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C. Control and Signal Modules

DT4—Profinet/IP Pass Through Control/Signal Module

1. Product Overview

The signal modules provide a means for the customer to provide auxiliary power and Profinet/IP signals to downstream I/O in Utility Coupler applications.

The Tool side module functions as a pass through for the Profinet network and power to downstream equipment.

When the Utility Coupler is coupled, the Master and Tool modules pass signals using a spring-loaded pin block. V-ring seals surround the pin blocks and are designed to be water resistant but not waterproof when modules are coupled. Refer to [Section 9—Drawings](#).

1.1 DT4 Master

A 5-pin Mini male connector is provided for the auxiliary power supply to the Profinet interface. A 4-pin M12 female D-coded connector is provided for Profinet communication interface with the Master and downstream tooling. There is also a 5-pin M12 male Tool Present connector E1.

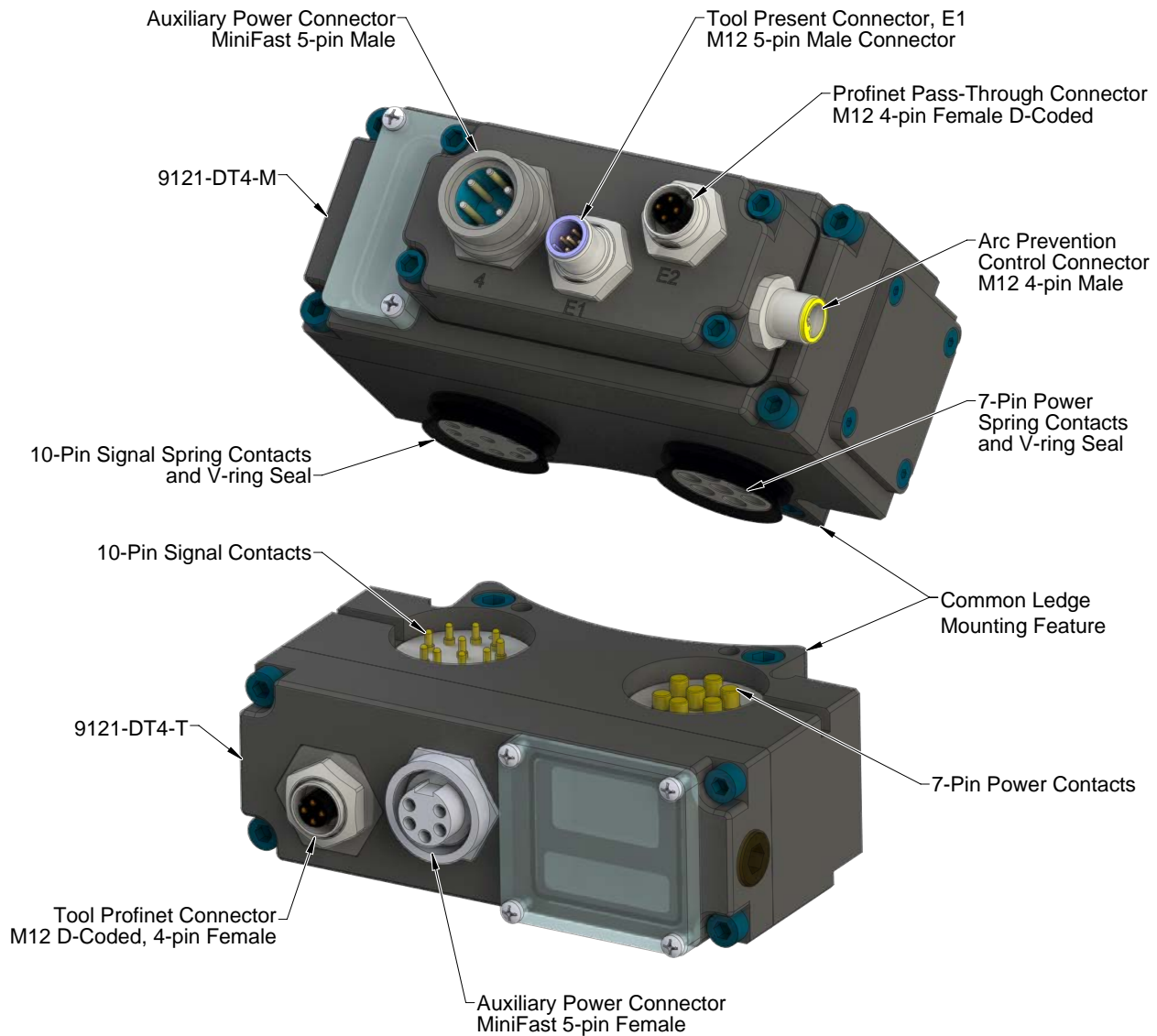
With the 4-pin M12 male connection, the Master module also incorporates ATI's exclusive Arc Prevention Circuit, which extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling. Refer to [Section 2.1.2—Arc Prevention Circuit](#) for additional information regarding the Arc Prevention Circuit.

Electrical interface drawings and connector details are provided in drawings in [Section 9—Drawings](#).

1.2 DT4 Tool

A 4-pin M12 female D-coded connector is provided on the Tool module for Profinet communication interface with the downstream tooling. A 5-pin Mini female connector is provided on the Tool for passing auxiliary power to the downstream tooling.

Figure 1.1—DT4 Modules



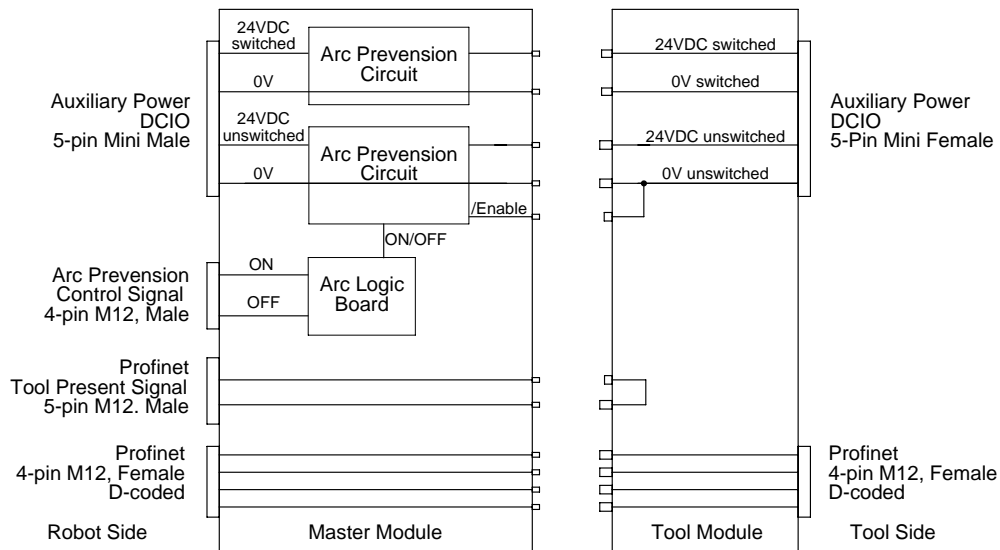
2. Product Information

The signal modules provide a pass-through capable module for Profinet applications and, by employing ATI's Arc Prevention Circuit, provides a means to reliably pass auxiliary power to end-of-arm devices. The module also provides the Profinet controller a signal indicating that the Tool is present and that it is now safe to turn on power. Please refer to [Section 9—Drawings](#) for specific module wiring and connector interface information.

2.1 Master Module Information

The following information is about the Master module's behavior. The block diagram in [Figure 2.1](#) illustrates the basic functional features of the DT4 module:

Figure 2.1—Block Diagram of the DT4 Module



For a fully detailed electrical schematic of the module see [Section 9—Drawings](#). [Section 2.1.1—Profinet ‘Tool Present’ Signal](#) and [Section 2.1.2—Arc Prevention Circuit](#) below describe the Profinet ‘Tool Present’ signal and Arc Prevention control in further detail.

2.1.1 Profinet ‘Tool Present’ Signal

The Profinet ‘Tool Present’ signal in the signal modules provides a signal to the controller indicating that the Master and Tool modules have fully coupled and that power can be turned ON.

The 24 V ‘Tool Present’ signal, originating from the controller, is provided to Pin 1 of the M12 5-Pin ‘Tool Present’ connector on the DT4 Master (reference [Section 9—Drawings](#)). When the Master and Tool modules are fully coupled, the ‘Tool Present’ signal is routed to the Tool module over a recessed pin and then sent back to the controller via Pin 4 of the ‘Tool Present’ connector.

After receiving an active ‘Tool Present’ signal from the DT4 Master, the controller can send an ON signal to the Arc Prevention circuit to turn on auxiliary power to the end-of-arm devices.

NOTICE: The time between the ON command being provided to the Arc Prevention circuit and power actually turning on is approximately 100 ms.

2.1.2 Arc Prevention Circuit

The DT4 modules incorporate ATI's exclusive Arc Prevention Circuit. The Arc Prevention Circuit extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling.

In the DT4 modules, the Arc Prevention Circuit is controlled by ON and OFF signals provided by the controller. A M12 4-Pin connector on the DT4 Master module is used to interface with these ON and OFF signals. A recessed pin at the pin block interface is used to ensure that power cannot be turned on unless the electrical contacts are fully mated. Consequently, when the ON signal is active and the Master and Tool are fully coupled, the Arc Prevention Circuit will turn on unswitched and switched auxiliary power.

A truth table listing the auxiliary power status for all possible ON and OFF signal states is shown in [Table 2.1](#).

Table 2.1—Arc Prevention Truth Table		
ON Input (Pin 2)	OFF Input (Pin 4)	Response
Low	Low	Remain in current state.
Low	High	Power off
High	Low	Power on
High	High	Power on

Notes:

1. When powering up, the power will be on and there will be a 500 ms delay before accepting input.

Before uncoupling the Tool Changer or Utility Coupler, it is recommended that the ON signal is made low and the OFF signal is made high. This will help ensure that power is turned off while the Utility Coupler is uncoupling, further reducing the probability of arcing between contacts. The sequence of operations included in [Section 4.1—Recommended Sequence of Operation](#) contains additional information regarding the recommended operation of the module.

NOTICE: The power ON signal should be made low and the OFF signal should be made high prior to uncoupling of the Tool Changer or Utility Coupler in order to prevent arcing of the contact pins.

3. Installation

The control/signal modules are typically installed by ATI prior to shipment. The steps below outline the field installation or removal as required. For wiring information refer to [Section 9—Drawings](#).



WARNING: Do not perform maintenance or repair on Utility Coupler or modules unless 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 energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, verify all energized circuits are de-energized before performing maintenance or repair on Utility Coupler or modules.



CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.



CAUTION: Profinet cabling layout is critical to the overall performance of the system. Interface connections from the controller up the robot arm to the ATI Master should be minimized (less than 3 connections, e.g.). Use of hi-flex, robot rated cable is essential for long term performance.

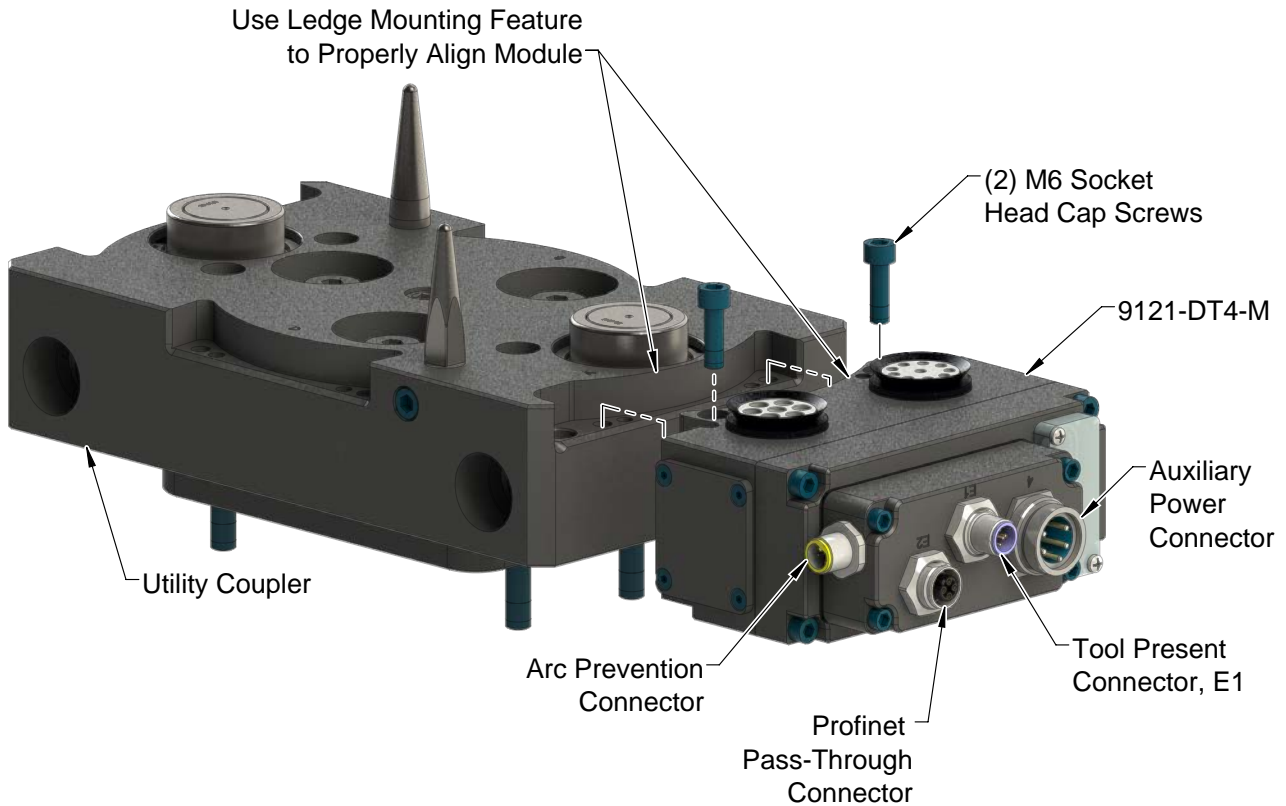
3.1 DT4-M Control/Signal Module Installation

Tools required: 5 mm Allen[®] wrench (hex key), torque wrench

Supplies required: Clean rag, Loctite 242[®]

1. Place the Tool in a secure location.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Clean the mounting surfaces.
4. Using the ledge feature, place the module into the appropriate location on the valve adapter. Align the module with the valve adapter using the dowels in the bottom of the ledge feature. Refer to [Figure 3.2](#).
5. Apply Loctite 242 to the supplied M6 socket head cap screws. Install the (2) M6 socket head cap screws securing the module to the valve adapter and tighten to 70 in-lbs (7.9 Nm).
6. Connect the power, Arc Prevention, Tool present, and Profinet cable connectors to the DT4-M module.
7. The module will automatically get the name and IP address assigned.
8. After a few seconds, it should be operating on the network.
9. If installation is complete, the module may be put into normal operation.

Figure 3.1—DT4-M Module Installation



3.2 DT4-M Control/Signal Module Removal

Tools required: 5 mm Allen wrench (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. Disconnect the power, Arc Prevention, Tool present, and Profinet cable connectors from the DT4-M module.
5. Support the control/signal module and remove the (2) M6 socket head cap screws and lower the module until it clears the guide pin. Refer to [Figure 3.1](#).

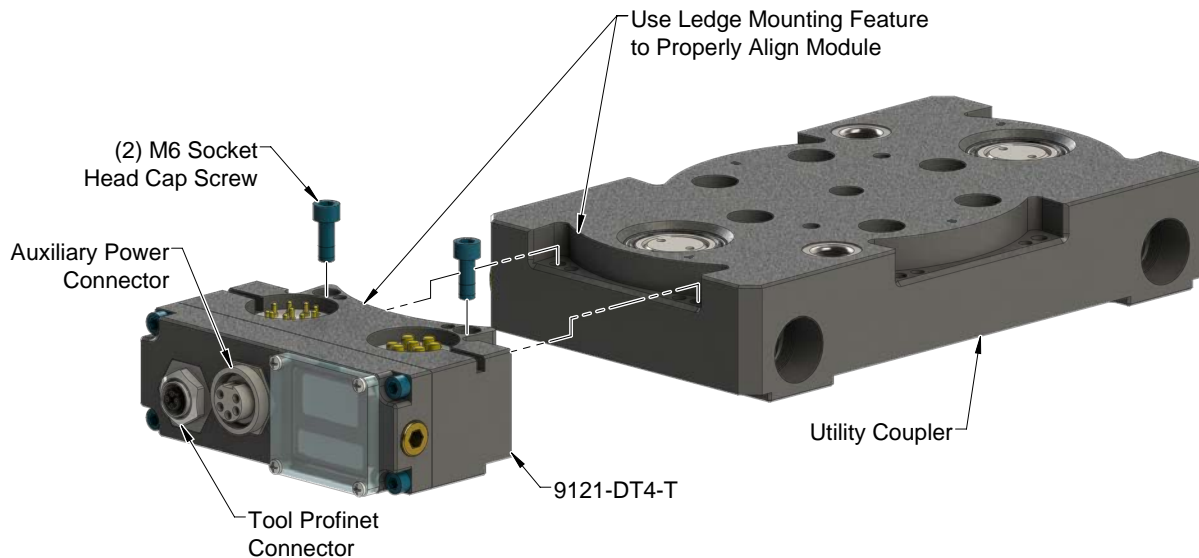
3.3 DT4-T Control/Signal Module Installation

Tools required: 5 mm Allen wrench (hex key), torque wrench

Supplies required: Clean rag, Loctite 242

1. Place the Tool in a secure location.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Clean the mounting surfaces.
4. Using the ledge feature, place the module into the appropriate location on the Tool adapter assembly spacer. Align the module with the valve adapter spacer using the dowels in the bottom of the ledge feature.
5. Apply Loctite 242 to the supplied M6 socket head cap screws. Install the (2) M6 socket head cap screws securing the module to the valve adapter spacer and tighten to 70 in-lbs (7.9 Nm).
6. Connect the power and Profinet cable connectors to the DT4-T module.
7. If installation is complete, the module may be put into normal operation.

Figure 3.2—DT4-T Module Installation



3.4 DT4-T Control/Signal Module Removal

Tools required: 5 mm Allen wrench (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. Disconnect the power cable and Ethernet cable connectors from the DT4-T module.
5. Support the DT4-T module and remove the (2) M6 socket head cap screws and lift up on the module until it clears the guide pin. Refer to [Figure 3.2](#).

3.5 Utility Schematic

Refer to drawings in [Section 9—Drawings](#) of this manual for customer interface and wiring details for the DT4-M/DT4-T modules.

4. Operation

A recommended Sequence of Operations is provided in this manual. This procedure is to be used as a general guide when programming a robot or PLC for use with a Tool Changer and DT4 control/signal modules. This procedure is intended for “automatic” modes used during normal application processes.

4.1 Recommended Sequence of Operation

1. **Start**→ The Master and Tool are uncoupled. The Master is positioned within coupling distance of the Tool.
 - a. The **Tool Present** input is false.
 - b. The **ON** output from the controller is false.
 - c. The **OFF** output from the controller is true.
 - d. Downstream devices are offline.
2. Drive the Master and Tool together to couple the Utility Coupler The Utility Coupler is fully coupled.
 - a. The **Tool Present** input goes true.
 - b. The **ON** output from the controller is made true.
 - c. The **OFF** output from the controller is made false.
 - d. Downstream devices come online.
3. Normal operation
 - a. The following inputs are true:
 - i. **Tool Present**
 - b. The following outputs are true:
 - i. **ON**
 - c. The following outputs are false:
 - i. **OFF**
4. Prepare to Uncouple the Utility Coupler. **IMPORTANT:** The Master and Tool are still coupled.
 - a. The **ON** output from the controller is made false.
 - b. The **OFF** output from the controller is made true.
 - c. Downstream devices are brought offline.
5. Separate the Master and Tool to uncouple the Utility Coupler. The Utility Coupler is fully uncoupled.
 - a. The **Tool Present** input goes false.
 - b. The **ON** output from the controller is false.
 - c. The **OFF** output from the controller is true.
 - d. Downstream devices are offline.

5. Maintenance

Once installed, the operation of the control modules is generally trouble free. The modules are not designed to be field serviced as all point-to-point wiring connections are soldered. Component replacement is limited to the V-ring seal on the Master.



WARNING: Do not perform maintenance or repair on Utility Coupler or modules unless 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 energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, verify all energized circuits are de-energized before performing maintenance or repair on Utility Coupler or modules.

If the Utility Coupler is being used in dirty environments (e.g. welding or deburring applications), care should be taken to limit the exposure of the 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.

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. Perform the following visual inspection monthly:

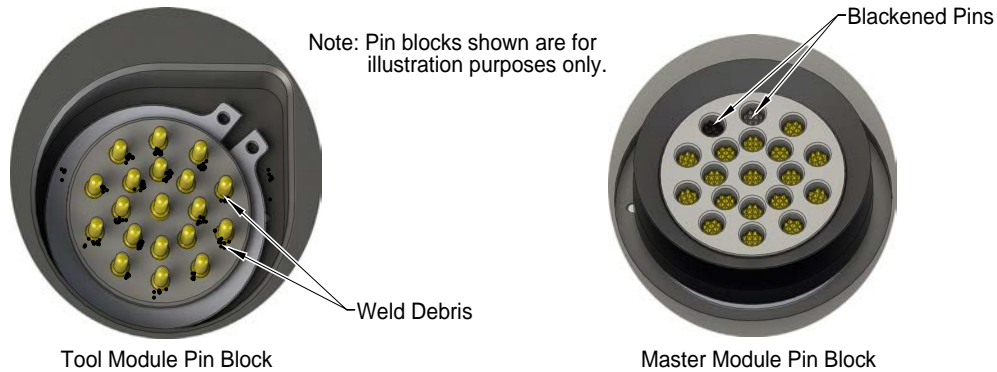
- Inspect mounting fasteners to verify they are tight and if loose, then tighten to the proper torque. Refer to [Section 3.1—DT4-M Control/Signal Module Installation](#) and [Section 3.3—DT4-T Control/Signal Module Installation](#).
- Cable connections should be inspected during maintenance periods to ensure they are secure. Loose connections should be cleaned and re-tightened as appropriate. Inspect cable sheathing for damage, repair or replace damaged cabling. Loose connections or damaged cabling are not expected and may indicate improper routing and/or strain relieving.
- Inspect the Master and Tool pin blocks for any pin damage, debris or darkened pins. Refer to [Section 5.1—Pin Block Inspection and Cleaning](#).
- Inspect V-ring seals for wear, abrasion, and cuts. If worn or damaged, replace. Refer to [Section 6.2.1—V-ring Seal Replacement](#).

5.1 Pin Block Inspection and Cleaning

Tools required: Nylon Brush (ATI Part Number 3690-0000064-60)

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. Inspect the Master and Tool pin blocks for any debris or darkened pins.

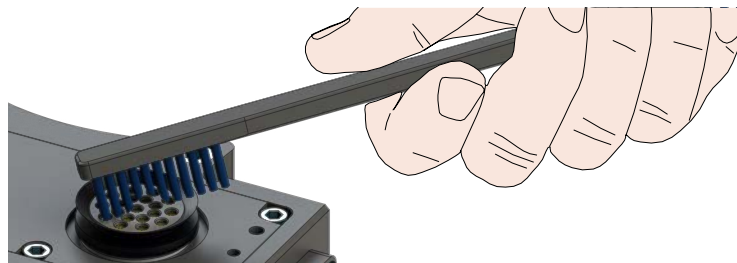
Figure 5.1—Inspect Master and Tool Pin Blocks



5. If debris or darkened pins exist, remove debris using a vacuum and clean using a nylon brush (ATI Part Number 3690-0000064-60).

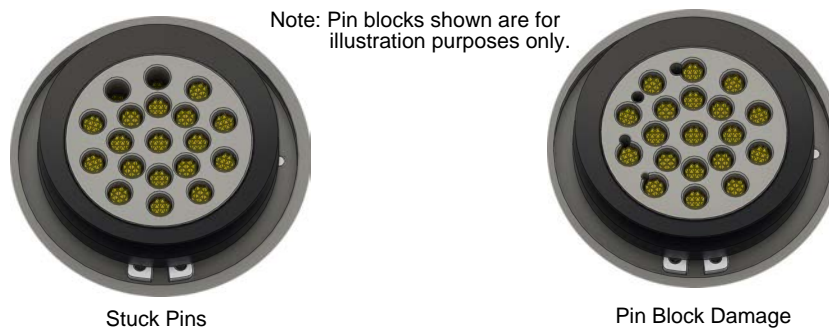
NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI Part Number 3690-0000064-60)

Figure 5.2—Clean Pin Blocks with a Nylon Brush



6. Inspect the Master and Tool pin blocks for stuck pins or pin block damage.

Figure 5.3—Stuck Pin and Pin Block Damage



7. If stuck pins or pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.
8. After the procedure is complete, resume normal operation.

6. Troubleshooting and Service Procedures

The following section provides troubleshooting information to help diagnose conditions with the Tool Changer and service procedures to help resolve these conditions.



WARNING: Do not perform maintenance or repair on Utility Coupler or modules unless 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 energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, verify all energized circuits are de-energized before performing maintenance or repair on Utility Coupler or modules.

6.1 Troubleshooting

Refer to the table below for troubleshooting information.

Symptom	Possible Cause	Correction
Loss of Communication	Debris trapped between modules	Remove debris, then re-attempt coupling.
	Module contact pin contamination	Ensure that the spring pins on the Master 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 5.1—Pin Block Inspection and Cleaning . Inspect seal, replace if damaged refer to Section 6.2.1—V-ring Seal Replacement
	Cable damage: Pinched, torn, or fatigued cables	Examine cables for damage, perform a continuity test on cables and replace any bad cables.
No Power on the Tool side	Debris trapped between modules	Remove debris, then re-attempt coupling.
	Module contact pin contamination	Ensure that the spring pins on the Master 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 5.1—Pin Block Inspection and Cleaning . Inspect seal, replace if damaged refer to Section 6.2.1—V-ring Seal Replacement
	Utility Coupler not fully coupled	Verify that the Master and Tool are fully coupled.
	Cable damage: Pinched, torn, or fatigued cables	Examine cables for damage, perform a continuity test on cables and replace any bad cables.

6.2 Service Procedures

The following service procedures provide instructions for inspection, adjustment, test or replacement of components.

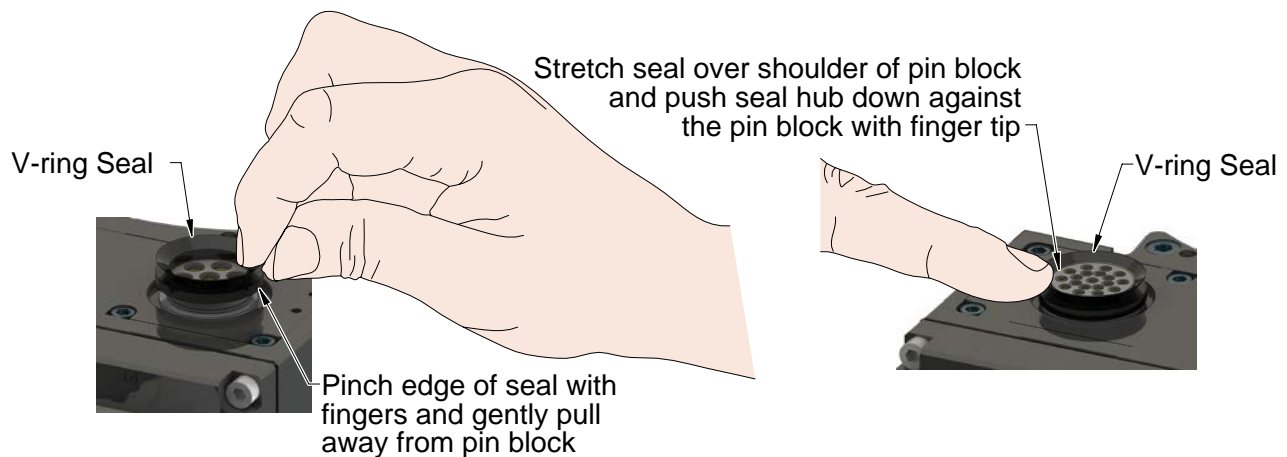
6.2.1 V-ring Seal Replacement

Parts required: Refer to *Section 7.1—Master Module Serviceable Parts*.

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

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. To remove the existing seal, pinch the edge of the seal with your fingers and pull the seal away from the pin block on the Master.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal hub down against the pin block using your finger tip.
7. After the procedure is complete, resume normal operation.

Figure 6.1—V-ring Seal Replacement



7. Serviceable Parts

7.1 Master Module Serviceable Parts



Table 7.1—Master Module Serviceable Parts

Item No.	Qty	Part Number	Description
1	1	9121-DT4-M	Profinet Pass-Through Master module w/ Aux. Power Pass-Through for Utility Coupler Applications
2	2	4010-0000030-01	V-ring Seal
3	2	3500-1066020-15A	M6 x 20mm socket head cap screws Blue Dyed Magni ND Microspheres

7.2 Tool Module Serviceable Parts

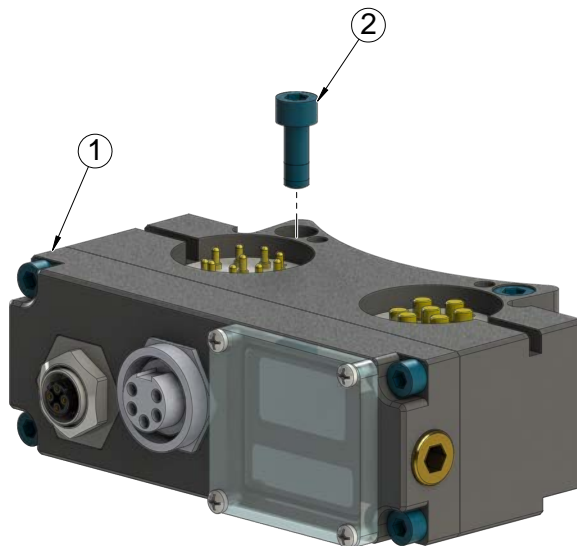


Table 7.2—Tool Module Serviceable Parts

Item No.	Qty	Part Number	Description
1	1	9121-DT4-T	Profinet Pass-Through Tool module w/ Aux. Power Pass-Through for Utility Coupler Applications
2	2	3500-1066016-15A	M6x16 SHCS, Class 12.9, Blue dyed Magni-565, ND Microspheres Epoxy, Yellow

7.3 Accessories

Table 7.3—Accessories

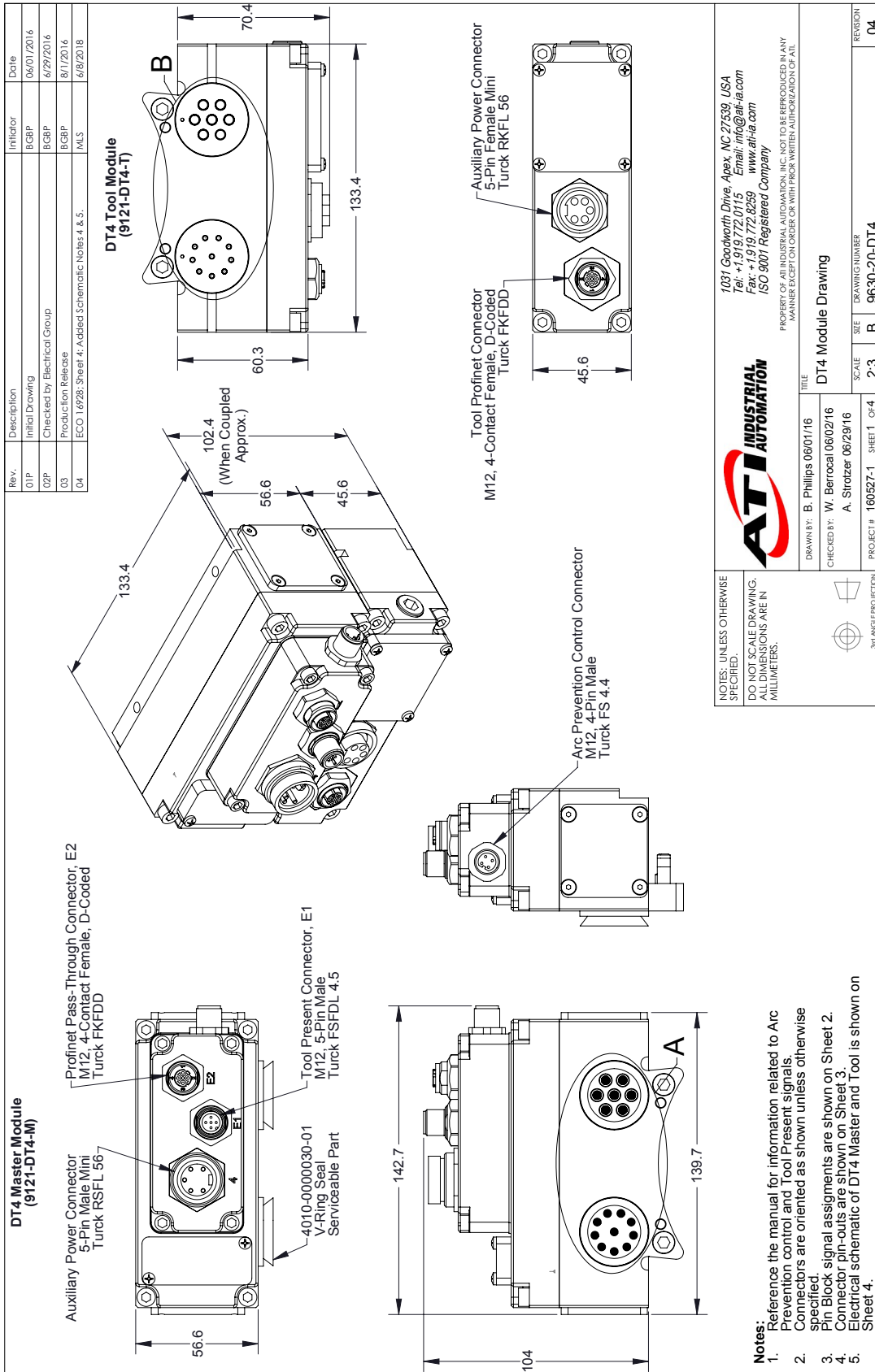
Item No.	Qty	Part Number	Description
*	*	3690-0000064-60	Brush, Blue Nylon All Purpose (Contact Pin Cleaning)

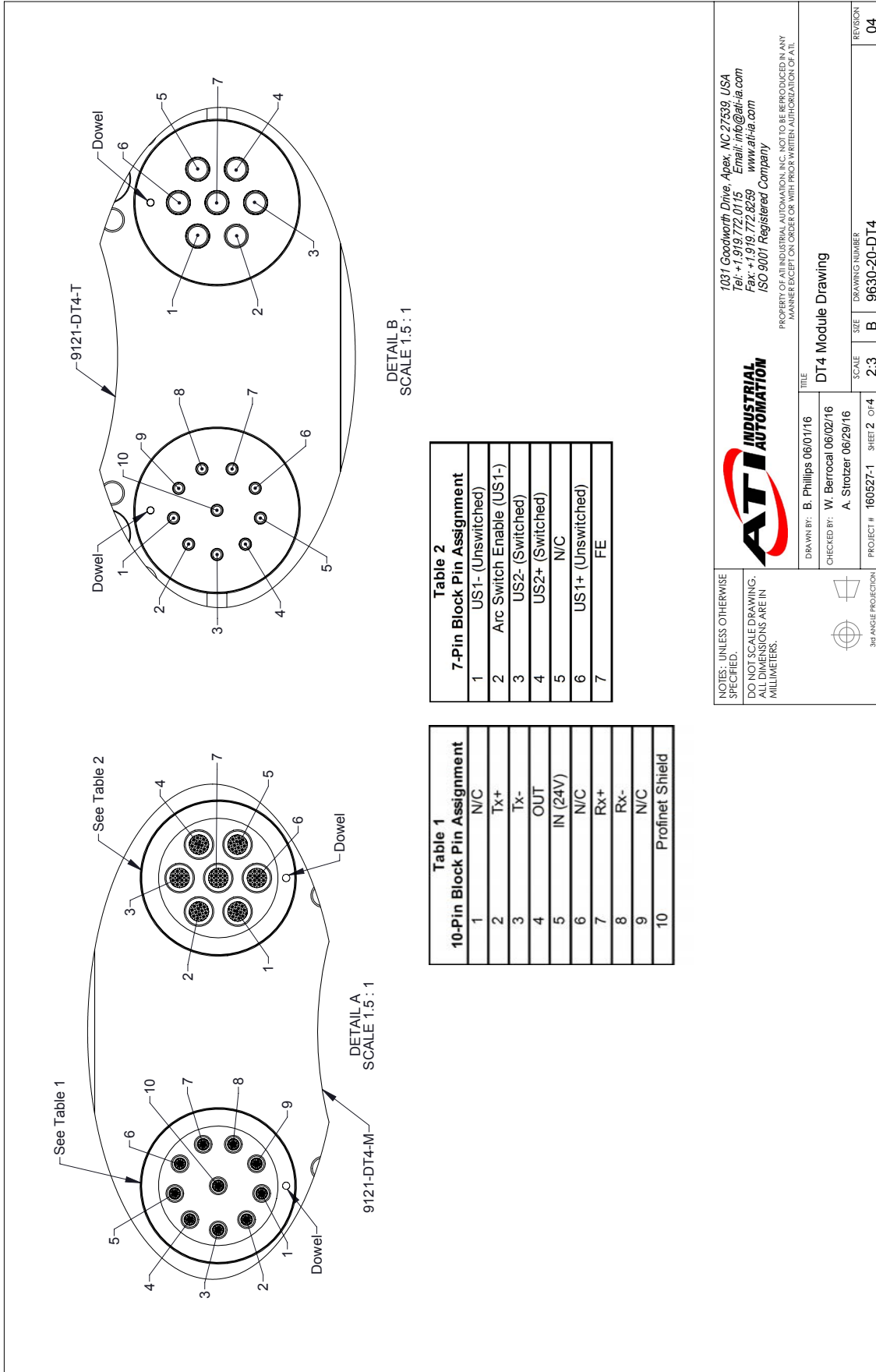
8. Specifications

Table 8.1—Master Module	
9121-DT4-M	Profinet Pass-Through Master module w/ Aux. Power Pass-Through for Utility Coupler Applications. M12 D-coded Female Connector for Profinet communication, Mini 5-Pin Male Connector for Switched and Un-Switched Aux. Power circuits. Two (2) M12 4-Pin Connectors for Connection Verification signal and Arc Prevention Control. Arc Prevention .
Interface Connector(s)	(1) 5-pin male auxiliary power connector (1) M12 4-pin female Profinet pass-through connector, E2 (1) M12 5-pin male Tool present connector, E1 (1) M12 4-pin male arc prevention control
Electrical Rating	Profinet/IP Quick Connect Signal: 24 V on pin 1 of the M12, 4-pin connector Arc Prevention Control: 24 V on pins 2 and 4, 0 V on pin 3 of the M12, 4-pin connector Pass Through to Tool: Power: 8 A/ 12-30 VDC Signal: 3 A/60 V Max
Temperature	-20°F to 150°F (-28.9 to 65.6°C)
Weight	2.10 lbs (0.95 kg)

Table 8.2—Tool Module	
9121-DT4-T	Profinet Pass-Through Tool module w/ Aux. Power Pass-Through for Utility Coupler Applications. M12 D-coded Female Connector for Profinet communication, Mini 5-Pin Female Connector for Switched and Un-Switched Aux. Power circuits. Supports Arc Prevention on the Master. Mates with 9121-DT4-M.
Interface Connector(s)	(1) M12 4-pin female Tool Profinet connector (1) 5-pin female auxiliary power connector
Electrical Rating	Power: 8 A/ 12-30 VDC Signal: 3 A/60 V Max
Temperature	-20°F to 150°F (-28.9 to 65.6°C)
Weight	1.45 lbs (0.66 kg)

9. Drawings





NOTES: UNLESS OTHERWISE SPECIFIED,
 DO NOT SCALE DRAWING.
 ALL DIMENSIONS ARE IN MILLIMETERS.

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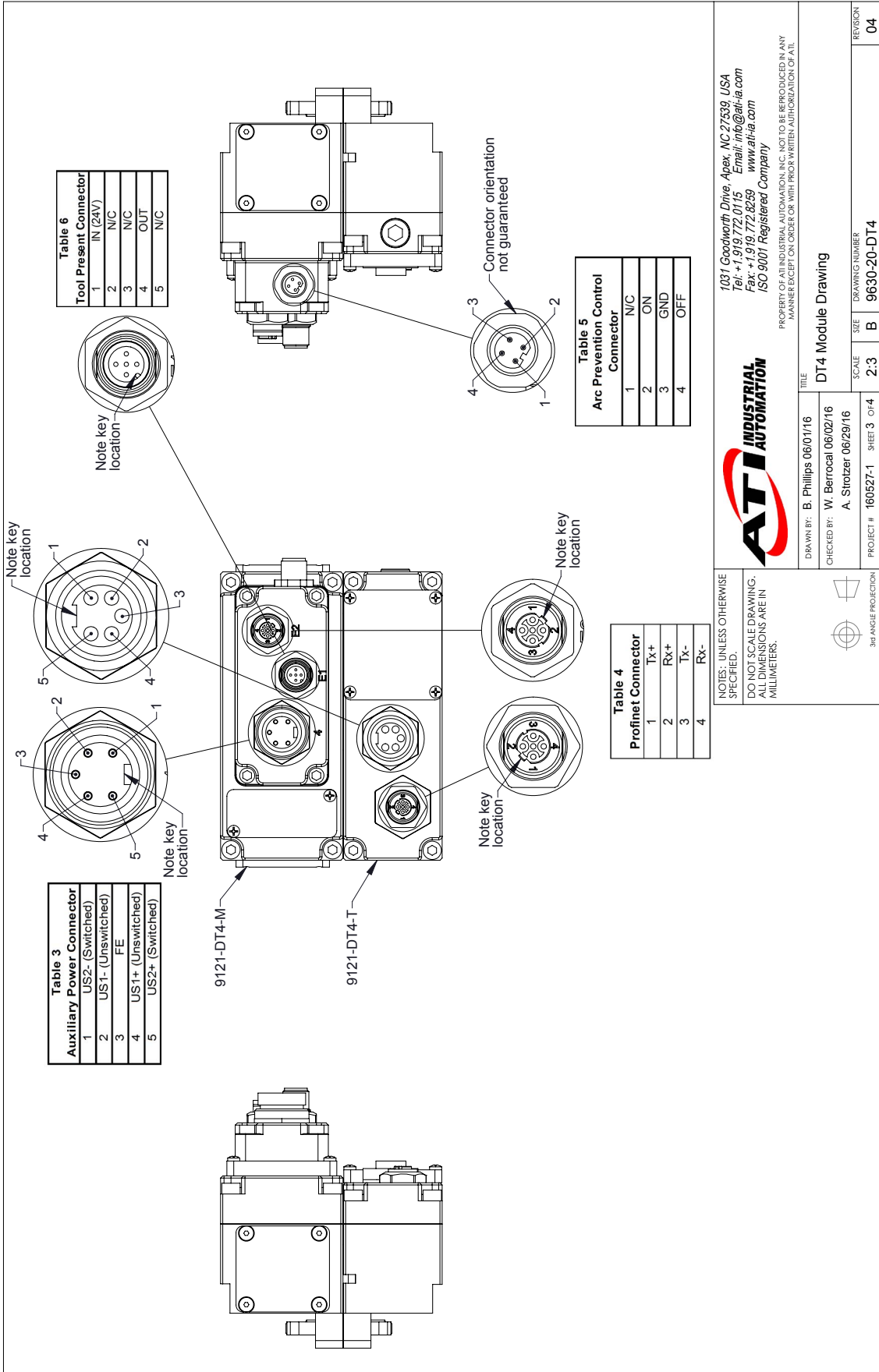
DRAWN BY: B. Phillips 06/01/16
 CHECKED BY: W. Berrocal 06/02/16
 A. Stratzer 06/29/16

PROJECT # 160527-1 SHEET 014

SCALE 2:3
 DRAWING NUMBER 9630-20-DT4
 REVISION 04

DT4 Module Drawing

3RD ANGLE PROJECTION



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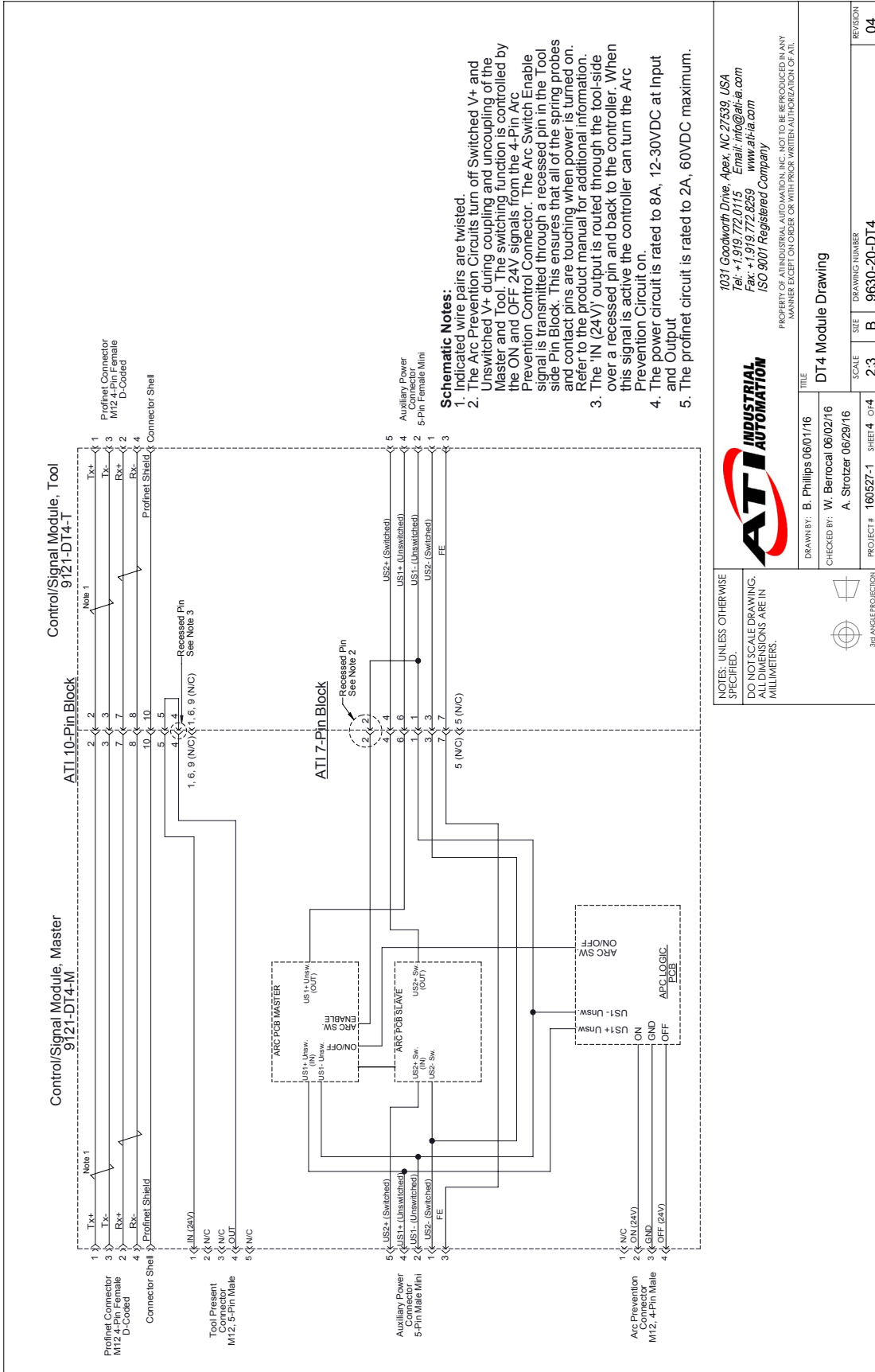
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