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Glossary

Term	Definition
DCP	Ethernet Discovery and Configuration Protocol.
EOAT	End Of Arm Tool (end effector).
Ethernet Switch	An Ethernet network component connecting multiple communication partners.
FE	Functional Earth
EDS File	Simple text files used by network configuration tools to help identify products and easily commission them on the network.
Latch	The output supplied to the ATI Master module to couple the Tool Changer.
LLDP	Link Layer Discovery Protocol
Locked	A proximity sensor input indicating that the coupling mechanism is in the Locked position. The “LOCKED” bit in the I/O bitmap will only be set high if the following conditions are on: LOCKED sensor input is high
MS	Module Status
NS	Network Status
EtherNet/IP™	EtherNet/IP™ (Ethernet Industrial Protocol) is a fieldbus communication network, used mostly by devices in industrial settings, that communicates using Ethernet. EtherNet/IP™ is a trademark of ControlNet International Ltd. used under license by ODVA®.
RTL (Ready To Lock)	A proximity sensor input that senses when the ATI Tool is within locking distance.
SNMP	Simple Network Management Protocol
Tool Power is On	The “Tool Power is ON” bit is set high when the Arc Prevention Circuit has activated power on the tool side. If this bit is low there will be neither Input/Logic Power nor Output power available on the tool.
Tool Present	A hard connect input (sourced from the Tool) indicating the Master and Tool are electrically connected to each other.
Tool-ID	An input from the Master node reporting the values from the Tool-ID switch on the Tool module.
TSI	The Tool Stand Interlock feature is a custom ATI safety solution and circuit designed to only allow the Tool Changer to release while in the stand or storage location.
Unlatch Enable	Indicates it is safe to proceed with an unlatch request.
Unlatch	The output supplied to the ATI Master module to uncouple the Tool Changer.
Unlocked	A proximity sensor input indicating that the coupling mechanism is in the Unlocked position. The “UNLOCKED” bit in the I/O bitmap will only be set high if the following conditions are on: UNLOCKED sensor input is high

C. Control and Signal Modules

CYE1—EtherNet/IP™ Control/Signal Module

1. Product Overview

The CYE1 Master and Tool modules are designed to be used with ATI's Series 8 Tool Changer line (9128-) or on a Heavy Duty (9121) Tool Changer with an adapter.

Master modules enable the customer to control and communicate with the Tool Changer through a network using an EtherNet/IP™ interface.

An EtherNet/IP™ node is established on the Master module, but not on the Tool module. Control of the Tool Changer is realized through the Master Node along with the reporting of various Tool Changer I/O. The Tool module supports Tool-ID reported through the Master and functions as a pass-through for EtherNet/IP™ network and power to downstream equipment.

A card edge connector is used to transmit the Latch/Unlatch requests from the Control Module to the Valve Module.

In addition to supporting the standard Tool Changer input signals (Locked, Unlocked, and Ready-to-Lock proximity sensors) the modules support advanced diagnostic and fault reporting.

The Unlock signal to the integrated solenoid valve is routed through a Tool Stand Interlock (TSI) safety circuit that prevents the robot from unlocking the Tool from the Master, when the Tool is not in the tool stand. Refer to *Section 2.4—Tool Side TSI* for additional information regarding TSI.

A Minifast connector is provided on the Master and Tool modules for interfacing with power. The power source for input and output power must be capable of outputting an operating voltage (reverse polarity protected, regulated) of 24 +/- 15% VDC. A D-coded M12 connector is provided on the Master and Tool modules for interfacing with EtherNet/IP™. When the Tool Changer is coupled, the Master and Tool modules pass signals via spring loaded pin blocks. Flexible V-ring seals surround the pin blocks and are water resistant but are not water proof.

1.1 CYE1 Master Module

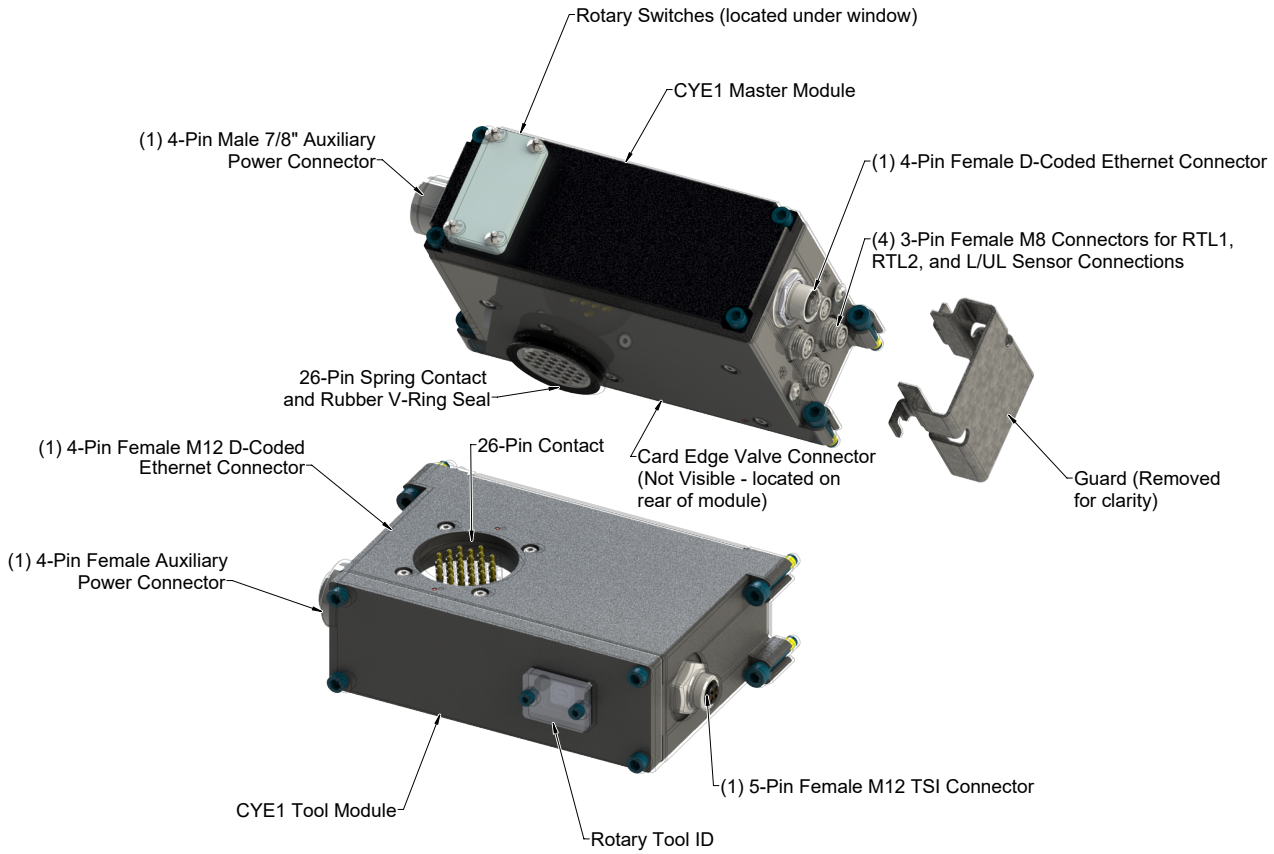
The module has the following connections:

- (1) 4-pin female D-coded Ethernet connector.
- (1) 4-pin male 7/8" auxiliary power connector.
- (4) 3-pin female M8 connectors for RTL1, RTL2, Lock, and Unlock sensor connections.
- (1) card edge connector that mates with the VY Series Valve Module.

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 2.2—Arc Prevention Circuit* for additional information regarding the Arc Prevention Circuit.

The module provides status LEDs to visually indicate its operation. A reset button provides the ability to return to factory default settings. Refer to *Section 2.1.6—Module Status (MS) and Network Status (NS) LEDs* and *Section 2.1.7—E1 and E2 LEDs*.

Figure 1.1—CYE1 Modules



1.2 CYE1 Tool Module

The module has the following connections:

- (1) 4-pin female M12 D-coded Ethernet connector.
- (1) 4-pin female 7/8” auxiliary power connector.
- (1) 5-pin female M12 TSI connector. (refer to *Section 2.4—Tool Side TSI*).

The Tool module has a 0-F Rotary Switch for setting of the Tool-ID input that allows the customer to distinguish between the different tools that are used in a robotic cell or on a production line. The Tool-ID is reported through the Master module bitmap. See *2.1.1-Ethernet Interface Information* for I/O bitmap and detailed I/O information.

2. Product Information

This section provides more detailed information on the behavior of the CYE1 modules.

2.1 Master Module

2.1.1 EtherNet/IP™ Interface Information

Table 2.1 lists the EtherNet/IP™ interface parameters employed in the CYE1 Master module.

Table 2.1—EtherNet/IP™ Interface Parameters

Parameter	Description
DCP	supported
Used Protocols (subset)	UDP, IP, ARP, ICMP (Ping)
Topology recognition	LLDP, physical device
VLAN- and priority tagging	yes
Context Management	by CL-RPC
Minimum cycle time	2 ms
Baud rate	100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3

An EDS file for the Master node is available by contacting ATI Sales. Reference the part number: EDS file 9031-20-1101. The default setting from the factory for the Master module is IP Address 192.168.1.54.

Robot input and output bitmaps for the Master node are provided in *Table 2.4* and *Table 2.5.*

2.1.2 Integrated Web Server

A web browser, such as Internet Explorer or Mozilla Firefox, is required to access the web server. The module's webpages use simple HTML and do not require any plug-ins.

To bring up the main page of the web server:

1. Type "http://"
2. Type the module's IP address into the browser's address field
3. Press enter.

The module's integrated web server hosts webpages broken down in the following sections.

2.1.2.1 Overview Webpage

The 'Overview' page is the first that comes up. It reports the module name, serial number, firmware (FW) version, uptime, and CPU load of the module. Refer to *Figure 2.1*.

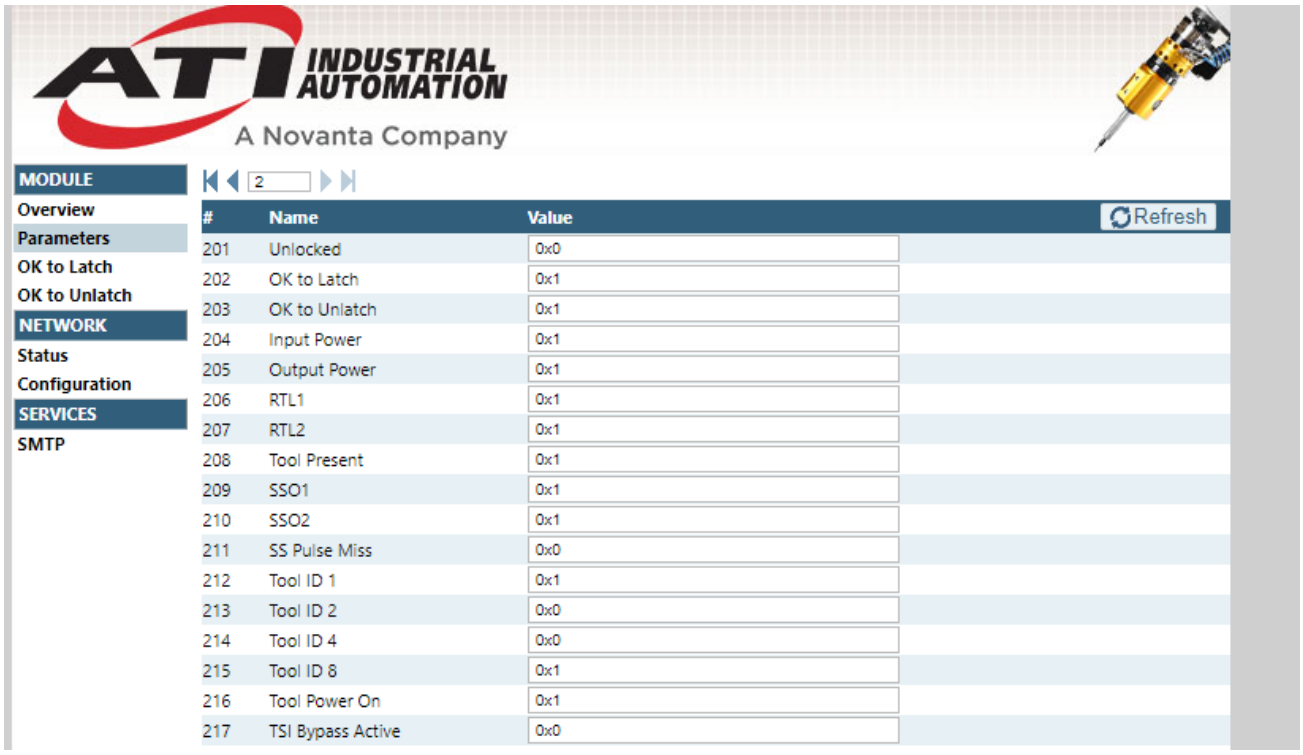
Figure 2.1—Module Overview

2.1.2.2 Parameters Webpage

This page is used to change Input and Output values. The Latch and Unlatch outputs cannot be activated via this webpage. Refer to *Section Figure 2.2* and *Section Figure 2.3*.

Figure 2.2—Module Parameters Page 1

Figure 2.3—Module Parameters Page 2



2.1.2.3 Module Status Webpage

This page contains current IP Address, EtherNet/IP™ Status, Interface Counters, and Media Counters. Refer to *Section Figure 2.4* and *Section Figure 2.45*.

Figure 2.4—Module Status Page 1

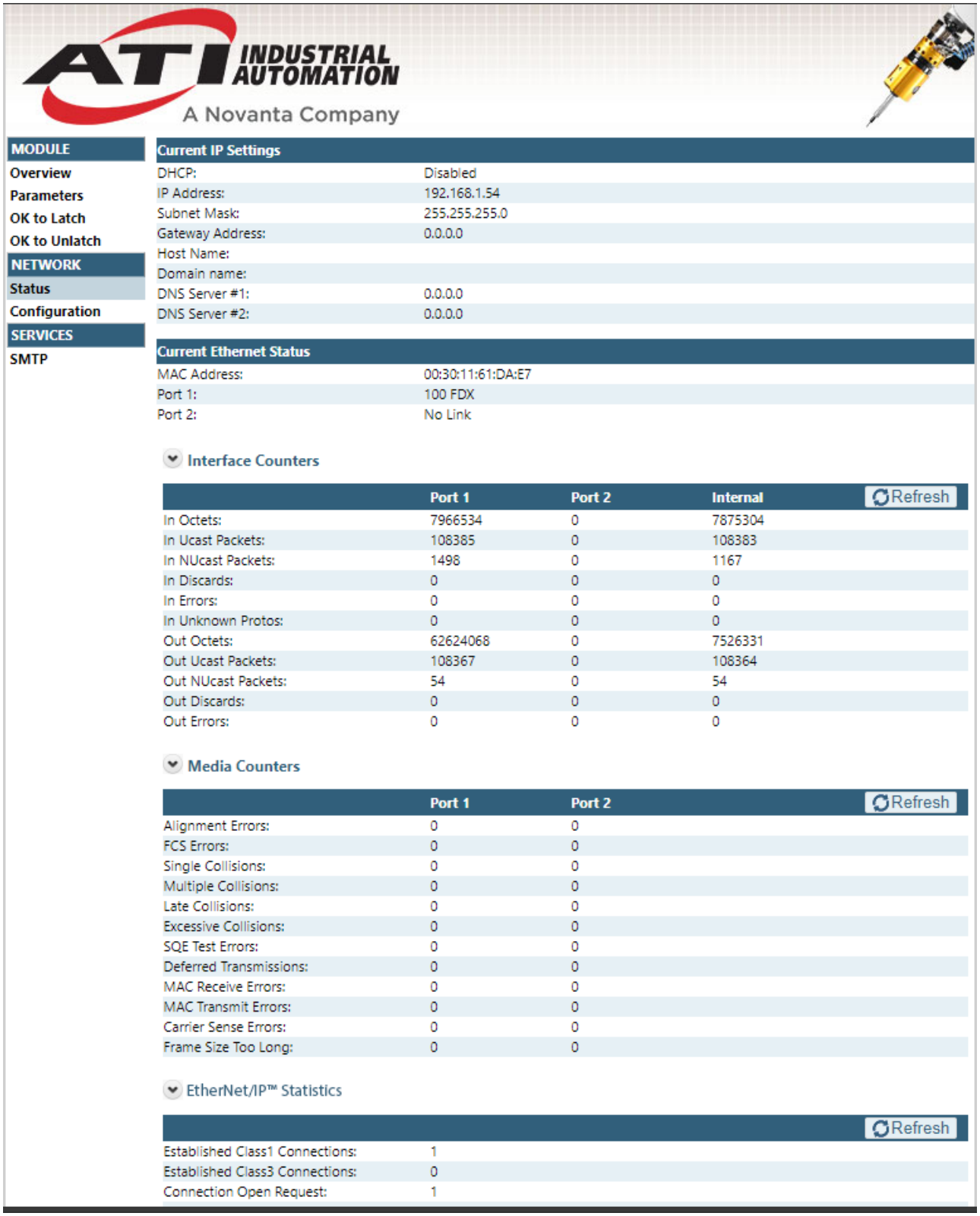
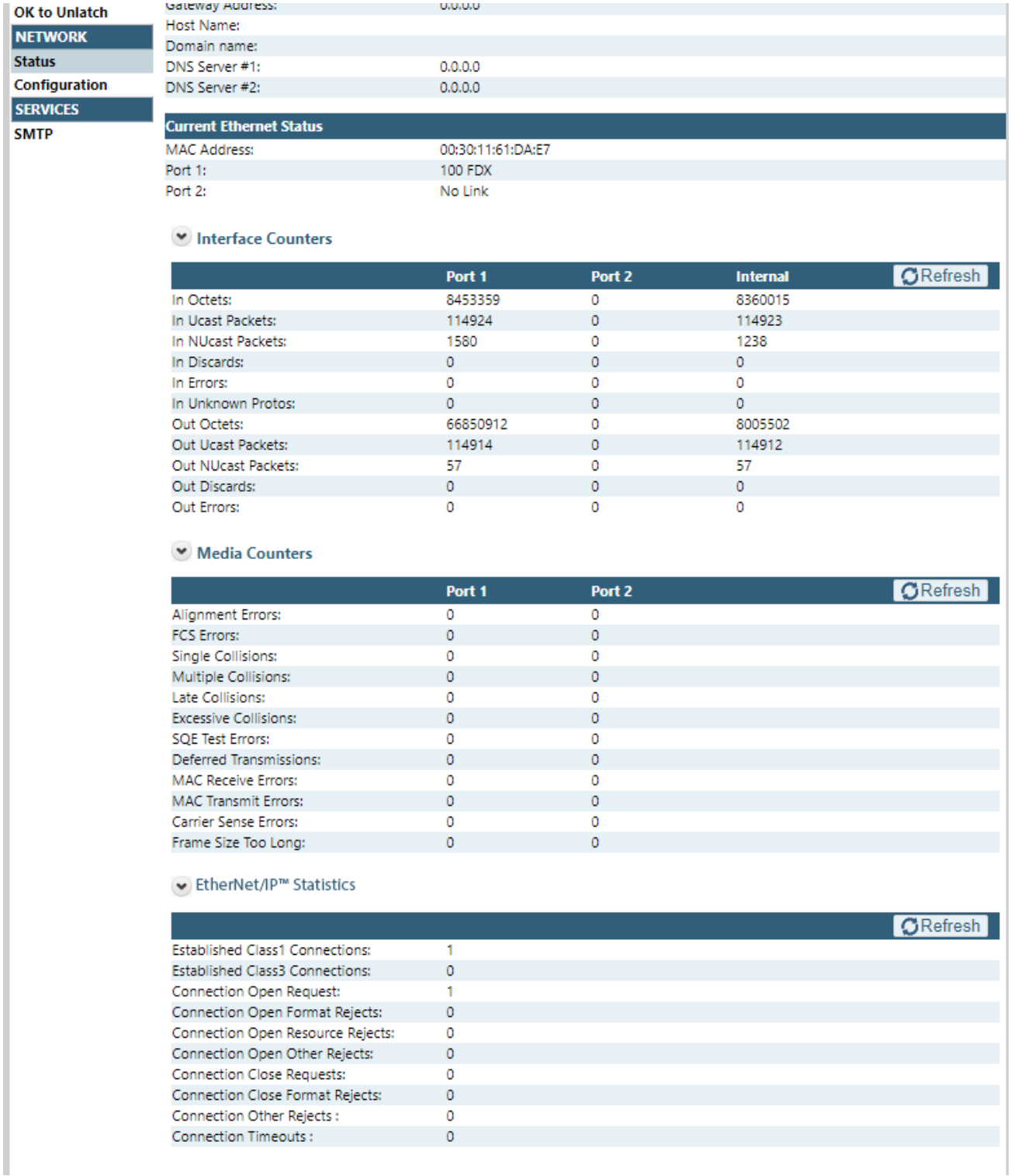


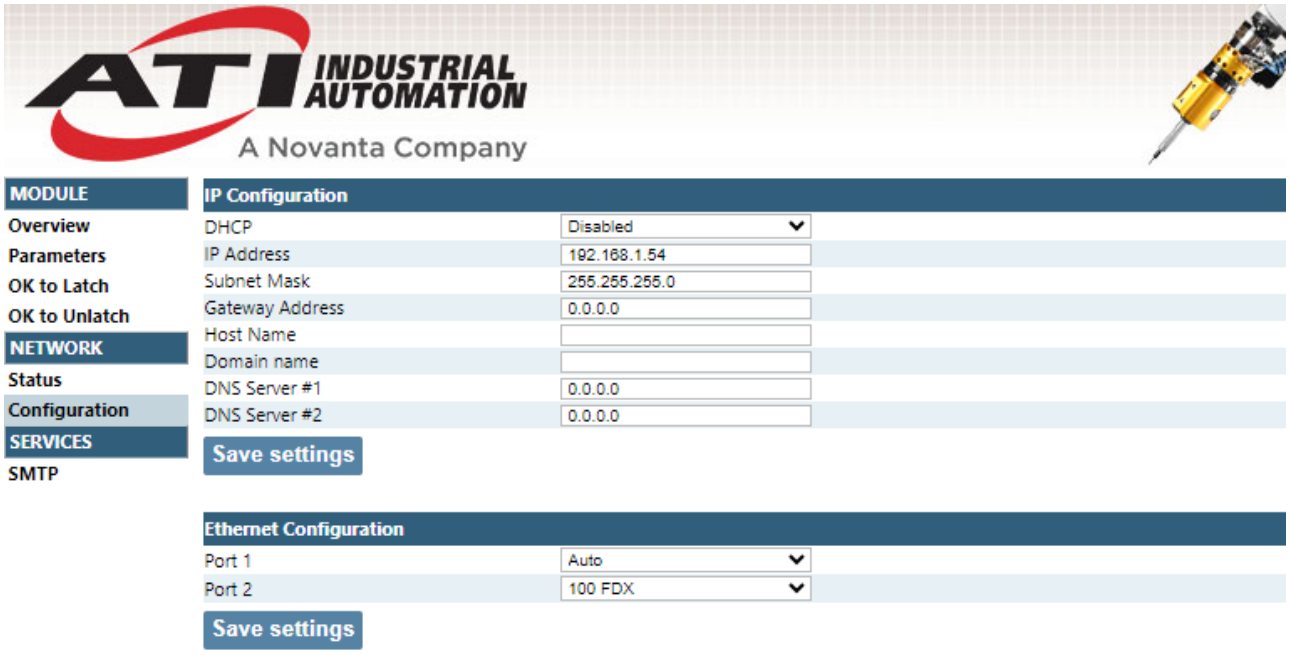
Figure 2.5—Module Status Page 2



2.1.2.4 Module Configuration Webpage

This page is used to change IP Configuration. Refer to *Section Figure 2.6*.

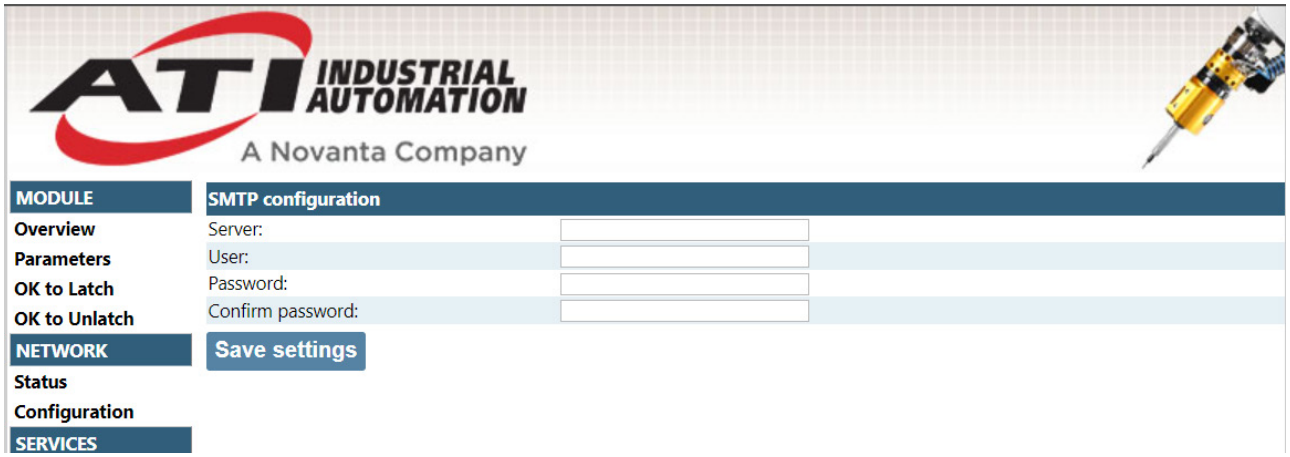
Figure 2.6—Module Configuration



2.1.2.5 Module SMTP Webpage

This page is used to change SMTP (server, username, and password) configuration. Refer to *Section Figure 2.7*.

Figure 2.7—Module SMTP



2.1.3 Integrated Ethernet Switch

The Master module provides an integrated 2-port Ethernet switch which supports the following:

- Transmission rate 100 MBit/s
- Interface type 100 BASE-TX, isolated
- Half duplex/Full duplex
- Auto Negotiation
- Auto Crossover

2.1.4 Network

The following information contains Network Switch Configurations (Robot and Tool side ports) and Network Counters. The CYE1 module has an integrated Ethernet switch. The CYE1 module is shipped with the following switch settings. Default settings can be changed within the **Network Configuration** webpage, refer to *Section 2.1.2.4—Module Configuration Webpage.*

2.1.4.1 Robot Side Port

Robot Side Port default settings:

- Auto-Negotiation: Enabled
- Auto-MDIX: Enabled
- MDI Setting: Enabled

2.1.4.2 Tool Side Port

Tool Side Port default settings:

- Auto-Negotiation: Disabled
- Speed: 100 MPS
- Duplex: Full Duplex
- Auto-MDIX: Disabled
- MDI Setting: MDI-X

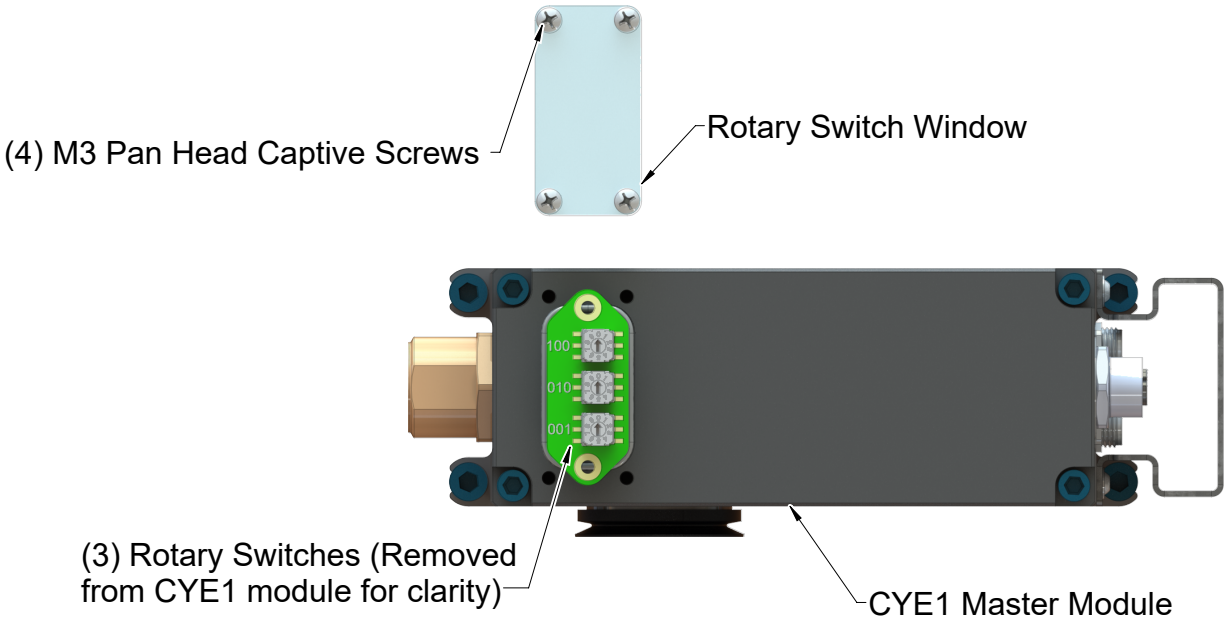
Table 2.2—I/O Bitmap, Inputs to Master Module			
Byte	**Bit#**	**Name**	**Description/Function**
0	0	Latch	Request Lock.
	1	Unlatch	Request Unlock.
	2	Reserved	
	3	Reserved	
	4 to 7	Reserved	

Table 2.3—I/O Bitmap, Outputs from Master Module			
Byte	**BitNumber**	**Name**	**Description/Function**
0	0	Locked	Tool Changer is locked.
	1	Unlocked	Tool Changer is unlocked.
	2	OK to Latch	Input indicating that all required criteria are met to allow the Tool Changer to latch.
	3	OK to Unlatch	Input indicating that all required criteria are met to allow the Tool Changer to unlatch.
	4	Input Power	Input voltage is greater than 21V.
	5	Output Power	Output voltage is greater than 20V.
	6	RTL1	Ready-to-Lock Prox1 Input
	7	RTL2	Ready-to-Lock Prox2 Input
1	0	Tool Present	Master and Tool are in electrical contact.
	1	SSO1	Input from safety switch that indicates it is safe to unlatch the tool. Should always agree with SSO2
	2	SSO2	Input from safety switch that indicates it is safe to unlatch the tool. Should always agree with SSO1
	3	Pulse Missing	On if SSO1 is ON and does not pulse within 2s
	4	Tool ID (1)	0-15 Tool-ID Input.
	5	Tool ID (2)	
	6	Tool ID (4)	
	7	Tool ID (8)	
2	0	Tool Power is on	Indicates that the Arc Prevention Circuit is sending power to the Tool
	1	TSI Bypass Active	When TSI Bypass is active, this bit will display 1, when TSI Bypass is inactive this bit will display 0.
	2	Reserved	
	3		
	4		
	5		
	6		
	7		

2.1.5 Setting Last Octet Via Rotary Switches

The octet board has three rotary switches with a range from 0-9. The three switch settings together make up the binary-coded decimal value that can be used to set the fourth octet of the module IP address. The switch settings are read via a serial shift register connected to the micro controller unit. In order to access and set the rotary switches, the customer will need to remove the rotary switch window by loosening the (4) M3 pan head captive screws using a phillips screwdriver.

Figure 2.8— Setting Last Octet Via Rotary Switches



The last octet behavior is determined by the following octet board switch states:

- If switches read 001-254, then the last octet will be the current switch setting.
- If switches read 000, then the application will not attempt to set the IP address.
- If switches read 999, then the default IP address (192.168.1.54) will be used.
- If any other value is set, then the setting will be ignored, and the application will not attempt to set the IP address.

Once the the rotary switches have been set as desired, re-install the window and tighten the (4) M3 pan head captive screws using a phillips screwdriver.

2.1.6 Module Status (MS) and Network Status (NS) LEDs

When the modules are coupled and communicating properly on the network, the CYE1-M LEDs should display as shown in *Figure 2.9*, with the E1 and E2 LEDs flashing green based on the Ethernet communication.

Figure 2.9—LEDs on the Master Module

The Module Status (MS) LED is identified on the module as "MS". It provides device status for power and proper operation. Refer to *Table 2.4* for an outline of this LED's operation.

The Network Status (NS) LED is identified on the module as "NS". It provides Ethernet status information. Refer to *Table 2.5* for an outline of this LED's operation.

Table 2.4—Master Module MS status LED

Status	LED		Note
No Power		Off	No power applied. Check if the voltage is greater than 21 volts.
Operational[1]		Green (solid)	Normal operation.
Network Reset		Green (flashing, 3 seconds)	The factory reset button has been pressed and network settings have been reset to default.
Idle		Green (flashing)	Network connection is idle.
Minor Fault		Red (flashing)	A recoverable network fault has occurred or the device has detected that the Input and Logic Power voltage is out of range.
Major Fault[2]		Red (solid)	An unrecoverable exception state or firmware update failure has occurred.
POST		Alternate Red/Green (flashing)	The device is performing a Power On Self-Test or firmware update.

Notes:

1. The LED will be green even if no network connection is established.

2. The device enters an exception state after a factory reset. Power cycle the module.

Table 2.5—Master Module NS status LED		
Status	**LED**	**Note**
Offline	Off	No IP address or powered off.
Online	Green (flashing)	Online, no connections established.
Connected	Green (solid)	Online, one or more connections established.
Minor Fault	Red (flashing)	One or more connections has timed out.
Major Fault	Red (solid)	Duplicate IP address.

2.1.7 E1 and E2 LEDs

The E1 and E2 LEDs provide information about link status and activity on the ports of the integrated EtherNet/IP™ switch.

The E1 LED displays the status of the robot side Ethernet port. The E2 LED displays the status of the tool side Ethernet port. The module status is indicated by the specified LED behavior in the following tables.

Table 2.6—Master Module Ethernet 1 (E1) LED		
LED		**Note**
	Off	No link, no activity.
	Green (solid)	Link (100 Mbit/s) established.
	Green (flickering)	Activity (100 Mbit/s).
	Red (solid)	Link (10 Mbit/s) established.
	Red (flickering)	Activity (10 Mbit/s).

Table 2.7—Master Module Ethernet 2 (E2) LED		
LED		**Note**
	Off	No link, no activity.
	Green (solid)	Link (100 Mbit/s) established.
	Green (flickering)	Activity (100 Mbit/s).
	Red (solid)	Link (10 Mbit/s) established.
	Red (flickering)	Activity (10 Mbit/s).

Figure 2.10—Master Module Reset (RST) Button

2.1.8 Reset-To-Factory (RST) Push-Button

A push button, located under the socket head cap screw allows the user to perform a Reset-To-Factory function which resets the module's IP address to the default address.

After the push button is pressed for three seconds the MS LED will blink green, indicating that with the next power cycle the IP address will be reset to 192.168.1.54

Make sure to re-apply the socket head cap screw after access to the push button is no longer needed. The torque on the reset button screw should be 4 in-lbs (0.45 Nm).

2.2 Arc Prevention Circuit

The CYE1 Module incorporates 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. The Arc Prevention Circuit makes it possible to couple/uncouple without switching power off and prevents damage to the contacts.

In the CYE1 Module, the Arc Prevention Circuit controls the ON/OFF status of the following (2) power signals:

- Input and Logic power
- Output power

The behavior of the Arc Prevention circuit is described in the following sections

2.2.1 Arc Prevention Circuit Behavior during Coupling

The Master module incorporates ATI's 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. The Arc Prevention Circuit makes it possible for the customer to couple/uncouple without switching power off and prevents damage to the contacts.

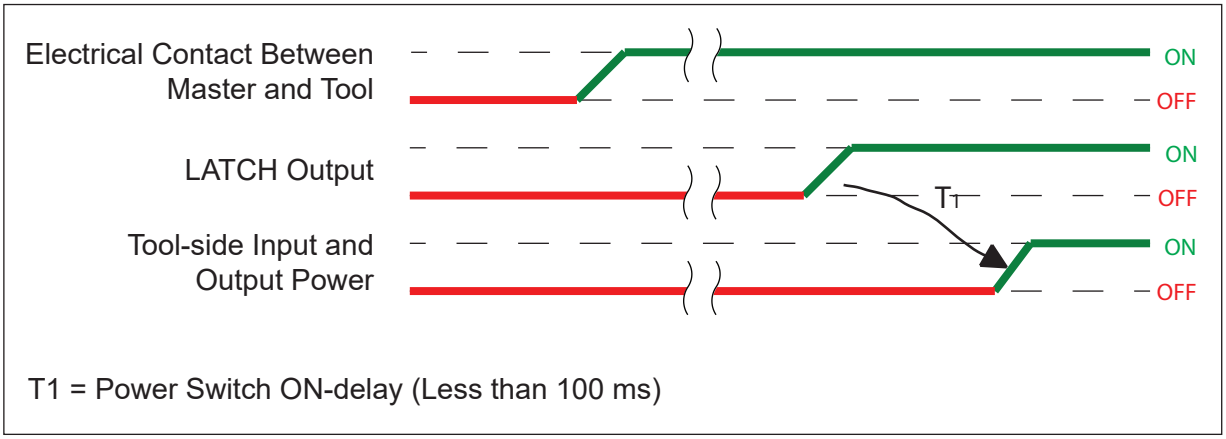
2.2.2 Arc Prevention Circuit Behavior during Coupling

The behavior of the Arc Prevention circuit during coupling can be more clearly understood by referring to *Figure 2.11*.

When the robot and Master approach the Tool for pick up, electrical contact between the Master and Tool pin contacts occurs. Soon after the Latch command is turned ON, the Arc Prevention Circuit will turn on input and output power. The time delay between when the LATCH output is turned ON to when power is actually available to the EOAT (time T1 in the diagram) is less than 100 ms.

Important: The Arc Prevention Circuit will only allow power to pass to the Tool after the LATCH command has been issued and the Master and Tool module's electrical contacts are fully engaged.

Figure 2.11—Power On Timing



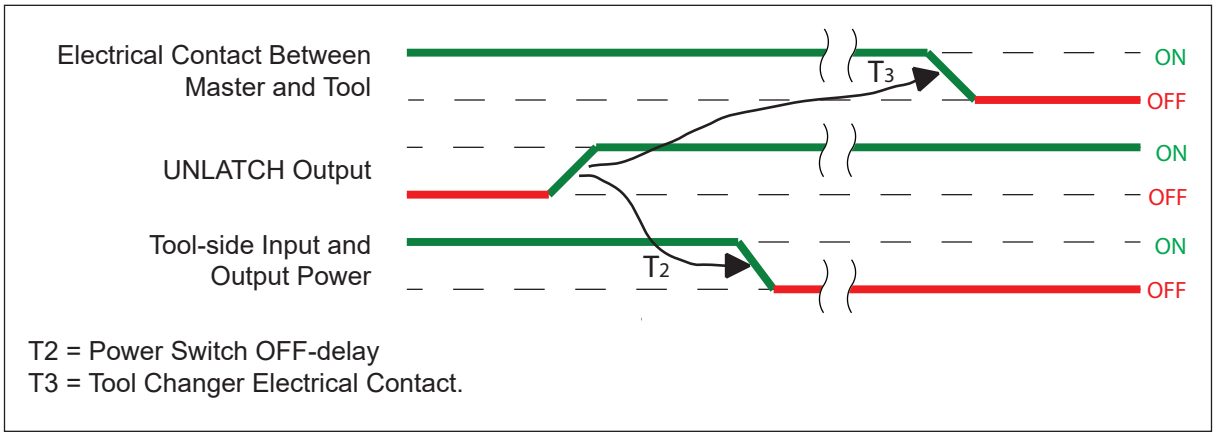
2.2.3 Arc Prevention Circuit Behavior during Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to *Figure 2.12*.

Immediately after the UNLATCH command is issued, the Arc Prevention Circuit will turn off input and output power. The power off time delay between the UNLATCH command and the switching off of power (designated T2 in the diagram) is less than 50 ms.

Some time after power is turned off and the Master and Tool begin to separate, electrical contact between Master and Tool pin contacts will be lost. This occurs with a delay, designated T3 in the diagram, after the UNLATCH command is issued. The magnitude of time T3 is a function of many factors, including the weight of the EOAT, the friction between Master and Tool alignment pins, etc. but is usually not shorter than 100 ms.

Figure 2.12—Power Off Timing



2.3 Tool Module

In addition to providing Tool-ID and Tool side TSI, the Tool module is a pass-through for EtherNet/IP™ signals and power to downstream equipment. For details, refer to *Section 9—Drawings*.

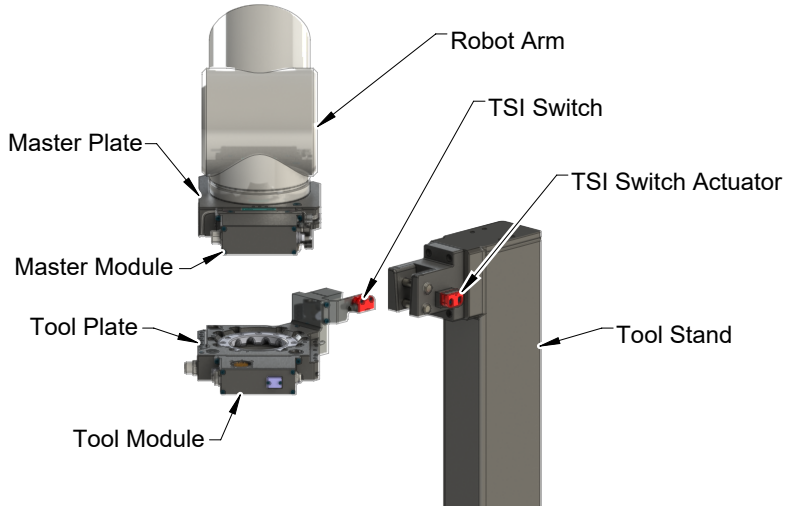
2.3.1 Tool-ID

0-F rotary switch is provided on the Tool module for setting of a Tool-ID number. Refer to *Section 3.5—Setting the Tool-ID.*

2.4 Tool Side TSI

The Tool Stand Interlock (TSI) circuit ONLY allows Tool release in the stand or storage location as indicated by actuation of a customer integrated safety switch. The Safety Sensor is powered Input Power (reference *Figure 2.13)*. The safety switch should be mounted to the end effector in such a way that the switch is "made" only when the Tool is in the stand or storage location.

Figure 2.13—(CYE1) Tool Stand Interlock (TSI) with a RFID Safety Switch



Both the CYE1 Control Module and VY Series Valve Module play a role in determining whether it is safe to unlatch (refer to *Figure 2.13*). The safety critical inputs from the Safety Switch, SSO1 and SSO2, are first transmitted from the CYE1 Tool module to the CYE1 Master module via the pin block and then to the VY Valve Module via the Card Edge connector.

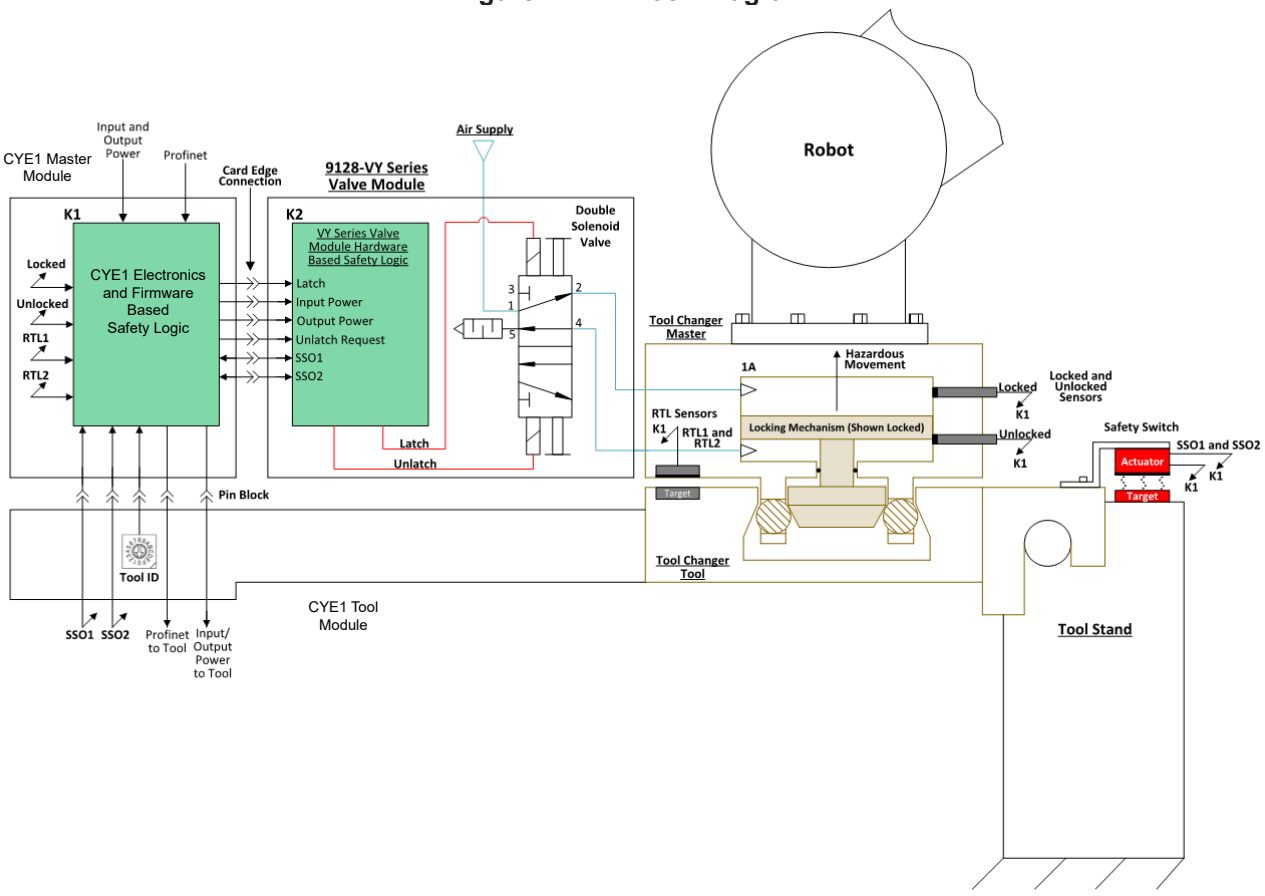
The CYE1 Master module firmware evaluates the SSO1 and SSO2 inputs to determine if it is safe to unlatch. Only when the following conditions are met will the CYE1 determine that it is safe to unlatch:

- Both SSO1 and SSO2 inputs must be ON.
- Input and Output power must be within the specified voltage range

The CYE1 will switch the OK to Unlatch bit ON when the conditions for unlatching have been met and will then send an unlatch request to the VY Valve Module.

The VY Valve Module contains hardware logic that processes the same SSO1 and SSO2 safety switch inputs as the CYE1 Master Module. Only when the SSO1 and SSO2 inputs are both ON will the VY Valve Module send the unlatch output to the double solenoid pneumatic valve.

Figure 2.14—Block Diagram



Section 4.2—Recommended Sequence of Operation describes in detail the behavior of the OK to Unlatch and SSO1 and SSO2 bits during the operation of the Tool Changer.

The CYE1 module can support the following types of safety switches:

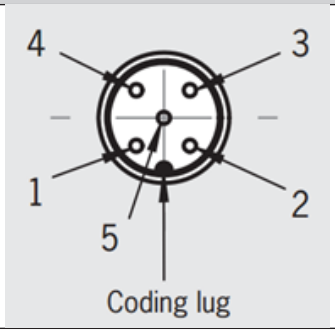
1. Mechanical safety rated limit switches that have two sets of normally open contacts.
2. Magnetically Coded Non-contact Interlock Switches such as the Allen-Bradley Ferrogard™ or Sipha™ switches that have two sets of NO contacts.

3. Non-contact RFID safety switches, including:
   - Euchner CES-I-AP such as ATI P/N 9120 TSL SS 9025. Note, these are not capable of series connection.
   - Euchner CES-I-AR series connected PLe rated safety switches. The CYE1 can support a maxium of four (4) non-contact type RFID safety switches connected in series.
   - SICK STR1 series connected PLe rated safety switches.
   - PILZ PSEN cs3.1p/M12 series connected PLe rated safety switches
   - ABB JOKAB Adam OSSD-Info M12-8 series connected PLe rated safety switches
   - Banner SI-RFPT-LP5 switch

The safety switches listed above are not included with the CYE1. If selecting a safety switch that is not listed above, ensure that the selected safety switch meets the following requirements:

1. Meets PLd or PLe safety standards.
2. Includes an M12 A-coded connector pin-out matching that shown in table below.

Table 2.8—Safety Switch Connector Pinout

Pin Number	Description	Pinout
1	24V+	
2	Safety Switch Output Channel 1	
3	0V	
4	Safety Switch Output Channel 2	
5	N/C	

2.4.1 TSI Bypass

If the Tool Changer is inadvertently locked without a Tool attached, the Tool Changer can still be safely unlocked electronically since no Tool is present with the TSI Bypass functionality. TSI Bypass will be activated in factory default settings.

The microcontroller will evaluate the RTL1, RTL2, and Tool Present inputs to determine whether it is safe to unlatch the Tool Changer. If all three inputs are false, the hardware channel will send TSI Bypass signals to the valve adapter through the card-edge connector to enable the Unlatch command.

If any of the three inputs (RTL1, RTL2, or Tool Present) are true, the TSI ByPass input will remain false and SSO1 and SSO2 inputs will be used to determine if it is safe to unlatch.

The TSI Bypass bit is monitored in the bitmap and when active will be off. The TSI Bypass bit is active when the following conditions are met:

- The TSI Bypass input is true.
- The RTL1 and RTL2 sensor inputs are false.
- Tool Present input is false.

Reference *Section 9—Drawings* for detailed schematics on the TSI Bypass functionality.

3. Installation

The control/signal modules are typically installed by ATI prior to shipment. The following procedure outline the field installation or removal as required. For wiring information refer to *Section 9—Drawings*.

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: 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.

3.1 Master Control/Signal Module Installation

Refer to Figure 3.1.

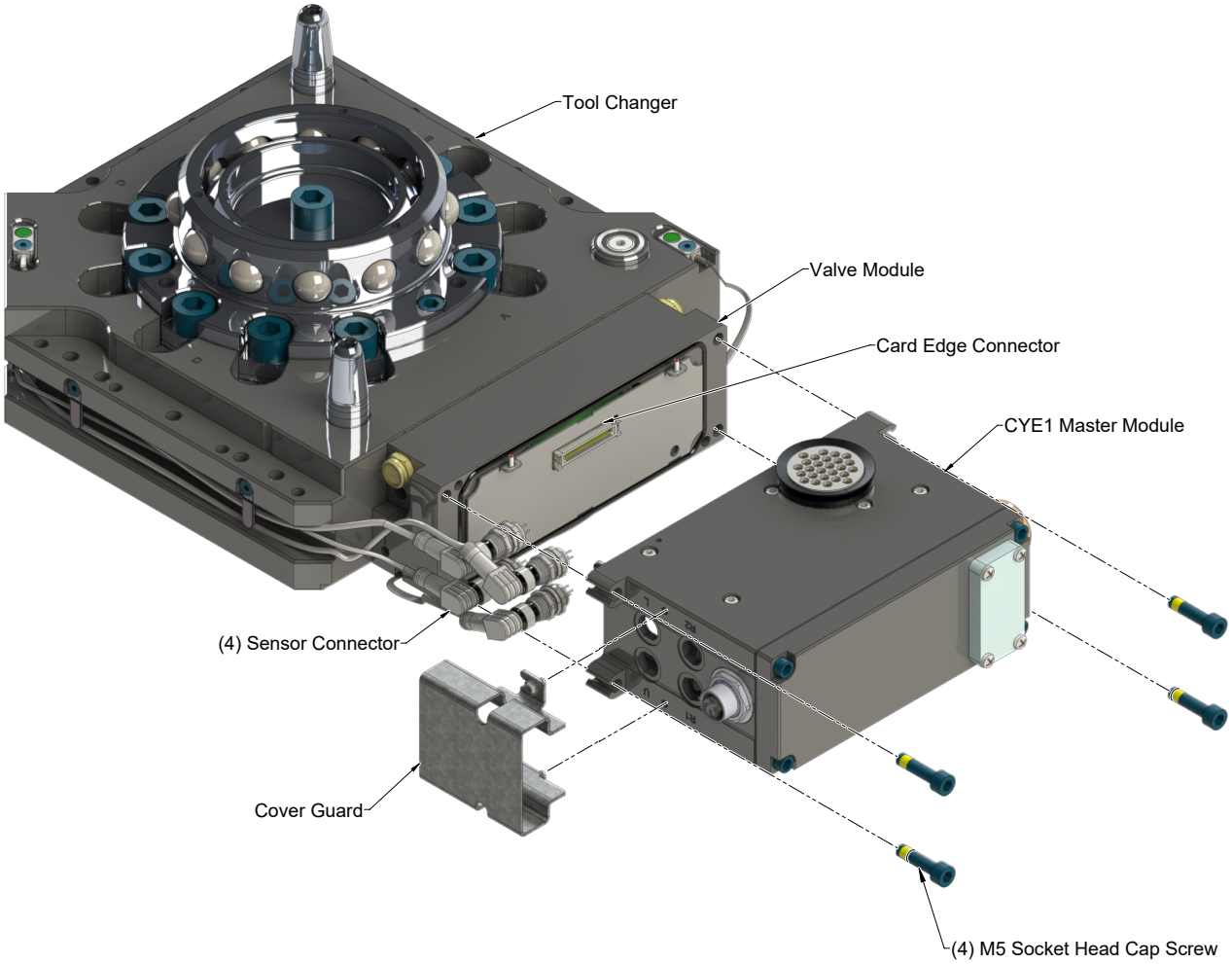
Tools required: *3 mm and 4 mm hex keys*

Supplies required: *Clean rag, Loctite® 242*

NOTICE: Avoid contact with the card edge connector. Debris and contaminants on the connector can impede signals.

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. Wipe down the mounting surfaces with a clean rag.
5. Place the module into the appropriate location on the valve module. Align card edge with mating connector on valve module. Refer to *Figure 3.2*.
6. Apply Loctite 242 to the (4) M5 socket head cap screws. Install the (4) M5 socket head cap screws securing the module to the valve module and tighten to 45 in-lbs (5.1 Nm).
7. Connect the (L) Lock, (U) Unlock, and (R1 and R2) RTL sensor cable connectors to the Master module.
8. Install guard over connectors.
9. Connect the power cable and Ethernet cable connectors to the Master module.
10. Safely resume normal operation.

Figure 3.1—Master Module Installation



3.2 Master Control/Signal Module Removal

Tools required: *4 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 (for example: electrical, pneumatic, and hydraulic circuits).
4. Remove guard over connectors.
5. Disconnect the (L) Lock, (U) Unlock, and (R1 and R2) RTL sensor cable connectors from the Master module.
6. Disconnect the power cable and Ethernet cable connectors from the Master module.
7. Support the control/signal module and remove the (4) M5 socket head cap screws and lower the module until it clears the dowel pins.

3.3 Tool Control/Signal Module Installation

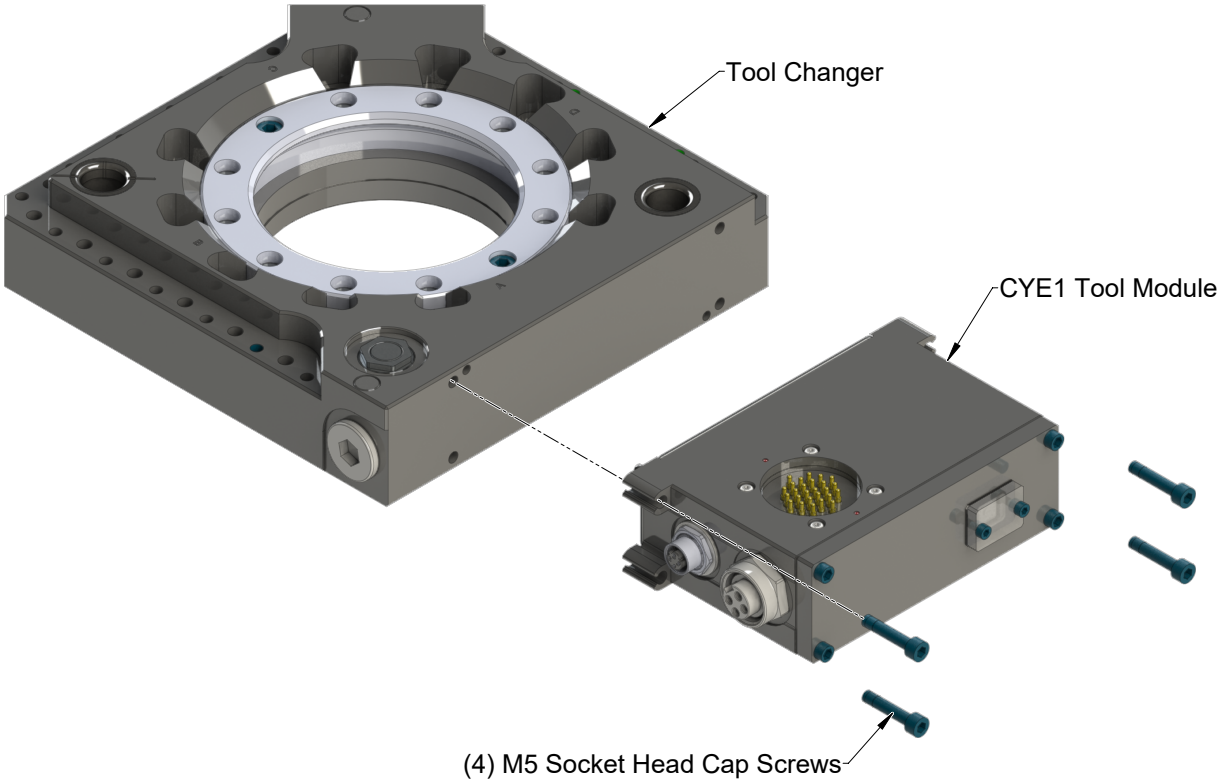
Refer to Figure 3.2.

Tools required: *3 mm and 4 mm hex keys*

Supplies required: *Clean rag, Loctite 242, M5 fastener for grounding terminal*

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. Wipe down the mounting surfaces with a clean rag.
5. Set the Tool-ID. Refer to *Section 3.5—Setting the Tool-ID.*
6. Place the module into the appropriate location on the valve module spacer. Align the module with the valve module spacer using the card edge connector and the dowels. Refer to *Figure 3.2*.
7. Apply Loctite 242 to the supplied M5 socket head cap screws. Install the (4) M5 socket head cap screws securing the module to the valve module spacer and tighten to 45 in-lbs (5.1 Nm).
8. Connect the TSI safety switch cable to the Tool module.
9. Connect the power cable and Ethernet cable connectors to the Tool module.
10. Safely resume normal operation.

Figure 3.2—Tool Module Installation (CYE1-T Shown)



3.4 Tool Control/Signal Module Removal

Tools required: *4 mm hex key*

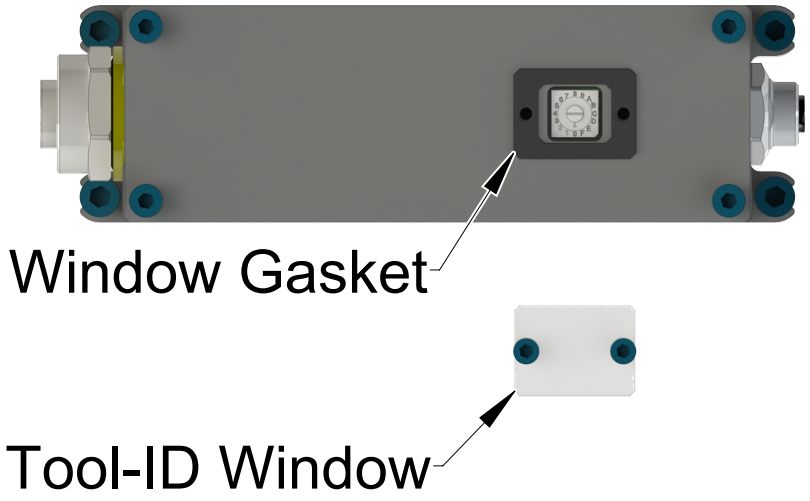
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Disconnect the TSI safety switch cable from the Tool module.
5. Disconnect the power cable and Ethernet cable connectors from the Tool module.
6. Support the Tool module and remove the (4) M5 socket head cap screws using a 4 mm hex key. Lift up on the module until it clears the guide pin. Refer to *Figure 3.2*.

3.5 Setting the Tool-ID

A rotary switch is provided on the Tool module for setting of a Tool-ID number.

Tools required: *2 mm hex key, small slotted screwdriver*

Figure 3.3—Setting the Tool ID



1. Loosen the (2) M3 socket head cap screws and remove the Tool-ID window.
2. Use a small slotted screwdriver, turn rotary switch.
3. Ensure that window gasket is intact.
4. Re-install the Tool-ID window.
   a. Tighten the M3 socket head cap screws.
   b. Tighten the socket head cap screws to 48 in-oz (34 cmN).

3.6 EtherNet/IP™ Interface

The EtherNet/IP™ interface parameters and I/O bitmaps in the modules are found in *Section 2.1.1—EtherNet/IP™ Interface Information* of the manual. These should be thoroughly understood prior to operating the Tool Changer. A detailed operational sequence is provided in *Section 4.2—Recommended Sequence of Operation.*

3.7 Electrical Connections

Refer to drawings in *Section 9—Drawings* for the electrical connections and pin/signal information.

4. Operation

A recommended Sequence of Operations is provided in *Section 4.2—Recommended Sequence of Operation* of 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 control/signal modules. This procedure is intended for "automatic" modes used during normal application processes.

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.

NOTICE: Grounding and power supply lines are required to be on certain pin locations of the customer interface connector. See the drawings for pin out information and location of the I/O signals.

Refer to the specific Tool Changer manual for coupling conditions of the Tool Changer and *Section 4.2—Recommended Sequence of Operation*. When coupled, the Tool module can be communicated with, Tool-ID can be read (if equipped), and attached end-effectors can be used.

4.1 Inputs

The following describes the most critical inputs from the ATI Master module.

4.1.1 Locked

An input indicating that the coupling mechanism is in the Lock position.

4.1.2 Unlocked

A proximity sensor input indicating that the coupling mechanism is in the Unlocked position.

4.1.3 Input Power OK

An input indicating the presence of Input and Logic Power at the ATI master module. Input voltage must be between 21V to 30V.

4.1.4 Output Power OK

An input indicating the presence of Output Power at the ATI master module. Output voltage must be between 20V to 30V; otherwise, the Tool Changer may not properly latch or unlatch.

4.1.5 RTL1 and RTL2

RTL proximity sensor inputs indicate that the Tool Changer Master and Tool are close enough to couple. These proximity sensors are installed in the Master plate. They sense targets which are installed in the Tool plate to indicate the Master is adjacent to the tool (within ~ 0.06” or 1.5 mm). RTL signals are not required to be ON before latching.

4.1.6 Tool Present

An input indicating the Master module is electrically connected to the Tool.

4.1.7 Tool Power Is On

The Tool Power Is On bit indicates that the Arc Prevention circuit has activated and power is passed to the tool side.

4.1.8 OK to Latch

The OK to Latch bit indicates when the preconditions for latching the Tool Changer have been met. The preconditions include:

- Input supply voltage must be in the specified range
- Output supply voltage must be in the specified range
- The Latch command must not be asserted

4.1.9 OK to Unlatch

The OK to Unlatch bit indicates when the preconditions for unlatching the Tool Changer have been met. The preconditions include:

- SSO1 and SSO2 must be active
- Input supply voltage must be in the specified range
- Output supply voltage must be in the specified range
- The Unlatch command must not be asserted

4.2 Recommended Sequence of Operation

Before programing can take place, the following condition must be met:

- Input and Output Auxiliary power is available and within acceptable range
- Air is supplied to the integrated valve and within acceptable range (60 - 120 psi)

Figure 4.1—Master Free with Tool In the Tool Stand

NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.6— Modules Status (MS) and Network Status (NS) LEDs* or *Section 2.1.7—E1 and E2 LEDs* for possible issues.

1. The robot and Tool Changer master are free of the stand or storage location, the Tool Changer is uncoupled and the Tool Changer locking mechanism is fully retracted (unlocked condition). The tool is by itself in the tool stand. No error or fault conditions exist.

    a. The following inputs are ON:
        i. Unlocked
        ii. OK to Latch
        iii. Input Power OK
        iv. Output Power OK

    b. The following inputs are OFF:
        i. Locked
        ii. Tool Present
        iii. RTL1 and RTL2
        iv. Tool Power is ON
        v. SSO1 and SSO2
        vi. OK to Unlatch

    c. The following output is OFF:
        i. Latch

2. If the Master is locked, unlock the Master.

> **CAUTION:** The Master locking mechanism must be fully retracted prior to the Master entering the Tool. Failure to do so will cause ball bearings to damage the Tool Bearing Race. If the Tool Changer is locked or in a missed tool condition, use the valve manual override procedure (refer to the *9620-20-C-VYB1* manual) to unlock the Tool Changer before attempting to latch Master with Tool.

Figure 4.2—Master Moves into Tool and is parallel at 0.06” (1.5 mm)

> **NOTICE:** If the LEDs don’t match what is shown, refer to *Section 2.1.6—Module Status (MS) and Network Status (NS) LEDs* or *Section 2.1.7—E1 and E2 LEDs* for possible issues.

3. Robot and Master move into the Tool are parallel and within 0.06” (1.5 mm) of the Tool.
   a. The **RTL1** and **RTL2** sensors are ON, indicating that its ok to couple the Tool.
   b. The **OK to Latch** bit is ON.

Figure 4.3—Master Coupled with Tool

NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.6—Module Status (MS) and Network Status (NS) LEDs* or *Section 2.1.7—E1 and E2 LEDs* for possible issues.

4. Couple the Tool Changer.
   a. If ON, turn the **Unlatch** output OFF and turn the **Latch** output ON.
   b. With the **Latch** output ON, power is available on the Tool and the **Tool Power is ON** input turns ON.
   c. The **Unlocked** input turns OFF and a short time later the **Locked** input turns ON and remains ON, indicating that the Tool Changer locking mechanism latch operation is complete. After the **Locked** input turns ON, the **Latch** output can be turned OFF.
   d. Sometime thereafter, communications should be established with the downstream Ethernet device(s) (The time it takes to establish connection with a downstream Ethernet node depends on the power up and reconnect time of the individual Ethernet equipment that is installed on the Tool.)
   e. Read **Tool-ID** inputs.

Figure 4.4—Master Coupled with Tool Moves Out of the Stand

NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.6—Module Status (MS) and Network Status (NS) LEDs* or *Section 2.1.7—E1 and E2 LEDs* for possible issues.

5. The robot moves away from the tool stand with the Tool Changer coupled.
   a. The TSI Switch is deactivated, and the **SSO1** and **SSO2** input goes OFF.
   b. The **OK to Unlatch** turns OFF.
6. Normal operation.
   a. The following inputs are ON:
      ii. Locked
      iii. Input Power OK
      iv. Output Power OK
      v. RTL1 and **RTL2**
      vi. Tool Present
      vii. Tool Power is On
   b. The following inputs are OFF:
      i. Unlocked
      ii. SSO1 and **SSO2**
      iii. OK to Unlatch

NOTICE: The **Latch** output can be turned OFF, after the Locked input indicates the Tool Changer is in the locked state.

c. The following outputs are OFF:
   i. **Unlatch**
   ii. **Latch**

Figure 4.5—Master Coupled with Tool Returned to Stand

NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.6—Module Status (MS) and Network Status (NS) LEDs* or *Section 2.1.7—E1 and E2 LEDs* for possible issues.

7. The robot moves into the tool stand with the Tool Changer coupled.

   a. When the tool is returned to the stand, the TSI Switch is activated and the **SSO1** and **SSO2** go ON.
   b. The **OK to Unlatch** is ON, indicating that it is safe to uncouple the Tool Changer.

8. Uncouple the Tool Changer.

   a. If ON, turn the **Latch** output OFF and turn the **Unlatch** output ON.
   b. The **Tool Power is ON** input is OFF and the power on the Tool turns off.
   c. Communication is lost with downstream device(s).
   d. The **Locked** input turns OFF and a short time later the **Unlocked** input turns ON and remains ON, indicating that the Tool Changer locking mechanism unlatch operation is complete. After the **Unlocked** input turns ON, the **Unlatch** output can be turned OFF.

9. The Robot and Master are in free space.

   a. The following inputs are ON:
      i. **Unlocked**
      ii. **Input Power OK**
      iii. **Output Power OK**
      iv. **OK to Latch**
   b. The following inputs are OFF:
      i. **Locked**
      ii. **Tool Present**
      iii. **RTL1** and **RTL2**
      iv. **SSO1** and **SSO2**
      v. **Tool-ID** invalid (all zeros)
   c. The following output is ON:
      i. **Unlatch**

NOTICE: The **Unlatch** output can be turned OFF, after the **Unlocked** input indicates the Tool Changer is in an unlocked state.

   d. The following output is OFF:
      i. **Latch**

5. Maintenance

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(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 is used in dirty environments (for example: welding or deburring applications), limit the exposure of the Tool Changer. 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, perform periodic inspections to assess for unexpected damage and assure long-lasting performance. 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—Installation*.
- Cable connections should be inspected during maintenance periods to ensure they are secure. Loose connections should be cleaned and retightened. Inspect cable sheathing for damage, repair or replace damaged cabling. Loose connections and/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—Seal Replacement*.

5.1 Pin Block Inspection and Cleaning

Tools required: *Nylon Brush (ATI part number 3690-0000064-60)*

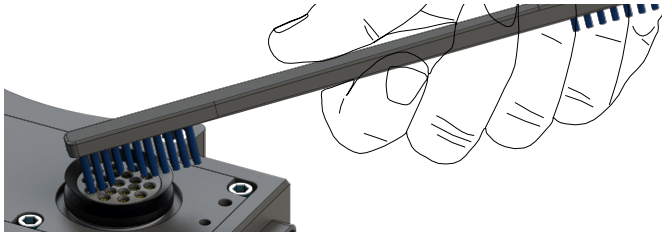
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Inspect the Master and Tool pin blocks for debris or darkened pins.

Figure 5.1—Inspect Master and Tool Pin Blocks

5. If debris or darkened pins are present, use a vacuum to remove the debris, and clean using a nylon brush (ATI part number 3690-0000064-60).

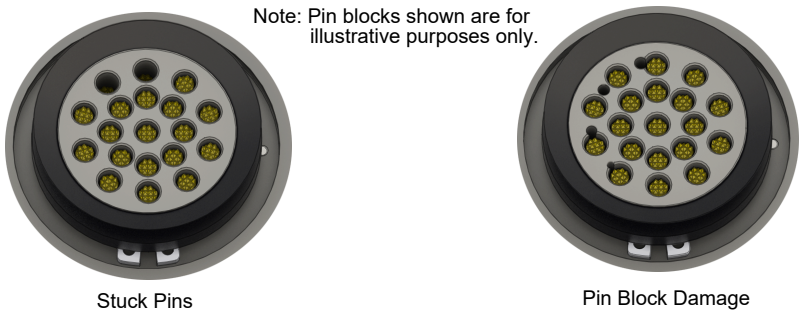
NOTICE: Do not use an abrasive media and/or cleaners or solvents to clean the contact pins. Using abrasive media and/or cleaners or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number 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 pins become stuck or if there is damage to the pin block, contact ATI for either a possible pin replacement procedure or module replacement.
8. Safely 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(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.

6.1 Troubleshooting

Troubleshooting information is provided in the following table:

Table 6.1—Troubleshooting

Symptom	Possible Cause	Correction
Unit will not lock or unlock	Debris caught between the Master and Tool plates	Clean debris from between Master and Tool plates. Verify mounting fasteners are secure and does not protrude above the mating surfaces.
	Ball bearings are not moving freely	Verify ball bearings are moving freely, clean and lubricate as needed (refer *to Maintenance section of Tool Changer manual for instructions)*
	Air supply not to specifications	Check air supply. *Refer to Pneumatic Connection section of the Tool Changer Manual for specifications.*
	Exhaust port is not properly vented	Check that exhaust port is properly vented. *Refer to Pneumatic Connection section of the Tool Changer Manual for valve requirements.*
	Card edge connection is dirty	Card edge connection must be cleaned. Clean any dust or debris off the card edge using an alcohol wipe.
	SSO1 and/or SSO2 are ON, to unlock. Not required to lock	SSO1 and SSO2 must be OFF.
	Incorrect valve operation	Check valve for proper operation. *Refer to Pneumatic Connection section of the Base Tool Changer Manual for valve requirements.*
	Signals are mapped incorrectly	Verify signals are mapped and communicating properly (refer to *Section 9—Drawings* for electrical schematic)
	Master and Tool are within the specified No-Touch zone	Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock. *Refer to the Operation Section of the Tool Changer manual for specifications.*
Sensors not operating properly (but Ethernet is operating correctly).	Sensor cables damage or incorrectly connected	Verify cables are connected correctly and not damaged, replace if damaged (refer *to Troubleshooting Section of Tool Changer manual)*
	Sensor is malfunctioning	Verify that the sensors are set correctly. *Refer to the Troubleshooting Section of the Tool Changer manual.*
	Tool plate is not secured properly or debris is trapped between surfaces	Ensure Tool plate is securely held to Master plate and nothing is trapped between plates
	Air trapped in the unlock (U) air port	Ensure that there is no Air trapped in the unlock (U) air port *Refer to Pneumatic Connection section of the Tool Changer Manual for valve requirements.*

Table 6.1—Troubleshooting		
Symptom	**Possible Cause**	**Correction**
Loss of communication	Contaminated or loose cable connections.	Ensure all cable connections are clean and tight.
	Damaged signal cabling	Check/replace signal cabling upstream and downstream of Tool Changer modules.
	Worn or damaged contact pins	Inspect module contact pins for debris/wear/damage. Contact ATI for contact pin replacement.
	Product upstream and downstream of Tool Changer failed or damaged	Check product upstream and downstream of Tool Changer for failure. This failure can “appear” to be caused by the Tool Changer or affect Tool Changer performance.
No power on the Tool side	Latch command not issued	Verify that the Latch command has been issued.
	The Tool Power is On bit is OFF.	Verify that the **Tool Power is On** bit is **ON**.
	The Tool Present bit is OFF.	Verify that the **Tool Present** bit is **ON**.
Loss of auxiliary power on the Tool side	Input power loss	Loss of Input power on the Master side will cause loss of Output power to the Tool. The Arc Prevention Circuit relies on Input power to operate. Restore Input power to the Master to restore Output power to the Tool.

6.2 Service Procedures

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

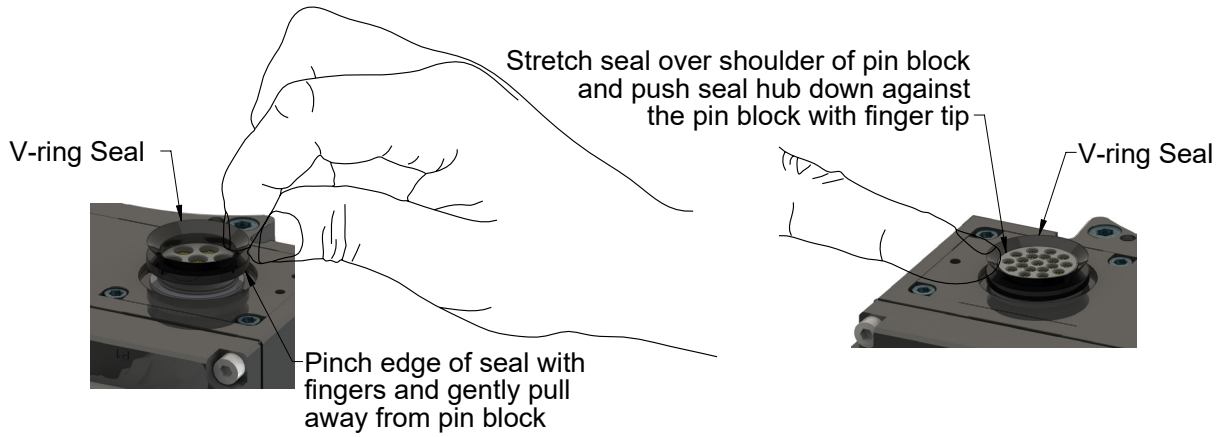
6.2.1 Seal Replacement

Parts required: *Refer to Section 9—Drawings.*

The seal protects the electrical connection between the Master and Tool module. Replace the seal if it becomes worn or damaged.

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. To remove the existing seal, pinch the edge of the seal and pull the seal away from the pin block on the Master module.
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.
7. Safely resume normal operation.

Figure 6.1—V-ring Seal Replacement



7. Serviceable Parts

7.1 Master Module Serviceable Parts

Figure 7.1—Master Serviceable Parts

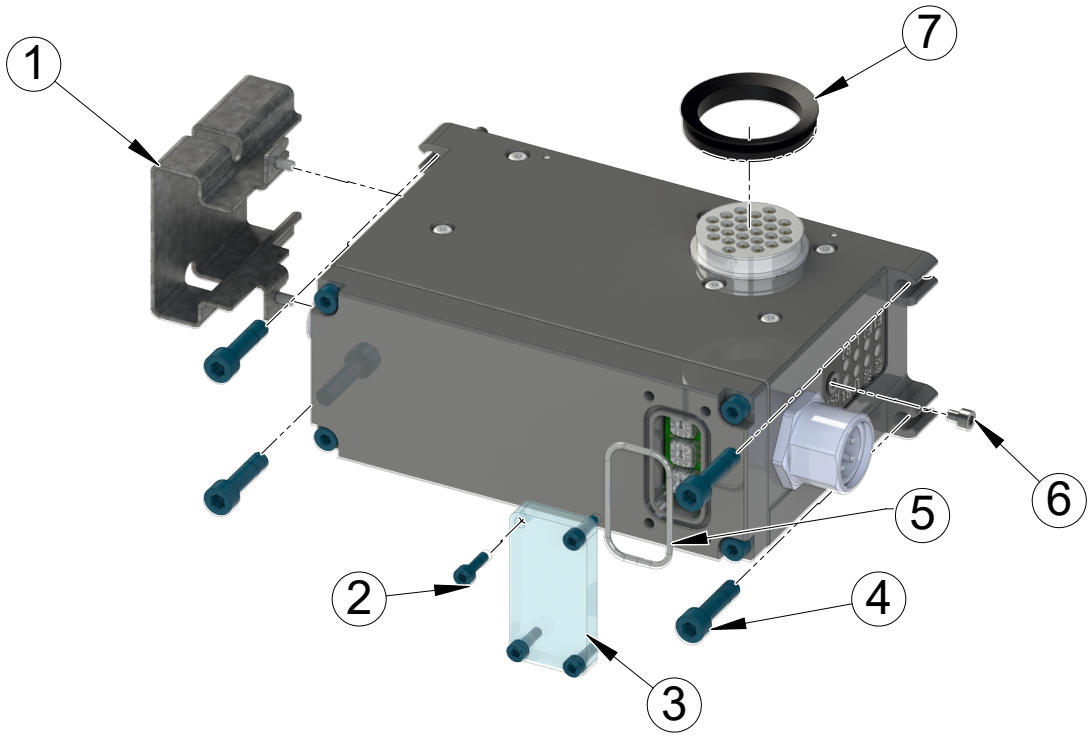


Table 7.1—Master Module Serviceable Parts			
No.	**Part Number**	**Qty**	**Description**
1	3700-20-11501	1	Ready-To-Lock, Lock, UnLock Sensor Connector Guard
2	3500-1058010-15	4	M3 x 10 Socket Head Cap Screw, 12.9, ISO4762/DIN912, ES-ATI-007.
3	3700-20-2696	1	Master Window
4	3500-1064020-15A	4	M5 x 20 Socket Head Cap Screw, ST 12.9, CPC, Pre-Applied, DIN 912 ISO 4762
5	3410-0001201-1	1	O-Ring
6	3500-1057004-21	1	M3 x 4 Socket Head Cap Screw, Stainless Steel
7	4010-0000041-01	1	V-Ring Seal

7.2 Tool Module Serviceable Parts

Figure 7.2—Tool Serviceable Parts

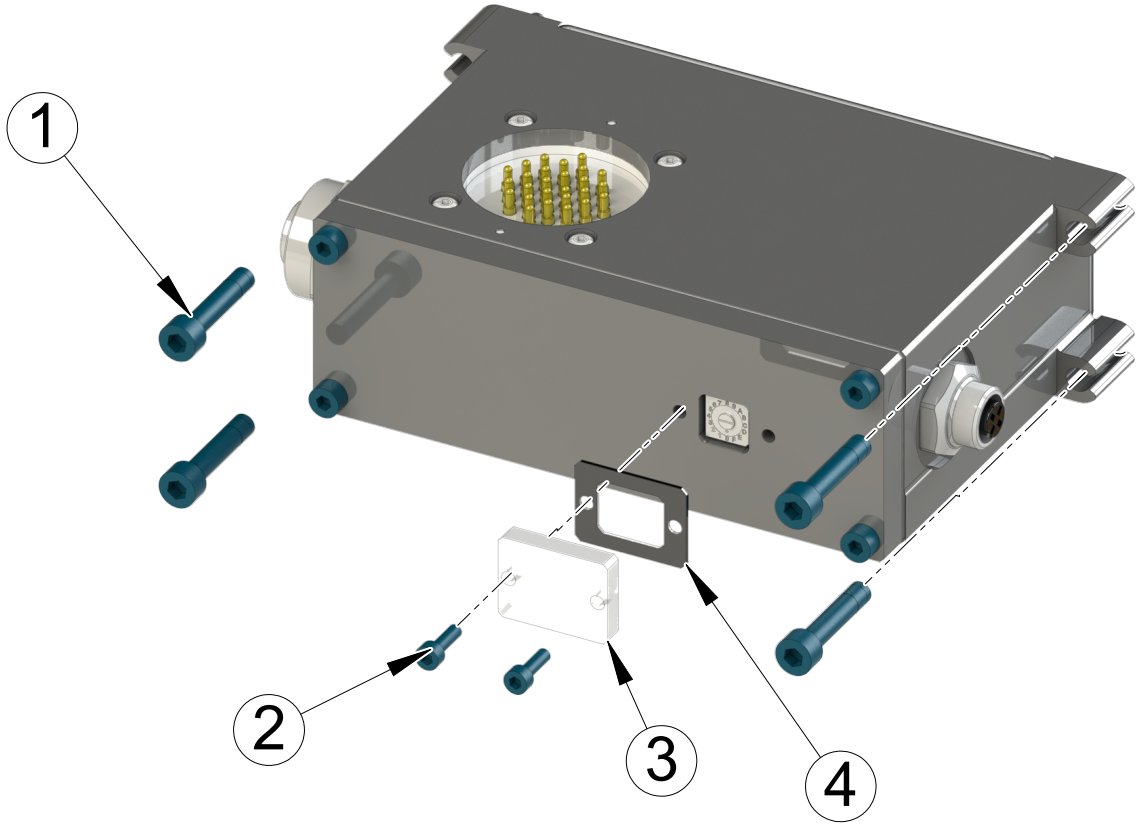


Table 7.2—Tool Module Mounting Fasteners			
No.	**Part Number**	**Qty**	**Description**
1	3500-1064025-15A	4	M5 X 25 Socket Head Cap Screw, 12.9, ISO4762/DIN912
2	3500-1058010-15	2	M3 X 10 Socket Head Cap Screw, 12.9, ISO4762/ DIN912, ES-ATI-007
3	3700-20-5621	1	Tool ID Window
4	3700-20-5622	1	Tool ID Gasket

7.3 Accessories

Table 7.3—Accessories	
Part Number	**Description**
3690-0000064-60	Brush, Blue Nylon All Purpose (Contact Pin Cleaning)

8. Specifications

Table 8.1—CYE1 Master Specifications	
9128-CYE1-M	Ethernet Master module with integrated Ethernet switch, D-Coded 4-Pin M12 connector for Ethernet communication, 4-Pin Mini Connector for Input and Output power, TSI on the Tool, Arc Prevention applied to Input and Output power. Lock, Unlock, and RTL sensing. Tool ID from the Tool module also supported. Mates with CYE1-T
Connector(s)	(1) 4-Pin male Mini-Fast Connector for auxiliary power (1) 4-Pin female M12 D-Coded Connector for Ethernet (4) 3-Pin female M8 Connector supporting Tool Changer Locked, Unlocked, and Ready-to-Lock Proximity sensors
Electrical Rating	Power: • Input Voltage: 21.6V to 30V, 4A • Output Voltage: 20V to 30V, 7A Note: The power source for input and output power must be capable of outputting an operating voltage that is overcurrent protected and regulated.
Current Draw	Input Power: 220mA @ 24VDC: Master and Tool with Locked, RTL1, and RTL2 sensors “on” and Limit Switches/ TSI Circuits made Output Power: 250mA @ 24VDC (Solenoid Valve).
Operating Temperature	32°F to 120°F (0 to 50°C)
Enclosure	IP65
Weight	1.75 lbs (0.79 kg)

Table 8.2—CYE1 Tool Specifications	
9128-CYE1-T	Ethernet Tool module provides one Ethernet port and supports Tool-ID through the Master module. D-Coded 4-Pin M12 connector for Ethernet communication, 4-Pin Mini Connector for Input and Output power, 4-pin M12 connector for TSI switch, 0-F Tool-ID. Supports Arc Prevention on the Master. Mates with CYE1-M.
Connector(s)	(1) 4-Pin female Mini-Fast Connector for auxiliary power (1) 4-Pin female M12 D-Coded Connector for Ethernet (1) 5-Pin female M12 Connector for TSI
Electrical Rating	Power: • Input Voltage: 21.6V to 30V, 4A • Output Voltage: 20V to 30V, 7A Note: The power source for input and output power must be capable of outputting an operating voltage that is overcurrent protected and regulated.
Tool-ID	0-F rotary switch
Enclosure	IP65
Weight	1.35 lbs (0.61 kg)

9. Drawings

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