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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.
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.
TSIV	A control reliable input supported for monitoring of a tool stand limit switch used with the TSI circuit.
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

DB12M DB10T—DeviceNet Module

1. Product Overview

The DeviceNet modules are required to provide a means for the customer to communicate with and control the Tool Changer. Refer to Section 3 of this manual for detailed DeviceNet programming information and operational capability.

An electrical interface is provided on the Master module for support of a **double-solenoid** integrated valve (**single-solenoid valve is not supported**). A double solenoid valve is provided with the master valve adapter for Lock/Unlock control of the Tool Changer. The user is only required to provide a pneumatic supply source to the Tool Changer.

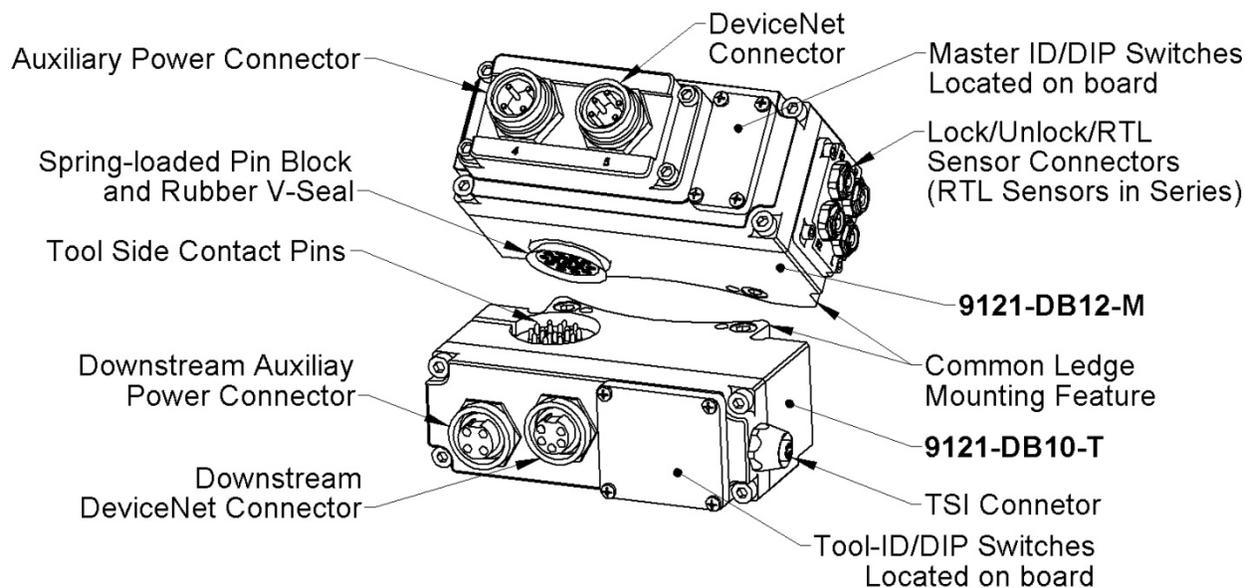
Power and signal connectors are provided for interfacing on the Master and Tool modules. When the Tool Changer is coupled, the Master and Tool modules pass signals using a spring-loaded pin block. A flexible boot surrounds the pin block to seal the connection from moisture and liquid while coupled.

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 release **ONLY** when the tool is in the stand or storage location. Refer to [Section 3.4—Tool-Side TSI](#) for more information regarding TSI.

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 3.6—Software](#) for DeviceNet bitmap and I/O information.

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 3.2—Arc Prevention Circuit](#) for additional information.

Figure 1.1— DB12M DB10T DeviceNet Module



2. Installation

The control/signal modules are typically installed by ATI prior to shipment. The steps below outline the field installation or removal as required.

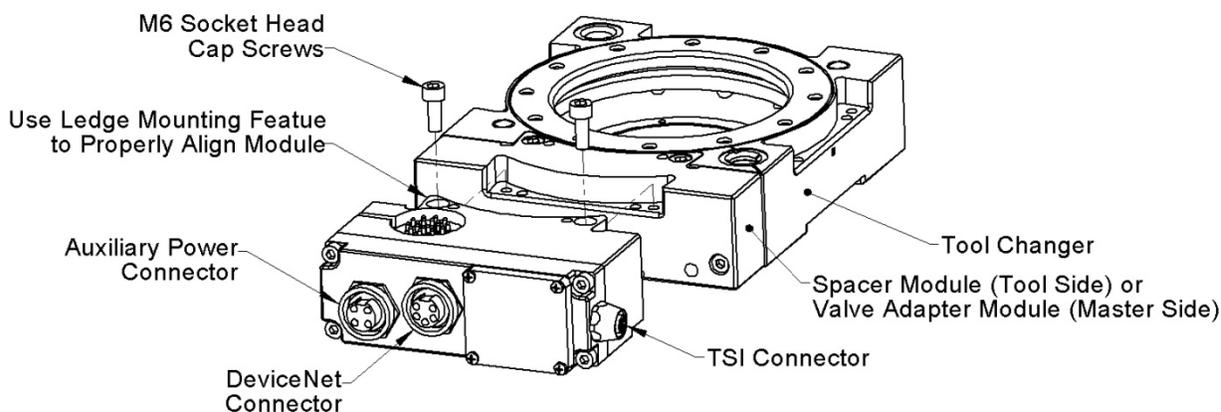


WARNING: Do not perform maintenance or repair on Tool Changer or modules unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on Tool Changer or modules.

2.1 Installing

1. It may be necessary to clean the mounting surface on the Tool Changer prior to installing the module in order to remove any debris that may be present.
2. Using the ledge feature as a guide place the module into the appropriate location on the Tool Changer body. Align the module with the Tool Changer using the dowels in the bottom of the ledge feature. Refer to *Figure 2.1*.
3. If fasteners do not have pre-applied adhesive, apply Loctite 242® to the supplied M6 SHCS fasteners. Install the two (2) M6 socket head screws securing the module to the Tool Changer and tighten to 40–70 in-lbs.
4. Power, signal, and auxiliary cables can be connected to the module after attaching the module to the Spacer or Valve Adapter Modules. Ensure that the connectors are cleaned prior to being secured as appropriate.

Figure 2.1—Module Installation



2.2 Removal

1. Prior to removing the module use a marker pen to scribe a line or indication between the Tool Changer and module body as a reminder where the module is to be re-installed.
2. Depending upon the service or repair being done, customer connections up to the module may or may not need to be disconnected.
3. Remove the socket head cap screws and lift the module from the Tool Changer. Refer to *Figure 2.1*.



CAUTION: It is recommended, not to use fasteners with pre-applied adhesive more than three times. Fasteners used more than three times may come loose and cause equipment damage. Discard fasteners used more than three times and install new fasteners with pre-applied adhesive.

2.3 DeviceNet Configuration

Various parameters for the DeviceNet modules need to be configured prior to operating the Tool Changer. Please refer to Section 3 of this manual for detailed information on installation and operation of the DeviceNet modules.

2.4 Utility Schematic

Refer to *Section 9—Drawings* of this manual for customer interface and wiring details for the modules.



WARNING: All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines. Failure to do so can cause some critical electrical and/or pneumatic lines not to function properly and may result in injury to personnel or damage to equipment. Follow the robot manufacturer's guidelines and carefully route hoses and cables to avoid damage.

3. Product Information

The modules enable the customer to control and communicate with the Tool Changer through a network using standard DeviceNet protocol (www.odva.org). A DeviceNet node is established on the Master module, but not on the Tool. 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 and Auxiliary Power 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 drawings in Section 9 for specific module wiring and connector interface information.

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.

3.1 Master Module Node

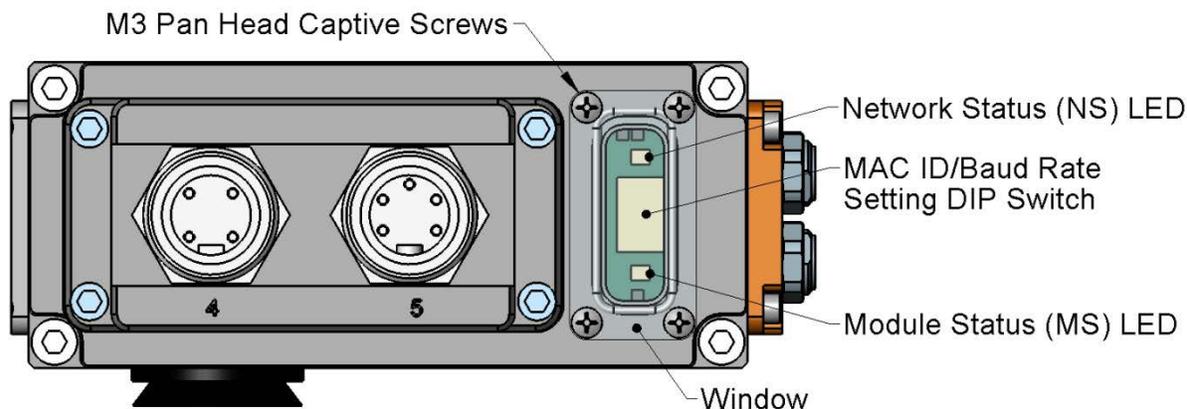
The Master Node operates as a Group 2-Only Server on the DeviceNet network. The Master Node supports Explicit Messages, Polled, Strobe and Change of State/Cyclic of the predefined Master/Slave Connection set. The Master Node supports Quick Connect operation as defined by ODVA (refer to the EDS file for 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.

3.1.1 Setting the DIP Switches

1. Loosen the four M3 Pan head Captive Screws and remove the window.
2. Set the DIP switches as needed, refer to Figure 3.2 for details.
3. Re-install the window and tighten the M3 Pan Head Captive Screws.

NOTICE: When replacing the window, ensure that the seal is positioned correctly to prevent fluid leakage into the module and damaging the electronics.

Figure 3.1— Master Module DIP Switches and LED's



3.1.2 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 must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to [Figure 3.2](#) for detailed information on DIP switch setup.

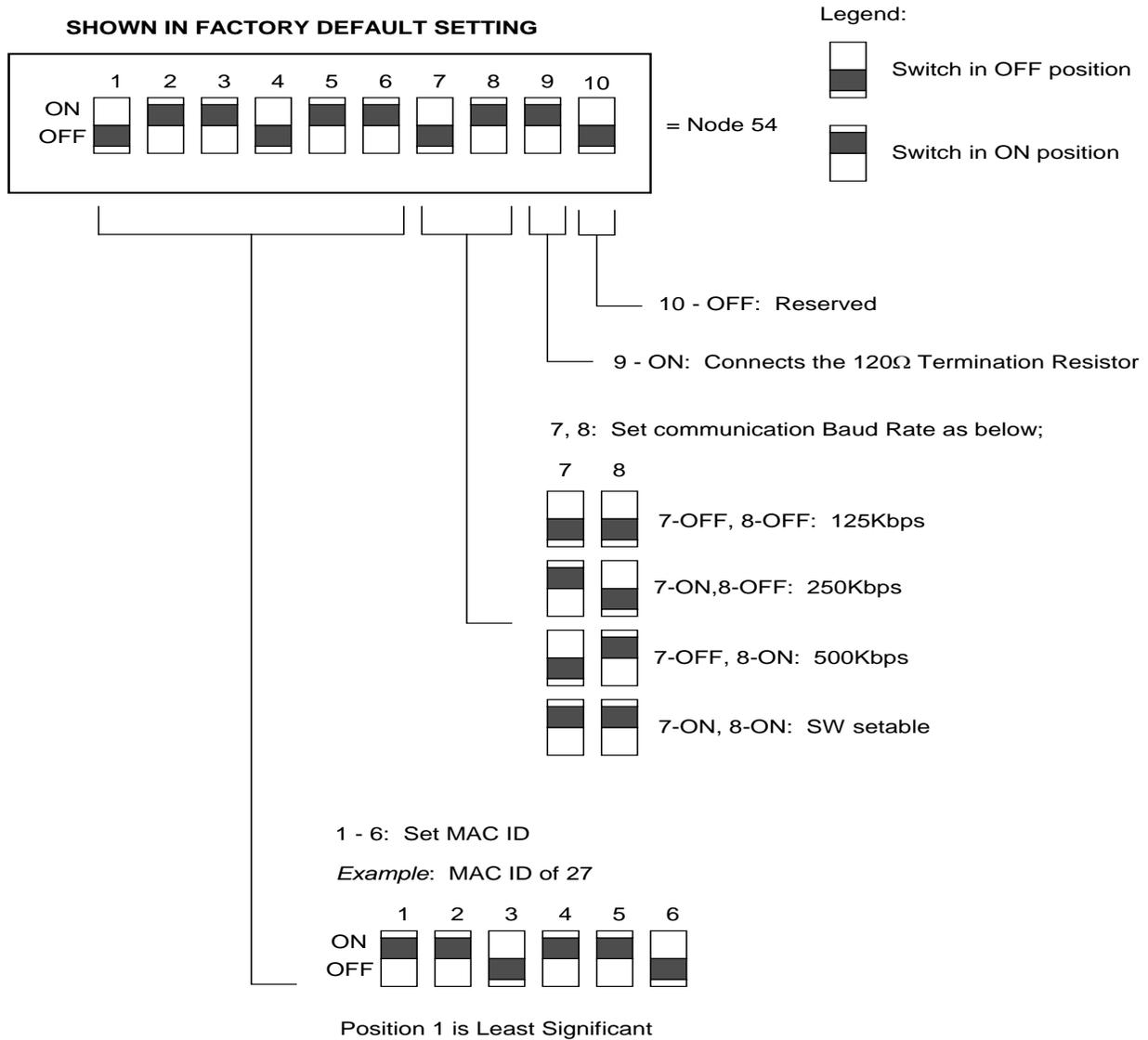
3.1.3 Baud Rate

Baud Rate is set by either hardware or software configuration. The possible settings are 125, 250 or 500Kbps. In order for the Baud Rate to be set by software, DIP switch positions 7 and 8 must be on. See [Figure 3.2](#) for DIP switch setup.

3.1.4 Termination Resistor

When DIP switch position 9 is on, a 120Ω 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 3.2— DeviceNet Master Module DIP Switch Settings



3.1.5 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 3.1* outlines this LED’s functions:

Table 3.1— 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 Tests	Flashing Green-Red	Device is performing self tests.

3.1.6 Network Status LED

The network status LED is identified on the device board as “NS”. It provides network status for power and communication. *Table 3.2* outlines this LED’s functions:

Table 3.2— 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.

3.2 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 behavior of the Arc circuit is more fully described in the following sections.

3.2.1 Arc Prevention Circuit Behavior During Coupling

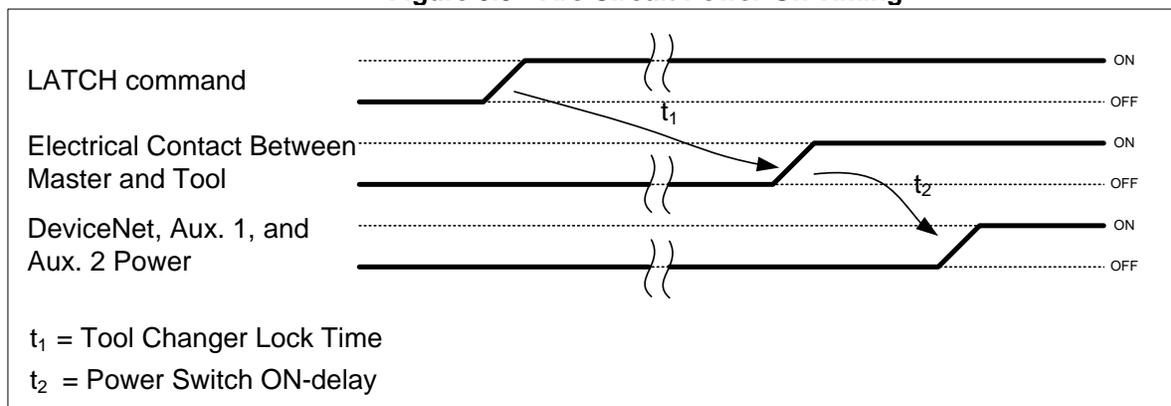
The behavior of the Arc Prevention circuit during coupling can be more clearly understood by referring to *Figure 3.3*, which shows the power-on timing diagram for the Arc Prevention circuit. Starting at the top of the diagram, the LATCH command is issued thus initiating locking of the Master and Tool.

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 100ms.

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 true until the LOCKED input goes true and remains true. **Only** after the coupling operation is complete, should the LATCH command be made false. Refer to the Recommended Sequence of Operation in Appendix A for additional details.

Figure 3.3—Arc Circuit Power-On Timing



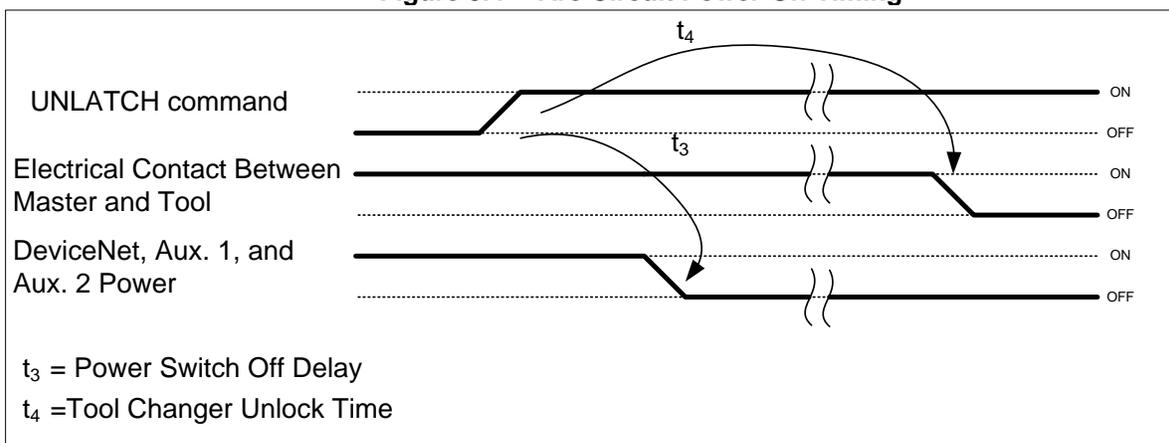
3.2.2 Arc Prevention Circuit Behavior During Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to [Figure 3.4](#) 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 50ms.

Sometime 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 100ms.

Figure 3.4— Arc Circuit Power-Off Timing



3.3 Tool Module Node

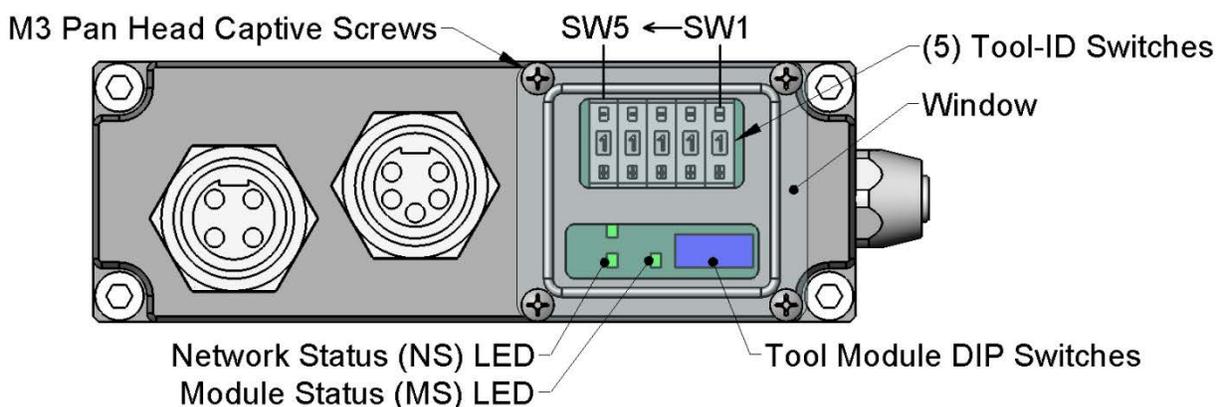
The Tool Node operates as a Group 2-Only Server on the DeviceNet network. The Tool Node supports Explicit Messages, Polled and Strobe of the predefined Master/Slave Connection set. The Tool Node supports Quick Connect operation as defined by ODVA (refer to the EDS file for specific information). The 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.

3.3.1 Setting the DIP Switches

1. Loosen the four M3 Pan head Captive Screws and remove the window.
2. Set the DIP switches as needed, refer to Figure 3.6 for details.
3. Re-install the window and tighten the M3 Pan Head Captive Screws.

NOTICE: When replacing the window, ensure that the seal is positioned correctly to prevent fluid leakage into the module and damaging the electronics.

Figure 3.5—Tool Module Tool-ID Switches, DIP Switches and LED's



3.3.2 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 must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to [Figure 3.6](#) for detailed information on DIP switch setup.

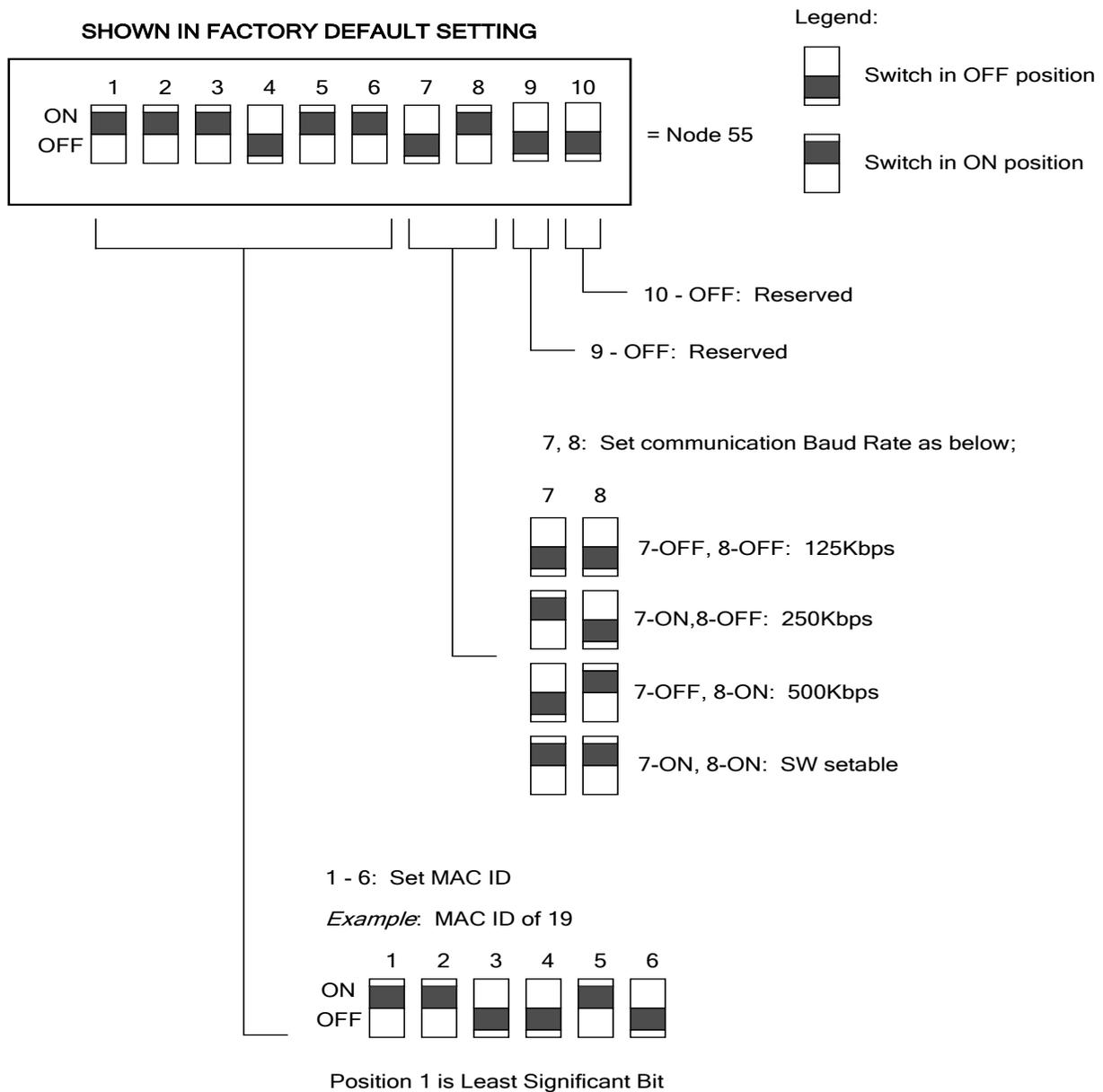
3.3.3 Baud Rate

Baud Rate is set by either hardware or software configuration. The possible settings are 125, 250 or 500Kbps. In order for the Baud Rate to be set by software, DIP switch positions 7 and 8 must be on. See [Figure 3.6](#) for DIP switch setup.

3.3.4 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.

Figure 3.6—DeviceNet Tool Module DIP Switch Settings



3.3.5 Tool-ID (Tool Node Only)

The Tool-ID for a particular tool is established from the setup of (5) pushbutton switches. The Tool module is available with switches configured to provide 5 independent (0–9) readings.

3.3.5.1 Setting the Tool-ID Switches

1. Loosen the four M3 Pan head Captive Screws and remove the window.
2. Use a non-conductive tool (e.g., plastic stylus) to press on the Tool-ID pushbuttons to increase (+) or decrease (-) the digit value from 1 to 9. Set the Tool-ID to the desired unique five digit number from 11111 to 99999 for each tool. Refer to [Figure 3.5](#).
3. Re-install the window and tighten the M3 Pan Head Captive Screws.

NOTICE: When replacing the window, ensure that the seal is positioned correctly to prevent fluid leakage into the module and damaging the electronics.

3.3.6 Module Status LED

The module status LED (Figure 3.6) is identified on the device board as “MS”. It provides device status for power and proper operation. Refer to [Table 3.1](#) for the module status LED’s functions.

3.3.7 Network Status LED

The network status LED (Figure 3.6) is identified on the device board as “NS”. It provides network status for power and communication. Refer to [Table 3.2](#) for the network status LED’s functions.

3.3.8 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—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.

3.4 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 (see [Figure 3.7](#)). 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.

3.4.1 TSI Overview

The DB12M DB10T modules rely on the status of the TSIV input to determine when it is appropriate to unlatch the Tool. The RTL sensors indicate if the Master and Tool are coupled while the TSIV 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.

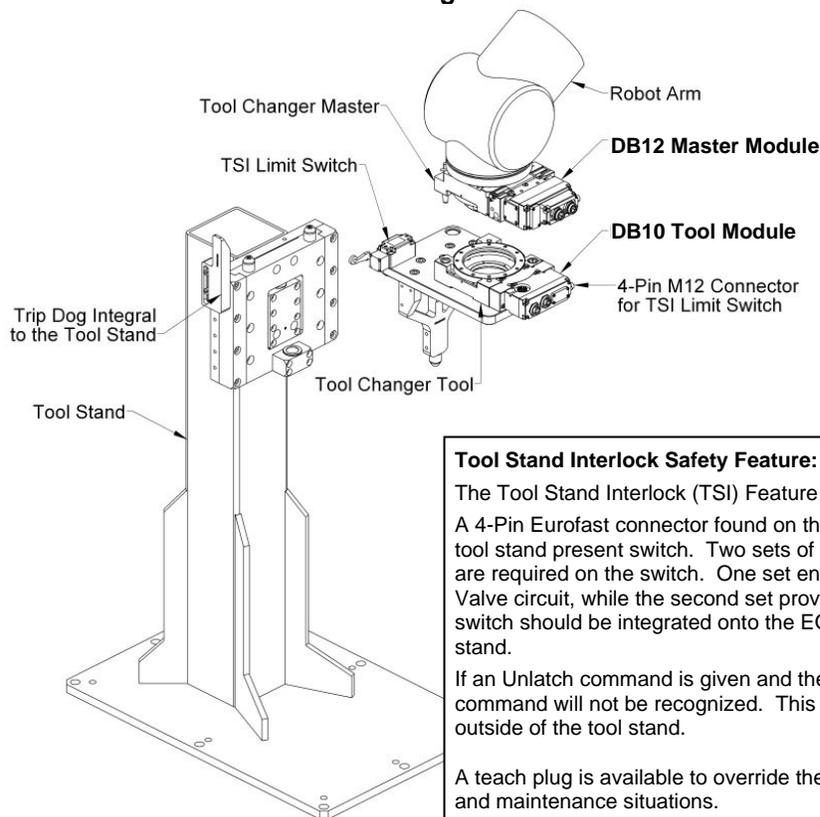
Control reliability monitoring of the Relays, limit switch and TSI circuit is achieved using the TSRV, and TSIV inputs, respectively. Refer to [Table 3.3](#) for suggested fault monitoring conditions.

On the DB10 Tool module, the TSIV 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 8 of this manual.

Table 3.3—Fault Monitoring				
Sensor/Input1	State1	Sensor/Input2	State2	Comment
RTL	0	Tool Module*	Present*	**RTL Not Operating Properly.
TSIV	0	TSRV	1	**TSI Relay or Switch Not Operating Properly.
TSIV	1	TSRV	0	TSI Relay or Switch Not Operating Properly.
TSIV	1	Clear of Stand	Yes	**Switch Failed Closed or Tied Off?
TSRV	1	Clear of Stand	Yes	TSI Relay Failed Closed?

* Slave Module Present as evidenced by Tool Presence Input or ability to read Tool ID
 ** Dangerous situation where an unintentional Unlatch command could result in Tool release.

Figure 3.7—Tool Stand Interlock (TSI)



Tool Stand Interlock Safety Feature:

The Tool Stand Interlock (TSI) Feature is provided with this tool changer. A 4-Pin Eurofast connector found on the Tool module is designed for use with a tool stand present switch. Two sets of NO, double-pole single-throw, contacts are required on the switch. One set energizes a tool-side relay to make the Valve circuit, while the second set provides an input for fault monitoring. This switch should be integrated onto the EOAT to sense when the tool is in the stand.

If an Unlatch command is given and the tool is not docked properly, the Unlatch command will not be recognized. This prevents the accidental release of the tool outside of the tool stand.

A teach plug is available to override the TSI safety feature during initial setup and maintenance situations.

NOTICE: This tool changer is equipped with Tool Stand Interlock (TSI). Special procedures are required to uncouple the tool changer. Refer to [Section 4—Operation](#) for specific sequence of operation instructions.

3.5 DB12 Latch Enable Logic

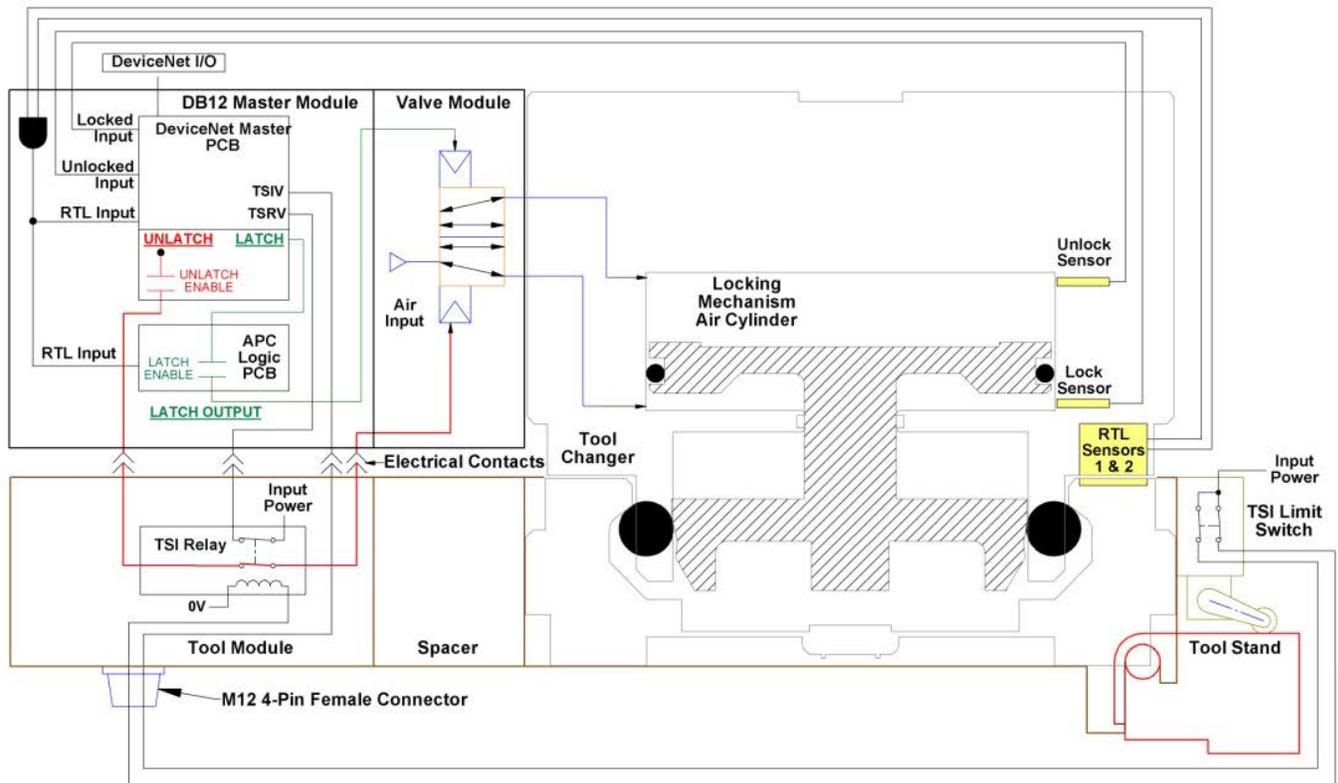
The DB12 prevents the tool changer from latching if a Tool is not present. Tool presence is determined from the RTL sensors. Therefore, if the RTL sensors indicate that no Tool is present, then the Tool Changer will ignore the latch command (see [Table 3.4](#)).

RTL	Latch Enable
0	0
1	1

NOTICE: The DB12 Master will NOT latch unless there is a Tool present. Tool presence is determined using the **RTL sensors**.

If the Master is left in a locked condition after being serviced it can be manually unlocked, refer to [Section 4.2—Solenoid Valve Manual Override Procedure](#).

Figure 3.8—Latch and Unlatch Circuit



3.6 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:

DB12-M Node EDS file 9031-20-1040

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 3.5—I/O Bitmap, Robot Input From Master DeviceNet Node 54 (DB12-M Module)		
Bit #	Name	Description/Function
0	Lock	Tool Changer Lock Prox I/P
1	Unlock	Tool Changer Unlock Prox I/P
2	Solenoid Energized	Latch/Unlatch Solenoid Energized I/P
3	Auxiliary Power Available	Auxiliary Power Present I/P
4	RTL	Ready-to-Lock Prox I/P
5	TSIV	TSI Switch Verify I/P
6		N/A
7	TSRV	TSI Relay Verify I/P

Table 3.1—I/O Bitmap, Robot Output To Master DeviceNet Node 54 (DB12-M Module)		
Bit #	Name	Description/Function
0	Latch	ToolChanger Valve Latch O/P
1	Unlatch	ToolChanger Valve Unlatch O/P
2		N/A
3		N/A
4		N/A
5		N/A
6		N/A
7		N/A

* Latch O/P only applicable for Double Solenoid Valve Adapter Versions

Table 3.1—I/O Bitmap, Robot Input From Tool DeviceNet Node 55 (DB10-T Module)			
Bit #	Name	Description/Function	
0	Low Bit	Tool-ID Byte 1	
1			N/A
2			N/A
3			N/A
4			N/A
5			SW1 Bit 1
6			SW1 Bit 2
7			SW1 Bit 4
8	High Bit	SW1 Bit 8	
8	Low Bit	Tool-ID Byte 2	
9			SW2 Bit 1
10			SW2 Bit 2
11			SW2 Bit 4
12			SW2 Bit 8
13			SW3 Bit 1
14			SW3 Bit 2
15			SW3 Bit 4
16	High Bit	SW3 Bit 8	
16	Low Bit	Tool-ID Byte 3	
17			SW4 Bit 1
18			SW4 Bit 2
19			SW4 Bit 4
20			SW4 Bit 8
21			SW5 Bit 1
22			SW5 Bit 2
23			SW5 Bit 4
23	High Bit	SW5 Bit 8	

4. Operation

This Recommended Sequence of Operations procedure is to be used as a general guide when programming a robot or PLC for use with a Tool Changer and DB12M DB10T control/signal modules. This procedure is intended for "automatic" modes used during normal application processes.

4.1 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.
 - a. The **RTL** input is false.
 - b. The ATI Tool and any downstream device is offline.
 - c. The **Auxiliary Power Available** input is true provided the Auxiliary Power 1 power supply is on.
 - d. **TSIV** is false.
 - e. **TSRV** is false.
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. The **Latch** output command is false and the **Unlatch** output command is true.
 - b. The **Solenoid Energized** input is true.
 - c. The **Unlocked** input is true and remains true, indicating that the Tool Changer locking mechanism is fully retracted.

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

3. Robot and Master move within 0.06" of the Tool.
 - a. The **TSIV** inputs go true, 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 true, indicating that it is okay to couple the Tool.

NOTICE: The DB12 Master will NOT latch unless there is a Tool present. Tool presence is determined using the **RTL sensors**.

4. Couple the Tool Changer.
 - a. The **Unlatch** output is made false and the **Latch** output is made true.
 - b. The **Unlocked** input goes false a short time later, indicating piston travel. Subsequently, the **Locked** input goes true and remains true, indicating that the coupling operation is complete. It is recommended that the **Latch** command be made false after the **Locked** input goes true.
 - c. The Arc Prevention circuit makes power available to the Tool. 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 TSIV 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 **TSIV and TSRV** input goes false

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

6. Normal operation
 - a. The following inputs are true:
 - i. **Locked**
 - ii. **Auxiliary Power Available**
 - iii. **RTL**
 - b. The following inputs are false:
 - i. **Solenoid Energized**
 - ii. **Unlocked**
 - iii. **TSIV**
 - iv. **TSRV**
 - c. The following outputs are false:
 - 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 **TSIV** input goes true, indicating that it is safe to uncouple the Tool Changer.
 - b. **TSRV** becomes true.
8. Uncouple the Tool Changer.
 - a. The **Latch** output is made false and the **Unlatch** output is made true.
 - b. Power on the Tool turns off.
 - c. Communication is lost with the downstream devices.
 - d. **Tool-ID** becomes unavailable.
 - e. The **Locked** input goes false a short time later and subsequently the **Unlocked** input goes true and remains true, 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 are false.
10. Robot and Master move away from the Tool, are parallel and > 0.125" from the Tool (the module contact pins are no longer touching).
11. Robot and Master in free space.
 - a. The following inputs are true:
 - i. **Unlocked**
 - ii. **Auxiliary Power Available**
 - b. The following inputs are false:
 - i. **Locked**
 - ii. **RTL**
 - iii. **TSIV**
 - iv. **TSRV**

4.2 Solenoid Valve Manual Override Procedure



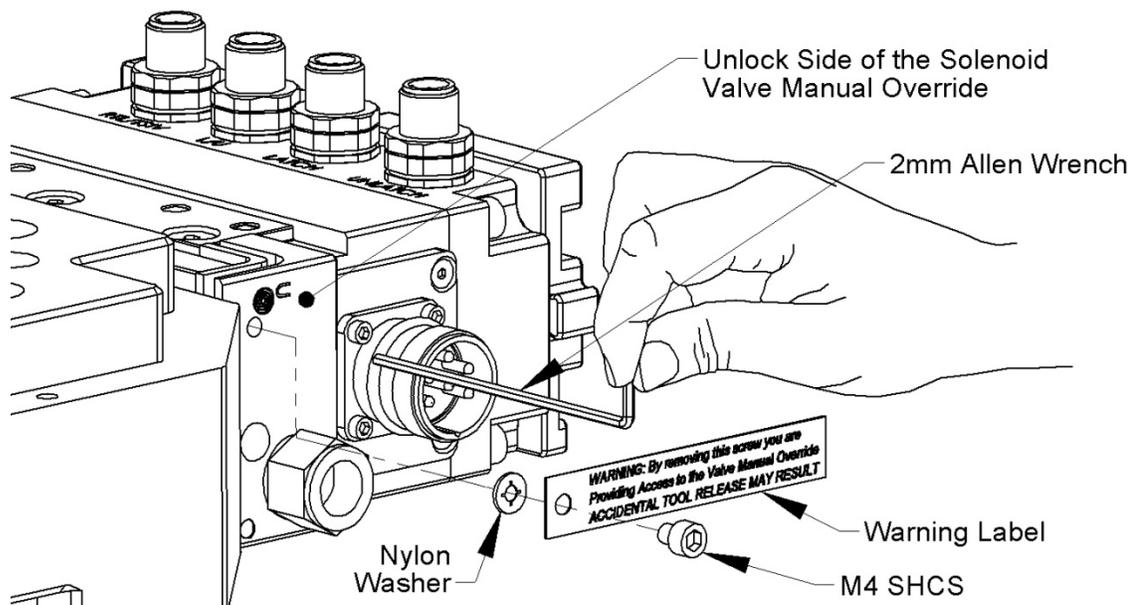
DANGER: Do not use the solenoid valve manual override if the tool is locked to the Master. Using the manual override will release the Tool and may cause bodily injury or damage to equipment. If the Tool is attached to the Master it must be secured in the tool stand or in a location where the tool weight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



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

1. Remove the M4 SHCS, warning label, and nylon washer from the Unlock side of the solenoid valve. The Unlock side is marked with a “U”.
2. Insert a 2mm ball end Allen wrench or similar blunt object in the Unlock valve screw hole and manually depress the valve override. Make sure locking mechanism is fully retracted.
3. Replace the M4 SHCS, warning label, and nylon washer and tighten the screw.

Figure 3.1—Solenoid Valve Manual Override



5. Maintenance

The DeviceNet modules are designed to provide a long life with little maintenance required. 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.



DANGER: For electrical modules using > 60VDC or 42VAC, NO contact should be attempted before removing power. This includes attaching and disconnecting cables or any contact with the Tool Changer or its components. Arcing and damage will occur if this is not observed. Remove power before attaching, disconnecting any cables or attempting any maintenance of Tool Changer.



WARNING: Do not perform maintenance or repair on Tool Changer or modules unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on 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.

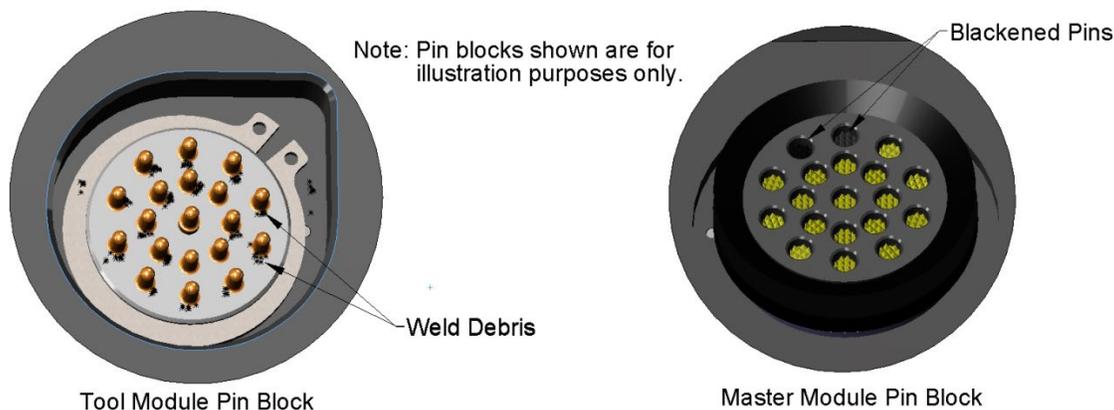
Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred. Perform the following visual inspection monthly:

- Inspect mounting fasteners to verify they are tight and if loose, then tighten to the proper torque.
- 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 5.2—Seal Replacement*.

5.1 Pin Block Inspection and cleaning

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

Figure 4.1—Inspect Master and Tool Pin Blocks

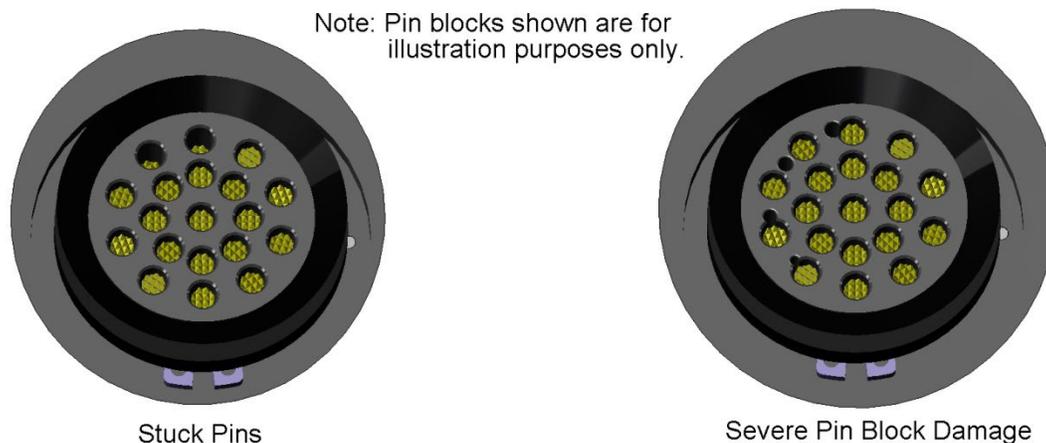


2. If debris or darkened pins exist, remove debris using a vacuum, and clean using a nylon brush (ATI part number 3690-000064-60).

NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause erosion to the contact surface. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number 3690-000064-60).

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

Figure 4.2—Stuck Pin and Pin Block Damage



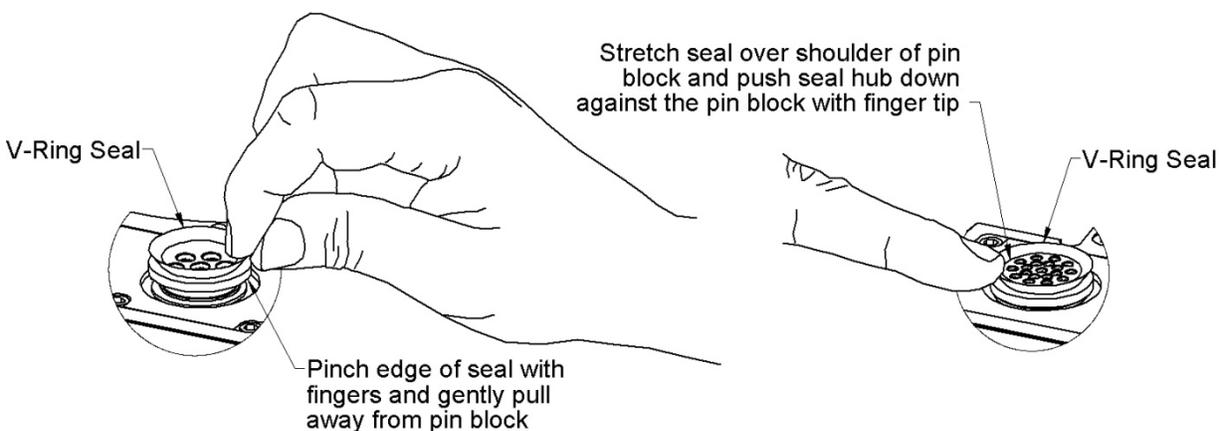
4. If stuck pins or severe pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.

5.2 Seal Replacement

Replace the V-Ring seal:

1. To remove the existing seal, pinch edge of seal with fingers and gently pull the seal away from the pin block on the Master.
2. Pull the seal off the pin block.
3. To install a new seal, stretch the new seal over the shoulder of the pin block.
4. Push the seal's hub down against the pin block using finger tip.

Figure 4.3—V-Ring seal Replacement



6. Troubleshooting

Refer to the table below for troubleshooting information:

Symptom	Possible Cause / Correction
Unit will not lock or unlock	<p>Verify that ball bearings are not moving freely. Clean and lubricate as needed (see Section 5 - Maintenance).</p> <p>Check air supply.</p> <p>Check that exhaust port is properly vented (check muffler).</p> <p>Verify that DeviceNet and DeviceNet signals are operating correctly.</p> <p>Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock.</p> <p>Verify TSI switch and circuit are operating properly.</p>
Master will not Latch even when Tool is within locking distance	Failure of RTL Sensor in OFF position
	RTL Sensors unplugged
Master Latches when Tool is NOT present**	Failure of RTL Sensor in ON position
Sensors not operating properly (but DeviceNet is operating correctly).	<p>Verify that cables are connected correctly</p> <p>Verify that the sensors are set correctly.</p> <p>Ensure that the Tool Plate is securely held to the Master Plate, that nothing is trapped between their surfaces, and that there is no air trapped in the Unlock (U) air port.</p>
Loss of DeviceNet Communication	<p>Check/replace DeviceNet cabling up- and down-stream of Tool Changer modules.</p> <p>Inspect DeviceNet Module contact pins for debris/wear.</p> <p>Check nodes up- and down-stream of Tool Changer nodes for failures. These failures can “masquerade” as Tool Changer node faults.</p> <p>Verify DeviceNet network and cabling is properly tuned.</p> <p>Lower Baud Rate if communication problems persist.</p> <p>Check for duplicate MAC addresses, particularly duplicates of modules with quick-connect enabled.</p> <p>Note: If using Quick-Connect, Check that the ATI Tool module and the scan list both have the quick-connect feature enabled. Check for duplicate MAC addresses, particularly duplicates of modules with quick-connect enabled.</p>
No power on the Tool-side	<p>Verify that the LATCH command has been issued by the robot.</p> <p>Verify that the Master and Tool are fully coupled.</p> <p>Inspect DeviceNet Module contact pins for debris/wear.</p>
Loss of Aux. Power on the Tool-side	<p>Loss of DeviceNet power on the Master-side will cause loss of Aux. Power to the Tool. The Arc Prevention Circuit relies on DeviceNet power to operate.</p> <p>Restore DeviceNet Power to the Master to restore Aux. Power to Tool.</p>
<p>Note: ** 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 4.2—Solenoid Valve Manual Override Procedure.</p>	

7. Recommended Spare Parts

See *Section 9—Drawings* of this manual.

8. Specifications

DB12 DeviceNet Master Module	
Factory Default Configuration	MAC ID 54, Baud 500 Kbps, termination resistance “on”.
Interface Connections	<p><u>Auxiliary Power</u>: Mini, 4-Pin Male supporting two Auxiliary Power Circuits</p> <p><u>DeviceNet</u>: Mini, 5-Pin Male</p> <p><u>Integrated Tool Changer I/O</u>:</p> <ul style="list-style-type: none"> • 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.
Electrical Rating	<p><u>Power Pass-Thru</u>:</p> <ul style="list-style-type: none"> • Aux1 V+ and Aux2 V+ Power: 5A, 12-30 VDC <i>Note: Arc prevention is applied to Aux1 V+ and Aux2 V+ power.</i> • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC <i>Note: Arc prevention is applied to CANV+ power.</i>
	<p><u>Signal Pass-Thru</u>: 3 Amp, 30VDC maximum</p>
	<p><u>Tool Changer Control</u>:</p> <ul style="list-style-type: none"> • Lock, Unlock, and Ready-to-Lock sensors: 10-30 VDC operational voltage <i>Note: CAN V+ Power provides power to the L, U, and RTL sensors.</i> • Latch/Unlatch integrated solenoid valve: 21-26 VDC operational voltage <i>Note: Aux1 V+ Power provides power to the Latch/Unlatch solenoid valve.</i>
	<p><u>Valve Control Power</u>:</p> <ul style="list-style-type: none"> • Latch and Unlatch Valve control: 19-29 VDC operational voltage.
*Current Draw	183mA @ 24VDC: Master and Tool coupled (Locked, RTL1, and RTL2 sensors “on”, Limit Switches/ TSI Circuits made, i.e.; TSIV1 “on”)
Weight	2.24 lbs (1.02 kg)
*Current Draw totals for DeviceNet-powered circuits, not including downstream I/O devices and Auxiliary powered valves. Please refer to the module manufacturer for these specifications.	

DB10 DeviceNet Tool Module	
Factory Default Configuration	MAC ID 55, Baud 500Kbps, No termination resistance. (5) Independent Tool ID switches, each reading a (0–9) position (all factory set to Tool Position 1).
Interface Connections	<p><u>Auxiliary Power</u>: Mini, 4-Pin, Female</p> <p><u>DeviceNet</u>: Mini, 5-Pin, Female</p> <p><u>TSI connectors</u>: M12, 4-Pin, Female</p>
Electrical Rating	<p><u>Power Pass-Thru</u>:</p> <ul style="list-style-type: none"> • Aux1 V+ and Aux2 V+ Power: 5A, 12-30 VDC • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC
	<p><u>Signal Pass-Thru</u>: 3 Amp, 30VDC maximum</p>
*Current Draw	61mA @ 24VDC: Tool Only
Weight	1.35 lbs (0.61 kg)
*Current Draw totals for DeviceNet-powered circuits, not including downstream I/O devices and Auxiliary powered valves. Please refer to the module manufacturer for these specifications.	

9. Drawings

Drawings are available on the [ATI website](#) or by contacting an ATI representative.