR OF THE MECHANICAL COUPLING MECHANISM AND THE COUPLING INTERFACE.

WARNING

**IF XCHANGE SYSTEM IS BEING USED ON A ROBOTIC MANIPULATOR,
KEEP OUT OF THE ROBOT WORK ENVELOPE
WHEN DRIVE POWER IS ON.**

CAUTION

BE SURE HANDS ARE CLEAR OF MOVING PARTS BEFORE APPLYING AIR PRESSURE TO THE UNIT.

4.1 Robot Adaptor test

1. With the Tooling Adaptor Assembly uncoupled from the Robot Adaptor Assembly, apply air (no electrical power) to your system:
The Robot Adaptor coupling cams should be in a "coupled"/extended position.
2. Apply system air and power.
No change in the above conditions should occur.
The Robot Adaptor coupling cams should be in a "coupled"/extended position.
3. Energize the solenoid that controls the coupling mechanism. The coupling cams should move to the "uncoupled"/retracted position.

4. Alternately de-energize and energize the solenoid several times. The cam action should be smooth and quick.

5. GUIDE TO OPERATIONS

5.1 Usage Considerations

Programs should be written with all XChange Tooling Adaptor Assemblies resting in tool storage fixtures during start-up and manipulator calibration (if applicable).

5.1.1 Identify and Record Couple and Uncouple Point



THE ROBOT SHOULD NEVER BE RUN WITHOUT A MINIMUM CLEAN, DRY AIR PRESSURE OF 4.9 BAR (72 PSIG) SUPPLIED TO THE TOOL CHANGER

To identify the couple point of each Tooling Adaptor Assembly during the teaching phase, the Robot Adaptor Assembly should be brought to a point directly on the centerline axis of the Tooling Adaptor Assembly. The Robot Adaptor Assembly's face should be parallel to the Tooling Adaptor Assembly's face. The taper pins should enter the bushings in the Tooling Adaptor Assembly when the Robot Adaptor Assembly is slowly moved toward it.

1. **Move** the Adaptor Assemblies slowly toward each other while visually checking the alignment of the taper pins and their bushings. Make whatever lateral corrections necessary to center the pins in the bushings. Exact alignment in either the horizontal or lateral positions is not required, although the pins should not interfere with the bushings inside diameters.
2. **Stop** the motion when the distance between the Robot Adaptor Face and the Tooling Adaptor Face is approximately 1.5 mm or (.06 in).



THERE MUST BE NO MORE THAN 1.5 MM BETWEEN THE ROBOT AND TOOLING ADAPTOR ASSEMBLIES TO SUCCESSFULLY COUPLE THE SIGMA 3.1 OR 5.1. THE TWO UNITS ARE PULLED TOGETHER WHEN THE COUPLING MECHANISM IS ENGAGED.

3. **De-energize** the solenoid that controls the air pressure to the Sigma 3.1 or Sigma 5.1 couple port. This will couple the Tooling Adaptor Assembly with the Robot Adaptor Assembly. Any electrical or pneumatic connections are made at this time.
4. **Energize and de-energize** the coupling solenoid several times to verify that the Tooling Adaptor Assembly is properly connected and released from the Robot Adaptor Assembly.
5. **Record** the position from Step 3 as the "pick-up" and "replacement" coordinates for this Tooling Adaptor Assembly.

5.1.2 Other Programming Considerations

Tooling Adaptors may be coded to verify connection to the correct tool. This may be accomplished by configuring the wiring such that two of the pins in the Tooling Adaptor Electrical Module are shorted together. This can produce a binary code (which can be read using your system controller inputs). The number of leads needed to allow a unique code for each Tooling Adaptor will depend upon the number of Tooling Adaptors used in your application.

 **CAUTION**

THERE ARE TWO WAYS THAT THE SYSTEM CAN BE SET UP TO PROVIDE ADDITIONAL SAFETY FROM ACCIDENTAL UNCOUPLING.

1. Set up with standard wiring with two controller outputs to solenoids of the valve. When you are coupled to a tool, (3) conditions must be met before uncoupling:

- A.) All tools in storage fixtures.
- B.) "Coupled" output turned off.
- C.) "Uncoupled" output turned on.

Accidental uncoupling is most likely to occur during "teaching", and for some reason, all of the fixture tool present sensors are bypassed. If the tool present sensors are bypassed or otherwise defeated and a single solenoid-spring return valve is used, accidentally turning that output on will cause the tool to drop. With a double-solenoid valve, even with tool present sensors bypassed you not only have to turn the "uncouple" output on, you have to turn the "couple" output off.

2. A system basically set-up as described above with an additional normally-open sensor mounted on the robot adaptor unit which is actuated (closed) by a target on the tool storage fixture*. While all other conditions could possibly be bypassed in the control, this will assure that no power gets to the uncoupled solenoid unless:

- A.) The robot adaptor is poised in the correct position above the storage fixture.
- Or
- B.) The sensor is manually activated by an operator while all other conditions are also met.

This set-up will not work with a single-solenoid system because as soon as you move between tools from one storage fixture to the next, power would be lost to the uncouple solenoid and the valve would shift back to coupled, not allowing you to approach the next tool.

Since the double solenoid valve will not change states by just losing power, the unit will remain "uncoupled", allowing you to approach the next tool.

*The switch and target must be set-up and designed around the tooling to ensure there is no interference with existing components.

 **CAUTION**

COUPLE AND UNCOUPLE SENSOR SIGNALS SHOULD BE CONTINUALLY MONITORED TO VERIFY THAT THE TOOL CHANGER IS IN THE PROPER STATE BEFORE COMMANDING THE ROBOT TO MOVE.

AIR PRESSURE TO THE TOOL CHANGER SHOULD BE AT LEAST 4.9 BAR (72 PSI) FOR PROPER OPERATION.

6. TROUBLESHOOTING

6.1 Assistance

If you require assistance, contact our Applications Engineers in our Technical Support Departments at:

USA	Main Office:	+ 1 518 384 1000
Europe	ARE:	+ 39 0322-96593

6.2 Method to Manually Uncouple

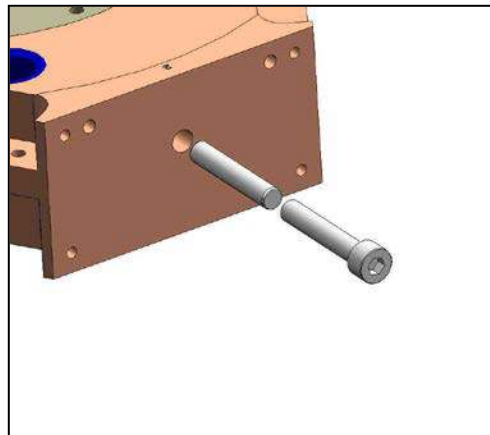
NOTICE

THE SIGMA SYSTEM SHOULD NEVER BE MANUALLY UNCOUPLED UNLESS THE ATTACHED TOOL IS FULLY SUPPORTED, PREFERABLY IN ITS TOOL STAND.

If damage occurs to the Sigma system that prevents the system from uncoupling under normal means, we have incorporated a feature in our design that allows the system to be manually uncoupled.

The following steps must be followed to ensure the Sigma system is manually uncoupled in a safe manner:

1. Ensure the attached tooling is safely supported, preferably in its tool stand, so that no damage or personal injury occurs when the tool is released.
2. Ensure all unnecessary personnel are clear of the tooling before going further in this procedure.
3. Shut off the air supply to the actuating cylinder. The cylinder must not be pressurized for this operation to be performed successfully.
4. Insert an 8mm diameter shaft 60 mm long followed by a M10 x 40 socket head cap screw in the hole located in the middle of the short sides (position 1, 3 and 5) of the tool side housing as pictured below. Requires any tool side modules on position 1, 3, and 5 to be removed.
5. Drive the M10 screw in until the cams are fully retracted. This action will allow the tool changer to uncouple. If the tool changer is binding, duplicated this action on the other two short sides of the tool changer simultaneously.



7. MAINTENANCE

NOTICE

FAILURE TO FOLLOW THE MAINTENANCE SCHEDULE DESCRIBED BELOW COULD ALTER OR VOID THE WARRANTY PROVIDED BY APPLIED ROBOTICS.

7.1 Maintenance Schedule

The following table provides a schedule for preventative maintenance procedures to be performed for the Sigma 3.1, 5.1, & 8.1 Tool Changer and associated modules.

COMPONENT	Frequency of Maintenance				
	Every 2 Weeks	250,000 Cycles	500,000 Cycles	750,000 Cycles	1,000,000 Cycles *
Robot Adaptor	Visual Checks	See Section 7.1.1	See Section 7.1.2	See Section 7.1.3	See Section 7.1.4
Tool Adaptor	Visual Checks	See Section 7.1.1	See Section 7.1.2	See Section 7.1.3	See Section 7.1.4
Electrical Module	Visual Checks	See Section 7.1.1	See Section 7.1.2	See Section 7.1.3	See Section 7.1.4
HIKVA Module	Visual Checks	See Section 7.1.1	See Section 7.1.2	See Section 7.1.3	See Section 7.1.4
Universal Module (pneumatic/coolant)	Visual Checks	See Section 7.1.1	See Section 7.1.2	See Section 7.1.3	See Section 7.1.4

* If you have experienced a sender spring failure with less than 1,000,000 cycles, Applied Robotics Inc. will replace the sender spring at no charge. See replacement procedure

COMPONENT	Frequency of Maintenance				
	1,250,00 Cycles	1,500,000 Cycles	1,750,000 Cycles	2,000,000 Cycles	2,250,000 Cycles
Robot Adaptor	See Section 7.1.5	See Section 7.1.6	See Section 7.1.7	See Section 7.1.8	See Section 7.1.9
Tool Adaptor	See Section 7.1.5	See Section 7.1.6	See Section 7.1.7	See Section 7.1.8	See Section 7.1.9
Electrical Module	See Section 7.1.5	See Section 7.1.6	See Section 7.1.7	See Section 7.1.8	See Section 7.1.9
HIKVA Module	See Section 7.1.5	See Section 7.1.6	See Section 7.1.7	See Section 7.1.8	See Section 7.1.9
Universal Module (pneumatic/coolant)	See Section 7.1.5	See Section 7.1.6	See Section 7.1.7	See Section 7.1.8	See Section 7.1.9

COMPONENT	Frequency of Maintenance		
	2,500,000 Cycles	2,750,000 Cycles	3,000,000 Cycles
Robot Adaptor	See Section 7.1.10	See Section 7.1.11	See Section 7.1.12
Tool Adaptor	See Section 7.1.10	See Section 7.1.11	See Section 7.1.12
Electrical Module	See Section 7.1.10	See Section 7.1.11	See Section 7.1.12
HIKVA Module	See Section 7.1.10	See Section 7.1.11	See Section 7.1.12
Universal Module (pneumatic/coolant)	See Section 7.1.10	See Section 7.1.11	See Section 7.1.12

7.1.1 250,000 Cycles

Robot Adaptor: Lubrication. Continue all visual checks

Tool Adaptor: Lubrication. Continue all visual checks

Electrical Module: Contact surface inspection. Continue all visual checks

HIKVA Module: Contact spring inspection (Tool Side). Continue all visual checks

Universal Module:
(Coolant/Pneumatic) Lubrication. Continue all visual checks

7.1.2 500,000 Cycles

Robot Adaptor: Lubrication. Continue all visual checks

Tool Adaptor: Lubrication. Continue all visual checks

Electrical Module: Contact surface inspection. Continue all visual checks

HIKVA Module: Contact spring inspection (Tool Side). Continue all visual checks

Universal Module:
(Coolant/Pneumatic) Lubrication. Continue all visual checks

7.1.3 750,000 Cycles

Robot Adaptor: Lubrication. Continue all visual checks

Tool Adaptor: Lubrication. Continue all visual checks

Electrical Module: Contact surface inspection. Continue all visual checks

HIKVA Module: Contact spring inspection (Tool Side). Continue all visual checks

Universal Module:
(Coolant/Pneumatic) Lubrication. Continue all visual checks

7.1.4 **1,000,000 Cycles**

Robot Adaptor:	Continue lubrication and all visual checks. At this number of cycles, start looking for wear on the locating pins. Replace if worn or damaged
Tool Adaptor:	Continue lubrication and all visual checks. At this number of cycles, start looking for wear at the locating bushing. Replace if worn or damaged
Electrical Module:	Continue surface inspection and all visual checks. At this number of cycles, start looking for wear at the spring probes (male/female). Replace if worn or damaged
HIKVA Module:	Contact spring replacement (Tool Side). Continue all visual checks
Universal Module: (Coolant/Pneumatic)	Replace O-Ring. Continue all visual checks

7.1.5 **1,250,000 Cycles**

Robot Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Tool Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Electrical Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
HIKVA Module:	Contact spring inspection (Tool Side). Continue all visual checks. Replace if worn or damaged parts
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.6 **1,500,000 Cycles**

Robot Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Tool Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Electrical Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
HIKVA Module:	Contact spring replacement (Tool Side). Continue all visual checks
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.7 **1,750,000 Cycles**

Robot Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Tool Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Electrical Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
HIKVA Module:	Contact spring inspection (Tool Side). Continue all visual checks. Replace if worn or damaged parts
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.8 **2,000,000 Cycles**

Robot Adaptor:	Check the following parts for wear or damage; locating pins, piston head, O-ring, cam shaft (helix), sender cams and prox. switches. If any part is worn or damaged, they should be replaced. Continue all visual checks
Tool Adaptor:	Check locating bushings. Tool adaptor should be evaluated for wear to loading areas
Electrical Module:	Check spring probes (male/female). Evaluate module for damage. Replace module if connectors or module is damaged
HIKVA Module:	Contact spring replacement (Tool Side). Continue all visual checks
Universal Module: (Coolant/Pneumatic)	Replace O-Ring

7.1.9 **2,250,000 Cycles**

Robot Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Tool Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Electrical Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
HIKVA Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.10 **2,500,000 Cycles**

Robot Adaptor:	Replace the locating pins, piston head, O-ring, cam shaft (helix) and sender cams if worn or damaged. Replace sender spring. Continue all visual checks
Tool Adaptor:	Replace locating bushings if worn or damaged. Continue all visual checks
Electrical Module:	Replace spring probes (male/female) if worn or damaged. Evaluate module for damage. Replace module if connectors or module is damaged. Continue all visual checks
HIKVA Module:	Replace insulator screws, HIKVA contact washers, tips and O-ring if worn or damaged. Evaluate HIKVA block and cable connector for damage and replace as needed. Continue all visual checks
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.11 **2,750,000 Cycles**

Robot Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Tool Adaptor:	Lubrication. Continue all visual checks. Replace if worn or damaged parts
Electrical Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
HIKVA Module:	Contact surface inspection. Continue all visual checks. Replace if worn or damaged parts
Universal Module: (Coolant/Pneumatic)	Lubrication. Continue all visual checks. Replace if worn or damaged parts

7.1.12 **3,000,000 Cycles**

Robot Adaptor:	Replace locating pins, piston head, O-ring and cam shaft (helix). Replace sender cams and prox. switches if worn or damaged. Continue all visual checks
Tool Adaptor:	Replace locating bushings. Tool adaptor should be evaluated for wear to loading areas. Continue all visual checks
Electrical Module:	Replace spring probes (male/female). Evaluate module for damage. Replace module if module or connectors are damaged. Continue all visual checks
HIKVA Module:	Contact spring replacement (Tool Side). Replace insulator screws, HIKVA contact washers, tips and O-ring. Evaluate HIKVA block and cable connector for damage and replace as needed. Continue all visual checks
Universal Module: (Coolant/Pneumatic)	Replace fittings. Continue all visual checks

7.2 Preventative Maintenance

7.2.1 Visual Checks

7.2.1.1 Utility Lines (applicable to all components)

1. Inspect for abraded conductors.
2. Inspect for proper conductor lengths.
3. Inspect coolant conductors and fittings for leaks.
4. Ensure all harness ties are in good physical condition.

7.2.1.2 Robot Adaptor

1. Inspect locating pins for rust, breakage, or wear.
2. Inspect latching cams for rust, breakage, or wear.
3. Inspect interface surface for raised material or dings that could prevent proper mating to Tool Adaptor.
4. Uncouple the Robot Adaptor from the Tool Adaptor and cycle the coupling mechanism 5 to 10 times and verify the latching cams are operating smoothly. The cycling of the coupling mechanism will also ensure that the operating cylinder remains properly lubricated.

7.2.1.3 Tool Adaptor

1. Inspect interface pads for rust, breakage, or wear.
2. Inspect locating bushings for rust, breakage, or wear.
3. Inspect interface surface for raised material or dings that could prevent proper mating to Robot Adaptor.

7.2.1.4 Electrical Modules

1. Inspect spring pins for excessive dirt, pitting, or bending. If bending or excessive pitting is observed replace the damaged spring pin. (See chapter 8.5.1)
2. Ensure spring pins are free to move inside their receptacle. If spring pins do not move freely, replace them. (See chapter 8.5.1)
3. Inspect signal cable connector for tightness.

7.2.1.5 HIKVA Modules

1. Inspect contact surfaces for excessive dirt or pitting. Replace contact surfaces if excessive pitting is observed. (See chapter 8.3.1 or 8.3.2)

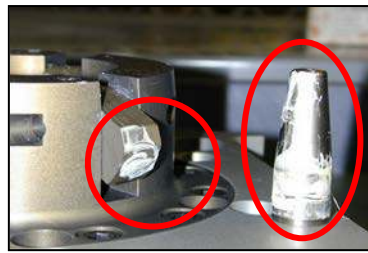
7.2.1.6 Universal Modules

1. Inspect universal fittings for leakage. If fitting is leaking due to o-ring damage, replace it. (See chapter 8.4.3 or 8.4.4) If leaking is due to damaged contact surfaces within the fitting, replace the fitting. 8.4.1 or 8.4.2)

7.2.2 Lubrication

7.2.2.1 Robot Adaptor

1. Apply a liberal coating of White Lithium Grease to the contact surface on latching cams.
2. Apply a liberal coating of White Lithium Grease to the upper cylindrical surface of the locating pins.



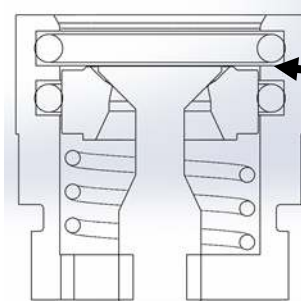
7.2.2.2 Tool Adaptor

1. Apply a liberal coating of White Lithium Grease to the latching pad dowels.
2. Apply a liberal coating of White Lithium Grease to the inner surface of the locating bushings.



7.2.2.3 Universal Modules

1. Apply a thin coat of Staburags NBU 30 or White EP Bearing Grease to the contact surface shown in the figure below.



Kluber
 Staburags NBU
 30 Grease or
 Dow EP White
 Bearing Grease

7.2.2.4 Lubricant Specifications

Lubricant	ARI Part #	Manufacturer	Manufacturer's Part Number
Lube A Cyl	51120	Parker	0766130000
White Lithium Grease	91504-P1037	Century Lubricants	ST-80
Staburags NBU 30 Grease or White EP Bearing Grease	0903-P11N or 96503-P1018	Kluber or Dow Corning	NBU 30 or White EP Bearing Grease

8 REPLACEMENT PROCEDURES

These Replacement Procedures are based on the following model numbers:

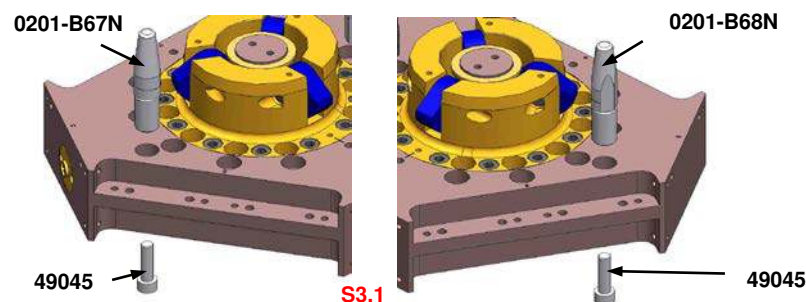
- *Robot Adaptor* : S3.1R-P-2PNP-A-080-A000 / S5.1R-P-2PNP-A-100-A000 / S8.1R-P-2PNP-H-160-A000
- *Tool Adaptor*: S3.1T-P-000-A-100-A000 / S5.1T-P-000-A-125-A000 / S8.1T-P-000-D-160-A000
- *HIKVA Module(Robot Side)* S-EM-R-E-HIKVAEPG-00
- *HIKVA Module(Tool Side)* S-EM-T-E-HIKVAEPG-00
- *Universal Module(Robot Side)* S-EM-R-U-2V1/2BS
- *Universal Module(Tool Side)* S-EM-T-U-2V1/2BS

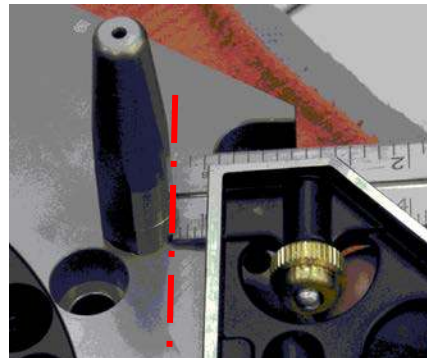
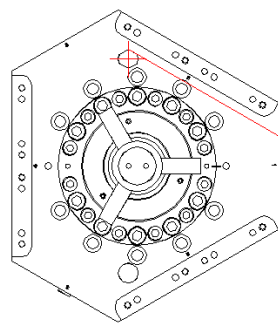
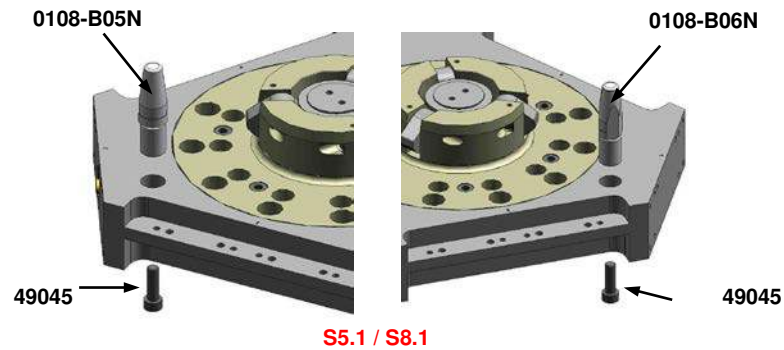
*All part numbers reference these model numbers. If you have any questions on part numbers for models not listed above contact **Applied Robotics Technical Support.** (See section 6.1)*

8.1 Robot Adaptor

8.1.1 Location Pins

1. Remove Robot Adaptor from Manipulator.
2. Remove M8 socket head cap screw, part number 49045.
3. Remove Diamond locating pin part number 0201-B68N (S3.1) / 0108-B06N (S5.1 / S8.1) or Remove Round locating pin part number 0201-B67N (S3.1) / 0108-B05N (S5.1 / S8.1). Locating Pins may need to be pressed out.
4. Place new Locating Pin into the appropriate mounting hole. Check the orientation of the diamond pin as shown in the picture below.
5. Apply Loctite 242 to M8 socket head cap screw removed in 8.1.1 step 2 and thread it into Locating Pin from the top side of the Robot Adaptor housing. Torque screws to 13.6 Nm (120in-lb).
6. Lubricate Locating Pin per Lubrication Procedure 7.2.2.1.

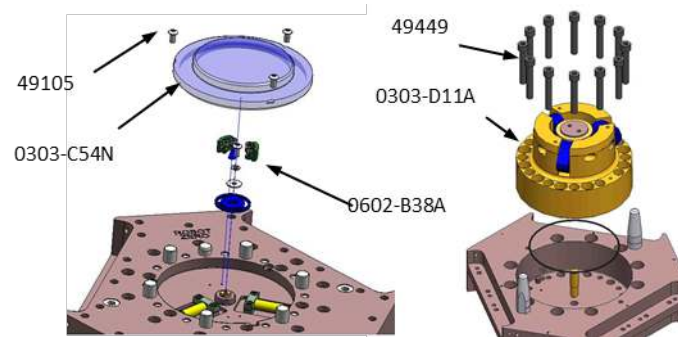




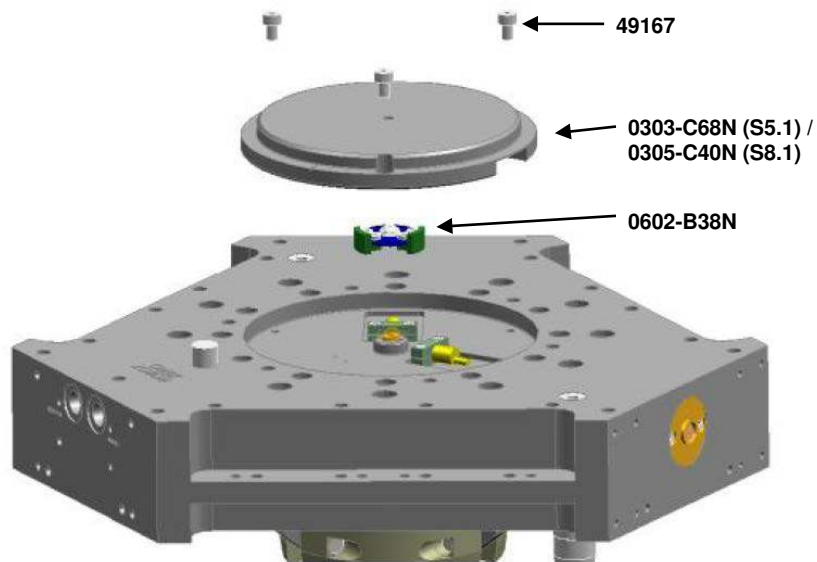
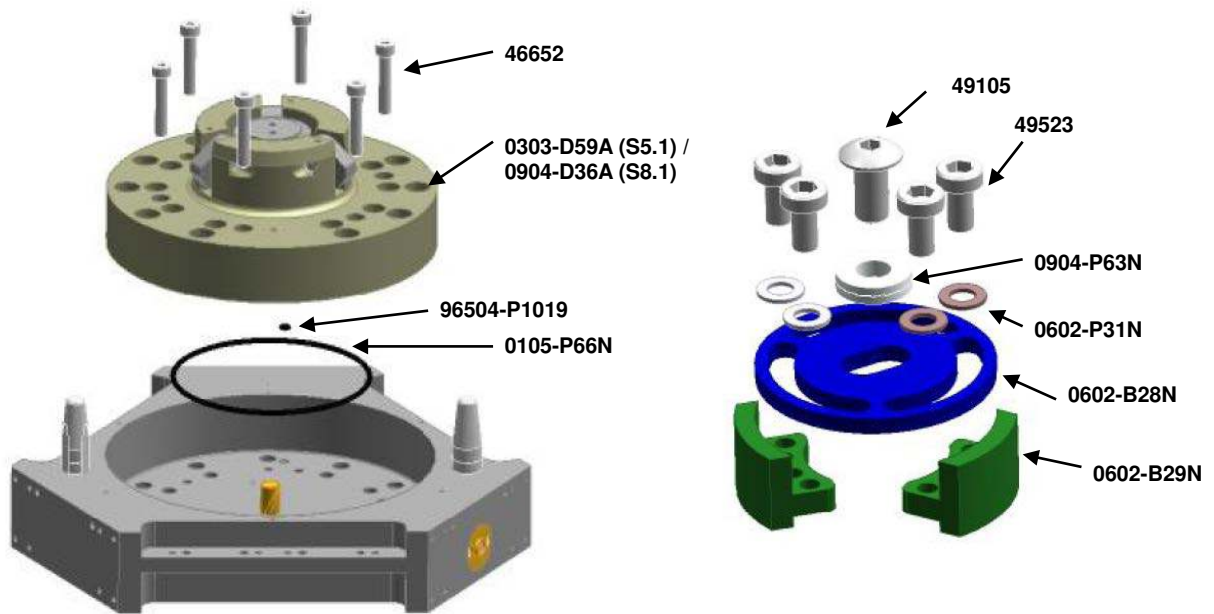
8.1.2 Sender Assembly

1. Remove Robot Adaptor from Manipulator.
2. Remove Boss, part number 0303-C54N(S3.1) / 0303-C68N(S5.1) by removing the button head socket cap screws(3), part number 49105 (S3.1)/ 49167 (S5.1). For S8.1; remove Boss (0305-C40N) by removing the (3) M5 SHCS (49167).
3. Remove Switch Actuator part number 0602-B38A by removing M5 button head cap screw (1) part number 49105 and washer, part number 0904-P63N. Ensure orientation of Switch Actuator is marked for future installation.
4. Remove M8 socket head cap screws (12), part number 49449 (S3.1), and (6) 46652 (S5.1 & S8.1) from Sender Housing part number 0303-D11A (S3.1) / 0303-D59A (S5.1) / 0904-D36A (S8.1). This step will disconnect Sender Housing from Robot Adaptor.
5. Remove Sender Housing from Robot Adaptor.
6. Remove HELIX part number 0201-B66N (S3.1) / 0105-B55N (S5.1 & S8.1) from the Robot Adaptor Housing.
7. Lubricate O-rings, part number 99502-P1054 (S3.1) / 0105-P66N (S5.1 & S8.1) and part number 96504-P1019, with Lube-A-Cyl lubricant, refer to section 7.2.2.4. Ensure O-rings have a thin coating of lubricant so that they will remain in the proper position when remounting the Sender Housing.
8. Place O-ring part number 96504-P1019 into the machined bore around the air-port hole in the Robot Adaptor Housing.
9. Place O-ring part number 99502-P1054 (S3.1) / 0105-P66N (S5.1 & S8.1) in the machined groove around the inner diameter of the Sender Housing.
10. Place Sender Housing on flat surface with the Latching Cams facing down.
11. Apply a liberal coating of White Lithium Grease refer to Section 7.2.2.4 to the outer surface and inside the Cam Follower Groove of the Actuating Cam.
12. Insert Actuating Cam into the Sender Assembly ensuring that the Cam Follower Groove lines up with the dowel inside the Cam Actuator.
13. Lineup sender housing to Robot Adaptor Housing by lining up machined match marks and dowels in both the Sender and Robot Adaptor Housings.

14. Insert the Sender Housing by setting the Robot Adaptor onto the Sender Housing. Ensure the O-rings placed in the previous steps do not move while inserting the Sender Housing.
15. Flip the Robot Adaptor over, while holding the Sender Housing in place, and place it on a flat surface.
16. Apply Loctite 242 to M8 socket head cap screws removed in 8.1.2 step 2 and thread them into Robot Adaptor Housing through the Sender Housing. Torque screws to 26 Nm (19 ft-lb).
17. Apply Loctite 222 to the M5 button head cap screw removed in 8.1.2 step 3.
18. Install Switch Actuator removed in 8.1.2 step 3 by threading the M5 button head cap screw into the HELIX through the washer, Flat Washer and Switch Actuator. Torque screw to 1.3 Nm (1.01 ft-lb). Ensure the Switch Actuator is placed in the same orientation as before removal in 8.1.2 step 3.
19. See section 3.4 for factory tooling numbers and procedure if there is any question of actuator orientation.
20. Apply Loctite 222 to the threads of the M3 button head cap screws (3) removed in 8.1.2 step 2.
21. Reinstall Boss removed in 8.1.2 step 2 by threading the M3 button head cap screws or SHCS (3) into the Robot Adaptor Housing through the Boss. Torque screws to 1.3 Nm (1.01 ft-lb).
22. Remount the Robot Adaptor to the Manipulator if no other maintenance is to be performed.



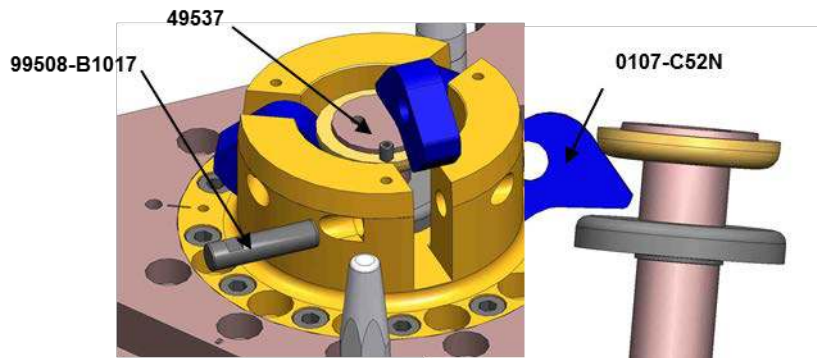
**Sigma
3.1**



Sigma
5.1 / S8.1

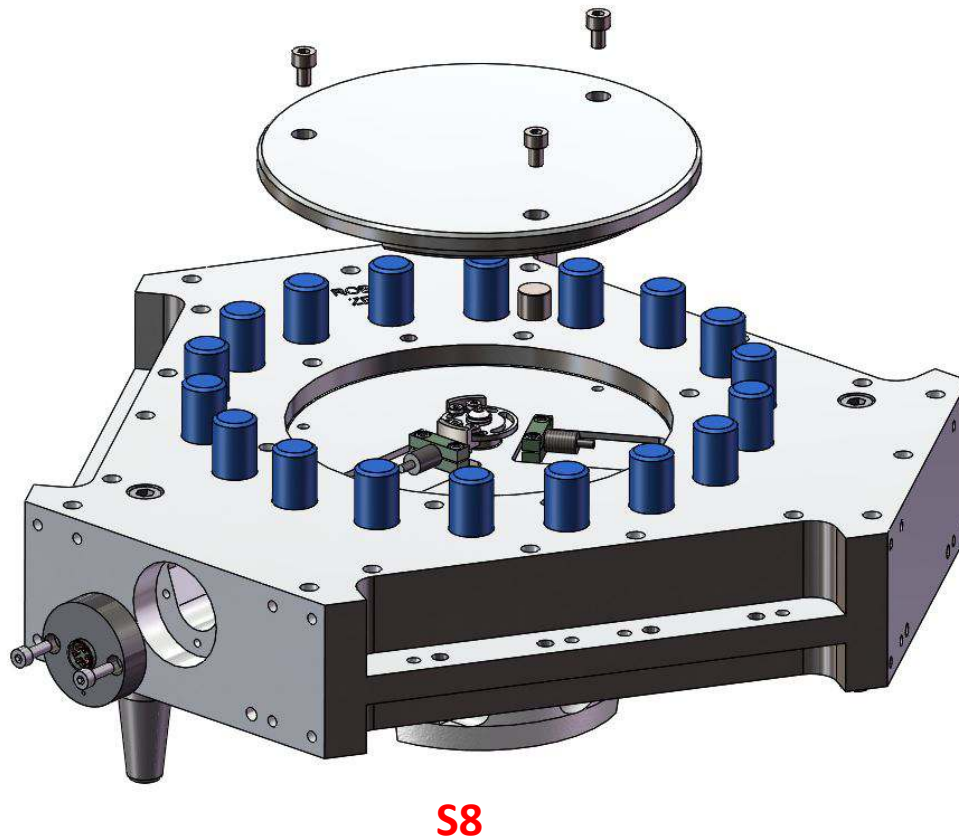
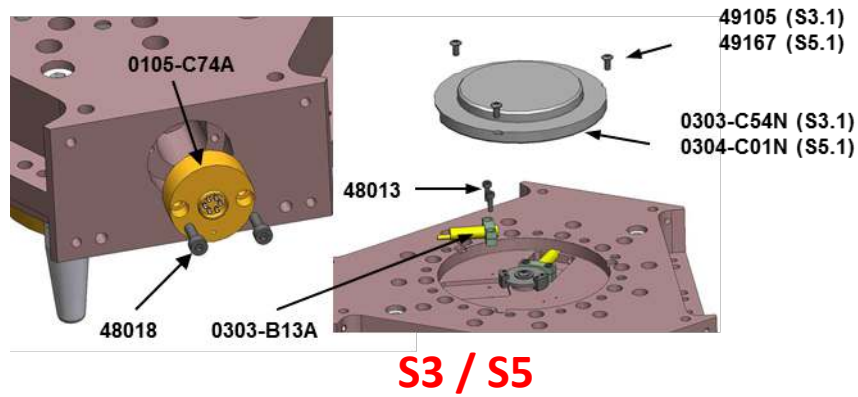
8.1.3 Latching Cams

1. Remove set screws (3) part number 49537.
2. Push out the Modified Dowel, part number 99508-B1017, while holding the Latching Cam in place part number 0107-C52N. Replace the Modified Dowel if excessive wear is observed.
3. Lubricate Modified Dowel removed in previous step and all contact surfaces on new Latching Cam with White Lithium Grease, refer to Section 7.2.2.4.
4. Hold the Latching Cam in the correct position by lining up the hole in the Cam to the hole in the Sender Housing.
5. Insert the Modified Dowel through the Sender Housing so that it is pushed through the Latching Cam and back into the Sender Housing. Ensure the flat portion of the Modified Dowel is lined up with and perpendicular to the hole for the set screw.
6. Apply Loctite 222 to the set screws (3) removed in 8.1.3 step 1 and thread them into the holes in the Sender Housing. Torque set screws to 8 Nm (67 in-lb).



8.1.4 Couple / Uncouple Proximity Switches

1. Remove Quick-Connect Assembly, part number 0105-C74A, by removing the M4 socket head cap screws (2), part number 48018.
2. Cut the crimps off the Proximity Switch cables from the Quick-Connect assembly Receptacles, part number 96504-P1022.
3. Remove Boss, part number 0303-C54N (S3.1) / 0304-C01N (S5.1) / 0305-C40N (S8.1) by removing the M3 button head cap screws(3), part number 49105 (S3.1) / 49167 (S5.1). For S8.1; remove the (3) M5 SHCS (49167) to remove the Boss.
4. Remove the Proximity Switch Assembly, part number 0303-B13A, by removing the M3 socket head cap screws (2), part number 48013.
5. Feed new Proximity Switch cables through the hole in the Robot Adaptor Housing that leads to the cavity where the Quick-Connect Assembly is mounted.
6. Apply Loctite 222 to M3 screws removed in 8.1.4 step 4.
7. Mount the new Proximity Switches to the Robot Adaptor Housing by placing it between the Proximity Bracket, part number 0303-B14N, and threading the M3 socket head cap screws(2) through the Proximity Bracket and into the Robot Adaptor Housing. Torque screws to .12 Nm (17 in-lb).
8. Re-Crimp the Proximity Switch cables to Quick-Connect Assembly Receptacles per electrical schematic 0208-B09A.
9. Apply Loctite 222 to the M4 socket head cap screws removed in 8.1.4 step 1.
10. Remount the Quick-Connect Assembly by lining up the dowel pin and threading the M4 socket head cap screws (2) into the Robot Adaptor Housing. Torque screws to 4.4 Nm (39 in-lb).
11. Apply Loctite 222 to the button head socket cap screws removed in 8.3.1.4 step 3.
12. Remount Boss removed in 8.1.4 step 3 by threading the button head socket cap screws through the Boss and into the Robot Adaptor Housing. Torque screws to .12 Nm (17 in-lb).

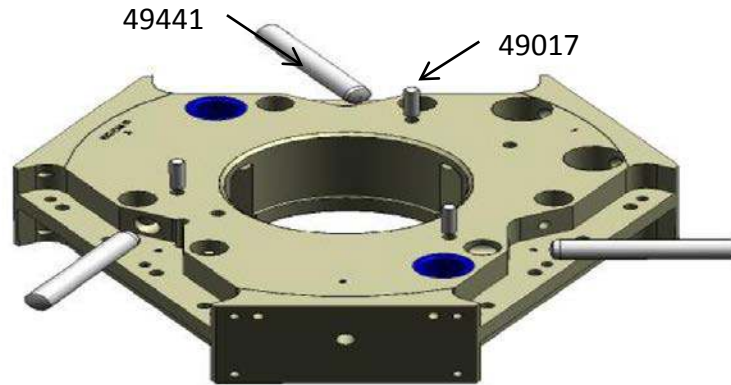


8.2 Tool Adaptor

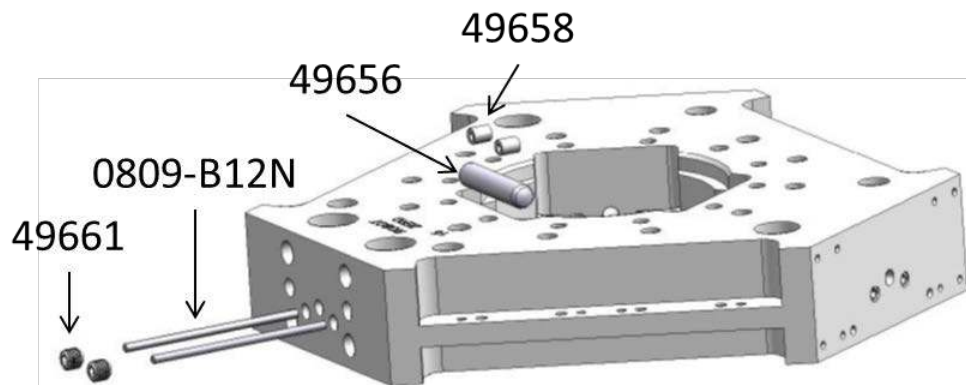
8.2.1 Receiver Assembly

1. Remove Tool Adaptor from Tool.
2. For Sigma 3, press retaining dowels (3) part number 49017 out from the tool attachment side. Press Latch dowels (3) part number 49441 out.
3. Press in new Latch dowels (3) followed by retaining dowels (3).
4. Lubricate Latch Dowels per procedure 7.2.2.2.
5. For Sigma 5, remove set screws (6) part number 49661 from tooling adaptor. Latch dowel rods (6) part number 0809-B12N and bushings (6) part number 49658 should slide out easily. Remove latch dowel (3) part number 49656 from housing.
6. Install new Latch Dowels (3) into pockets in tool adaptor.
7. Insert Latch Dowel Rods (6) into holes on sides of changer. Slide Bushings (6) on rods over latch dowel.

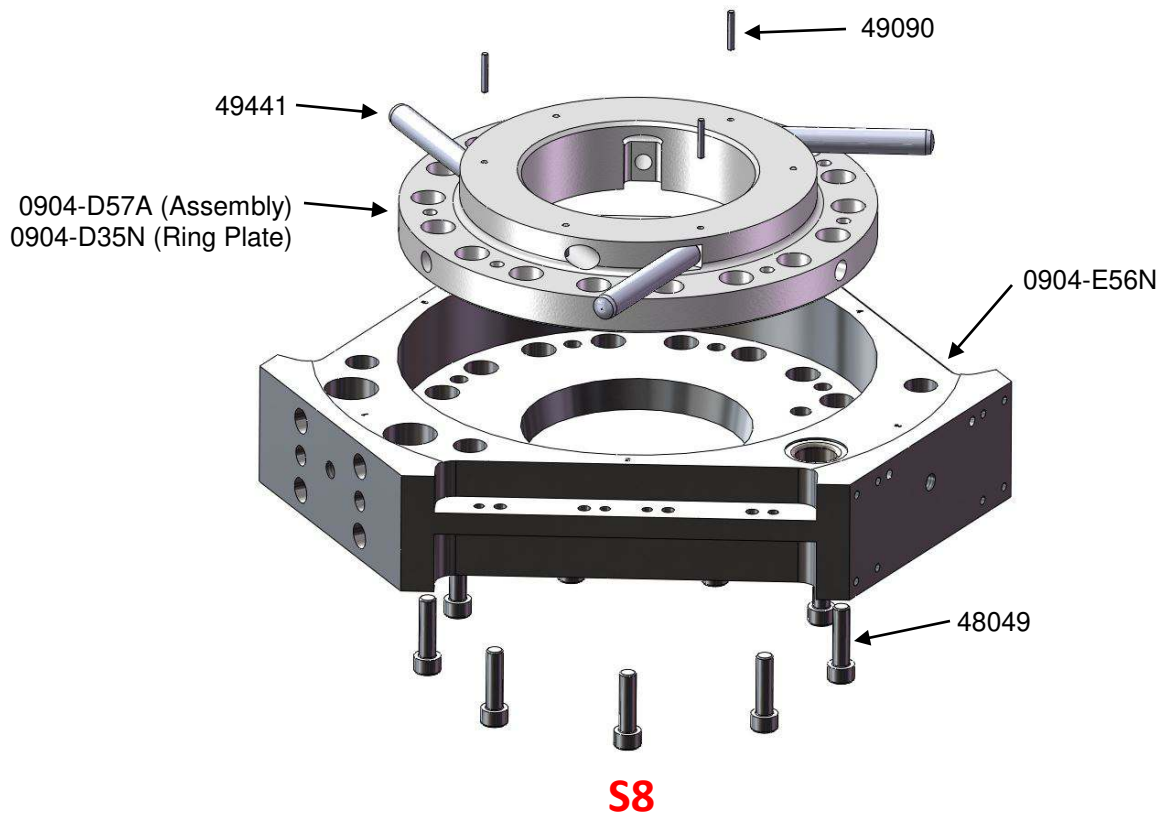
8. Apply Loctite 242 to set screws (6) and install into holes containing Latch Dowel rods. Torque to 6 in/lbs.
9. Lubricate Latch Dowels per procedure 7.2.2.2.
10. For Sigma 8, remove (9) M8 SHCS (48049) to allow the Receiver Subassembly (0904-C57A) to be removed from the Tool Housing.
11. Press out 3mm diameter pins (49090) to allow latch dowels (49441) to be removed from the Receiver Subassembly.



S3

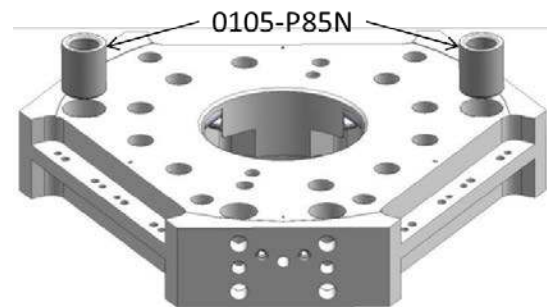
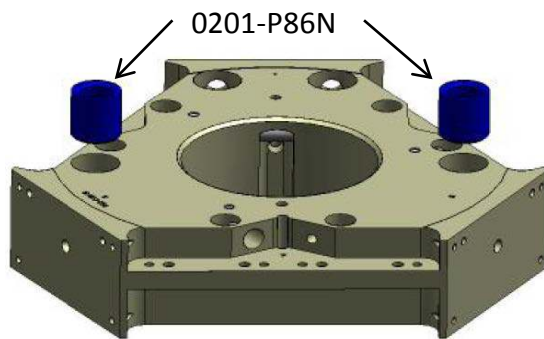


S5



8.2.2 Locating Bushings

1. Press out Locating Bushings (2) part number 0201-P86N (S3.1) / 0105-P85N (S5.1 & S8.1) from the bottom of the Tool Adaptor Housing.
2. Press in new Locating Bushings from the top of the Tool Adaptor Housing until it is flush with the Tool Adaptor Housing surface. Ensure the rounded edge of the Locating Bushing faces the top surface of the Tool Adaptor Housing.
3. Lubricate the Locating Bushing per Lubrication Procedure 7.2.2.2.



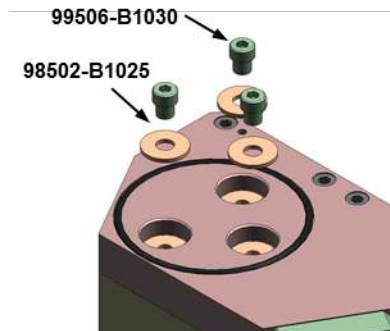
8.3 HIKVA Modules

8.3.1 Connectors

1. When installing the Strain Relief (PG36), ensure the wrench flats of the Strain Relief are parallel to the base of the Tool or Robot housing.

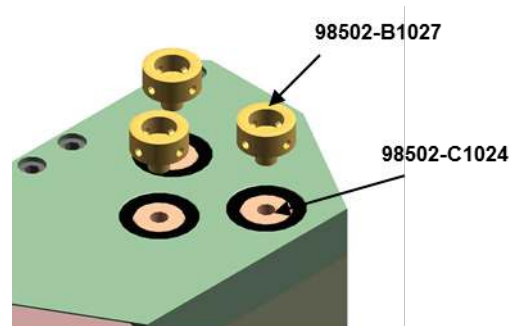
8.3.2 Contact tips (Robot side)

1. Remove Insulated Screws (3) part number 99506-B1030.
2. Remove Contact Tips (3) part number 98502-B1025.
3. Apply a thin film of Conductive Paste ARI part number 86005-P1208 / Jet Lube Inc. KOPR-SHEILD to one side of the new Contact Tips.
4. Lay the Contact Tip onto the High Power Contact so that the side coated with Conductive Paste is in contact with the High Power Contact.
5. Thread the Insulated Screws removed in 8.3.1 step 1 into the High Power Contacts through the Contact Tips. Torque the Insulated Screws to 1.1 Nm (10 in-lb).



8.3.3 Contact tips (Tool side)

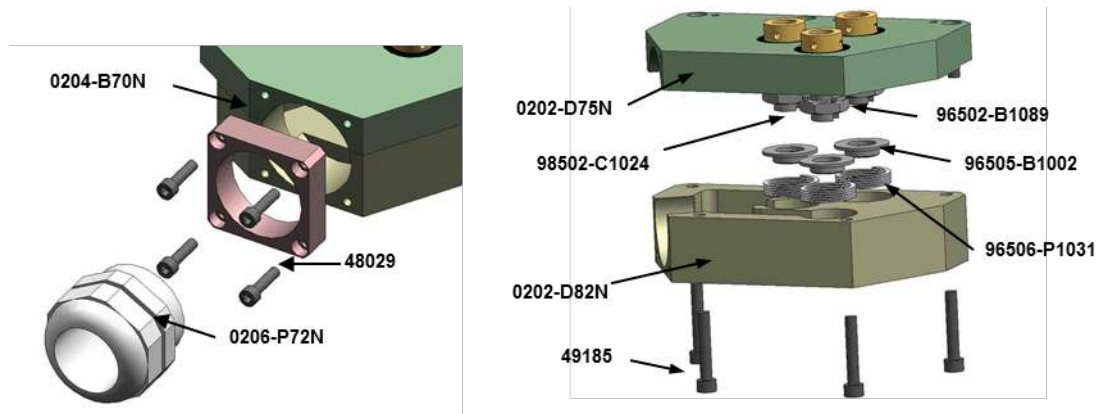
1. Remove Contact Tips (3) part number 98502-B1027.
2. Apply a thin coat of Conductive Paste ARI part number 86005-P1208 / Jet Lube Inc. KOPR-SHEILD to the exposed surfaces of the High Power Contact Bodies (3) part number 98502-C1024.
3. Thread new Contact Tips into the High Power Contact Bodies. Torque contact tips to 7.9 Nm (70 in-lb).



8.3.4 Contact springs (Tool side)

1. Unthread and remove Strain Relief (1) part number 0206-P72N.
2. Remove M5 socket head cap screws (4) part number 48029 this step will remove PG36 Strain Relief Adaptor (1) part number 0204-B70N.
3. Remove M6 socket head cap screws (4) part number 48041. This step will disconnect Tool Cover (1) part number 0202-D82N from Tool Base (1) part number 0202-D75N. Be aware that the Spring Retainers (3) part number 96505-B1002 and the Contact Springs (3) part number 96506-P1031 will be loose when the Tool Cover is removed from the Tool Base.
4. Note locations of High Power Contact Bodies for installation of new Contact Springs.
5. Remove Spring Retainers and Contact Springs.
6. Place new Contact Springs and Spring Retainers, removed in the previous step into the Tool Cover.
7. Check torque on lock nuts (3) part number 96502-B1089 at 12.4 Nm (110 in-lb).
8. Ensure High Power Contact Bodies (3) part number 98502-C1024 is placed into the correct locations in the Tool Base.
9. Apply Loctite 242 to M6 socket head cap screws (4) removed in 8.3.3 step 3.
10. Remount the Tool Cover to the Tool Base by threading the M6 socket head cap screws (4) into the Tool Base through the Tool Cover. Torque screws to 13.1 Nm (116 in-lb).

11. Apply Loctite 242 to M5 socket head cap screws removed in 8.3.3 step 2.
12. Remount PG36 Strain Relief Adaptor removed in 8.3.3 step 2 by threading the M5 socket head cap screws into the Tool Base and Tool Cover through the PG36 Strain Relief Adaptor. Torque screws to 7.6 Nm (67 in-lb).
13. Reinstall Strain Relief removed in 8.3.3 step 1. Ensure flats of Strain Relief are parallel to Tool Base.

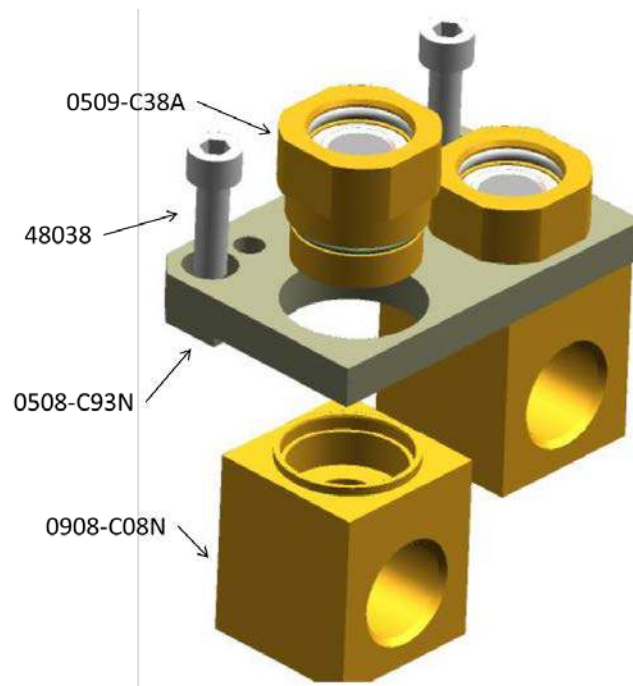


8.4 Universal Modules

Modules S-EM-R-U-2VE1/2BS and S-EM-T-U-2VE1/2BS used as a guide for all Universal Modules.

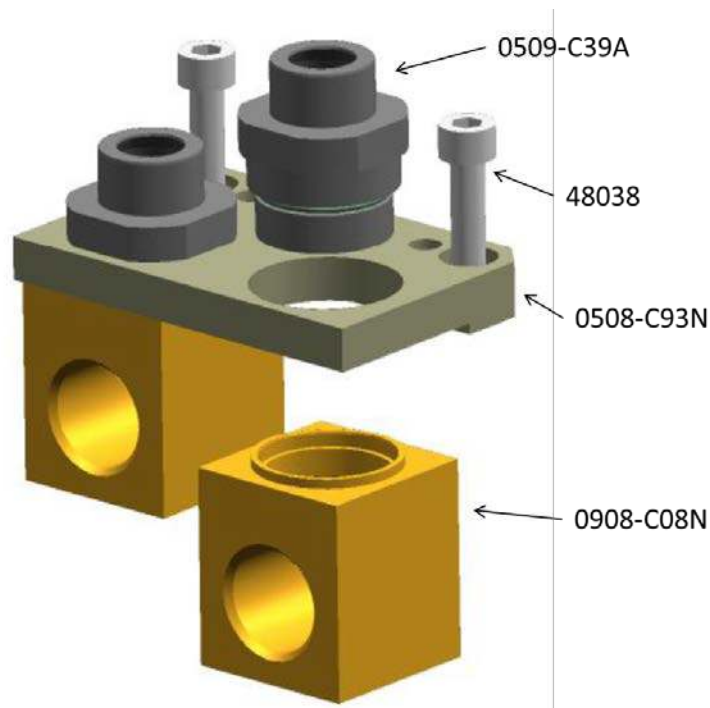
8.4.1 Fittings (Tool Side)

1. Remove Universal Module by removing the M6 socket head cap screws (2) part number 48038.
2. Remove hoses and fittings connected to Bulkhead Adaptors (2) part number 0908-C08N.
3. Unthread and remove Fittings (2) part number 0509-C38N from Bulkhead Adaptors.
4. Install new Fittings by threading them into the Bulkhead Adaptors through the Mounting Plate (1) 0508-C93N.
5. Tighten Fitting until snug. Ensure o-ring on Fittings seal to Bulkhead Adaptors.
6. Apply Loctite 242 to M6 socket head cap screws removed in 8.4.1 step 1.
7. Mount Universal Module to Robot Adaptor by threading the M6 socket head cap screws through the Mounting Plate into the Robot Adaptor. Torque screws to 13.1 Nm (116 in-lb).



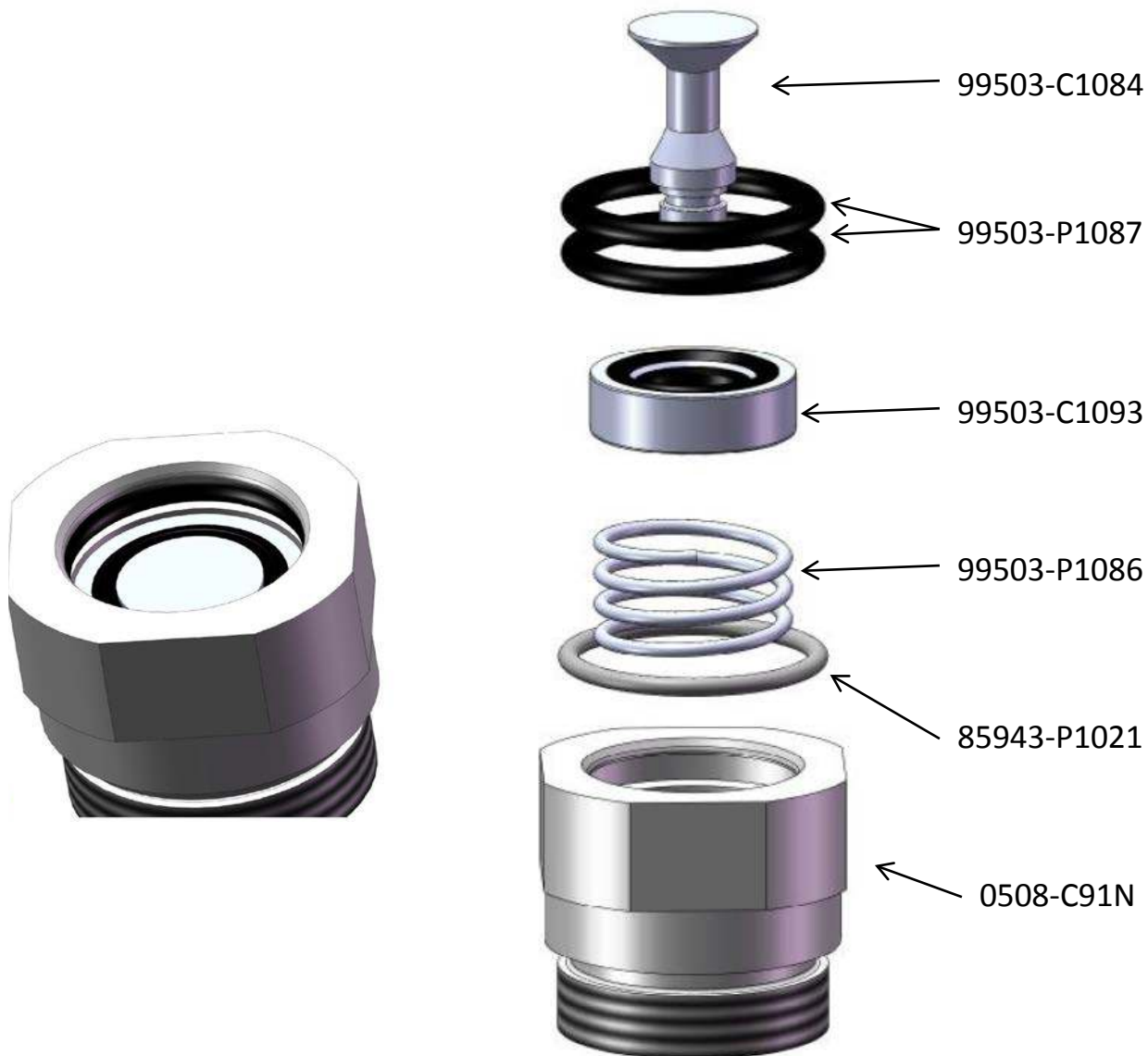
8.4.2 Fittings (Robot Side)

1. Remove Universal Module by removing the M6 socket head cap screws (2) part number 48038.
2. Remove hoses and fittings connected to Bulkhead Adaptors (2) 0908-C08N.
3. Unthread and remove Fittings (2) part number 0509-C39N from Bulkhead Adaptors.
4. Install new Fittings by threading them into the Bulkhead Adaptors through the Mounting Plate (1) part number 0508-C93N. Tighten Fitting until snug. Ensure o-ring on Fitting seals to Bulkhead Adaptors.
5. Apply Loctite 242 to M6 socket head cap screws removed in 8.4.2 step 1.
6. Mount Universal Module to Tool Adaptor by threading the M6 socket head cap screws through the Mounting Plate into the Tool Adaptor. Torque screws to 13.1 Nm (116 in-lb).



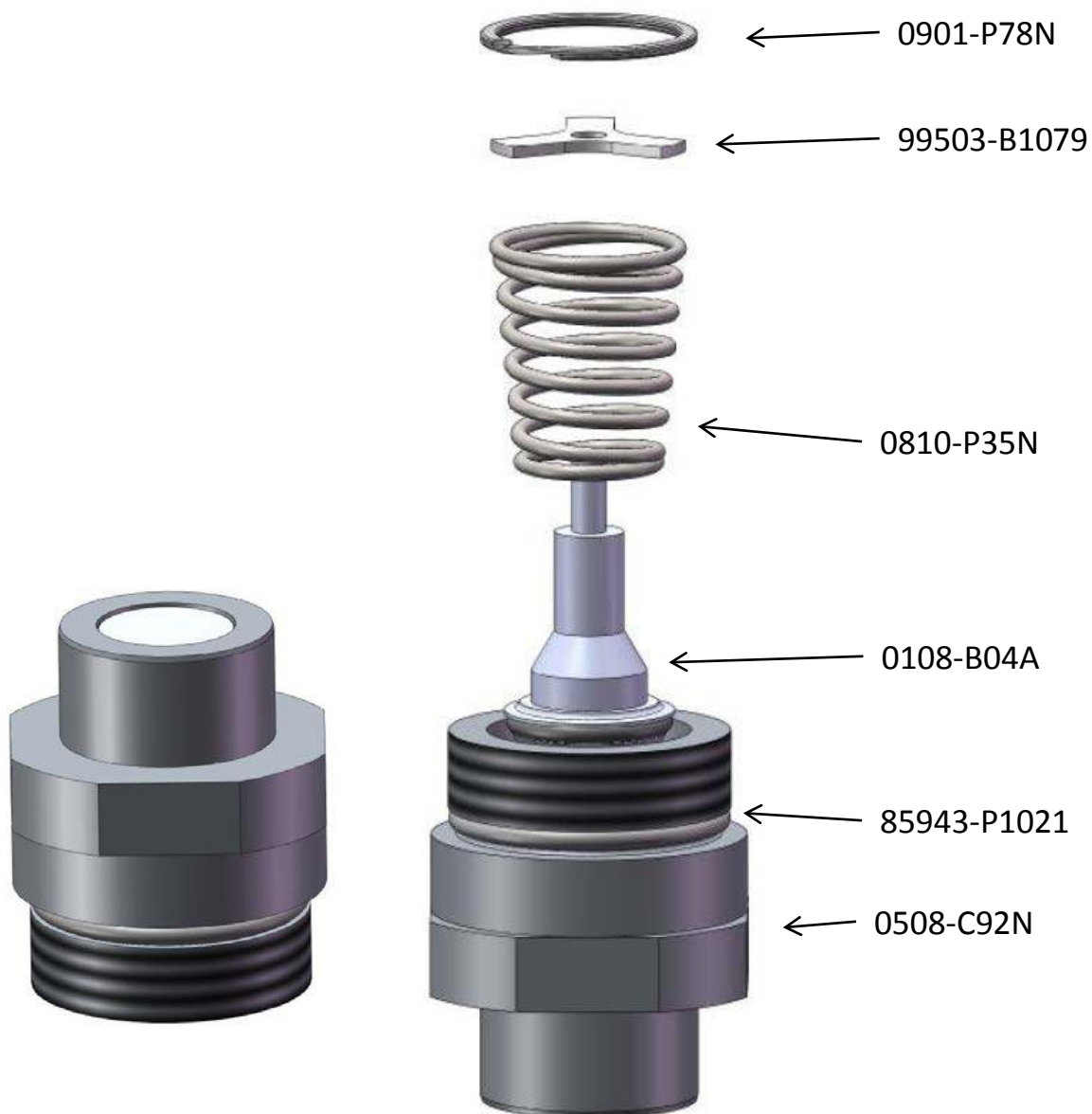
8.4.3 Fittings O-rings (Tool Side)

1. Remove per the Fitting Replacement procedure 8.4.1 steps 1 through 3.
2. Remove the Master Spool (1) part number 99503-C1084 from the Master Body (1) part number 0508-C91N. Note that the Master Spool is held in position under pressure from a spring part number 99503-P1086EX.
3. Remove Master Seal part number 99503-C1093 and spring part number 99503-P1086EX from the Master Body.
4. Remove 2 O-rings, part number 99503-P1087.
5. Apply a liberal film of White EP Bearing Grease, refer to Section 7.2.2.4, to the new O-ring and place it into the groove in the Master Body.
6. Apply a thin film of White EP Bearing Grease refer to Section 7.2.2.4 to the internal surface of the Master Body.
7. Place the spring and Master Seal into the Master Body and thread the Master Spool into the Master Body.
8. Install Fitting into Universal Module per 8.4.1 step 4 of the Fitting Replacement procedure.
9. Mount Universal Module per 8.4.1 steps 5 through 6 of the Fitting Replacement procedure.



8.4.4 Fittings O-rings (Robot Side)

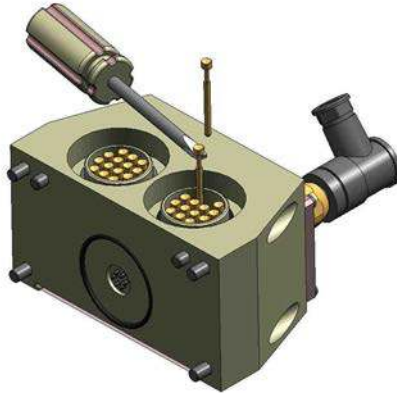
1. Remove per the Fitting Replacement procedure 8.4.2 steps 1 through 3.
2. Remove the C-ring (1) part number 0901-P78N. Note that the Spool is held in position under pressure from a spring part number 0810-P35N.
3. Remove the spider part number 99503-B1079, spring part number 0810-P35N and the spool part number 0108-B04A.
4. Remove O-ring part number 85943-P1021.
5. Apply a liberal film of White EP Bearing Grease, refer to Section 7.2.2.4 to the new O-ring and place it into the groove in the master body.
6. Apply a liberal film of White EP Bearing Grease, refer to Section 7.2.2.4 to the internal surface of the tooling body.
7. Assemble all parts as shown below on the picture.
8. Install Fitting into Universal Module per 8.4.2 step 4 of the Fitting Replacement procedure.
9. Mount Universal Module per 8.4.2 steps 5 through 6 of the Fitting Replacement procedure.



8.5 Electrical Modules

8.5.1 Spring Pins

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.



9 SPARE PARTS

The spare parts listed below are recommended to be maintained in stores for the life of the unit. The quantities are based on a single unit. If higher unit quantities are purchased please contact Technical Support to determine the recommended quantities of spares. **(See section 6.1)**

Along with the spare parts listed below it is also recommended that at least one Robot Adaptor and one Tool Adaptor be maintained in stock as immediate replacements.

9.1 Sigma 3.1

Robot Adaptor		
Description	Part Number	Quantity
Proximity Switch / Mechanical Switch*	0303-B13A / 0303-B74A	2 / 1
Sender	0303-D11A	1
Diamond Locating Pin	0201-B68N	1
Round Locating Pin	0201-B67N	1
Couple/Uncouple Spring Probes	95505-P1087	6
Latching Cam	0107-C52N	3
Pivot Pin	99508-B1017	3
Set Screw	49537	3

Tool Adaptor		
Description	Part Number	Quantity
Locating Bushing	0201-P86N	2
Latching Dowel	49441	3
Dowel Pin	49017	3

** Part number includes 2 switches. Only used with part descriptions beginning with S3.1R-P-2MEC.*

9.2Sigma 5.1

Robot Adaptor		
Description	Part number	QTY
Proximity switch / Mechanical switch*	0303-B13A / 0303-B74A	2 / 1
Sender	0303-D59A / 0307-D08A	1
Location pin (Diamond)	0108-B06N	1
Location pin (Round)	0108-B05N	1
Couple/Uncouple spring pins	95505-P1087	6
Latching cams	0107-C52N	3
Pivot pin	99508-B1017	3
Set screw	49537	3

Tool Adaptor		
Description	Part number	QTY
Locating bushing	0105-P85N	2
Latching dowel	49656	3
Dowel Rod	0809-B12N	6
Spacer	49658	6
Set Screw	49661	6

* Part number includes 2 switches. Only used with part descriptions beginning with S5.1R-P-2MEC....

9.3Sigma 8.1

Robot Adaptor		
Description	Part number	QTY
Proximity switch	0303-B13A	2 / 1
Sender	0904-D36A	1
Location pin (Diamond)	0108-B06N	1
Location pin (Round)	0108-B05N	1
Couple/Uncouple spring pins	95505-P1087	6
Latching cams	0107-C52N	3
Pivot pin	99508-B1017	3
Set screw	49537	3

Tool Adaptor		
Description	Part number	QTY
Locating bushing	0105-P85N	2
Latching dowel	49441	3
Pin to contain latching dowel	49090	6
SHCS to attach ring plate to housing	48049	9

9.4 Sigma Modules

Description	Part Number	Quantity
-------------	-------------	----------

9.4.1 External Valve Module

O-ring	91502-P1060	2
Cable	0307-P90N	1

9.4.2 Universal Module (Robot)

Fitting – coolant	0509-C39A	2
Fitting – pneumatic	99503-C1075A	2

9.4.3 Universal Module (Tool)

Fitting – coolant	0509-C38A	2
Fitting – pneumatic	99503-C1076A	2

9.4.4 HIKVA Module (Robot)

Contact Tip	98502-B1025	3
Insulated Screw	99506-B1030	3

9.4.5 HIKVA Module (Tool)

Contact Tip	98502-B1027	3
Spring	96506-P1031	3

9.4.6 Electrical Module (Robot)

5 amp Spring Probe	96504-P1087	XY*
25 amp Spring Probe	0106-P29N	XY*
Couple/Uncouple Spring Probes	96504-P1023	6
O-ring	0106-P18N	1

9.4.7 Electrical Module (Tool)

5 amp Spring Probe	96504-P1088	XY*
25 amp Spring Probe	0106-P30N	XY*

10 ENGINEERING DATA

10.1 Sigma 3, 5, & 8

	Sigma 3		Sigma 5		Sigma 8	
	S3R	S3T	S5R	S5T	S8R	S8T
Payload	350 kg (770 lb)		500 kg (1,100 lb)		800 kg (1,760 lb)	
Moment - Mx, My (Static*)	2,000 Nm (17,701 in-lb)		2,937 Nm (26,000 in-lb)		7,796 Nm (69,000 in-lb)	
Moment - Mx, My (Dynamic**)	5,000 Nm (48,680 in-lb)		7,500 Nm (66,380 in-lb)		9,000 Nm (79,655 in-lb)	
Moment - Mz (Static*)	2,075 Nm (18,365 in-lb)		3,084 Nm (27,000 in-lb)		7,796 Nm (69,000 in-lb)	
Moment - Mz (Dynamic**)	5,775 Nm (51,110 in-lb)		7,875 Nm (69,700 in-lb)		9,000 Nm (79,655 in-lb)	
Height	107 mm (4.21 in)	60 mm (2.36 in)	107 mm (4.21 in)	60 mm (2.36 in)	107 mm (4.21 in)	60 mm (2.36 in)
Coupled Height	120 mm (4.72 in)		120 mm (4.72 in)		120 mm (4.72 in)	
Weight	7.34 kg (16.5 lb)	5.13 kg (11.2 lb)	11.43 kg (24.7 lb)	8.66 kg (18.7 lb)	21.18 kg (46.6 lb)	11.84 kg (26.0 lb)
Couple/Uncouple Port Size	1/4" BSPP		1/4" BSPP		1/4" BSPP	
Repeatability - X, Y	± 0.02 mm (± 0.0008 in)		± 0.02 mm (± 0.0008 in)		± 0.02 mm (± 0.0008 in)	
Repeatability - Z	± 0.013 mm (± 0.0005 in)		± 0.013 mm (± 0.0005 in)		± 0.013 mm (± 0.0005 in)	
Operating Temperature	5 to 60 °C (40 to 140 °F)		5 to 60 °C (40 to 140 °F)		5 to 60 °C (40 to 140 °F)	
Operating Pressure	5 to 7 bar (72 to 101 psi)		5 to 7 bar (72 to 101 psi)		5 to 7 bar (72 to 101 psi)	
Noise Emissions	≤ 70 dB(A) in any direction		≤ 70 dB(A) in any direction		≤ 70 dB(A) in any direction	

* The static load rating is the maximum moment load the Sigma Tool Changer can receive during normal operating conditions (100% duty cycle).

** The dynamic load rating is the maximum moment load the Sigma Tool Changer can receive during abnormal (e.g., E-Stop) operating conditions.

10.2 Sigma Modules

*Universal Modules can be used for coolant or pneumatic pass through.

**Contain fittings and tubing required to supply air to external valve module S.1-EM-R-VD.

10.2.1 Valves

Universal Modules*	Installable on these sides	Working pressures	Port Sizes
S.1-EM-R-V	1	6 bar, 87 psi	¼ BSPP
S.1-EM-R-VD	1	6 bar, 87 psi	¼ BSPP

10.2.2 Universal Modules

Universal Modules*	Installable on these sides	Working pressures	Port Sizes
S-EM-R-U-2VE1/2BS	2,4,6	17 bar, 250psi max	½ BSPP
S-EM-T-U-2VE1/2BS			
S-EM-R-U-2VE1/2BS-V**			
S-EM-R-U-2VE1/2BS-B			
S-EM-T-U-2VE1/2BS-B			
S-EM-R-U-2VE1/2N			½ NPT
S-EM-T-U-2VE1/2N			
S-EM-R-U-2VE1/2N-V**			
S-EM-R-U-2VE1/2N-B			
S-EM-T-U-2VE1/2N-B			

10.2.3 HIKVA Modules

HIKVA Modules	Installable on these sides	# of Contacts	Amp rating	Voltage rating
S-EM-R-E-HIKVAEPG-00	2,4,6	3	200A**	600v
S-EM-T-E-HIKVAEPG-00				

** 200 Amps Continuous.

NOTICE

RECOMMEND CLEAN, DRY AIR TO MAINTAIN LONGEVITY OF ASSOCIATED AIR VALVES.

RECOMMEND FILTERED WATER (50 MICRON) TO HELP MAINTAIN WATER/UNIVERSAL VALVE PERFORMANCE.

10.2.4 Electrical Modules

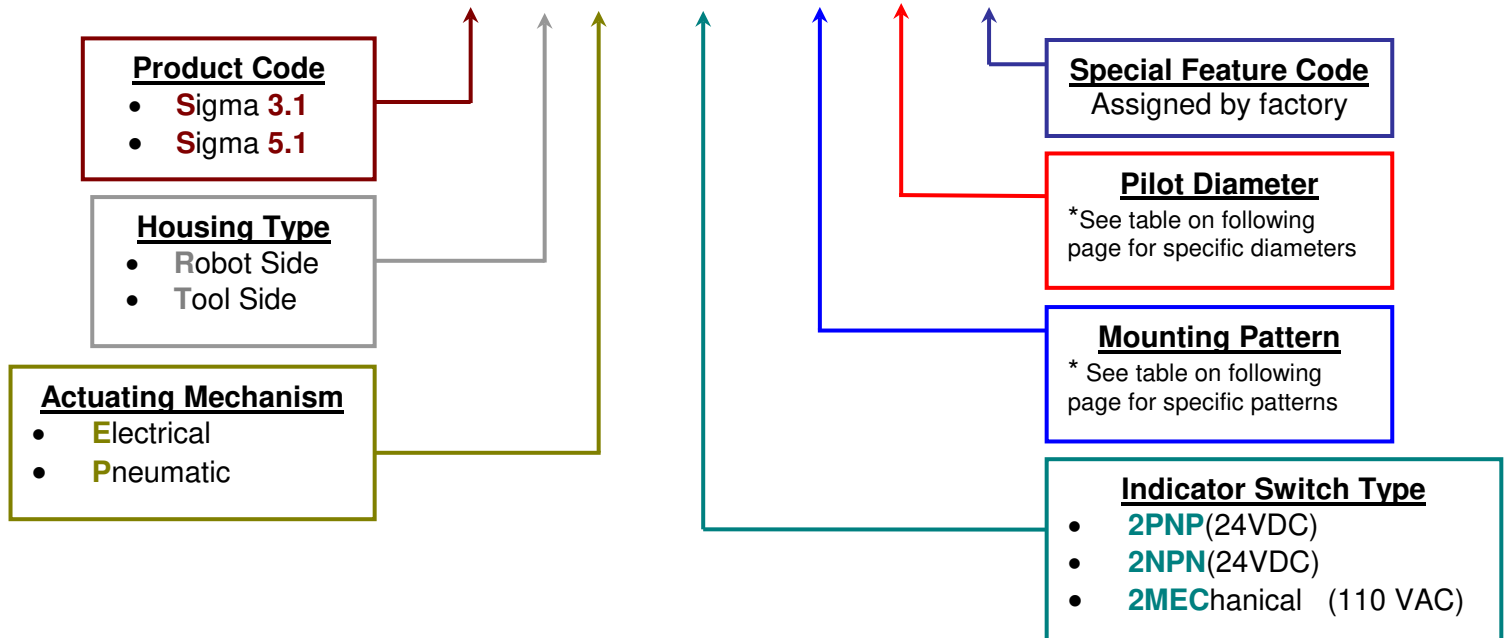
Electrical Modules	Installable on these sides	# of Contacts	Amp rating	Voltage rating
S-EM-R-E-C/UC-TK	3	6 pin Turck	5A	N/A
S-EM-R-E-13.05/4.25	3*, 5	13 / 4	5A / 25A	
S-EM-T-E-13.05/4.25				
S-EM-R-E-13.05-MS		13	5A	
S-EM-T-E-13.05-MS				
S-EM-R-E-15.05-MS		15		
S-EM-T-E-15.05-MS				
S-EM-R-E-15.05-PG29		27		
S-EM-T-E-15.05-PG29				
S-EM-R-E-27.05-MS-VD		27		
S-EM-T-E-27.05-MS-VD				
S-EM-R-E-29.05-MS-VD		29		
S-EM-T-E-29.05-MS-VD				
S-EM-R-E-30.05-MS		30		
S-EM-T-E-30.05-MS				
S-EM-R-E-32.05-MS		32		
S-EM-T-E-32.05-MS				
S-EM-R-E-32.05-PG29		32		
S-EM-T-E-32.05-PG29				
S-EM-R-E-35.05-MS		35		
S-EM-T-E-35.05-MS				
S-EM-R-E-37.05-MS		37		
S-EM-T-E-37.05-MS				
S-EM-R-E-37.05-PG29				
S-EM-T-E-37.05-PG29				

* Module must be mounted on Side 3 if used to pass Couple/Uncouple signals.

11 ORDERING INFORMATION

11.1 XChange Sigma 3.1 & Sigma 5.1

S3.1R-P-2PNP-A-080-A000



11.1.1 Sigma 3.1

Assembly pattern	Ø flange-collar	Brand Robot	Type Robot
A	050	NACHI	SH133-01/SH166-01
A	063	MOTOMAN	SP100X/SP200X-150 UP130/UP165/UP200
A	080	ABB	IRB 640 IRB 6400(R/S)
A	080	FANUC	F-200IB M-410IHS/IHW R-2000IA(165F/165R/125L/165CF) S-430I(Standard) S-900IH/IL/IW
B	080	FANUC	R-2000IA(200F/200R/200T) S-430I
B	080	KAWASAKI	ZX130/ZX165
C	100	KUKA	KR(150/180/180PA/125/150/200/210)
C	100	NACHI	SH200-01
D	100	FANUC	M-410IWW
D	100	KAWASAKI	ZX200S/ZX300S
E	100	ABB	IRB 6600
F	050	NACHI	SC80LF-02/ SC120LF-02/ SC300F-02

11.1.2 Sigma 5.1

Assembly pattern	Ø flange-collar	Brand Robot	Type Robot
A	080	NACHI	SH200-01
A	100	KUKA	KR(150/180/180PA/125/150/200/210)
B	100	FANUC	M-410IWW
C	125	KUKA	KR(350/360/500)
C	160	MOTOMAN	UP350/UP500
E	100	ABB	IRB6600
F	125	ABB	IRB7600
G	100	MOTOMAN	SP400X

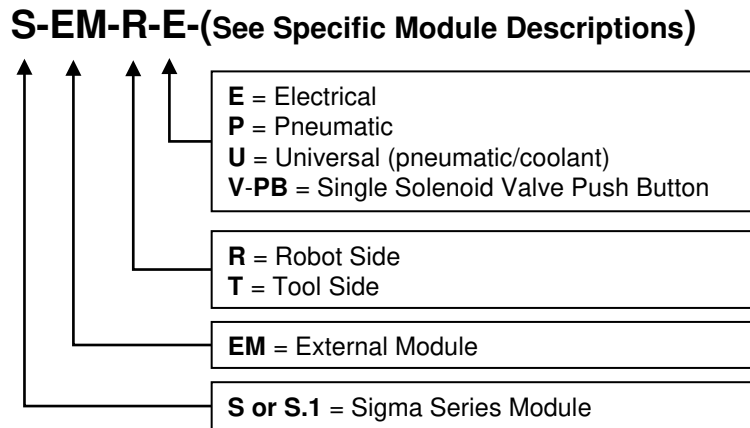
11.1.3 Sigma 8.1

Assembly pattern	Ø flange-collar	Brand Robot	Type Robot
H	160	KUKA	Titan
J	160	FANUC	New Titan

** If the manipulator in use does not coincide with the table above, contact Technical support
 For further assistance. (See section 6.1)*

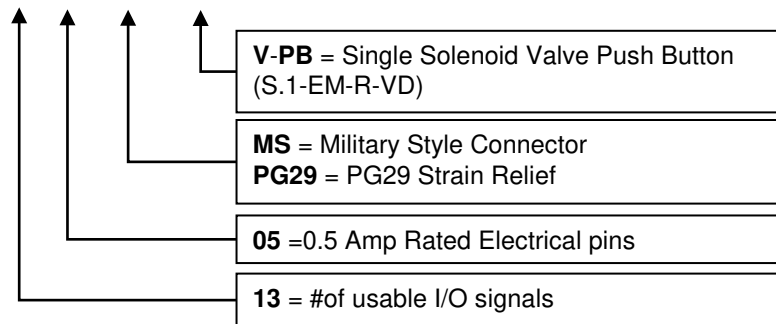
11.2 Sigma Modules

11.2.1 General Modules Description

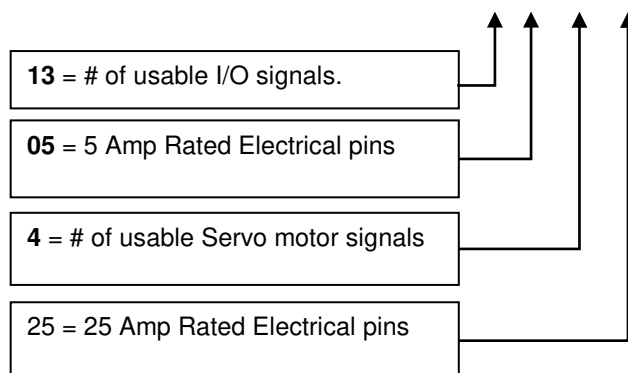


11.2.2 Specific Module Description

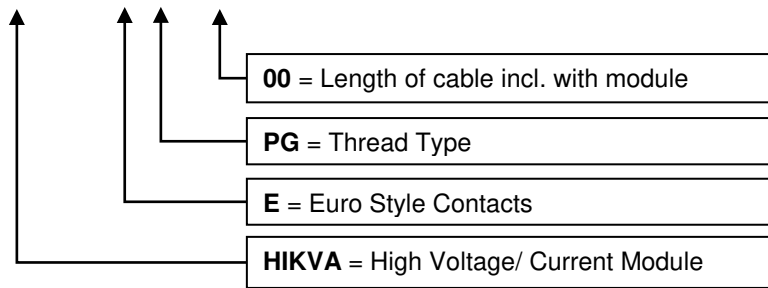
13.05-MS-VD



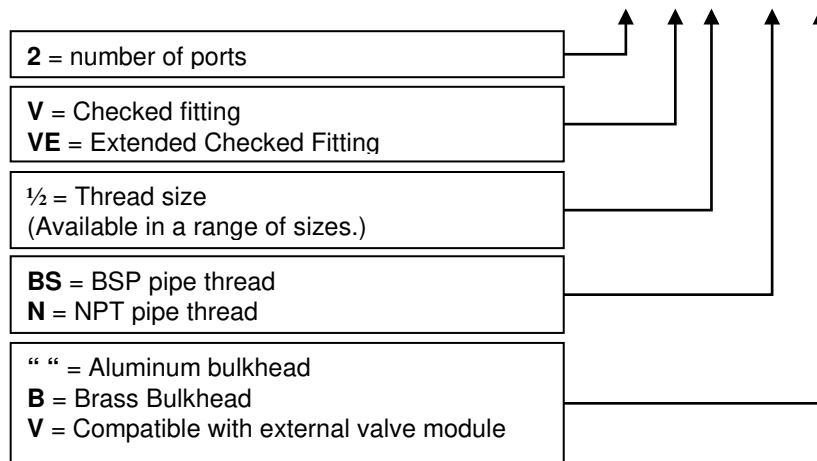
13.05/4.25



HIKVAEPG-00



2VE1/2BS-B



12 INFORMATIONAL DRAWINGS

The drawings in this section can assist with installation, use and identification of replacement parts for Sigma 3.1, Sigma 5.1, & Sigma 8.1 XChange Tool Change Systems. These drawings are a representative sample of all modules available. Please contact **Applied Robotics Technical Support** if you have any questions or need drawings for your specific modules. (See section 6.1)

12.1 Sigma 3.1

DRAWING NUMBER	DESCRIPTION
1206-D03A sheets 1, 2, & 3	Outline drawings for S3.1R-P-2PNP-A-080-H-A000
0303-D53A sheets 1 & 2	Outline drawings for S3.1T-P-A-100-A000
1206-D09A sheets 1, 2, & 3	Outline drawings for S3.1R-P-2PNP-E-100-H-A000
0305-D13A sheets 1 & 2	Outline drawings for S3.1T-P-B-100-A000
1206-D03A sheet 3	Mounting pattern drawing for S3.1R-P-2PNP-A-080-H-A000
0303-D53A sheet 3	Mounting pattern drawing for S3.1T-P-000-A-100-A000
1206-D09A sheet 3	Mounting pattern drawing for S3.1R-P-2PNP-E-100-H-A000
0305-D13A sheet 3	Mounting pattern drawing for S3.1T-P-000-B-100-A000
0208-B09A	Electrical Schematic for Couple/Uncouple switches

12.2 Sigma 5.1

DRAWING NUMBER	DESCRIPTION
1206-E13A sheets 1, 2, & 3	Outline drawings for S5.1R-P-2PNP-A-100-H-A000
0303-E62A sheets 1 & 2	Outline drawings for S5.1T-P-000-A-125-A000
1206-E18A sheets 1, 2, & 3	Outline drawings for S5.1R-P-2PNP-F-125-H-A000
0305-E65A sheets 1 & 2	Outline drawings for S5.1T-P-000-B-125-A000
1206-E13A sheet 3	Mounting pattern drawing for S5.1R-P-2PNP-A-100-H-A000
0303-E62A sheet 1	Mounting pattern drawing for S5.1T-P-000-A-125-A000
1206-E18A sheet 3	Mounting pattern drawing for S5.1R-P-2PNP-F-125-A000
0305-E65A sheet 3	Mounting pattern drawing for S5.1T-P-000-B-125-A000
0802-E25A sheet 3	Mounting pattern drawing for S5.1T-P-000-C-125-A000
0208-B09A	Electrical Schematic for Couple/Uncouple switches

12.3 Sigma 8.1

DRAWING NUMBER	DESCRIPTION
0902-E96A	S8.1R-P-2PNP-H-160-A000
0902-E97A	S8.1T-P-000-D-160-A000
0208-B09A	Electrical Schematic for Couple/Uncouple switches

12.4 Sigma Modules

DRAWING NUMBER	DESCRIPTION
0310-E99A	Sigma 3.1 & 5.1 Side Designations
0108-C71A	S-EM-R-U-2V1/2BS
0108-C72A	S-EM-T-U-2V1/2BS
0309-C71A	S-EM-R-U-2V1/2BS-V
0311-C05A	S-EM-R-U-2V1/2N-V
0305-C80A	S.1-EM-R-VD
0306-B30A	Schematic for S.1-EM-R-VD
0202-D71A	S-EM-R-E-HIKVAEPG-00
0202-D72A	S-EM-T-E-HIKVAEPG-00
0304-C28A	S-EM-R-E-C/UC-TK
0304-B30A	Electrical Schematic for S-EM-R-E-C/UC-TK
0305-D24A	S-EM-R-E-13.05-MS
0305-D25A	S-EM-T-E-13.05-MS
0305-D99A	Electrical Schematic for S-EM- <u>R</u> /T-E-13.05-MS
0305-D30A	S-EM-R-E-15.05-PG29
0305-D31A	S-EM-T-E-15.05-PG29
0306-D03A	Electrical Schematic for S-EM- <u>R</u> / <u>T</u> -E-15.05-PG29
0309-D41A	S-EM-R-E-27.05-MS-VD
0309-D42A	S-EM-T-E-27.05-MS-VD
0309-D43A	Electrical Schematic for S-EM- <u>R</u> / <u>T</u> -E-27.05-MS-VD
0202-D89A	S-EM-R-E-13.05/4.25
0202-D90A	S-EM-T-E-13.05/4.25
0107-D38A	Electrical Schematic for S-EM- <u>R</u> / <u>T</u> -E-13.05/4.25

13 APPENDIX

13.1 Letter Aug 28, 2006 : In response to a recent occurrence involving the release of a tool unexpectedly the following applies

The most recent manual clearly states that air pressure *should not* be applied unless the proper signals, indicating a safe condition have been checked and verified to be valid.

It is also clearly stated that any operation of the tool changer without consideration of these conditions may result in damage to a tool and/or bodily injury to the individual performing these unapproved actions.

When air pressure is removed from a tool changer that is in the uncoupled (cams retracted) position, the fail safe mechanism will move the cams into the coupled (extended) position

When reapplying air pressure to a tool changer that has been previously left in an uncoupled state and the air pressure removed, the results can only be to uncouple. Any expectations otherwise is illogical and evident of a lack of attention to the conditions at hand.

In addition to the previous, it is **never** an accepted practice to run a robot or any other system or device without the required services being properly and sufficiently applied specifically electrical control of the valves and pressurized air.

Whenever a situation arises, whereby the robot is restarted after a stoppage of any kind, the tool changer should be moved to the tool stand, and then and only then be evaluated. Using this procedure insures that any unexpected couple or uncouple actuations that occur, are safe and without damaging effects.

I hope this clarifies our position and depicts our solution for the event.

Best Regards,

Clay Cooper
Engineering Manager