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F. High-Current Modules

PG1—Ground Module

1. Product Overview

The high-current modules are designed to carry high-current from a power supply to customer tooling. They consist of plated contacts, capable of carrying 200 Amps when coupled. The voltage should not exceed 600 Volts. Power must be off when coupling and uncoupling. Refer to *Section 8—Drawings* for more information.

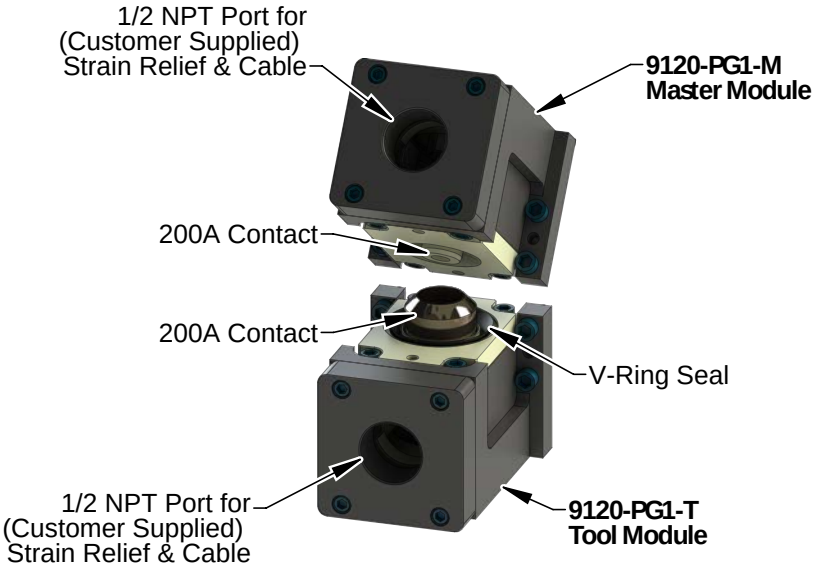
DANGER: This module has a voltage of 50V or greater; always remove power before contacting the module. Arcing and damage occur if power is not removed from the module during maintenance or service. Always remove power before attaching or disconnecting cables, separating or inserting the mating couplers, or making any contact with the Tool Changer or Utility Coupler.

The high-current modules use advanced, patented, cone-mating technology to transfer current from the Master to the Tool. The mating conical surfaces provide a large contact area, excellent misalignment capability, and allow efficient coupling/uncoupling without high spring forces or excessive wear. If required, the contact tips on either the Master or Tool can be easily replaced without removing the wiring.

The contact tip on the Master side are recessed well below the surface and contain a central insulated post. The modules were designed so that the finger of an average human adult cannot touch the metallic parts.

The high current Tool module provides compliant motion in the power contacts, ATI requires the use of high-flex type with fine stranding cables and proper stain relief to allow for free axial motion of the Tool module's contact base.

Figure 1.1 —PG1 Modules



CAUTION: Do not couple or uncouple the high-current modules unless electrical power has been disconnected and discharged both upstream and downstream from the modules. Arcing and contact damage will occur. Remove power and discharge both upstream and downstream modules before coupling or uncoupling modules.

2. Installation

The PG1 modules has a high-current electrical contact and are equipped with a 1/2" NPT port in order to support a customer supplied strain relief fitting. Prepared cable ends are fed through the strain relief and into the modules where the conductors are attached to the contact bases. For ease of cable installation it is recommended that the modules be removed from the tool changer

Installation and removal are outlined in the following section. These steps also detail connecting cables to the contacts.

DANGER: This module has a voltage of 50V or greater; always remove power before contacting the module. Arcing and damage occur if power is not removed from the module during maintenance or service. Always remove power before attaching or disconnecting cables, separating or inserting the mating couplers, or making any contact with the Tool Changer or Utility Coupler.

WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

CAUTION: Do not use stiff, heavy stranded cables which can inhibit operation of the high current module. Stiff cables can prevent compliant motion of the contacts and cause an intermittent or improper power connection. Operation of the high current module requires the customer supplied cables to be high-flex type with fine stranding and sufficient strain relief to allow free cable motion.

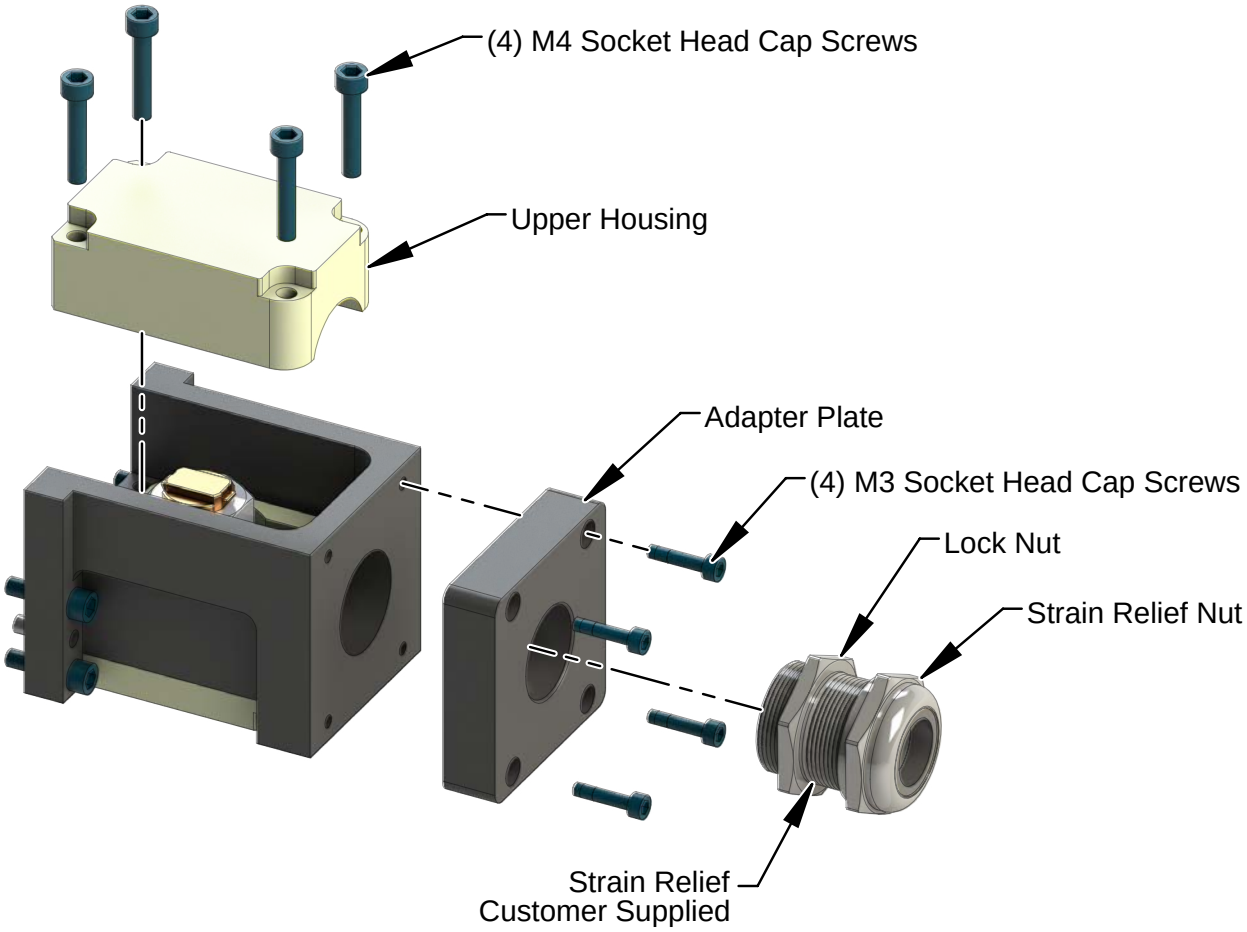
2.1 Cable Installation

Refer to *Figure 2.1*

Tools required: *2.5 mm and 3 mm hex keys, 13 mm hex key, crimping tool, wire strippers, torque wrench*

1. If already installed on the application, remove the module. Refer to *Section 2.4—Module Removal*.
2. Remove the (4) M3 socket head cap screws securing the adapter plate to the module using a 2.5 mm hex key.
3. Remove the adapter plate, this will make it easier to install the strain relief.
4. Insert the customer supplied strain relief fitting (with lock nut) into the adapter plate and orient the fitting as desired.
5. Use an appropriate tool and tighten the strain relief lock nut to the front face of the adapter plate. Leave the strain relief nut loose.
6. Remove the (4) M4 socket head cap screws securing the upper housing to the module using a 3 mm hex key.
7. Assemble the adapter plate to the housing, secure with the (4) M3 socket head cap screws and tighten to 10 in-lbs (1.13 Nm).

Figure 2.1—Install Strain Reliefs and Remove Cover

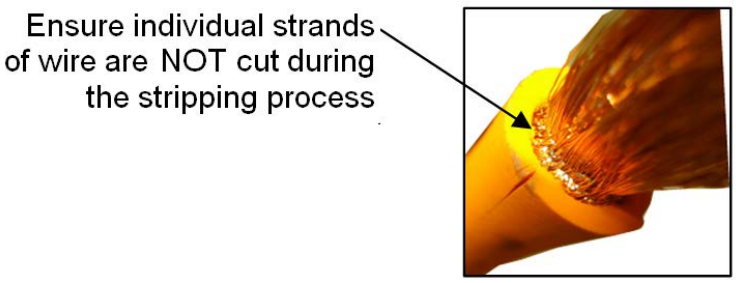


8. Prepare the cable end by stripping (1-1/8 inches suggested length) of the cables inner and outer jackets.

NOTICE: Ensure individual strands of wire are NOT cut while removing the cable jack.

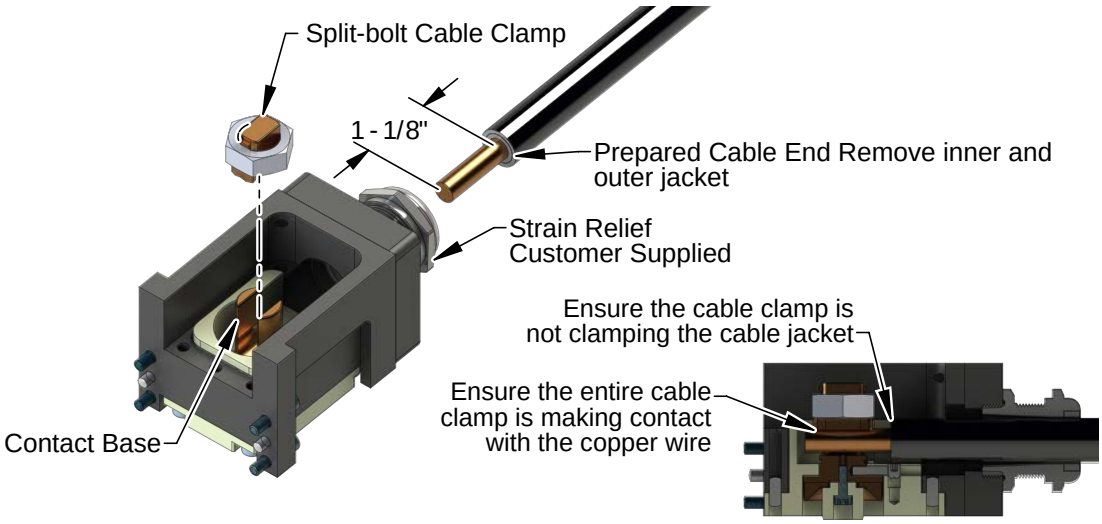
NOTICE: Dimensions given in the cable preparation are suggested lengths only. The customer must determine the proper length for jacket removal and heat shrink tubing if required based on your specific application.

Figure 2.2—Wire Stripping



9. Remove the split-bolt cable clamp using a 13 mm wrench. Refer to *Figure 2.3*.
10. Insert the prepared cable end through the customer supplied strain relief fitting and the contact base.
11. Thread the split-bolt cable clamp on the contact base. Tighten securely using a 13 mm wrench. Torque to 90 in-lbs (10 Nm). After you have made sure that no loose wire filaments are protruding.
12. Tighten the strain relief nut.

Figure 2.3—Attach Cable to the PG1 Module



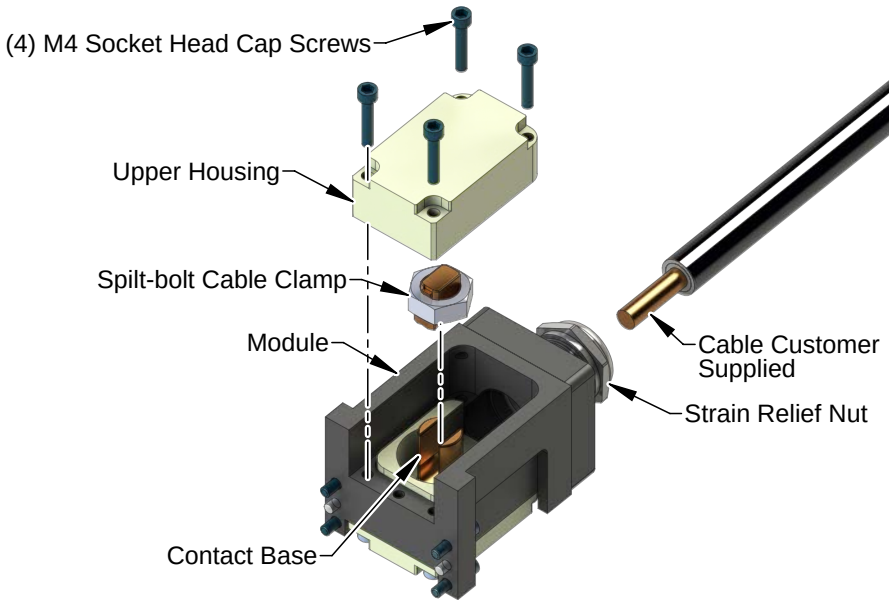
13. Assemble the upper housing to the module and secure it with the (4) M4 socket head cap screws using a 3 mm hex key. Tighten to 12 in-lbs (1.35 Nm)
14. Install the module to the application. Refer to *Section 2.3—Module Installation*.

2.2 Cable Removal

Tools required: *13 mm hex key*

1. Remove the module from the application. Refer to *Section 2.4—Module Removal*.
2. To access the inside of the housings remove the four M4 socket head cap screws securing the upper housing to the module.
3. Loosen the strain relief nuts.
4. Remove the split-bolt cable clamps holding the cables to the contact base and set aside.
5. Pull the cable out through the strain relief.
6. To install a new cable refer to *Section 2.1—Cable Installation* and start with step *10*.

Figure 2.4—Installation



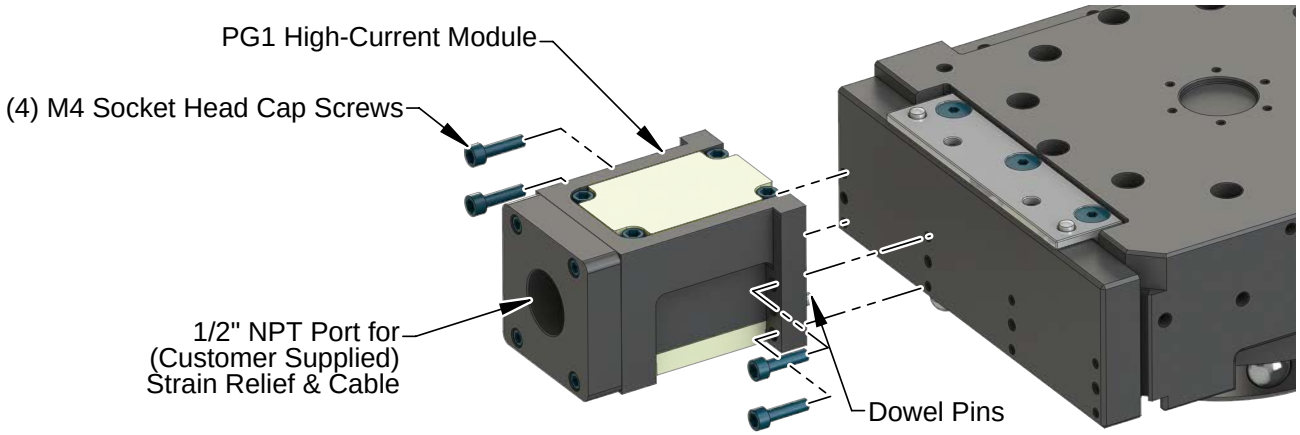
2.3 Module Installation

Tools required: *3 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite® 222*

1. Clean the mounting surfaces
2. Place the module on the appropriate location of the Tool Changer or Utility Coupler body.
3. If the (4) M4 socket head cap screws do not have pre-applied adhesive, apply Loctite 222 to the (4) M4 fasteners.
4. Using a 3 mm hex key, secure the module to the application. Tighten to 15 in-lbs (1.7 Nm).
5. Safely resume normal operation.

Figure 2.5—Installation



2.4 Module Removal

Tools required: *3 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Prior to removing the module, use a marker pen to scribe a line or indication between the Tool Changer or Utility Coupler and module body as a reminder where the module is to be re-installed.
5. Remove the (4) M4 socket head cap screws, using a 3 mm hex key, and remove the module from the application.

3. Operation

The high-current modules are designed to carry large currents to various industrial devices, providing a separable joint in the power wiring. To maximize the service life of these components the following points must be observed:



WARNING: The contacts are not a switch. For safety and to prevent equipment damage, disconnect and drain all power before coupling or uncoupling the Tool Changer or Utility Coupler.



CAUTION: Do not couple or uncouple the high-current modules unless electrical power has been disconnected and discharged both upstream and downstream from the modules. Arcing and contact damage will occur. Remove power and discharge both upstream and downstream modules before coupling or uncoupling modules.



CAUTION: Improper cable routing can result in wires and cables being pinched in the joint between the Tool Changer plates and premature failure of the electrical connectors. Properly route and secure all cables, particularly on the Master side.



CAUTION: Use of stiff heavy stranded cables can cause improper operation of the high current module. The use of stiff cables can prevent compliant motion of the contacts and cause an intermittent or improper power connection. For proper operation the ATI requires the customer supplied cables be of the high-flex type with fine stranding and proper strain relief to allow for 4 mm of free axial motion of the module's Tool side contact base.

4. Maintenance

Under normal conditions, no special maintenance is necessary; however, it is recommended that periodic inspections be performed to assure long-lasting performance and verify that unexpected damage has not occurred. Refer to the list below for periodic maintenance items.



DANGER: This module has a voltage of 50V or greater; always remove power before contacting the module. Arcing and damage occur if power is not removed from the module during maintenance or service. Always remove power before attaching or disconnecting cables, separating or inserting the mating couplers, or making any contact with the Tool Changer or Utility Coupler.



WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

If the Tool Changer or Utility Coupler is used in dirty environments (for example: welding or deburring applications), limit the exposure of the Tool Changer or Utility Coupler. Idle Tool assemblies should be covered to prevent debris from settling on the mating surface. Also, the Master assembly should be exposed for only a short period of time during Tool change and down time. Perform the following visual inspection monthly:

- Inspect that mounting fasteners are tight, and if loose, tighten to proper torque. Refer to *Section 2.3—Module Installation*.
- Inspect the Master and Tool contact tips and springs for any damage or debris. Refer to *Section 5.2.1—Master Module Contact Tip Replacement* and *Section 5.2.2—Tool Module Contact Tip and Wave Spring Replacement*.

5. Troubleshooting and Service Procedures

Troubleshooting and service information to help diagnose conditions and repair the module is provided in the following section.

DANGER: This module has a voltage of 50 V or greater; NO contact should be attempted before removing power. This especially includes separation or insertion of the mating connectors or any contact with the Tool Changer, Utility Coupler, or its components. Arcing and damage will occur if this is not observed. Remove power before attaching, disconnecting any cables or attempting any maintenance of Tool Changer or Utility Coupler.

WARNING: Do not perform maintenance or repair on Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections purged and power discharged from circuits in accordance with the customer's safety practices and policies. Injury or equipment damage can occur with Tool not placed and energized circuits on. Place the Tool safely in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, verify all energized circuits are de-energized before performing maintenance or repair on Tool Changer or modules.

5.1 Troubleshooting

The high-current modules provide a separable joint in the cabling between various power sources and various industrial devices. Failure of the industrial devices to operate for any reason must be diagnosed electrically.

Table 5.1—Troubleshooting

Symptom	Possible Cause	Correction
Power malfunctioning	Object trapped between modules	Remove object, then re-attempt coupling.
	Contact contamination due to environment	Ensure that the spring loaded contacts on the Tool-side can move freely and are not bound by debris. Clean the spring pins to restore free operation. Clean Tool-side module contacts, refer to *Section 5.2.2—Tool Module Contact Tip and Wave Spring Replacement*.
	Contact pin separation	Any contamination on the contacts should be removed using a stiff nylon brush.
		Air supplied to Tool Changer insufficient, Improper valve used. Refer to Tool Changer manual for pneumatic requirements.
	Module contact damage due to coupling/uncoupling under load.	Revise operating procedures to only couple/uncouple with power disconnected and discharged. Replace module contacts, refer to *Section 5.2.1—Master Module Contact Tip Replacement* for the Master module and *Section 5.2.2—Tool Module Contact Tip and Wave Spring Replacement* for the Tool module.
	Rigid customer cable connection to module termination	Change to high-flex, fine strand cables to terminate to high current module. Route and properly restrain cables to allow for 4 mm of motion on the Tool side.
	Cable damage - Pinched, torn, or fatigued cables, contact base, or contact spring worn out or damaged.	Inspect cables and contact base for damage, test cables, test contact springs, refer to *Section 5.1.1—Troubleshooting Sequence.*

5.1.1 Troubleshooting Sequence

DANGER: This module has a voltage of 50 V or greater; NO contact should be attempted before removing power. This especially includes separation or insertion of the mating connectors or any contact with the Tool Changer, Utility Coupler, or its components. Arcing and damage will occur if this is not observed. Remove power before attaching, disconnecting any cables or attempting any maintenance of Tool Changer or Utility Coupler.

Complete the following steps in accordance with the customer's energy control and electrical safety practices or programs for isolating hazardous energy sources (i.e. electricity, air, etc.). The following sequence is recommended for troubleshooting primary current problems:

1. First examine all the cables, cable connectors, and power sources for problems and correct as necessary.
2. Use a known good cable to bypass the modules and directly connect the supply to the load.
3. If the load does not operate properly with known good cables, the problem is in the supply or load. Troubleshoot these components using that manufacturer's procedures.
4. If the load operates properly, use the known good cables from step 2 to connect between the supply and Master module. Use a second set of known good cables to connect the Tool module to the load.
5. If the load operates properly, the problem is in the old cables, which must be repaired or replaced.
6. If the load does not operate properly, the problem is in the high-current modules.
7. Externally, examine the modules for loose, missing, or damaged contacts, replacing and tightening as necessary.
8. Remove the covers from the modules and insure that the cables have not come loose from the contact bases. Re-secure the cable ring terminals as necessary. Torque the M8 ring terminal securing screws to the 150 A contact base 90 in-lbs (10 Nm) max.
9. Use a hardwood dowel or other non-metallic, soft rod to push axially on the tool side contacts to verify free axial motion. If the springs under these contacts do not allow axial motion of the contacts, replace the springs accordingly as outlined above in the maintenance section.

If the above steps fail to restore proper operation contact ATI for service.

5.2 Service Procedures

Component replacement procedures are provided in the following section.

5.2.1 Master Module Contact Tip Replacement

Parts required: *Refer to Section 8—Drawings.*

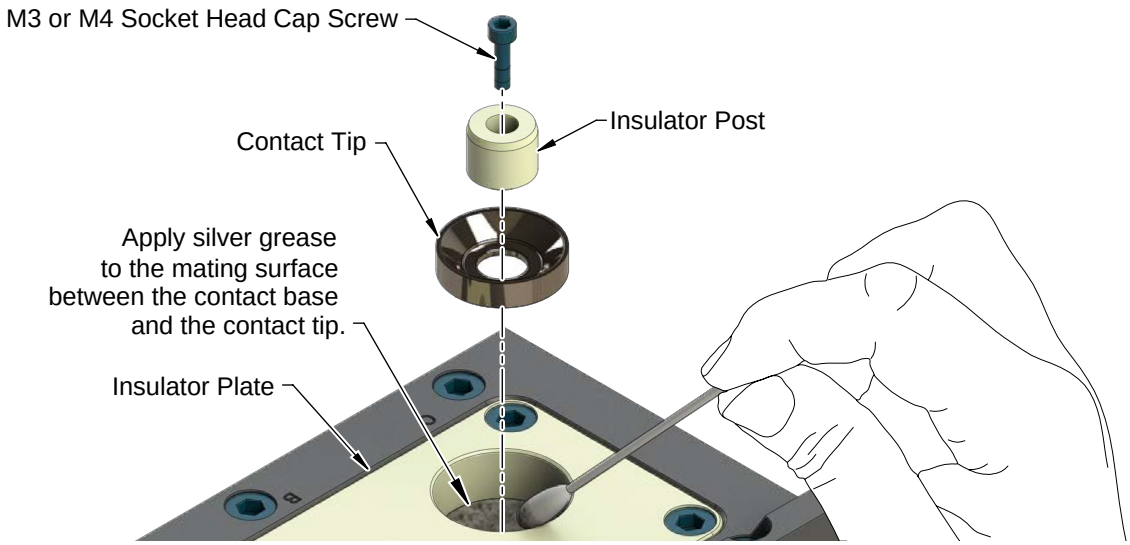
Tools required: *2.5 mm or 3 mm hex key, torque wrench*

Supplies required: *Non-hardening, conductive silver bearing grease (ATI #0290-70-0000-50-008, McMaster-Carr #1219K57, AI Technology #ELGR8501 or equivalent)*

Removal:

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Remove the M3 or M4 socket head cap screw from the center of the insulator post using a 2.5 mm or 3 mm hex key.
5. Remove the insulator post and the Master contact tip. Discard the contact tip.

Figure 5.1—Master Module Contact Tip Replacement



Installation:

NOTICE: Always replace Master and Tool contact tips at the same time (as pairs). Failure to change both halves of a mating pair will result in decreased life of the new component.

6. Apply a liberal amount of non-hardening, conductive silver bearing grease (ATI #0290-70-0000-50-008, McMaster-Carr #1219K57, AI Technology #ELGR8501 or equivalent) with a volume resistivity of 0.001 ohm-cm minimum to the mating surface between the contact base and the new contact tip. Insert the new contact tip into the insulator plate and reinstall the center insulator post.
7. For a M3 socket head cap screw, insert the screw into the insulator post and secure using a 2.5 mm hex key. Tighten to 10 in-lbs (1.1 Nm). For a M4 socket head cap screw, insert the screw into the insulator post and secure using a 3 mm hex key. Tighten to 12 in-lbs (1.36 Nm).
8. Safely resume normal operation.

5.2.2 Tool Module Contact Tip and Wave Spring Replacement

Parts required: *Refer to Section 8—Drawings.*

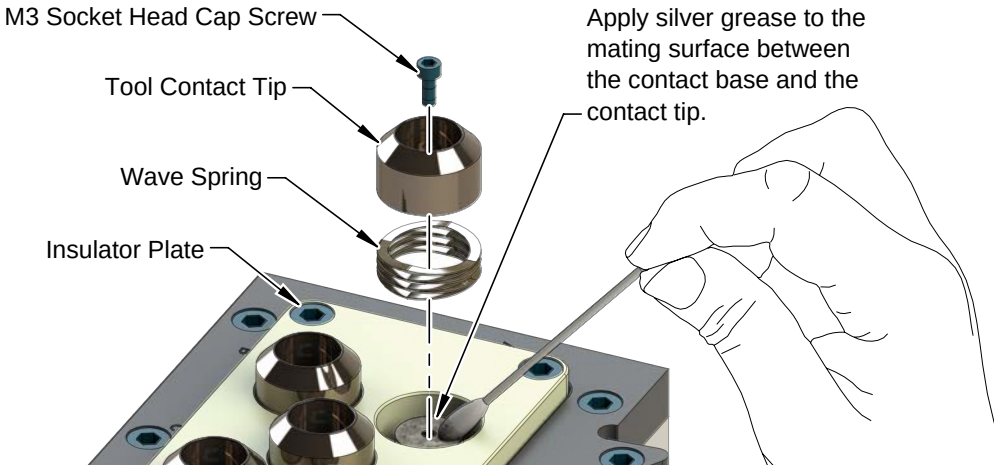
Tools required: *2.5 mm hex key, torque wrench*

Supplies required: *Non-hardening, conductive silver bearing grease (ATI #0290-70-0000-50-008, McMaster-Carr #1219K57, AI Technology #ELGR8501 or equivalent)*

Removal:

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Remove the M3 socket head cap screw from the center of the Tool contact tip using a 2.5 mm hex key.
5. Remove the Tool contact tip and wave spring from the insulator plate and discard.

Figure 5.2—Tool Module Contact Tip and Wave Spring Replacement



Installation:

NOTICE: Always replace Master and Tool contact tips at the same time (as pairs). Failure to change both halves of a mating pair will result in decreased life of the new component.

6. Apply a liberal amount of non-hardening, conductive silver bearing grease (ATI #0290-70-0000-50-008, McMaster-Carr #1219K57, AI Technology #ELGR8501 or equivalent) with a volume resistivity of 0.001 ohm-cm minimum to the mounting surface between the contact tip and the contact base.
7. Insert the new wave spring and contact tip into the insulator plate.
8. Insert the M3 socket head cap screw into the Tool contact tip and secure using a 2.5 mm hex key. Tighten to 10 in-lbs (1.1 Nm).
9. Safely resume normal operation.

5.2.3 Tool Module Dust V-Ring Seal Replacement

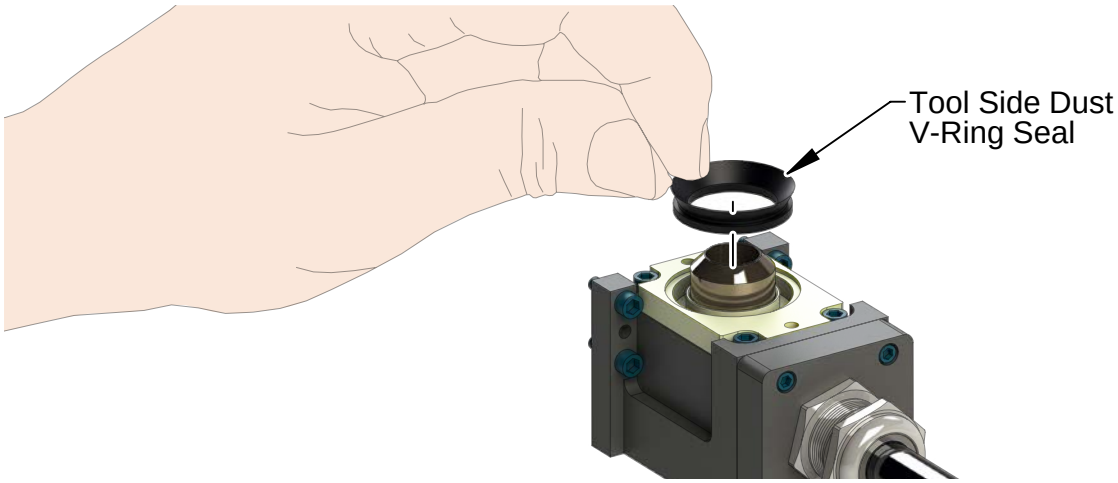
Parts required: *Refer to Section 8—Drawings.*

Tools required: *Small screw driver*

The seal protects the electrical connection between the Master and Tool module. If the seal becomes worn or damaged it needs to be replaced.

1. Place the Tool in a secure location.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. To replace the V-Ring dust seal, use a small screwdriver or similar to gently pry the seal out of its retention groove.
4. To install a new seal, place it over the empty groove in the master side insulator plate and press the seal in place.
5. Safely resume normal operation.

Figure 5.3—V-ring Seal Replacement



5.2.4 Master Module Contact Base Replacement

Parts required: *Refer to Section 8—Drawings.*

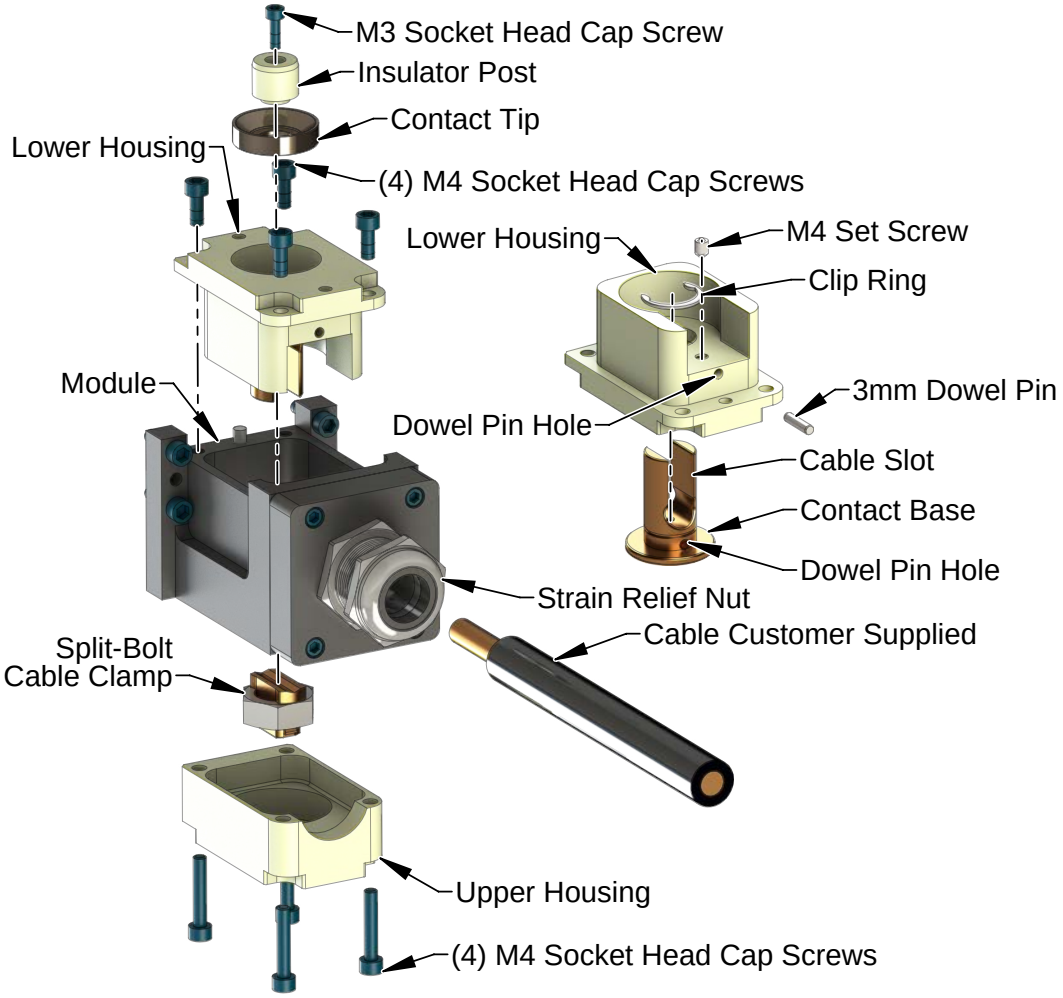
Tools required: *2.5 mm and 3 mm hex key, 13 mm wrench, torque wrench*

Supplies required: *Loctite Primer 7649, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the module from the Tool Changer or Utility Coupler. Refer to *Section 2.4—Module Removal*.
5. Remove the cable, refer to *Section 2.2—Cable Removal*.
6. Remove the contact tip components. Refer to *Section 5.2.1—Master Module Contact Tip Replacement*.
7. Remove the (4) M4 socket head cap screws securing the (fiberglass) lower housing from the module using a 3 mm hex key. Refer to *Figure 5.4*.
8. Remove the clip ring from the back side of the contact base and set aside.
9. Remove the M4 set screw from the bottom of the lower housing holding the dowel pin in place using a 2.5 mm hex key.

10. Set the lower housing on its side with the dowel hole facing down and tap the edge of the lower housing on the work bench until the dowel pin drops out.
11. Remove the contact base from the lower housing and discard.

Figure 5.4—Replacing the Master Contact Base



12. Insert new contact base into lower housing and secure to base with clip ring. **Note:** Make sure the dowel pin hole and the cable slot in the contact base are aligned with the dowel pin hole in the lower housing.
13. Set the lower housing on its side with the dowel hole facing up and insert the 3 mm dowel pin.
14. Apply Loctite Primer 7649 to the threads of the set screw hole in the lower housing.
15. Apply Loctite 222 to the M4 set screw and insert it into the lower housing. Tighten until the top of the set screw is flush with the housing using a 2.5 mm hex key.
16. Assemble the lower housing to the module, secure using the (4) M4 socket head cap screws using a 3 mm hex key. Tighten to 10 in-lbs (1.13 Nm)
17. Install the contact tip components. Refer to *Section 5.2.1—Master Module Contact Tip Replacement*.
18. Install the cable, refer to *Section 2.1—Cable Installation*.
19. Install the module onto the Tool Changer or Utility Coupler. Refer to *Section 2.3—Module Installation*.
20. Safely resume normal operation.

5.2.5 Tool Module Contact Base Replacement

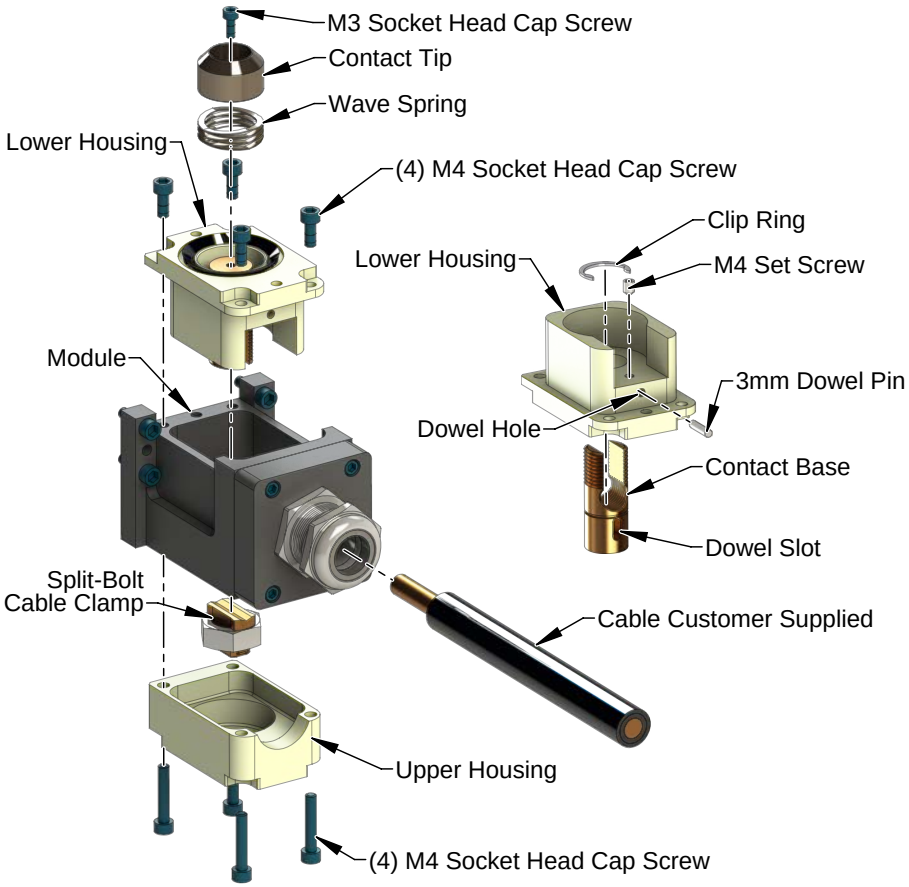
Parts required: *Refer to Section 8—Drawings.*

Tools required: *2.5 mm and 3 mm hex key, 13 mm wrench, torque wrench*

Supplies required: *Loctite Primer 7649, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the module from the Tool Changer or Utility Coupler. Refer to *Section 2.4—Module Removal*.
5. Remove the cable, refer to *Section 2.2—Cable Removal*.
6. Remove the contact tip and spring. Refer to *Section 5.2.2—Tool Module Contact Tip and Wave Spring Replacement*.
7. Remove the (fiberglass) lower housing from the module by extracting the (4) M4 socket head cap screws using a 3 mm hex key.
8. Remove the clip ring from the back side of the contact base and set aside.
9. Remove the M4 set screw from the lower housing holding the dowel pin in place using a 2.5 mm hex key.
10. Set the lower housing on its side with the dowel hole facing down and tap the edge of the lower housing on the work bench until the dowel pin drops out.
11. Remove the contact base from the lower housing and discard.

Figure 5.5—Replacing the Tool Contact Base



12. Insert new contact base into lower housing and secure with clip ring. Note: Make sure the dowel slot in the contact base faces the dowel hole in the lower housing, as shown in *Figure 5.5*.
13. Set the lower housing on its side with the dowel hole facing up and insert the 3 mm dowel pin.
14. Apply Loctite Primer 7649 to the threads of the set screw hole in the lower housing.
15. Apply Loctite 222 to the M4 set screw and insert it into the lower housing. Tighten until the top of the set screw is flush with the housing using a 2.5 mm hex key.
16. Assemble the lower housing to the module and secure with the (4) M4 socket head cap screws using a 3 mm hex key. Tighten to 10 in-lbs (1.13 Nm)
17. Install the contact tip and spring. Refer to *Section 5.2.2—Tool Module Contact Tip and Wave Spring Replacement*.
18. Install the cable, refer to *Section 2.1—Cable Installation*.
19. Install the module onto the Tool Changer or Utility Coupler. Refer to *Section 2.3—Module Installation*.
20. Safely resume normal operation.

6. Serviceable Parts

Refer to *Section 8—Drawings*.

7. Specifications

Table 7.1—Master Module	
9121-PG1-M	High Current Module, J16 Mount, Master
Interface Connections	(1) Power Contact
Electrical Rating	200 A, 600 V Max.
Cable Sizes Supported	#2 AWG (Others, Contact ATI)
Weight	1.0 lb (0.45 kg)

Table 7.2—Tool Module	
9121-PG1-T	High Current Module, J16 Mount, Tool
Interface Connections	(1) Power Contact
Electrical Rating	200 A, 600 V Max.
Cable Sizes Supported	#2 AWG High-flex type with fine stranding (Others, Contact ATI)
Weight	1.06 lbs (0.48 kg)

8. Drawings

Drawings are available on the *ATI website* or by contacting an ATI representative.