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Glossary of Terms

Table 1.1—Glossary of Terms	
Term	**Definition**
Auxiliary Power Available	An input indicating the presence of Auxiliary Power Supply to the ATI Master module.
EOAT	End-Of-Arm-Tool (end effector).
Latch	The output supplied to the ATI Master DeviceNet node to couple the Tool Changer (only valid for double solenoid valve equipped units).
Lock	A proximity sensor input indicating that the coupling mechanism is in the Lock position.
RTL	A proximity sensor input that senses when the ATI Tool is close.
Solenoid Energized	An input indicating current draw from the valve and the solenoid coil.
Tool ID	An input from the Master node reporting the values from the Tool-ID switches on the Tool module.
TSI	The Tool Stand Interlock feature is a custom ATI safety solution and circuit designed to only allow Tool Changer release while in the stand or storage location.
TSI Relay	A relay circuit present on the ATI Tool module that is triggered by a tool stand limit switch in order to close the TSI circuit and allow Tool Changer release
TSI Switch	A switch is installed on the EOAT and is used to indicate that the EOAT is in the stand or storage location.
Air Supply Pressure Available	A control reliable input supported for monitoring the air supply pressure for the Tool Changer.
TSRV	A control reliable input provided for health status monitoring of the TSI Relay.
Unlatch	The output supplied to the ATI Master DeviceNet node to uncouple the Tool Changer.
Unlock	A proximity sensor input indicating that the coupling mechanism is in the Unlock position.

C. Control and Signal Modules

DB15-M and DB10-T—DeviceNet Control/Signal Modules

1. Product Overview

The DeviceNet modules are required to provide a means for the customer to communicate with and control the Tool Changer on a DeviceNet network. Refer to *Section 2—Product Information* of this manual for detailed DeviceNet programming information and operational capability.

The DeviceNet modules are designed with special features to afford the user the opportunity to operate the Tool Changer in the safest manner possible. In addition to providing the standard Lock, Unlock, and Ready-to-Lock sensor inputs, the modules are outfitted with Tool Stand Interlock (TSI). The TSI feature consists primarily of a physical break in the unlatch solenoid valve circuit. The TSI circuit is designed to allow tool changer uncouple ONLY when the tool is in the stand or storage location. The Unlock circuit is also dependant on the air pressure switch integrated into the valve adapter module. The Tool Changer will not be able to unlock unless the air supply pressure exceeds 63 ±3 psi. Refer to *Section 2.4—Tool Side TSI* for more information regarding TSI and the solenoid air pressure switch.

The DeviceNet Modules also incorporate 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.

Control of the Tool Changer is realized through the Master Node along with the reporting of Tool Changer I/O, such as Lock, Unlock, and Ready-to-Lock (RTL) signals. The Tool-side module supports Tool-ID reported through the Master side and functions as a pass through for the DeviceNet network and power to downstream equipment.

General fault monitoring is provided for the RTL and TSI circuits. Refer to *Section 2—Product Information* and *Section 4—Operation* for more information on these attributes.

1.1 DB15 Master

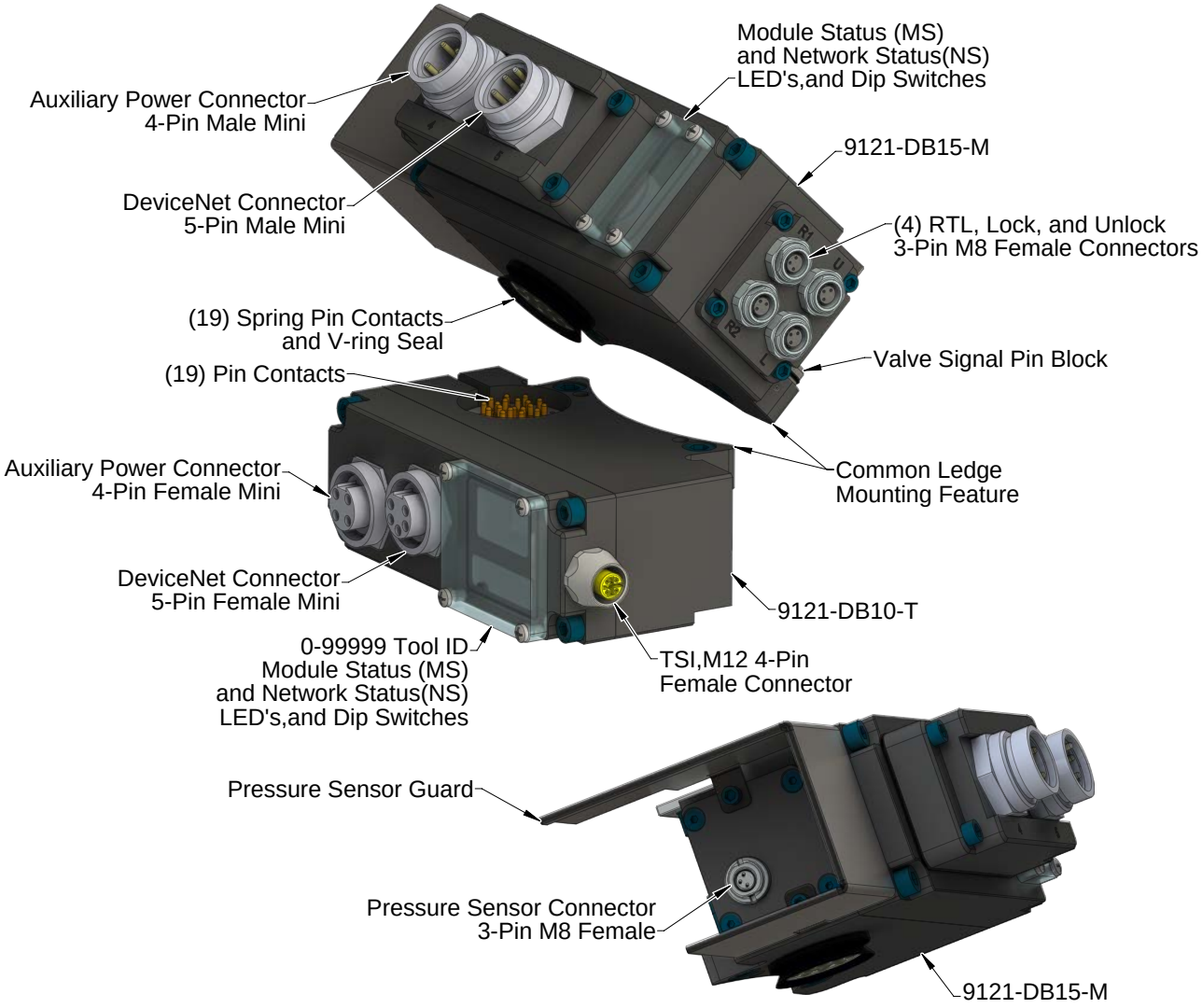
The Master module is equipped with a 5-pin, male mini DeviceNet connector for interfacing with the Tool Changer's Lock, Unlock, and Ready-to-Lock sensors and for supplying signals to the end-of-arm tooling. A 4-pin male mini axuiliary power connector provides power to the Master and Tool modules and end of arm tooling. Electrical schematics and connector details are provided in *Section 9—Drawings*.

Interface to the Tool Changers integrated RTL, Lock, and Unlock sensors are provided through (4) M8, 3-pin connectors on the Master module. Refer to the specific Tool Changer manual for details on the operation of RTL, Lock, and Unlock sensors. The Lock, Unlock, and RTL cables are provided as an integrated part of the Tool Changer.

An electrical interface is provided on the Master module for support of only integrated double solenoid valves with valve pass through and a pressure switch. The integrated valve can be supplied from ATI as part of the valve adapter block (such as 9121-JU6-M). Refer to the valve adapter manual for more information (9620-20-C-Jxx Valve Adapters w Double Solenoid Valve Pass Through Pres Switch). The user must provide a pneumatic supply source to the valve adapter. The DB15-M has a 3-pin M8 female connector interfacing with an air pressure switch. The pressure switch will indicate if the supplied air pressure exceeds 60 psi. The pressure switch in this assembly is potted to achieve an IP65 rating which ensures that the pressure switch is not adjustable. Electrical interface drawings and connector details are provided in drawings in *Section 9—Drawings*. When the Tool Changer is coupled, the Master and Tool modules interface using a spring-loaded pin blocks. A V-ring seal surrounds the pin block and is designed to be water resistant but not waterproof when modules are coupled.

The Master module provides DIP switches for setting Mac ID and Baud Rate. Refer to *Section 2.1.1—DIP Switches on the Master module*.

Figure 1.1—DB15-M DB10-T Modules



1.2 DB10 Tool

The DB10 Tool module is equipped with a 5-pin, female mini DeviceNet connector and provides the interface for supplying pass through signals and power to the end-of-arm tooling. Refer to *Section 9—Drawings* for additional information and connector details. A 4-pin female mini axuiliary power connector provides power to the end of arm tooling. The (5) digit Tool-ID feature distinguished between the different tools coupled by the Tool Changer.

The Tool module employs a series of thumbwheel switches for setting of the Tool-ID input. This allows the customer to distinguish between the different Tools that are being used in a robotic cell or on a production line. See *Section 3.5—Software* for DeviceNet bitmap and I/O information.

The Tool module provides DIP switches for setting Mac ID and Baud Rate. Refer to *Section 2.3.2—DIP Switches on the Tool Module*.

2. Product Information

The modules enable the customer to control and communicate with the Tool Changer through a network using standard DeviceNet protocol. Prior to using the Tool Changer and the DeviceNet modules, various hardware settings must be configured. Communicating with the DeviceNet modules requires knowledge of DeviceNet standards and operation.

DeviceNet nodes are established on the Master and 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 DeviceNet, auxiliary power, and signals to downstream equipment.

The modules employ standard Mini connectors, 5-pin for DeviceNet communications and power and 4-pin for auxiliary power. Please refer to *Section 9—Drawings* for specific module wiring and connector interface information.

ODVA® is a trade and standards development organization for various technologies including DeviceNet. Refer to their website (*www.odva.org*) for more information about DeviceNet standards.

2.1 Master Module Information

The Master Node operates as a Group 2-Only Server on the DeviceNet network. The Master Node supports Explicit Messages, Polled, Strobe and Change of State/Cyclic of the predefined Master/Slave Connection set. The Master Node supports Quick Connect operation as defined by ODVA (refer to the EDS file for specific information). The Master Node does not support the Unconnected Message Manager (UCMM). MAC ID, Baud Rate, and Termination Resistor settings for the Master Node are configured through a DIP switch. (2) LED's provide network and module status.

2.1.1 DIP Switches on the Master module

The DB15-M module has 10 DIP switches which have the following functions:

DIP 1 through 6:	Sets MAC ID.
DIP 7 and 8:	Sets Communication Baud Rate.
DIP 9:	Connects to Termination Resistor.
DIP 10:	Must always be in the OFF position.

2.1.2 MAC ID

The MAC ID is set by either hardware or software configuration. The range is 0-63. In order for the MAC ID to be set by software, all DIP switch positions (1-6) must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to *Figure 2.1* for detailed information on DIP switch setup.

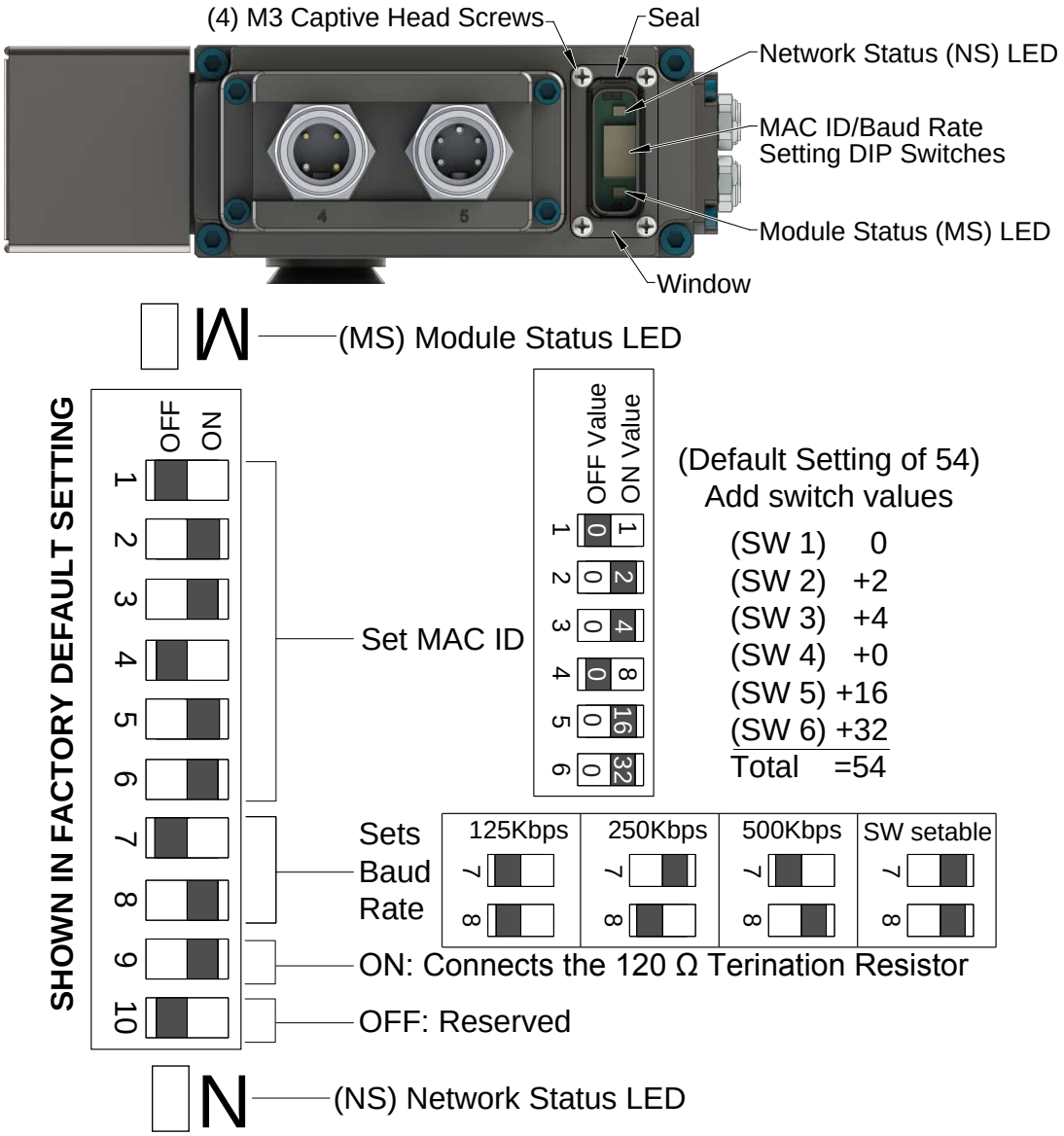
2.1.3 Baud Rate

Baud Rate is set by either hardware or software configuration. The possible settings are 125, 250 or 500 Kbps. In order for the Baud Rate to be set by software, DIP switch positions 7 and 8 must be on. See *Figure 2.1* for DIP switch setup.

2.1.4 Termination Resistor

When DIP switch position 9 is on, a 120 Ω resistor is placed across the CAN High and Low lines and termination to the CAN network is provided. If switch 9 is off, termination must be supplied by another device or through a termination cap at the end of the network cable.

Figure 2.1—DeviceNet Master Module LEDs and DIP Switch Settings



2.1.5 Module Status LED

The module status LED is identified on the device board as “MS”. It provides device status for power and proper operation.

Table 2.1—Module Status LED

Status	LED Function	Note
No Power	Off	No power applied. Check voltage is 24 VDC.
Operational	Green	Normal operation.
Standby	Flashing Green	Device needs commissioning/standby state. Configuration missing, incomplete or incorrect.
Recoverable Fault	Flashing Red	Recoverable fault.
Unrecoverable Fault	Red	Unrecoverable fault.
Self Test	Flashing Green-Red	Device is performing self tests.

2.1.6 Network Status LED

The network status LED is identified on the device board as "NS". It provides network status for power and communication.

Table 2.2—Network Status LED

Status	LED Function	Note
No Power/ Off Line	Off	Device not on line. Check Baud Rate. Device has not completed the duplicate MAC ID test. Module Status is On. Check for termination resistor. Device not powered. See Module Status.
On Line, Not Connected.	Flashing Green	Device is on line but connection is not established. Device not allocated to a Master.
OK On line, Connected	Green	Device is on line with connections established. Device is allocated to a Master.
Connection Timeout	Flashing Red	One or more I/Os are timed out.
Critical Link Failure	Red	Failed communication. Error detected and incapable of communication. Duplicate MAC ID or Bus off.
Communication Faulted and Received and Identify Communication Fault Request – Long Protocol Message	Flashing Green-Red	A specific Communication Faulted Device. Device has received and accepted an Identify Communication Faulted Request – Long Protocol message.

2.2 Arc Prevention Circuit

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

In the Modules, the Arc Prevention Circuit controls the ON/OFF status of the following three power signals:

1. Device Net Power (CAN V+)
2. Switched Auxiliary 1 Power V+
3. Unswitched Auxiliary 2 Power V+

The behaviour of the Arc circuit is more fully described in the following sections.

2.2.1 Arc Prevention Circuit Behavior during Coupling

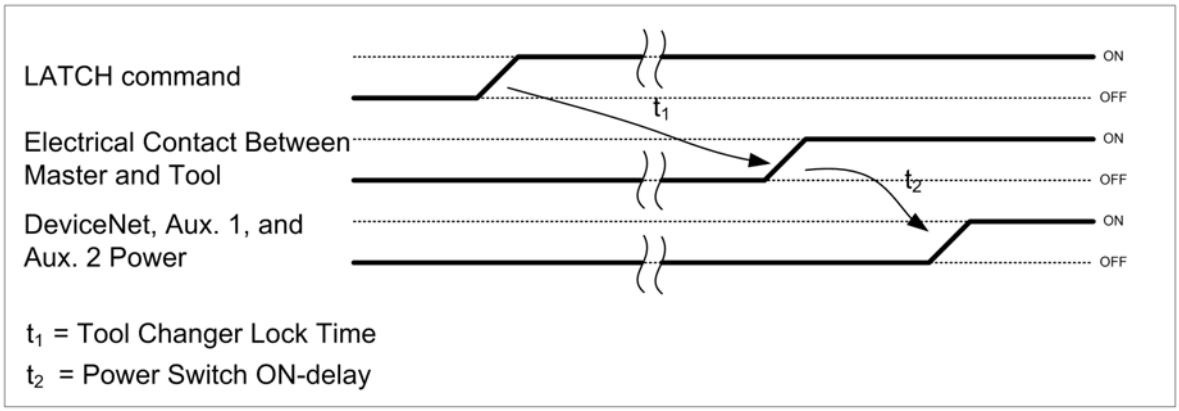
The behaviour of the Arc Prevention circuit during coupling can be more clearly understood by referring to *Figure 2.2*, which shows the power-on timing diagram for the Arc Prevention circuit. Starting at the top of the diagram, the LATCH command is issued thus initiating locking of the Master and Tool.

Soon after locking is initiated, electrical contact between Master and Tool Pin Contacts occurs (this time is designated t_1 in the diagram). The magnitude of time t_1 is a function of many factors including the weight of the EOAT, the distance between the Master and Tool when the LATCH command is issued, how well the Master and Tool are aligned during pick-up, etc.

As soon as electrical contact is made and the LATCH command is issued, the Arc Prevention Circuit will turn on DeviceNet, Auxiliary 1, and Auxiliary 2 power. The time delay between the electrical contacts becoming fully engaged and when power is actually available to the EOAT (time t_2 in the diagram) is less than 100 ms.

NOTICE: 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 electrical contacts are fully engaged. Loss of the LATCH command after it has been issued does not turn off power to the Tool. It is recommended that the LATCH output command remain ON until the LOCKED input goes ON and remains ON. Only after the coupling operation is complete, should the LATCH command be turned OFF. Refer to the *Section 4.2—Recommended Sequence of Operation* for additional details.

Figure 2.2—Power-On Timing



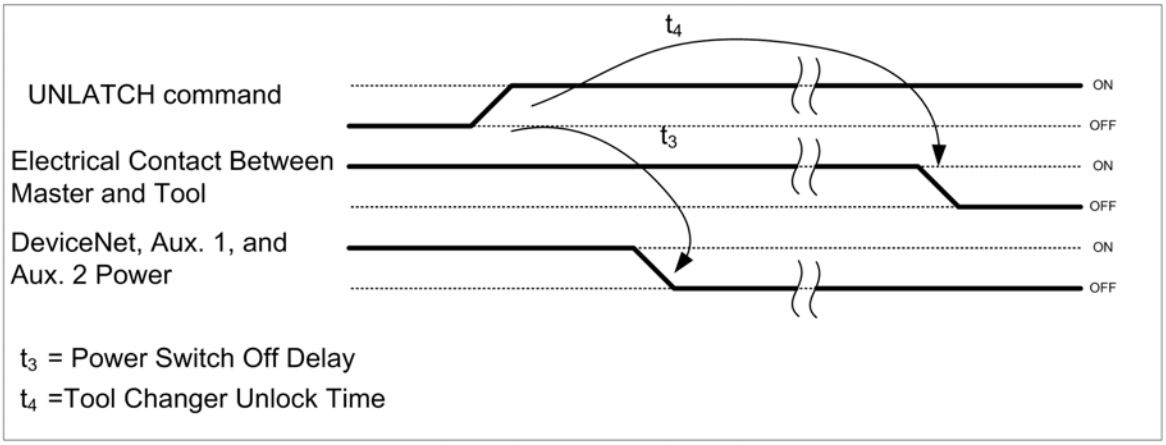
2.2.2 Arc Prevention Circuit Behavior during Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to *Figure 2.3* which shows the power-off timing diagram for the Arc Prevention Circuit. Starting at the top of the diagram, the UNLATCH command is issued thus initiating uncoupling of the Master and Tool.

Immediately after the UNLATCH command is issued, the Arc Prevention Circuit will turn off DeviceNet, Auxiliary 1, and Auxiliary 2 power. The power-off time delay between the UNLATCH command and the switching off of power (designated t_3 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 t_4 in the diagram, after the UNLATCH command is issued. The magnitude of time t_4 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.

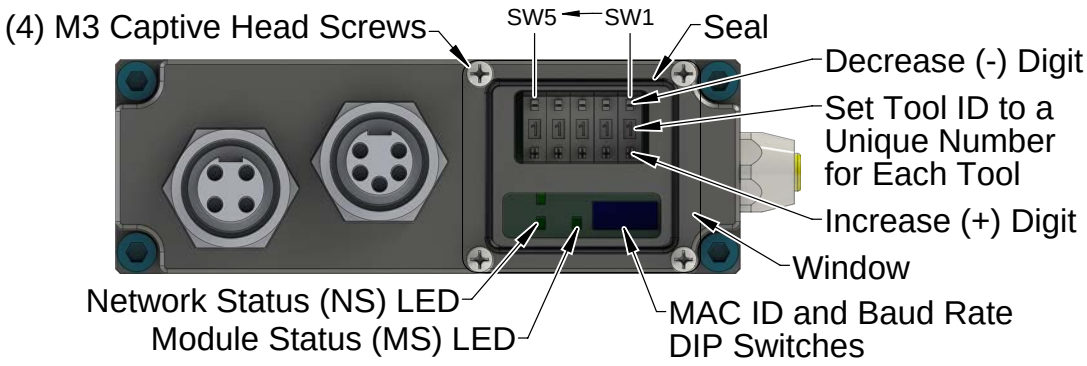
Figure 2.3—Power-Off Timing



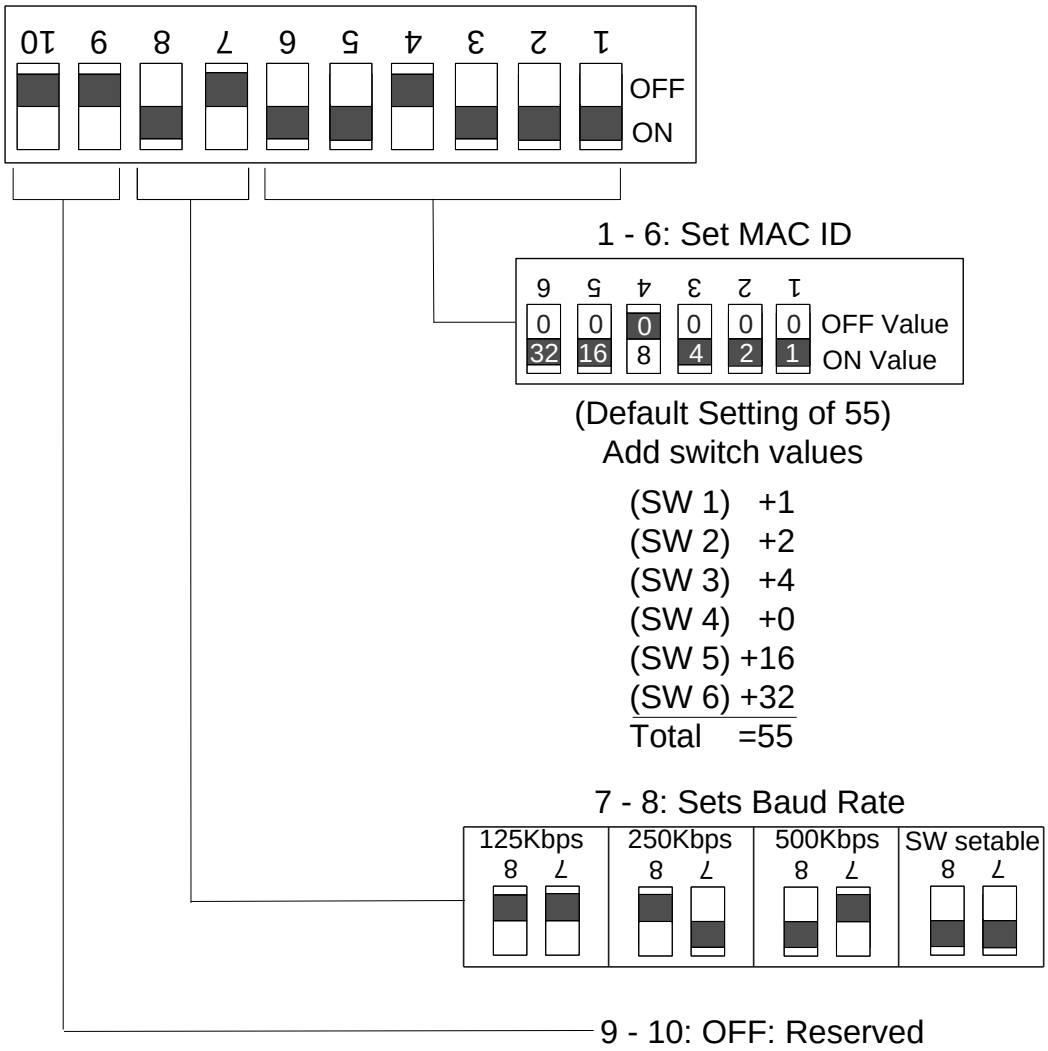
2.3 Tool Module

The Tool Node operates as a Group 2-Only Server on the DeviceNet network. The Tool Node supports Explicit Messages, Polled and Strobe of the predefined Master/Slave Connection set. The Tool Node supports Quick Connect operation as defined by ODVA (refer to the EDS file for specific information). The Tool Node does not support the Unconnected Message Manager (UCMM). The MAC ID and Baud Rate settings for the Tool Node are configured through a DIP switch. Tool-ID is set using (5) pushbutton switches. (2) LED's provide network and module status. For more details refer to *Section 9—Drawings.*

Figure 2.4—Tool-ID Switch Settings



SHOWN IN FACTORY DEFAULT SETTING



2.3.1 Tool-ID

The Tool-ID for a particular tool is established from the setup of (5) push-button switches. The Tool module is available with switches configured to provide 5 independent (0–9) readings. To set the Tool-ID refer to *Section 3.7—Setting the Tool-ID and DIP Switches.*

2.3.2 DIP Switches on the Tool Module

The DB10-T module has 10 DIP switches which have the following functions:

DIP 1 through 6:	Sets MAC ID.
DIP 7 and 8:	Sets Communication Baud Rate.
DIP 9 and 10:	Must always be in the OFF position.

2.3.3 MAC ID

The MAC ID is set by either hardware or software configuration. The range is 0-63. In order for the MAC ID to be set by software, all DIP switch positions (1-6) must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to *Figure 2.4* for detailed information on DIP switch setup.

2.3.4 Baud Rate

Baud Rate is set by either hardware or software configuration. The possible settings are 125, 250 or 500 Kbps. In order for the Baud Rate to be set by software, DIP switch positions 7 and 8 must be on. See *Figure 2.4* for DIP switch setup.

2.3.5 Termination Resistor

Internal termination resistance is not supported in the Tool module. Termination must be provided through the Master module or externally as required for proper operation of the network.

2.3.6 Module Status LED

The module status LED (*Figure 2.4*) is identified on the device board as “MS”. It provides device status for power and proper operation. Refer to *Table 2.1* for the module status LED’s functions.

2.3.7 Network Status LED

The network status LED (*Figure 2.4*) is identified on the device board as “NS”. It provides network status for power and communication. Refer to *Table 2.2* for the network status LED’s functions.

2.3.8 Quick Connect

The Quick-Connect feature can be enabled in the ATI Tool module. With the Quick-Connect feature enabled, the ATI Tool Changer module can reconnect to the DeviceNet network within 1 sec once power is applied to the pin block during tool change.

Tool Modules with Quick Connect enabled will not check for duplicate MAC addresses. If the DeviceNet network includes duplicate MAC addresses, this will cause communication faults. See *Section 6.1—Troubleshooting* for fault causes and correction.

In order to disable the Quick Connect feature in the Tool module, you must disable the feature during commissioning and module replacement. Contact ATI if you need additional help disabling this attribute.

2.4 Tool Side TSI

The tool stand Interlock (TSI) circuit is provided to ONLY allow Tool release while in the stand or storage location as indicated by actuation of a customer-integrated switch.

A momentary action double-pole, single-throw mechanical limit switch is recommended to be used in concert with TSI. The limit switch, with 2 sets of normally open (NO) contacts, is integrated on the EOAT (reference *Figure 2.5*). An interface to the TSI circuit is made available to the customer via a 4-pin M12 connector on the Tool module. An off-the-shelf cord set can be utilized to connect this interface to the limit switch assembly.

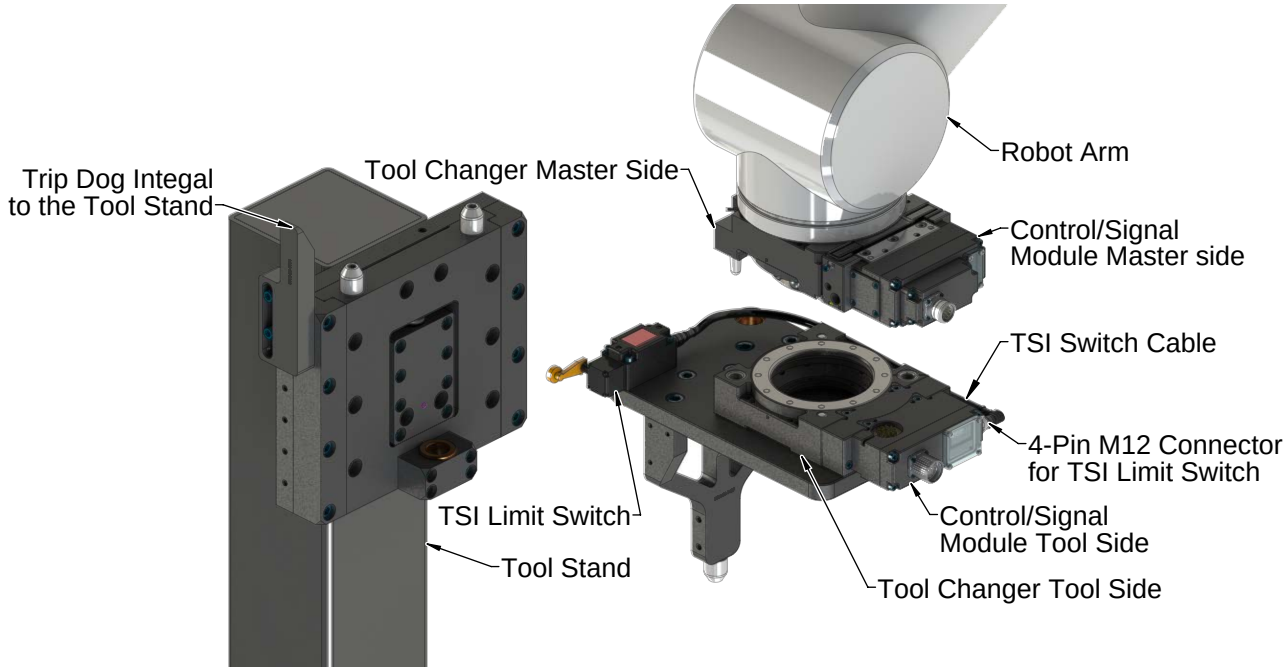
If the Tool Changer is provided the UNLATCH command, the TSRV input must be ON otherwise the Tool Changer will not unlatch. The TSRV input is driven by the TSI switch, the TSRV input will be ON only when the tool is in the tool stand.

The following TSI status signal is reported in the bitmap (refer to *Section 2.6—Software*):

- TSRV (TSI Relay Verify): Status of the TSI relay in the Tool module. The TSRV input will be OFF out of the stand and only ON when the tool is in the tool stand.

Section 4.2—Recommended Sequence of Operation describes in detail the behavior of the TSRV bit during the operation of the Tool Changer.

Figure 2.5—Tool Stand Interlock (TSI)



The DB15-M DB10-T modules rely on the status of the TSRV input to determine when it is appropriate to unlatch the Tool. The RTL sensors indicate if the Master and Tool are coupled while the TSRV input indicates when the TSI mechanical switch on the Tool is actuated, thereby indicating that the Tool is in the stand.

The TSI Relay is located in the Tool module and is triggered by closure of the limit switch. When the EOAT is in the stand and the limit switch is closed, the TSI Relay is closed, thus making the TSI circuit through the Tool side. When the EOAT is out of the stand the TSI Relay is open and the TSI circuit remains open regardless of any unintentional Unlatch command.

On the DB10 Tool module, the TSRV input is made available to the customer along with the TSI circuit via the 4-pin TSI connector. Refer to the TSI connector details in drawings in *Section 9—Drawings* of this manual.

2.5 Solenoid Air Pressure Switch

The DB15-M has a 3-pin M8 female connector to interface with an air pressure switch. The firmware will not allow the Tool Changer to unlatch unless the supplied air pressure exceeds 63 psi +/- 3 psi. The pressure switch in this assembly is potted to achieve an IP65 rating which ensures that the pressure switch is not adjustable.

If the Tool Changer is provided the UNLATCH command, the Air Supply Pressure Available input must be ON or the Tool Changer will not unlatch.

The following Air Pressure status signal is reported in the bitmap (refer to *Section 2.6—Software*):

- Air Supply Pressure Available: Air supply pressure is greater than 60 psi.

Section 4.2—Recommended Sequence of Operation describes in detail the behavior of the Air Supply Pressure Available bit during the operation of the Tool Changer.

2.6 Software

Working EDS files for the Master and Tool nodes are available from our website (www.ati-ia.com/download/edsfiles) or by e-mail, reference the part numbers given below:

DB15-M Node EDS file	9030-20-1009
DB10-T Node EDS file	9030-20-1010

I/O bitmaps for the DeviceNet nodes are provided in the tables below. The default settings are Node 54 for the Master module and Node 55 for the Tool module.

Table 2.3—I/O Bitmap, Robot Input From Master DeviceNet Node 54 (DB15-M module)

Byte	Bit#	Name	Description/Function
0	0	Locked	Tool Changer Lock Prox Input
	1	Unlocked	Tool Changer Unlock Prox Input
	2	Solenoid Energized	Latch/Unlatch Solenoid Energized Input
	3	Auxiliary Power Available	Auxiliary Power Present Input
	4	RTL	Ready-to-Lock Prox Input
	5	Air Supply Pressure Available	Air Supply Pressure is greater than 60 psi Input
	6	N/A	N/A
	7	TSRV	TSI Relay Verify Input

Table 2.4—I/O Bitmap, Robot Output To Master DeviceNet Node 54 (DB15-M module)

Byte	Bit#	Name	Description/Function
0	0	Latch (Lock)	Latch Solenoid Valve Output
	1	Unlatch (Unlock)	Unlatch Solenoid Valve Output
	2	N/A	N/A
	3	N/A	N/A
	4	N/A	N/A
	5	N/A	N/A
	6	N/A	N/A
	7	N/A	N/A

Table 2.5—I/O Bitmap, Robot Input From Tool DeviceNet Node 55 (DB10-T module)			
Bit Number		**Name**	**Description/Function**
0	Low Bit	Tool-ID Byte 1	N/A
1			N/A
2			N/A
3			N/A
4			SW1 Bit 1
5			SW1 Bit 2
6			SW1 Bit 4
7	High Bit		SW1 Bit 8
8	Low Bit	Tool-ID Byte 2	SW2 Bit 1
9			SW2 Bit 2
10			SW2 Bit 4
11			SW2 Bit 8
12			SW3 Bit 1
13			SW3 Bit 2
14			SW3 Bit 4
15	High Bit		SW3 Bit 8
16	Low Bit	Tool-ID Byte 3	SW4 Bit 1
17			SW4 Bit 2
18			SW4 Bit 4
19			SW4 Bit 8
20			SW5 Bit 1
21			SW5 Bit 2
22			SW5 Bit 4
23	High Bit		SW5 Bit 8

Table 2.6—I/O Bitmap, Robot Input From Tool DeviceNet Node 55 (DB10-T module)			
Bit Number		**Name**	**Description/Function**
0	Low Bit	Tool Number Bit 1	Tool Number Bit 1
1		Tool Number Bit 2	Tool Number Bit 2
2		Tool Number Bit 4	Tool Number Bit 4
3		Tool Number Bit 8	Tool Number Bit 8
4		Tool Number Bit 16	Tool Number Bit 16
5		Tool Number Bit 32	Tool Number Bit 32
6		Tool Number Bit 64	Tool Number Bit 64
7	High Bit	Tool Number Bit 128	Tool Number Bit 128
8	Low Bit	Robot Number Bit 1	Robot Number Bit 1
9		Robot Number Bit 2	Robot Number Bit 2
10		Robot Number Bit 4	Robot Number Bit 4
11		Robot Number Bit 8	Robot Number Bit 8
12		Line Number Bit 1	Line Number Bit 1
13		Line Number Bit 2	Line Number Bit 2
14		Line Number Bit 4	Line Number Bit 4
15	High Bit	Line Number Bit 8	Line Number Bit 8

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(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.

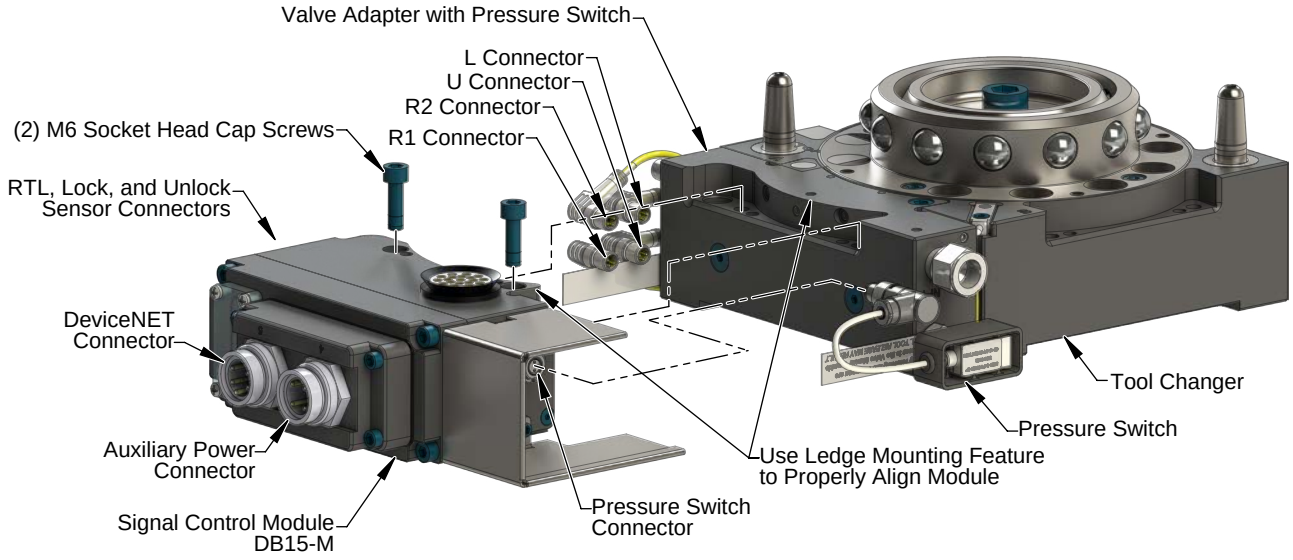
3.1 Master Module Installation

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

Supplies required: *clean rag, Loctite 242*

1. If the Tool Changer is already installed, place the Tool side of the Tool Changer safely in the tool stand and uncouple the Tool Changer to allow clear access to the Master and Tool plates of the Tool Changer.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. It may be necessary to clean the mounting surface on the valve adapter prior to installing the module in order to remove any debris that may be present.
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 3.1*.
5. If fasteners do not have pre-applied adhesive, apply Loctite 242® to the supplied M6 socket head cap screws. Using a 5 mm Allen wrench, install the (2) M6 socket cap head screws securing the module to the valve adapter and tighten to 70 in-lbs (7.9 Nm).
6. Connect the Lock, Unlock, RTL (R1), and RTL (R2) sensor cables from the Tool Changer to the control/signal module. Ensure that the connectors are cleaned prior to being secured as appropriate.
7. Connect the power and signals cable to the module. Ensure that the connectors are cleaned prior to being secured.
8. Connect the pressure switch cable to the Master module, ensure that the connectors are cleaned prior to being secured.
9. Set the MAC ID and baud rate DIP switches, refer to *Section 3.5—DeviceNet Configuration*.
10. After installation is complete, module(s) may be placed in normal operation. Note: After a few seconds it should be operating on the network.

Figure 3.1—DB15-M Module Installation



3.2 Master Module Removal

Tools required: *5 mm Allen wrench (hex key)*

1. If the Tool Changer is already installed, place the Tool side of the Tool Changer safely in the tool stand and uncouple the Tool Changer to allow clear access to the Master and Tool plates of the Tool Changer.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Disconnect the Lock, Unlock, RTL (R1), RTL (R2) sensor cables from the DB15-M module.
4. Disconnect the power and signal cable from the DB15-M module.
5. Disconnect the pressure switch cable from the DB15-M module.
6. Support the module and remove the (2) M6 socket head cap screws using a 5 mm Allen wrench. Lower the module until it clears the guide pin, set module aside. Refer to *Figure 3.1*.

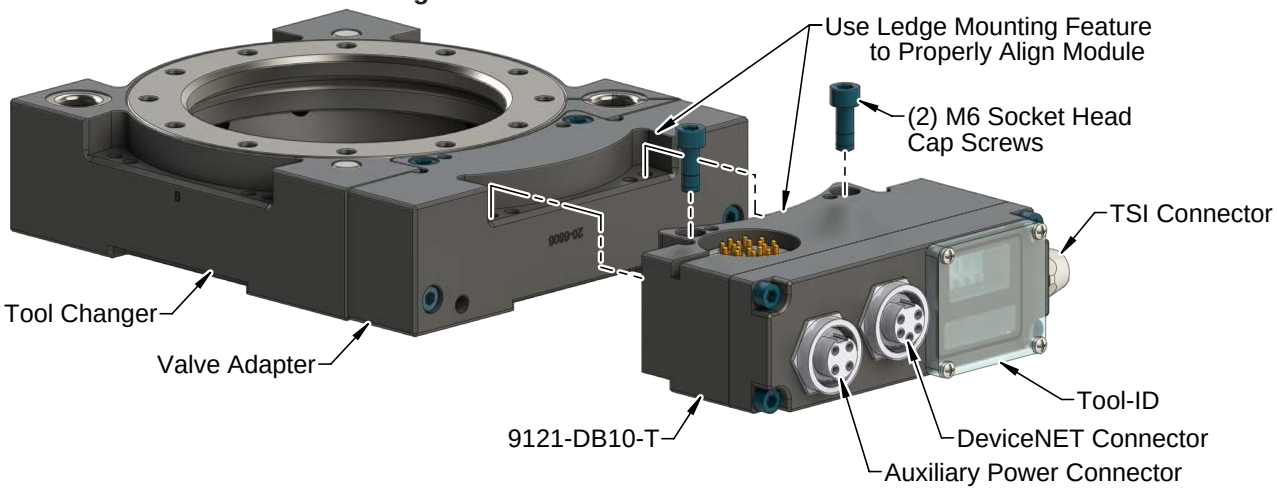
3.3 Tool Module Installation

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

Supplies required: *clean rag, Loctite 242*

1. If the Tool Changer is already installed, place the Tool side of the Tool Changer safely in the tool stand and uncouple the Tool Changer to allow clear access to the Master and Tool plates of the Tool Changer.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. It may be necessary to clean the mounting surface on the tool adapter prior to installing the module in order to remove any debris that may be present.
4. Using the ledge feature, place the module into the appropriate location on the tool adapter. Align the module with the tool adapter using the dowels in the bottom of the ledge feature. Refer to *Figure 3.2*.
5. If fasteners do not have pre-applied adhesive, apply Loctite 242 to the supplied M6 socket head cap screws. Using a 5 mm Allen wrench, install the (2) M6 socket cap head screws securing the module to the valve adapter and tighten to 70 in-lbs (7.9 Nm).
6. Connect the power and signal, and TSI switch cables to the Tool module. Ensure that the connectors are cleaned prior to being secured as appropriate.
7. Set the Tool-ID and DIP switches on the Tool module. Refer to *Section 3.7—Setting the Tool-ID and DIP Switches.*
8. After installation is complete, module(s) may be placed in normal operation.

Figure 3.2—DB10-T Module Installation



3.4 Tool Module Removal

Tools required: *5 mm Allen wrench (hex key)*

1. If the Tool Changer is already installed, place the Tool side of the Tool Changer safely in the tool stand and uncouple the Tool Changer to allow clear access to the Master and Tool plates of the Tool Changer.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Disconnect the power and signal, and TSI switch cables from the Tool module.
4. Remove the (2) M6 socket head cap screws using a 5 mm Allen wrench. Lift the module until it clears the guide pin, set module aside. Refer to *Figure 3.2*.

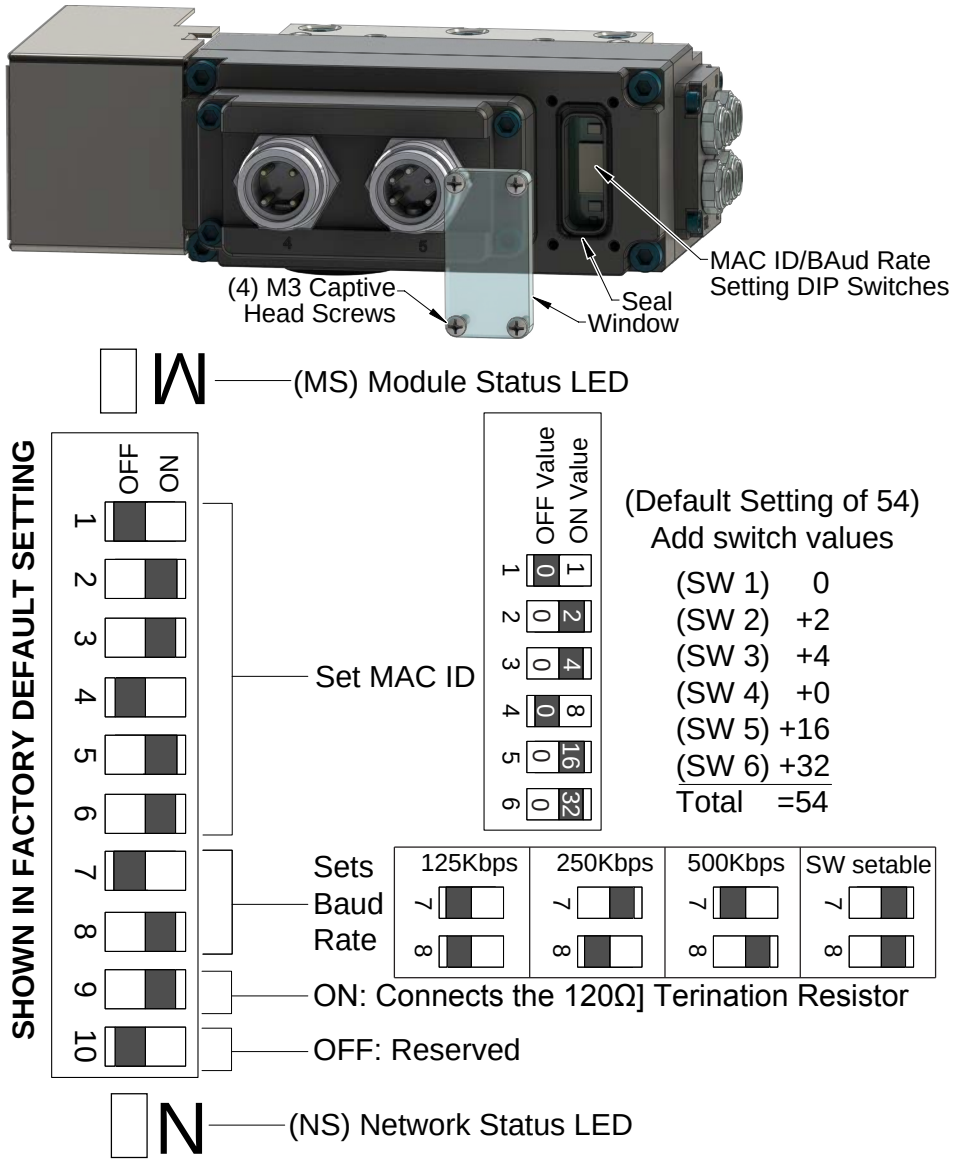
3.5 DeviceNet Configuration

Various parameters for the DeviceNet modules need to be configured prior to operating the Tool Changer. Please refer to *Section 2—Product Information* of this manual for detailed information on installation and operation of the DeviceNet modules.

Tools required: *Phillips screwdriver*

1. Loosen (4) M3 pan head captive screws and remove the window.

Figure 3.1—Set the MAC ID and Baud Rate DIP Switches



NOTICE: After adjustment is completed, ensure that the seal and window are re-positioned correctly to prevent a leakage path to inside the module.

2. Set the DIP switches. Refer to *Section 2.1—Master Module Information*.
3. Re-install the window and tighten the (4) M3 pan head captive screws.

3.6 Utility Schematic

Refer to drawings in *Section 9—Drawings* of this manual for customer interface and wiring details for the DB15-M/DB10-T modules.

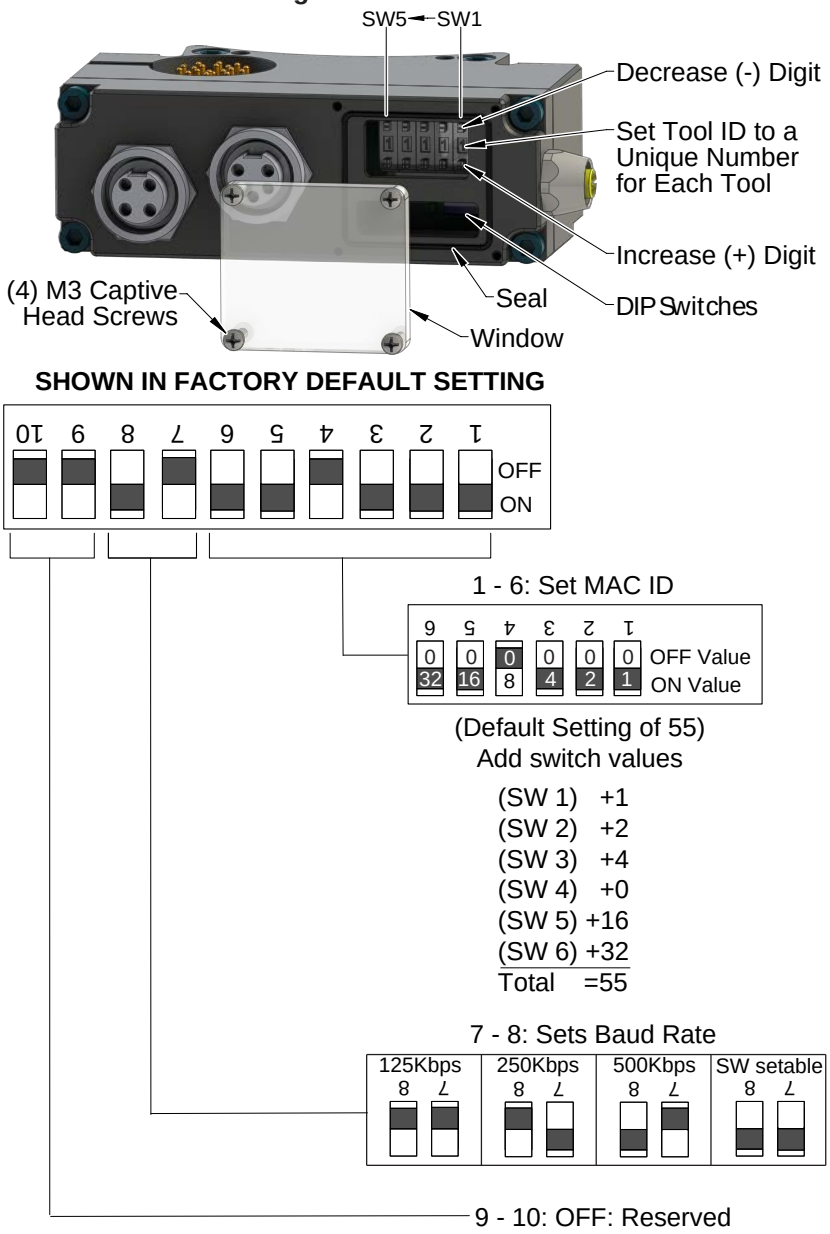
3.7 Setting the Tool-ID and DIP Switches

Tools required: *Phillips screwdriver*

Push button switches are provided on the Tool module for setting of a unique digit Tool-ID number from (0-9).

1. Loosen (4) M3 pan head captive screws and remove Tool-ID window.

Figure 3.1—Set Tool-ID



2. Use a non-conductive tool (e.g., plastic stylus) to press on the Tool-ID push buttons to increase (+) or decrease (-) the digit value. Set the Tool-ID to the desired unique digit number. Refer to *Section 9—Drawings* for Tool-ID output tables.

NOTICE: After adjustment is completed, ensure that the seal and window are re-positioned correctly to prevent a leakage path to inside the module.

3. Set the DIP switches. Refer to *Section 2.3.2—DIP Switches on the Tool Module*.
4. Re-install the Tool-ID window and tighten the (4) M3 pan head captive screws.

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 DB15 control/signal modules. This procedure is intended for "automatic" modes used during normal application processes.

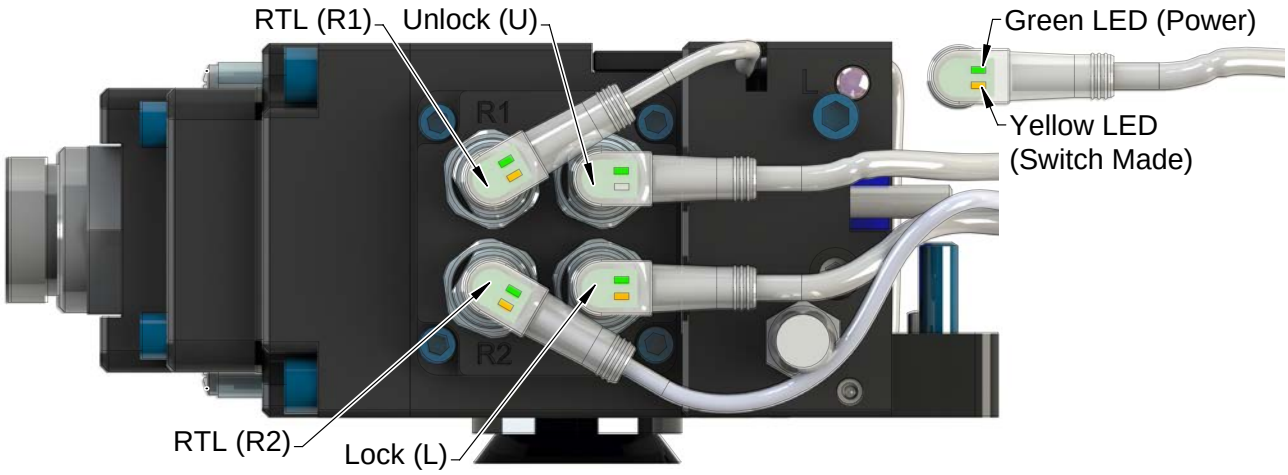
4.1 Lock, Unlock, and RTL Sensor Cable LED Behavior

The Lock, Unlock, and RTL sensor cables are equipped with two LEDs. The Green LED indicates the sensor has power and the yellow LED indicates the switch has been made. The LED behavior is affected by the control/signal module.

Table 4.1—Sensor Cable LED Behavior for Common Tool Changer Positions

Tool Changer Position	Sensor cable LED Behavior			
Unlocked (Tool Changer Master plate free of stand with no Tool plate attached)	RTL (R1) Sensor	ON OFF	ON ON	Unlock (U) Sensor
	RTL (R2) Sensor	ON OFF	ON OFF	Lock (L) Sensor
Ready to Lock (Tool Changer Master plate with Tool plate parallel and at a distance of 1.22 mm or less from each other)	RTL (R1) Sensor	ON ON	ON ON	Unlock (U) Sensor
	RTL (R2) Sensor	ON ON	ON OFF	Lock (L) Sensor
Locked (Tool Changer Master plate with Tool plate attached in fully locked position)	RTL (R1) Sensor	ON ON	ON OFF	Unlock (U) Sensor
	RTL (R2) Sensor	ON ON	ON ON	Lock (L) Sensor
Missed Tool (Tool Changer Master plate locked with no Tool plate attached)	RTL (R1) Sensor	ON OFF	ON OFF	Unlock (U) Sensor
	RTL (R2) Sensor	ON OFF	ON OFF	Lock (L) Sensor

Figure 4.1—Lock, Unlock, and RTL Sensor cable LED Behavior (Shown in Locked Position)



(Control module shown for reference only)

4.2 Recommended Sequence of Operation

1. **Start**→ 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 **RTL** input is OFF.
   b. The ATI Tool and any downstream device are offline.
   c. The **Auxiliary Power Available** input is ON provided the Auxiliary Power 1 power supply is on.
   d. The **Air Supply Pressure Available** input is ON indicating the supply pressure is greater than 60 PSI.
   e. The **TSRV** input is OFF.

NOTICE: In the event that the Tool Changer is locked without a Tool, it must be unlocked using the manual override button on the valve, refer to *Section 6.1.1—Solenoid Valve Manual Override Procedure.*

2. Ensure the Master is Unlocked. (The Master must be unlocked prior to entering the Tool to prevent the ball bearings from impinging on the Tool bearing race.)

   a. Turn the **Latch** output command OFF and turn the **Unlatch** output command ON.
   b. The **Solenoid Energized** input is ON.
   c. The **Unlocked** input is ON and remains ON, indicating that the Tool Changer locking mechanism is fully retracted.

NOTICE: For maximum safety, ATI strongly recommends editing the robot program to verify that TSRV is OFF just before tool pick up.

3. Robot and Master move into the tool, are parallel and within 0.06” of the Tool

   a. The **TSRV** inputs go ON, indicating that the Master and Tool are in close proximity of each other and verifying the operation of the TSI limit switch.
   b. Power is not yet available on the Tool.
   c. The **RTL** input is ON, indicating that it is okay to couple the Tool.

4. Couple the Tool Changer.

   a. Turn the **Unlatch** output OFF and turn the **Latch** output ON.
   b. The **Unlocked** input goes OFF a short time later, indicating piston travel. Subsequently, the **Locked** input goes ON and remains ON, indicating that the coupling operation is complete. It is recommended that the **Latch** command be turned OFF after the **Locked** input goes ON.
   c. The Arc Prevention circuit makes power available to the Tool.
   d. Sometime thereafter, Tool-ID will become available and communications should be established with the downstream DeviceNet device(s).

NOTICE: For maximum safety, ATI strongly recommends editing the robot program to verify that TSRV is ON at tool pick up.

5. Robot moves away from the tool stand with the Tool Changer coupled.
    a. The **TSI Limit Switch** becomes deactivated, and the **TSRV** input turns OFF.

NOTICE: For maximum safety, ATI strongly recommends editing the robot program to verify that TSRV is OFF when the tool is above the stand immediately after tool pickup.

6. Normal operation
    a. The following inputs are ON:
        i. Locked
        ii. Auxiliary Power Available
        iii. RTL
        iv. **Air Supply Pressure Available**
    b. The following inputs are OFF:
        i. Solenoid Energized
        i. Unlocked
        ii. TSRV
    c. The following outputs are OFF:
        i. Latch
        ii. Unlatch

7. Robot moves into the tool stand with the Tool Changer coupled.
    a. When the Tool is returned to the stand, the **TSI limit switch** becomes activated and the **TSRV** input turns ON, indicating that it is safe to uncouple the Tool Changer.
    b. The **Air Supply Pressure Available** is ON, indicating that the air supply pressure is greater than 60 psi.

8. Uncouple the Tool Changer.
    a. Turn the **Latch** output OFF and turn the **Unlatch** output ON.
    b. Power on the Tool turns off.
    c. Communication is lost with the downstream devices.
    d. The **Tool-ID** becomes unavailable.
    e. The **Locked** input turns OFF a short time later and subsequently the **Unlocked** input turns ON, indicating that the uncoupling operation is complete.

9. Robot and Master move away from the Tool, are parallel and between 0.125” to 0.06” of the Tool.
    a. The **RTL** inputs turn OFF.

10. Robot and Master move away from the tool, are parallel at a distance greater than 0.15” from the tool.

11. Robot and Master are in free space
    a. The following inputs are ON:
        i. Unlocked
        ii. Auxiliary Power Available
        iii. **Air Supply Pressure Available**
    b. The following inputs are OFF:
        i. Locked
        ii. RTL
        iii. TSRV

5. Maintenance

Once installed the operation of the control/signal 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(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 being used in dirty environments (e.g., welding or deburring applications), care should be taken to 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 it is recommended that periodic inspections be performed to assure long-lasting performance and to assure 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—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—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.

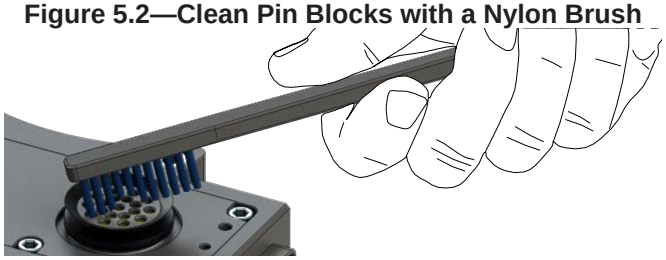
Figure 5.1—Inspect Master and Tool Pin Blocks



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

Refer to the table below for trouble shooting information.

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 is secure and does not protrude above the mating surfaces.
	Ball bearings are not moving freely.	Verify the ball bearings are moving freely. Clean and lubricate as needed. Refer to the *Maintenance section of the Tool Changer manual* for instructions.
	Air supply not to specifications.	If Air Supply Pressure Available bit OFF, check air supply. Refer to the *Installation section of the Tool Changer manual* for specifications. (must have at least 60 PSI, this should turn the Air Supply Pressure bit ON).
		If Air Supply Pressure Available bit still OFF, valve adapter air pressure switch malfunctioning, refer to *valve adapter manual* for replacement instructions.
	Valve adapter exhaust muffler clogged.	The valve adapter exhaust muffler may be clogged. Refer to the *valve adapter manual* for more information.
	TSI switch not functioning properly.	Verify the TSI switch is functioning and properly adjusted.
	Signals are mapped incorrectly.	Verify signals are mapped and are communicating properly. Refer to *Section 9—Drawings* for electrical schematic.
	Master and Tool are within the specified No-Touch zone.	Verify the Master and Tool are within the specified No-Touch zone when attempting to lock. *Refer to the Installation – tool stand Design Section of the Tool Changer manual for specifications.*
	Solenoid valve not functioning.	The valve adapter exhaust muffler may be clogged. Refer to the *valve adapter manual* for more information.

Table 6.1—Troubleshooting		
Symptom	**Possible Cause**	**Correction**
Sensors not operating properly (but DeviceNet is operating correctly).	Tool plate is not secured properly or debris is trapped between surfaces.	Ensure that the Tool plate is securely held to the Master plate, that nothing is trapped between their surfaces.
	Valve adapter exhaust muffler clogged.	The valve adapter exhaust muffler may be clogged. Refer to the *valve adapter manual* for more information.
	Sensor cables damage or incorrectly connected.	Verify the cables are connected correctly and not damaged, replace if damaged. Refer to the *Troubleshooting Section of the Tool Changer manual*.
	Sensors are not functioning.	Verify the sensors are functioning. *Refer to the Troubleshooting Section of the Tool Changer manual.*
Loss of DeviceNET Communication	Damaged signal cabling	Check/Replace signal cabling upstream and downstream of Tool Changer modules.
	Worn dirty, or damaged contact pins.	Inspect module contact pins for debris/wear/ damage. Refer to *Section 5.1—Pin Block Inspection and Cleaning*.
	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 the Latch command has been issued by the robot.
	Loss of DeviceNet power on the Master.	Restore DeviceNet Power to the Master.
	Worn dirty, or damaged contact pins.	Inspect module contact pins for debris/wear/ damage. Refer to *Section 5.1—Pin Block Inspection and Cleaning*.
Tool Changer is locked or in a missed tool condition. (without the Tool plate attached). The Tool Changer cannot be Unlocked using the Unlatch command.	The Latch command was sent to the robot without the Tool plate in position to be Locked.	Unlock Tool Changer Manually refer to *Section 6.1.1—Solenoid Valve Manual Override Procedure.*

6.1.1 Solenoid Valve Manual Override Procedure

The manual override procedure should be used when the Tool Changer is locked without the Tool plate attached. The control module safety circuit does not allow the Tool Changer to be unlatched without the Tool plate attached and the tool in the tool stand.

WARNING: Do not use the solenoid valve manual override if the tool is locked to the Master. Using the manual override will release the Tool and may cause bodily injury or damage to equipment. If the Tool is attached to the Master, it must be secured in the tool stand or in a location where the tool weight is supported before using the manual override.

CAUTION: The manual override is not intended for normal operations. Manual override is to be used in situations where no alternative is available to unlock the Master. Do not execute the Latch command unless the Master and the Tool are ready to be coupled.

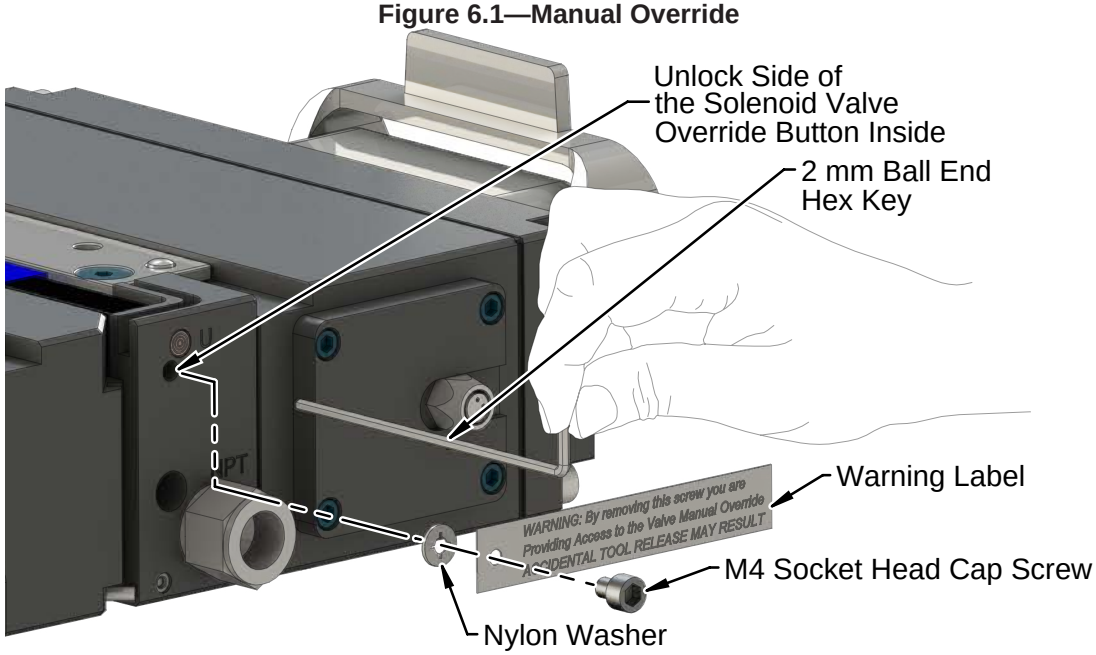
Tools required: *3 mm hex key, 2 mm ball end hex key*

1. Using a 3 mm hex key, remove the M4 socket head cap screws, warning label, and nylon washer from the Unlock side of the solenoid valve. The Unlock side is marked with a “U”.

CAUTION: Applying excess force can damage the solenoid or cause the override button to stick in one position. Actuation of valve override buttons requires about 1 mm of travel and minimal of force. Use a non-sharp object, similar to ball nose 2 mm hex key, to gently depress the override button; an air release should be heard when the solenoid is activated.

2. Insert a 2 mm ball end hex key in the unlock valve screw hole and gently depress the valve override button. An air release should be heard when the solenoid is actuated. Make sure the locking mechanism is fully retracted.
3. Using a 3 mm hex key, replace the M4 socket head cap screws, warning label, and nylon washer and tighten the screw.

Figure 6.1—Manual Override



6.2 Service Procedures

The following service procedures provide instructions for component replacement and adjustment.

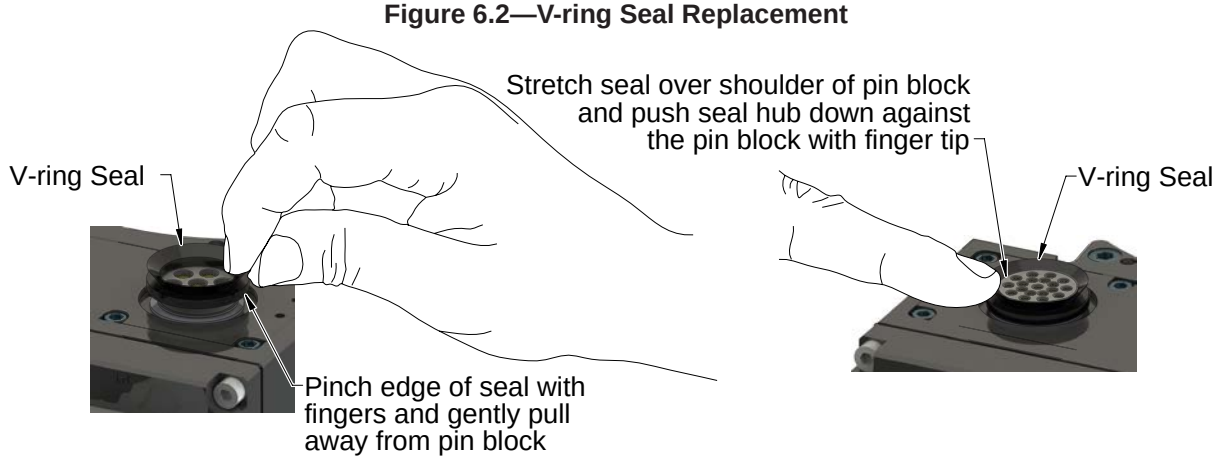
6.2.1 Seal Replacement

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 6.2—V-ring Seal Replacement



7. Serviceable Parts

Refer to *Section 9—Drawings.*

Table 7.1—Accessories

Part Number	Description
3690-0000064-60	Brush, Blue Nylon All Purpose (Contact Pin Cleaning)

8. Specifications

Table 8.1—DB15 Master module Specifications	
9121-DB15-M	Quick Connect Capable DeviceNet Master module with (2) Mini Connectors for DeviceNet and Aux. Power Interface, TSI on Tool, No RTL Bypass, Arc Prevention applied to Aux1, Aux2, and CAN V+ power. Lock, Unlock, and RTL sensing with LED cables on the Master (RTL Sensors in Series). Includes 3-Pin M8 Connector for Air Supply Pressure Monitoring. Tool ID from the Tool module also supported. Mates with DB10 Tool.
Factory Default Configuration	MAC ID 54, Baud 500 Kbps, termination resistance “on”.
Connector(s)	Auxiliary Power: Mini, 4-pin male DeviceNET: Mini, 5-pin male Integrated Tool Changer I/O: 4X M8, 3-pin female connectors supporting Tool Changer Locked, Unlocked, and Ready-to-Lock proximity sensors. RTL sensors are connected in series. 3-pin internal pin block used to transmit Latch and Unlatch signals to the solenoid valve. Pressure Sensor: M8, 3-pin female
Electrical Rating	Power and Signals: 5 A, 24 VDC Lock, Unlock, and Ready-to-Lock sensors: 10-30 VDC operational voltage Valve Control Power: 19-29 VDC operational voltage. Pressure Sensor: 5 A, 24 VDC
Current Draw	Power: 180 mA @ 24 VDC, Master only (Unlocked sensor “ON”, Locked) Valve Power (switched Auxiliary Power): 250 mA @ 24 VDC (Solenoid Valve) (only when locking or unlocking Tool Changer).
Temperature	32°F to 120°F (0 to 49°C).
Weight	2.24 lbs (1.02 kg)

Table 8.2—DB10 Tool module Specifications	
9121-DB10-T	Quick Connect Capable DeviceNet Tool module ith (2) Mini Connectors for DeviceNet and Aux. Power Interface, 5 independent switch Tool-ID and mechanical switch TSI, Supports Arc Switch on the Master
Factory Default Configuration	MAC ID 55, Baud 500 Kbps, No termination resistance. (5) Independent Tool ID switches, each reading a (0–9) position (all factory set to Tool Position 1).
Connector(s)	Auxiliary Power: Mini, 4-pin female DeviceNET: Mini, 5-pin female TSI: M12, 4-pin female
Electrical Rating	Auxiliary Power and DeviceNET: 5 A, 24 VDC
Current Draw	61 mA @ 24 VDC: Tool Only
Tool-ID	0-99999
Temperature	32°F to 120°F (0 to 49°C).
Weight	1.35 lbs (0.61 kg)

9. Drawings

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