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Glossary of Terms

TERM	DEFINITION
Auxiliary Power Available	An input indicating the presence of Auxiliary Power at the ATI Master.
DeviceNet Power Good	An input indicating the presence of DeviceNet Power at the ATI Master.
EOAT	End-Of-Arm-Tool (end-effector).
Latch	The output supplied to the ATI Master DeviceNet node to couple the Tool Changer.
Locked	A proximity sensor input indicating that the coupling mechanism is in the Locked position.
RTL	A proximity sensor input that senses when the ATI Tool is in close proximity.
RTL Relay	A relay circuit present on the ATI Master module that is driven by the RTL sensor and allows the Tool Changer locking mechanism to retract when there is no Tool present.
RTLV	An input provided for health status monitoring of the RTL Relay.
Tool Present	A hard-connect input (sourced from the tool) indicating the Master and tool are electrically connected to each other.
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 driven by a tool stand limit switch in order to close the TSI circuit and allow Tool Changer release.
TSIV	An input supported for monitoring of a tool stand limit switch used with the TSI circuit.
TSRV	An 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.
Unlocked	A proximity sensor input indicating that the coupling mechanism is in the Unlocked position.

C. Control and Signal Modules

DJ8—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 in a DeviceNet environment. Refer to *Section 3—Product Information* and *Section 4—Operation* of this manual for detailed DeviceNet programming information and a summary of module operational capabilities.

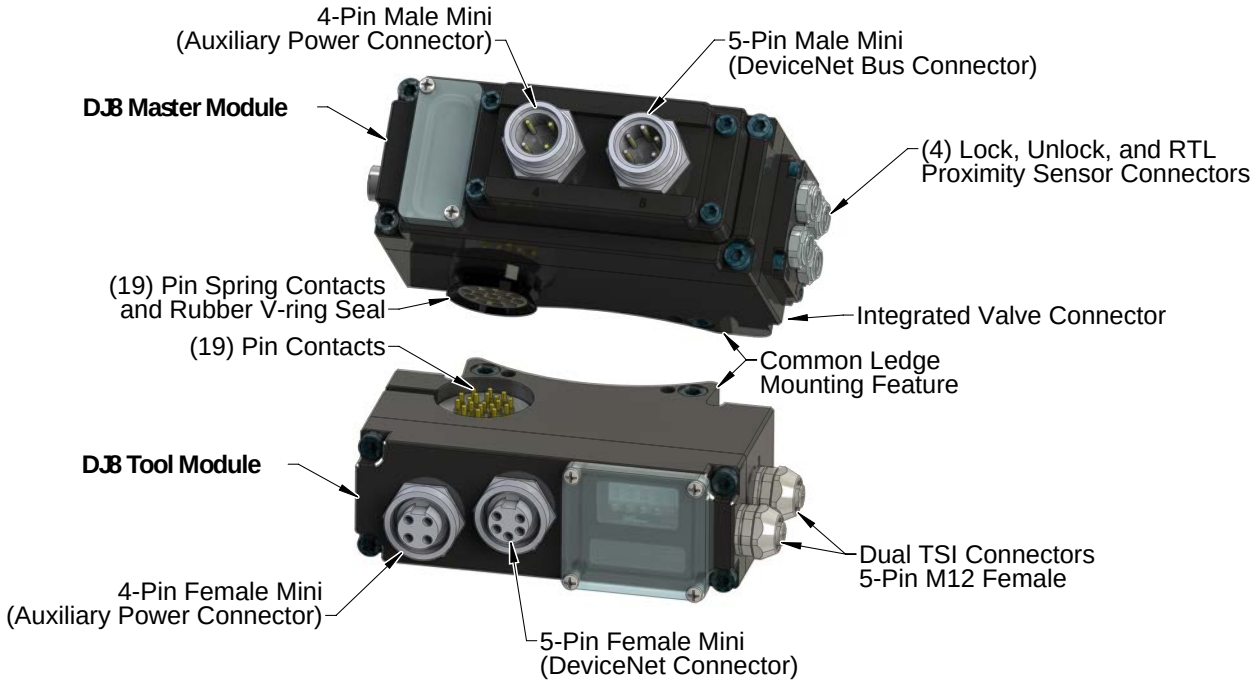
Standard Mini connectors are provided on the Master and Tool modules for interfacing with Auxiliary Power (4-Pin) and DeviceNet (5-Pin) signals. When the Tool Changer is coupled, the Master and Tool modules pass signals using a spring-loaded pin block. A flexible boot surrounds the pin block to seal the connection from moisture and liquid while coupled (See Fig. 1.1).

The DJ8 modules are designed with a dual redundant Tool Stand Interlock (TSI) circuit to allow the Tool Changer to be operated in the safest manner possible. In addition to supporting the standard Tool Changer input signals (Locked, Unlocked, and Ready-to-Lock proximity sensors) the modules also support advanced diagnostic and fault reporting. This greatly reduces the programming complexity on the customers end. Refer to *Section 3—Product Information* and *Section 4—Operation* for more information on these attributes.

1.1 DJ8 Master

The DJ8-M module supports the use of an integrated single solenoid valve, which is provided on the valve adapter module (9121-Jxx), for Latch/Unlatch control of the Tool Changer. The user is required to provide a pneumatic supply source to the Tool Changer. Please refer to the appropriate manual for specific module and Tool Changer requirements. Electrical interface drawings and connector details are provided in *Section 9—Drawings*

Figure 1.1—DJ8 Modules



The DJ8-M Module also incorporates ATI's exclusive Arc Prevention Circuit which extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling. Refer to *Section 3.2—Arc Prevention Circuit* for additional information regarding the Arc Prevention Circuit.

1.2 DJ8 Tool

The DJ8 Tool supports the use of (2) mechanical limits switches for integration with dual redundant TSI. The limit switches connected to the TSI connectors must have two sets of N.O. contacts (double-pole, single-throw). The limit switches are wired into the unlatch solenoid valve circuit, that will allow the solenoid valve to uncouple the tool changer only when the Tool is in the Tool Stand. A limit switch is available from ATI (PN 9005-20-1165) but is not included with the DJ8 modules. Contact ATI for specific switch requirements.

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. The Tool-ID is reported through the master module bitmap. See *Section 3.5—Software* for DeviceNet bitmap and detailed I/O information.

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. For wiring information refer to *Section 9—Drawings*.

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

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.

2.1 Module Installation

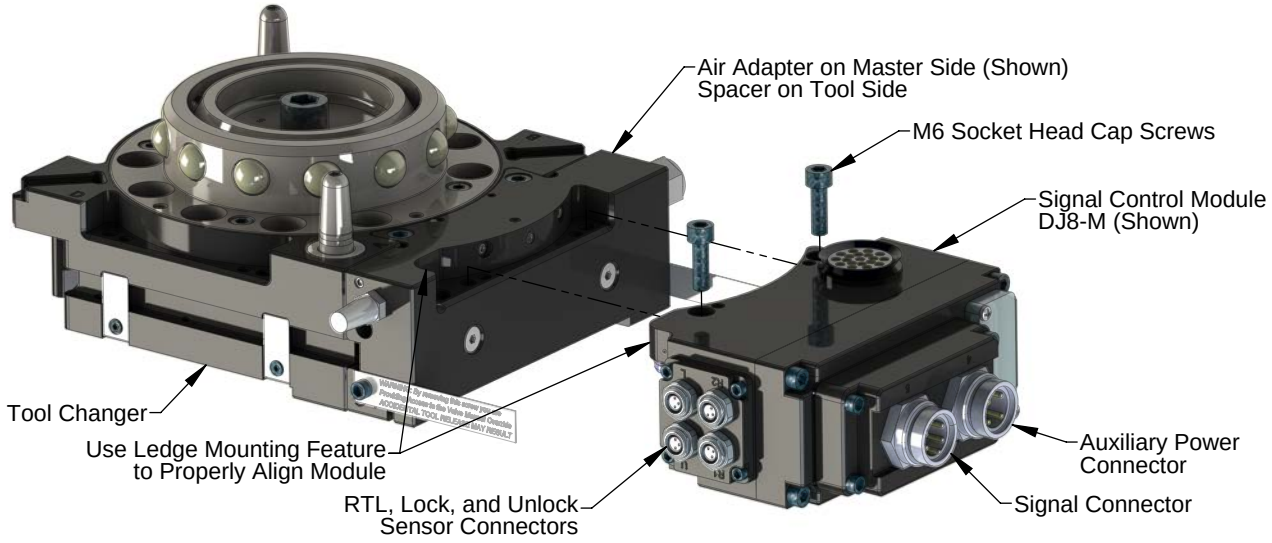
Refer to *Figure 2.1* for installation instructions. The DJ8 Master module provides Dip switches for setting the MAC ID and Baud Rate, refer to *Section 2.4—Setting the MAC ID and Baud Rate on the Master Module.* The DJ8 Tool module provides Tool-ID. The Tool-ID should be set to a unique number for each tool. Refer to *Section 2.3—Setting the Tool-ID on the Tool Module.*

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

Supplies required: *Clean rag, Loctite® 242 (if fasteners do not have pre-applied adhesive)*

1. For a Tool Changer, if the Tool Changer is installed place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all circuits (e.g. electrical, air, water, etc).
3. It may be necessary to clean the mounting surface on the air adapter prior to installing the module in order to remove any debris that may be present.
4. Using the ledge feature as a guide, place the module onto the air adapter. Align the module with the air adapter using the dowels in the bottom of the ledge feature..
5. If fasteners do not have pre-applied adhesive, apply Loctite 242® to the supplied M6 socket head cap screws. Install the (2) M6 socket head screws, securing the module to the air adapter, and tighten to 70 in-lbs.
6. Power, signal, auxiliary, and sensor cables can be connected to the module. Ensure that the connectors are cleaned prior to being secured as appropriate.
7. After installation is complete, energize all circuits (e.g. electrical, air, water, etc.)

Figure 2.1—Module Installation



2.2 Module Removal

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

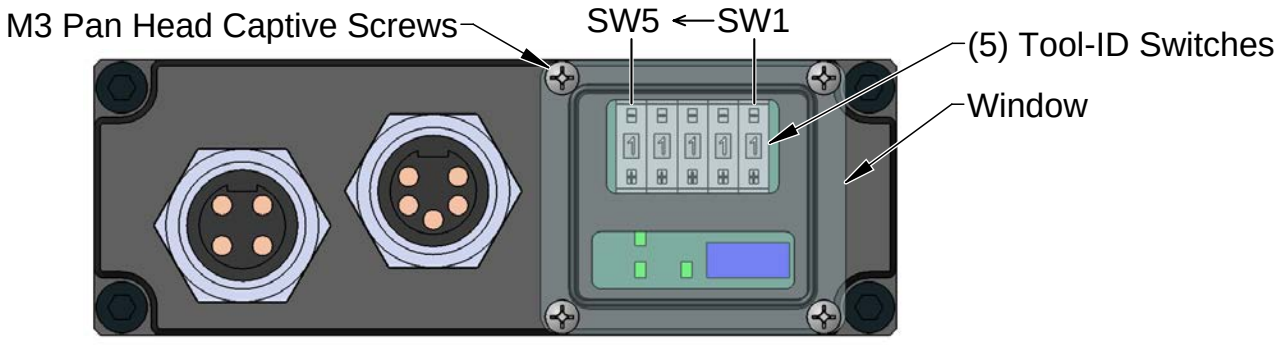
1. For a Tool Changer, if the Tool Changer is installed place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Prior to removing the rail assembly use a marker pen to scribe a line or indication between the Tool Changer or Utility Coupler and module as a reminder where the module is to be re-installed.
4. Disconnect the cables (e.g. power, signal, auxiliary, etc.) to the module.
5. Remove the socket head cap screws and lift off from the Tool Changer or Utility Coupler.

2.3 Setting the Tool-ID on the Tool Module

A push button switches is provided on the Tool module for setting of a unique (1) digit Tool-ID number.

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

Figure 2.2—Setting the Tool-ID on the Tool Module



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 from 0 to 9. Set the Tool-ID to the desired unique 5 digit number from 00000 to 99999 for each tool.

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

3. Re-install the Tool-ID window and tighten the (4) M3 pan head captive screws.

2.4 Setting the MAC ID and Baud Rate on the Master Module

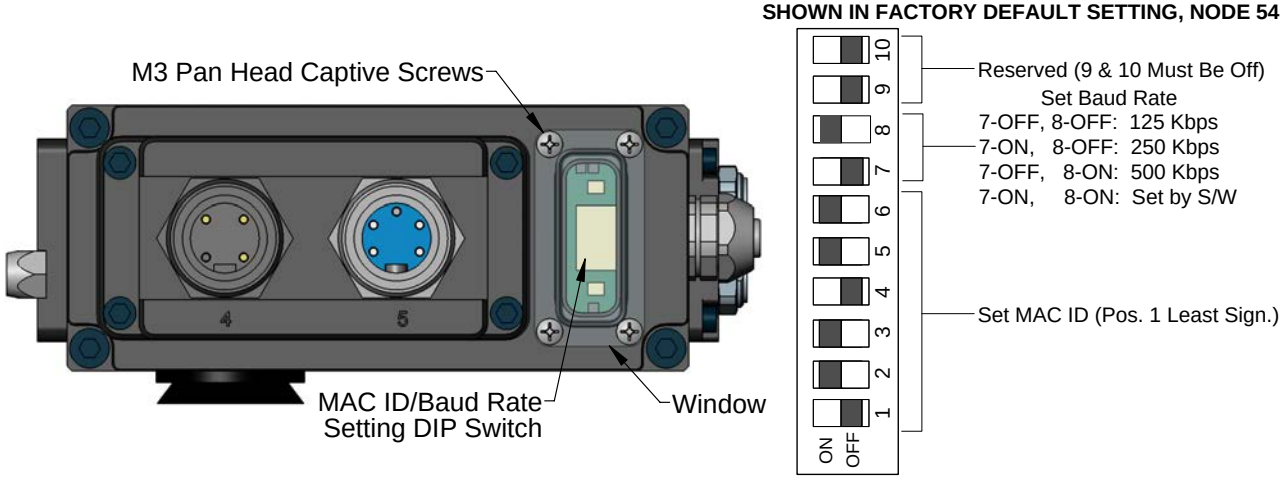
The MAC ID is set by either hardware or software configuration. The range is 0-63. In order for the MAC ID to be set by software, DIP switch positions 7 and 8 must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to Figure 3.1 for detailed information on DIP switch setup. The default MAC ID setting from the factory for the Master Node is 54. Refer to *Figure 2.3* for detailed information on DIP switch setup.

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 2.3* for DIP switch setup. The default Baud Rate setting from the factory for the Master Node is 500Kbps

1. Loosen the four M3 Pan head Captive Screws and remove the window.
2. Set the DIP switches as needed, refer to *Figure 2.3* 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 2.3—Setting the MAC-ID and Baud Rate on the Master Module



3. Product Information

The DJ8 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.

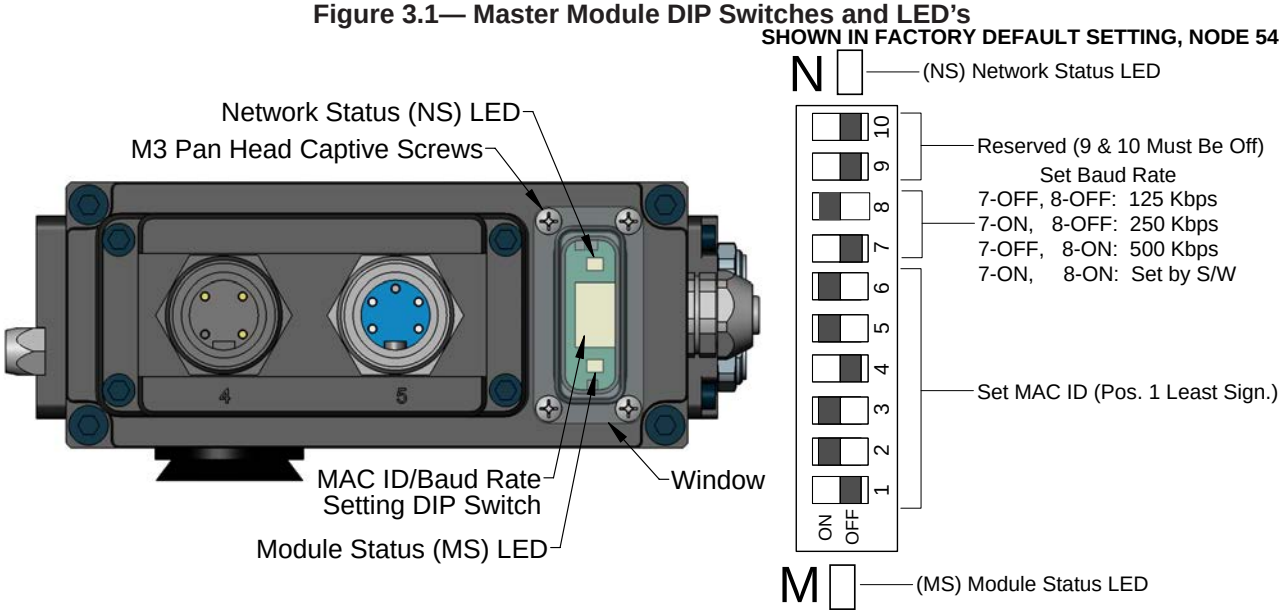
The DJ8 modules employ standard Mini connectors, 5-pin for DeviceNet communications and power and 4-pin for Auxiliary Power. Please refer to *Section 9—Drawings* for specific module wiring and connector interface information.

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 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.

Figure 3.1— Master Module DIP Switches and LED's



3.1.1 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, DIP switch positions 7 and 8 must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to Figure 3.1 for detailed information on DIP switch setup. The default MAC ID setting from the factory for the Master Node is 54. Refer to *Figure 3.1* for detailed information on DIP switch setup. To set the MAC ID refer to *Section 2.4—Setting the MAC ID and Baud Rate on the Master Module.*

3.1.2 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 3.1* for DIP switch setup. The default Baud Rate setting from the factory for the Master Node is 500Kbps. To set the Baud Rate refer to *Section 2.4—Setting the MAC ID and Baud Rate on the Master Module.*

3.1.3 Termination Resistor

Termination resistance is not supported with the Master Node. Required termination resistance must be provided external to the module.

3.1.4 Module and Network Status LED

The module status LED is identified on the module as "MS". It provides device status for power and proper operation. Refer to *Table 3.1* for an outline of this LED's operation. The network status LED is identified on the module as "NS". It provides network status for power and communication. Refer to *Table 3.2* for an outline of this LED's operation.

Table 3.1—Master Module Status LED

Color	State	Indication
None	Off	No Power
Red	Solid	Unrecoverable Fault
	Flashing	Recoverable Fault (Tool Connected) • Serial Communication Errors • Invalid Tool-ID • Tool Module Returns an Error Message
Green	Solid	Normal Operation
	Flashing	No Tool Connected

Table 3.2—Master Network Status LED

Color	State	Indication
None	Off	No Power
Red	Solid	Unrecoverable Fault
	Flashing	Output Error or Configuration Error
Green	Solid	Normal Runtime Operation
	Flashing	Device Is In Idle or Not Allocated to a Master

3.1.5 Cable Drop Length Calculation

Subtract 1 foot from the DeviceNet total drop line budget for each Master node installed on the network (Note: the Master node can exceed the 24pF limit for the differential input capacitance between CAN_H and CAN_L by up to 12pF which is equivalent to 1 foot cable).

3.2 Arc Prevention Circuit

The DJ8 Module incorporates ATI's exclusive Arc Prevention Circuit. The Arc Prevention Circuit extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling. The Arc Prevention Circuit makes it possible to couple/uncouple without switching power off and prevents damage to the contacts.

In the DJ8 Module, the Arc Prevention Circuit controls the ON/OFF status of CAN V+, Aux 1 V+, and Aux 2 V+ Power.

The behavior of the Arc Prevention Circuit is more fully described in the following sections.

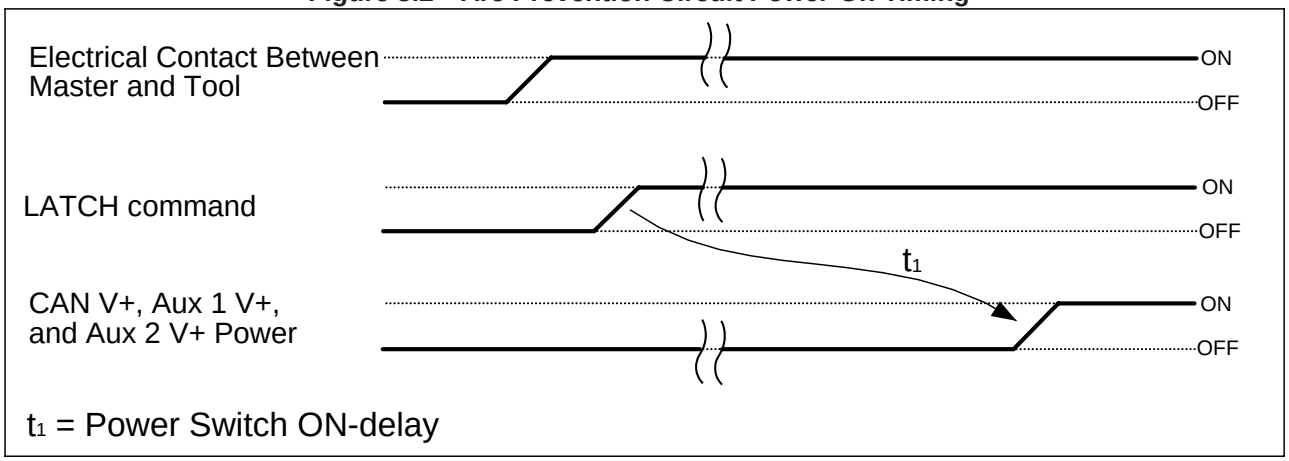
3.2.1 Arc Prevention Circuit Behavior during Coupling

The behavior of the Arc Prevention circuit during coupling can be more clearly understood by referring to *Figure 3.2*, which shows the power-on timing diagram for the Arc Prevention Circuit. Starting at the top of the diagram, electrical contact between Master and Tool Pin Contacts occurs. The LATCH command is issued initiating locking of the Master and Tool.

The Arc Prevention Circuit will turn on CAN V+, Aux 1 V+, and Aux 2 V+ Power. The time delay between when the electrical contacts become fully engaged to when power is actually available to the EOAT (time t1 in the diagram) is less than 100ms.

Important: The Arc Prevention Circuit will only allow power to pass to the Tool after the LATCH command has been issued and the Master and Tool module's electrical contacts are fully engaged. The Tool Power Is On (Byte 4, bit 7 - refer to *Section 3.5—Software*) indicates when this is the case.

Figure 3.2—Arc Prevention Circuit Power-On Timing



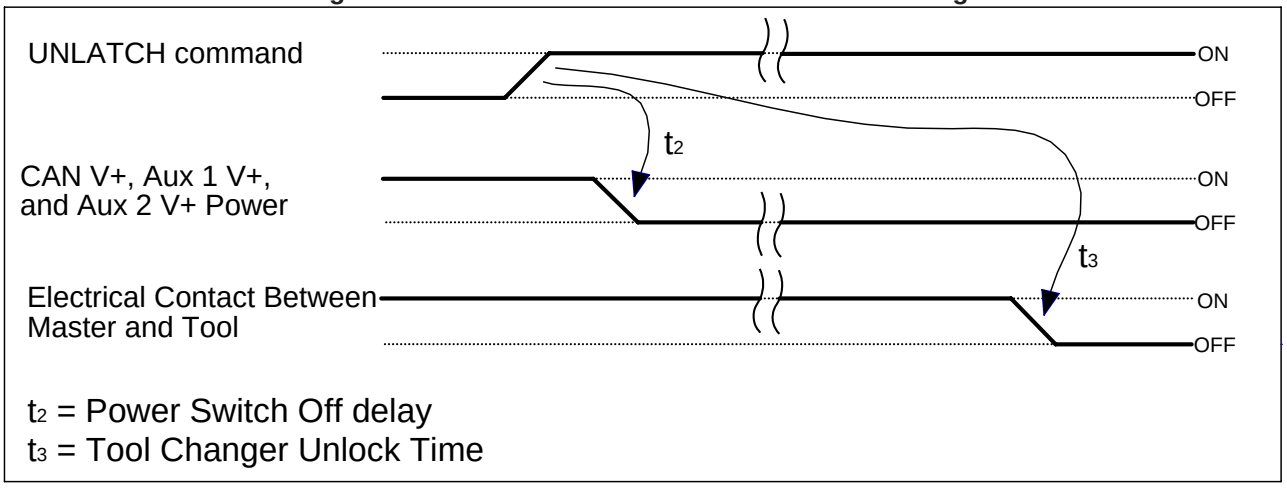
3.2.2 Arc Prevention Circuit Behavior during Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to *Figure 3.3* 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 CAN V+, Aux 1 V+, and Aux 2 V+ Power. The power-off time delay between the UNLATCH command and the switching off of power (designated t2 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 t3 in the diagram, after the UNLATCH command is issued. The magnitude of time t3 is a function of many factors, including the weight of the EOAT, the friction between Master and Tool alignment pins, etc. but is usually not shorter than 100ms.

Figure 3.3—Arc Prevention Circuit Power-Off Timing



3.3 Tool Module

A DeviceNet node is not established on the Tool module. The Tool module utilizes a patented, rapid communication method to report the Tool-ID information from the pushbutton switches to the Master module as soon as the Tool Changer is coupled. Typically the Tool-ID information is available to the Master within 150ms from the time the changer is coupled.

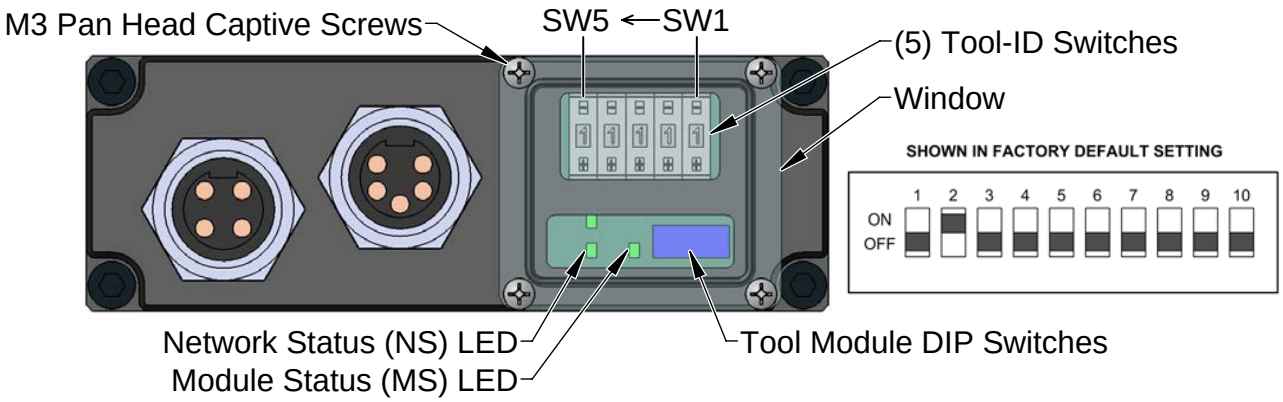
In addition to providing Tool-ID, the tool module also functions as a pass-through for the DeviceNet network and Auxiliary Power signals to downstream equipment. Standard 4 and 5-pin female Mini connectors are provided for interfacing on the Tool module (reference drawings in Section 9).

DIP switches provided on the Tool module are set from the factory and should not have to be adjusted (See *Figure 3.4* for factory DIP switch settings, if for some reason the plastic window and seal are removed, ensure the seal and window are re-positioned correctly to prevent a leakage path to the module inside). LEDs are integral to the Tool module and report module and network status.

3.3.1 Tool-ID Switches

Five pushbutton switches are provided on the Tool module for setting of a Tool-ID number. Refer to *Figure 3.4* for information about the Tool-ID switches. To set the Tool-ID refer to *Section 2.4—Setting the MAC ID and Baud Rate on the Master Module.*

Figure 3.4—Tool Module Tool-ID Switches, DIP Switches and LED's



3.3.2 Module and Network Status LED

The module status LED is identified on the module as "MS". It provides device status for power and proper operation. Refer to *Table 3.3* for an outline of this LED's operation. The network status LED is identified on the module as "NS". The network status LED functionality is not utilized in this product, but it will operate. The network LED should be green unless the DIP switches have be changed from the factory default settings. See *Table 3.4* for information about this LED's operation.

Table 3.3—Tool Module Status LED

Color	State	Indication
None	Off	No Power
Green	Flashing (0.5 Hz)	No Communications From the ATI Master Module
	Flashing (2.5 Hz)	Valid Communications From the ATI Master Module

Table 3.4—Tool Network Status LED

Color	State	Indication
None	Off	No Power
Red	Solid	Configuration Error
	Flashing	Not Applicable This Product
Green	Flashing	Not Applicable This Product
	Solid	Not Applicable This Product

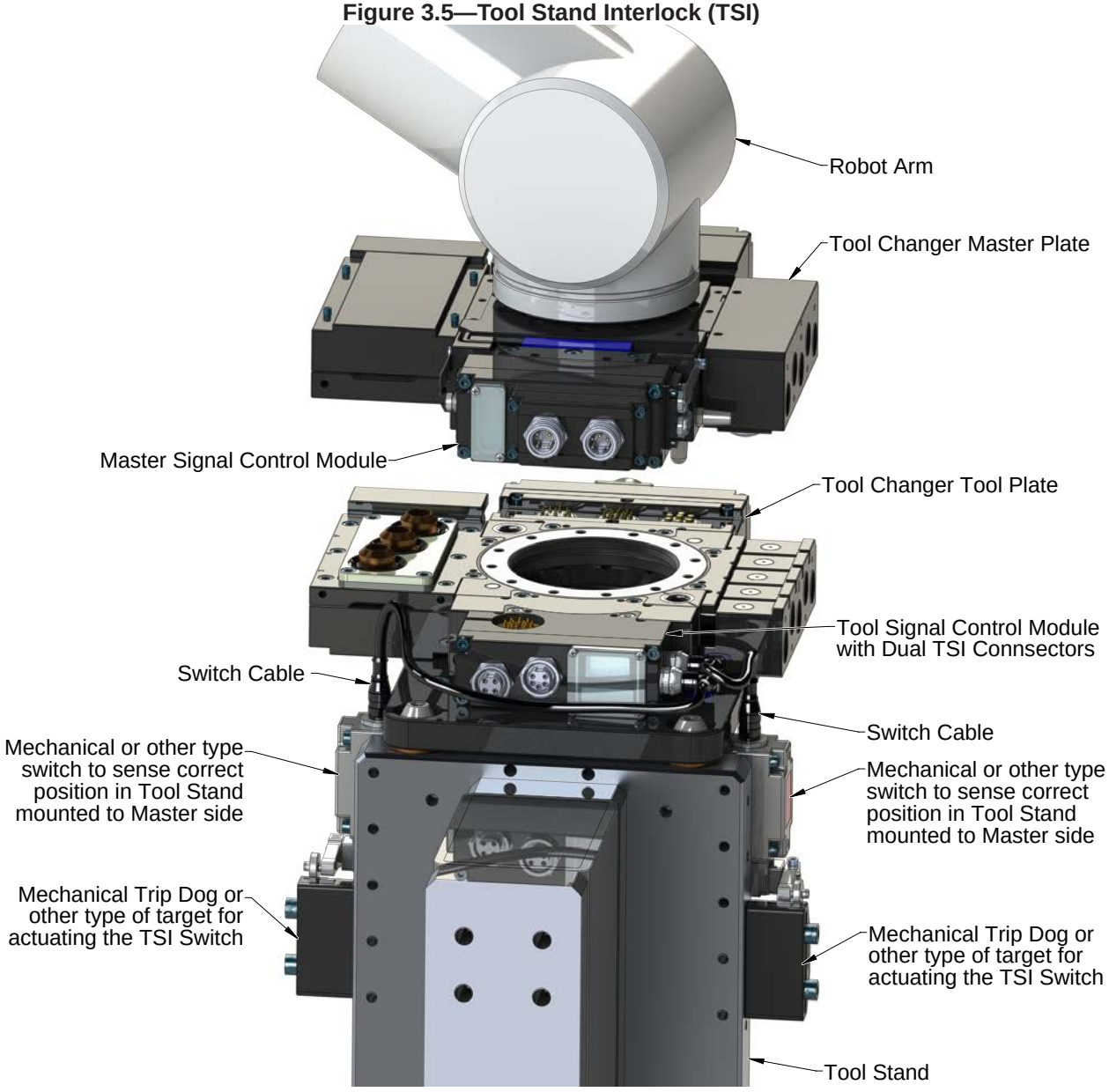
3.4 Tool Side TSI

The DJ8 module is designed with special features to afford the user the opportunity to operate the Tool Changer in the safest manner possible. 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.

3.4.1 TSI Overview

The TSI feature provides a “hard-wired” interrupt of the Unlatch solenoid circuit and is intended to prevent release of the tool except when in the stand or storage location.

Figure 3.5—Tool Stand Interlock (TSI)



The interrupt for the Unlatch solenoid circuit is passed electrically down to the Tool Changer tool where it is wired into the TSI Relay. The second set of TSI Relay contacts sources DeviceNet power and provides the TSRV input for health status monitoring of the TSI Relay.

A double pole, single-throw limit switch (TSI Limit Switch) is integrated on the EOAT such that it is made when the tool is in the stand. One set of the TSI Limit Switch contacts sources DeviceNet power and drives the TSI Relay, thus closing the Unlatch solenoid circuit. The second set of TSI Limit Switch contacts sources DeviceNet power and drives the TSIV input. A firmware condition

in the ATI master module requires that the TSIV input be high in order to process an Unlatch command (reference the truth tables below in the Dual Redundancy Section).

On the Tool Changer master side, a parallel path is required for the Unlatch solenoid circuit so that the Tool Changer can be Unlocked (i.e.; the locking mechanism can be fully retracted) prior to entering and coupling with the tool. This is necessary when there is no tool present because the Unlatch solenoid circuit is routed through the tool and the Tool Changer could not otherwise be Unlocked.

In order to achieve this parallel path, an RTL Relay is integrated into the module and is driven by the RTL sensor. When there is no tool present (therefore the RTL sensor is low) the RTL Relay allows the Unlatch solenoid circuit to be completed and an Unlatch command is processed. When a tool is present (and therefore the RTL sensor is high) the RTL Relay is energized and the Unlatch solenoid circuit is diverted through to the tool side. The second set of RTL relay contacts sources DeviceNet power and provides the RTLV input for health status monitoring of the RTL Relay.

3.4.2 TSI Dual Redundancy

In a single TSI circuit, the RTL sensor, RTL Relay, TSI limit switch and TSI Relay are critical components. Failure of any one of these components may result in an unsafe situation where an Unlatch command could result in Tool Changer release.

In the DJ Series module design, two TSI circuits are implemented in-series electrically to provide redundancy and enhance safety. Critical component mismatch conditions are evaluated internally and faults are communicated in the bitmap. If an unsafe condition occurs, then the Unlatch output is disabled so that an inadvertent tool release is avoided while in this condition.

Refer to *Section 4—Operation* for more details of how the redundant TSI circuit and associated components are being used and reported upon.

3.5 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:

DJ8-M Node EDS file 9030-20-1013

An I/O bitmap for the Master node is provided in the *Table 3.5* and *Table 3.6*. The default setting from the factory for the Master module is Node 54.

Table 3.5—Robot Input From ATI Master, (Node 54)

Byte	Bit#	Name	Description/Function
1	0	Locked	Tool Changer Lock Proximity Sensor Input
	1	Unlocked	Tool Changer Unlock Proximity Sensor Input
	2	DeviceNet Power Good	DeviceNet Power Present Input
	3	Auxiliary Power Available	Auxiliary Power Present Input
	4	RTL1	Ready-to-Lock 1 Proximity Sensor Input
	5	RTL2	Ready-to-Lock 2 Proximity Sensor Input
	6	RTLV1	RTL Relay Verify 1 Input
	7	RTLV2	RTL Relay Verify 2 Input
2	0	TSIV1	TSI Switch Verify 1 Input
	1	TSIV2	TSI Switch Verify 2 Input
	2	TSRV1	TSI Relay Verify 1 Input
	3	TSRV2	TSI Relay Verify 2 Input
	4	Tool Present	Hard-Connect Tool Present Input
	5	Tool Power Is On	Arc Prevention Circuit has activated power on the tool
	6	-	(Reserved)
	7	-	(Reserved)
3	0	RTL mismatch	RTL1 and RTL2 do not match
	1	TSIV mismatch	TSIV1 and TSIV2 do not match
	2	Error on Latch Output	Latch output overloaded
	3	Error on Unlatch Output	Unlatch output overloaded
	4	Error on Spare Output	Spare output overloaded
	5	RTL/RTLV Mismatch	RTL1/RTLV1 or RTL2/RTLV2 Do Not Match
	6	TSIV/TSRV Mismatch	TSIV1/TSRV1 or TSIV2/TSRV2 Do Not Match
	7	Unsafe Unlatch	Unlatch Rejected due to Unsafe Condition Present
4	0	Lock/Unlock Sensor Fault	Lock and Unlock Inputs True at Same Time
	1	Latch Not Completed	LatchProcessIncomplete, Expected Input Not Seen
	2	Unlatch Not Completed	UnlatchProcessIncompleteExpected Input Not Seen
	3	TSIV Fault	TSIV Input Stuck High
	4	RTL Fault	RTL Input Stuck High
	5	COMM Error	Tool ID Communication Timeout
	6	-	(Reserved)
	7	-	(Reserved)

Table 3.5—Robot Input From ATI Master, (Node 54)			
Byte	**Bit#**	**Name**	**Description/Function**
5	0	Tool ID Switch1 Bit1	(rightmost switch) Tool ID Data
	1	Tool ID Switch1 Bit2	Tool ID Data
	2	Tool ID Switch1 Bit4	Tool ID Data
	3	Tool ID Switch1 Bit8	Tool ID Data
	4	Tool ID Switch2 Bit1	Tool ID Data
	5	Tool ID Switch2 Bit2	Tool ID Data
	6	Tool ID Switch2 Bit4	Tool ID Data
	7	Tool ID Switch2 Bit8	Tool ID Data
6	0	Tool ID Switch3 Bit1	Tool ID Data
	1	Tool ID Switch3 Bit2	Tool ID Data
	2	Tool ID Switch3 Bit4	Tool ID Data
	3	Tool ID Switch3 Bit8	Tool ID Data
	4	Tool ID Switch4 Bit1	Tool ID Data
	5	Tool ID Switch4 Bit2	Tool ID Data
	6	Tool ID Switch4 Bit4	Tool ID Data
	7	Tool ID Switch4 Bit8	Tool ID Data
7	0	Tool ID Switch5 Bit1	(leftmost switch) Tool ID Data
	1	Tool ID Switch5 Bit2	
	2	Tool ID Switch5 Bit4	
	3	Tool ID Switch5 Bit8	
	4	Unlatch Enabled	
	5	-	(Reserved)
	6	-	(Reserved)
	7	-	(Reserved)
8	0	-	(Reserved)
	1	-	(Reserved)
	2	-	(Reserved)
	3	-	(Reserved)
	4	-	(Reserved)
	5	-	(Reserved)
	6	-	(Reserved)
	7	-	(Reserved)

Table 3.6—Robot Outputs to ATI Master, (Node 54)			
Byte	**Bit#**	**Name**	**Description/Function**
1	0	Latch (Lock)	Latch Solenoid Valve O/P
	1	Unlatch (Unlock)	Unlatch Solenoid Valve O/P
	2	-	(Reserved)
	3	Clear Errors	Reset errors, allow affected I/O to be reactivated
	4	Unlatch Disabled Mode	Unlatch Output Disabled
	5	Out of Nest	Tool Changer and EOAT are Out of the Nest
	6	-	(Reserved)
	7	-	(Reserved)

4. Operation

A recommended Sequence of Operations is provided in *Section 4.1—Recommended Sequence of Operations*. This procedure is to be used as a general guide when programming a robot or PLC for use with a Tool Changer and DJ control/signal modules. This procedure is intended for "automatic" modes used during normal application processes. Recommendations for operation in "teach" or "manual" modes where the operator has the teach pendant in-hand will be addressed in a separate Troubleshooting Guide.

A thorough understanding of the advanced diagnostic and fault reporting capability is required to proficiently operate this product. Refer to *Section Appendix A—– Error Handling* for helpful information related to troubleshooting a fault condition and how to recover from it. Additional information is provided below in the form of truth tables (*Table 4.1* and *Table 4.2)* to help define the behavior of the DJ8 modules.

Table 4.1—UNLATCH Enable Logic and Truth Table

Inputs				Output	
"Out of Nest" or "Unlatch Disabled" output bit	RTL1	TSIV1	Disable UNLATCH Error Condition (see Table 2 for definition)	UNLATCH Enable	Status of Master Body
0	0	0	0	1	No tool, positioned in free air
0	0	1	0	1	No tool, positioned in Tool Stand (this is a transient state which is only true just prior to RTL being made)
0	1	0	0	0	Tool is present, positioned in free air
0	1	1	0	1	Tool is present, positioned in Tool Stand
0	X	X	1	0	Error condition
1	X	X	X	0	Global UNLATCH Disable condition

Table 4.2—Error Conditions

Error Condition	Report update freeze immediately after UNLATCH command	Disable Unlatch and turn off Unlatch immediately	Reset with
AUX POWER failure	No	No	"Clear Errors" - Bit
LATCH output overload	No	Yes	"Clear Errors" - Bit
UNLATCH output overload	No	Yes	"Clear Errors" - Bit
SPARE output overload	No	No	"Clear Errors" - Bit
UNSAFE UNLATCH COMMAND	Yes	Yes	Cycle UNLATCH output bit or "Clear Errors" - Bit
RTL1 / RTL2 mismatch	Yes	Yes	Cycle UNLATCH output bit or "Clear Errors" - Bit
TSIV1 / TSIV2 mismatch	Yes	Yes	Cycle UNLATCH output bit or "Clear Errors" - Bit
DeviceNet Power Failure	No	Yes	"Clear Errors" - Bit
RTL/RTLV Mismatch	No	Yes	"Clear Errors" – Bit
TSIV/TSRV Mismatch	No	Yes	"Clear Errors" – Bit
Lock/Unlock Sensor Fault	No	No	Correct error
Latch Not Completed	No	No	Cycle LATCH output bit or "Clear Errors" - Bit
Unlatch Not Completed	No	No	Cycle UNLATCH output bit or "Clear Errors" - Bit
TSIV Fault	No	Yes	"Clear Errors" – Bit
RTL Fault	No	Yes	"Clear Errors" - Bit
Comm. Error	No	No	Cycle Tool Changer (unlock and lock again)

4.1 Recommended Sequence of Operations

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 DJ8 control/signal modules. This procedure is intended for "automatic" modes used during normal application processes.

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 may be fully retracted (unlocked condition) or fully extended (missed tool condition, i.e.; **Locked** and **Unlocked** inputs are false). The tool is by itself in the Tool Stand.
   a. The **RTL1** and **RTL2** inputs are false.
   b. **RTLV1** and **RTLV2** are false.
   c. **TSIV1** and **TSIV2** are false.
   d. **TSRV1** and **TSRV2** are false.
   e. The ATI tool and any downstream DeviceNet node(s) are offline.
   f. The **DeviceNet Power Good** and **Auxiliary Power Available** inputs are true and must remain so at all times.
   g. **Tool-ID** invalid (all 1 → 0xFFFF)
2. Unlock the master. (This must be done prior to the master entering the tool to prevent the ball bearings from impinging on the tool bearing race.)
   a. The Latch output command is made false and the **Unlatch** output command is made true.
   b. The **Unlocked** input goes true, indicating that the Tool Changer locking mechanism is fully retracted and the **Unlatch** operation is complete.
3. Robot and Master move into the Tool are parallel and within 0.06" of the Tool (i.e., the module contact pins are touching, the **RTL** sensors have sensed the targets on the Tool).
   a. The **RTL1** and **RTL2** inputs are true, indicating that it is okay to couple the tool.
   b. The **RTLV1** and **RTLV2** are true.
   c. The **Tool Present** and **TSIV1** and **TSIV2** inputs go true, indicating that the master and tool are in close proximity of each other and verifying the operation of the **TSI Limit Switches.**
   d. **TSRV1** and **TSRV2** are true.
   e. Communication is initiated with the ATI tool and downstream nodes. When the **Tool Present** input goes true **Tool-ID** becomes available via DeviceNet communications within 100–150ms.
   f. Shortly thereafter, communications should be established with the downstream DeviceNet nodes.
   g. **Unlatch Enabled** is true.
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, indicating that the coupling operation is complete.
   c. Power becomes available on the Tool and the **Tool Power is ON** bit becomes true.
   d. **Unlatch Enabled** is true.
5. Robot moves away from the Tool Stand with the Tool Changer coupled.
   a. The **TSI Limit Switches** become deactivated, and the **TSIV1**, **TSIV2**, **TSRV1**, and **TSRV2** inputs go false.
   b. The **Out of Nest** output is made true when the tool leaves the stand, disabling the **Unlatch** output. Note: If the **Out of Nest** functionality is not used a single component failure of the limit switch in the "on" position may not be detected.
   c. **Unlatch Enabled** changes to false.

6. Normal operation
   a. The following inputs are true:
      i. **Locked**
      ii. **DeviceNet Power Good**
      iii. **Auxiliary Power Available**
      iv. **RTL1 and RTL2**
      v. **Tool Present**
      vi. **RTLV1** and **RTLV2**
   b. b. The following inputs are false:
      i. **Unlocked**
      ii. **TSIV1** and **TSIV2**
      iii. **TSRV1** and **TSRV2**
      iv. **Unlatch enabled**
   c. The following outputs are true:
      i. **Latch**
   d. The following outputs are false:
      i. **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 Switches** become activated and the **TSIV1, TSIV2**, **TSRV1**, and **TSRV2** inputs go true, indicating that it is safe to uncouple the Tool Changer.
   b. **Unlatch Enabled** becomes true, indicating that it is safe to uncouple the Tool Changer.
8. Uncouple the Tool Changer.
   a. The **Out of Nest** output is made false.
   b. The **Latch** output is made false and the **Unlatch** output is made true.
   c. **Tool Power** is ON becomes false.
   d. Communication is lost with downstream devices.
   e. The **Locked** input goes false a short time later and subsequently the **Unlocked** input goes true, indicating that the uncoupling operation is complete.
   f. **Unlatch Enabled** is true.
9. Robot and master move away from the tool, are parallel at a distance greater than 0.125" Robot and master in free space (>0.15" from the Tool)
   a. The following inputs are true:
      i. **Unlocked**
      ii. **DeviceNet Power Good**
      iii. **Auxiliary Power Available**
      iv. **Unlatch Enabled**
   b. The following inputs are false:
      i. **Locked**
      ii. **RTL1** and **RTL2**
      iii. **RTLV1** and **RTLV2**
      iv. **TSIV1** and **TSIV2**
      v. **TSRV1** and **TSRV2**
      vi. Tool Present
      vii. **Tool-ID** invalid (all 1 → 0xFFFF)

5. Maintenance

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

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

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 verify that unexpected damage has not occurred. Perform the following visual inspection monthly:

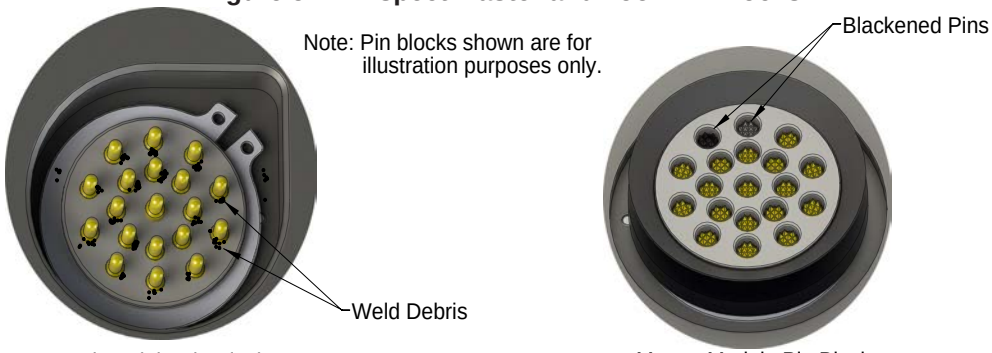
- Inspect mounting fasteners to verify they are tight and if loose, then tighten to the proper torque.
- Cable connections should be inspected during maintenance periods to ensure they are secure. Loose connections should be cleaned and re-tightened as appropriate. Inspect cable sheathing for damage, 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 6.3—Seal Replacement*.

5.1 Pin Block Inspection and Cleaning

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

1. For a Tool Changer, if the Tool Changer is installed place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Inspect the Master and Tool pin blocks for any debris or darkened pins.

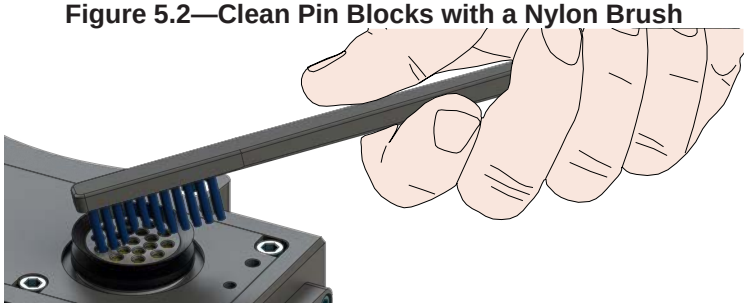
Figure 5.1—Inspect Master and Tool Pin Blocks



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

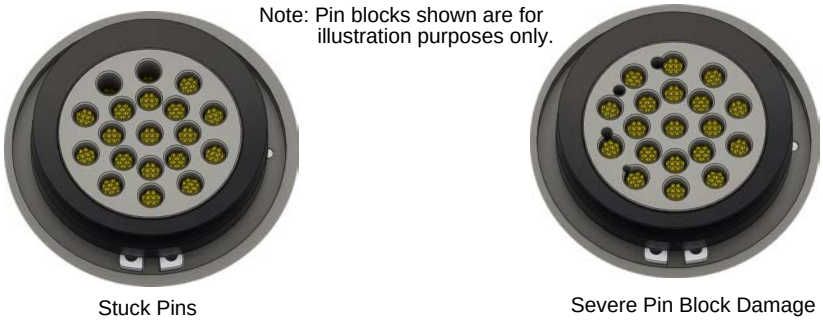
NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause erosion to the contact surface or pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI Part Number 3690-0000064-60)

Figure 5.2—Clean Pin Blocks with a Nylon Brush



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

Figure 5.3—Stuck Pin and Pin Block Damage



6. If stuck pins or severe pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.
7. If repairs are complete, return circuits to normal operation.

6. Troubleshooting and Service Procedures

Refer to the table below for trouble shooting information. Refer to *Appendix A – Error Handling* for helpful information related to troubleshooting a fault condition and how to recover from it.

6.1 Troubleshooting Procedures

Refer to the table below for troubleshooting information.

Table 6.1—SC22 Troubleshooting Procedures

Symptom	Possible Cause	Correction
Unit will not lock or unlock	Verify that ball bearings are moving freely. Clean and lubricate as needed.	Verify that 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.	Check air supply. Refer to the Installation section of the Tool Changer manual for specifications.
	Check that exhaust port is properly vented.	Check that exhaust port is properly vented. *Refer to Pneumatic Connection section of the Base Tool Changer Manual for valve requirements.*
	Incorrect valve operation.	Check valve for proper operation. *Refer to Pneumatic Connection section of the Base Tool Changer Manual for valve requirements.*
	Master and Tool are within the specified No-Touch zone.	Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock. *Refer to the Installation – Tool Stand Design Section of the Tool Change manual for specifications.*
	Conditions for safe unlatch are not meet (Unlatch Enabled inputs is false)	Verify the Unlatch Enabled bit input is false, if so refer to *Table 4.1* and *Appendix A – Error Handling* for possible error conditions.
	Auxiliary Power not available (Auxiliary Power Available inputs is false)	Verify the Auxiliary Power Available inputs is false, if so refer to *Appendix A – Error Handling* for possible error conditions.
Sensors not operating properly	Sensor cables damage or incorrectly connected.	Verify that cables are connected correctly and not damaged, replace if damaged. Refer to the Troubleshooting Section of the Tool Change manual.
	Sensors are set correctly.	Verify that the sensors are set correctly. *Refer to the Troubleshooting Section of the Tool Changer manual.*
	Tool Plate is not secured properly or debris is trapped between surfaces.	Ensure that the Tool Plate is securely held to the Master Plate, that nothing is trapped between their surfaces.
	Air trapped in the Unlock (U) air port.	Ensure that there is no air trapped in the Unlock (U) air port. *Refer to Air and Valve adapter section for pneumatic specification and requirements.*
Loss of DeviceNet Communication	Damaged signal cabling or not tuned properly	Check/Replace signal cabling up- and down-stream of Tool Changer modules.
		Verify DeviceNet network and cabling is properly tuned.
	Worn or damaged contact pins	Inspect module contact pins for debris/wear/damage. refer to *Section 5.1—Pin Block Inspection and Cleaning*
	Product up- and downstream of Tool Changer failed or damaged	Check nodes up- and downstream of Tool Changer for failures. These failures can “masquerade” as Tool Changer node faults.
No Power on the Tool-side	Damaged signal cabling	Verify that the **Latch** output is true. Verify that the **Tool Power** bit is **HIGH**. Verify that the **Tool Present** bit is **HIGH**.
Loss of Aux. Power on the Tool-side	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.	Restore DeviceNet Power to the Master to restore Aux. Power to Tool.

6.2 Service Procedures

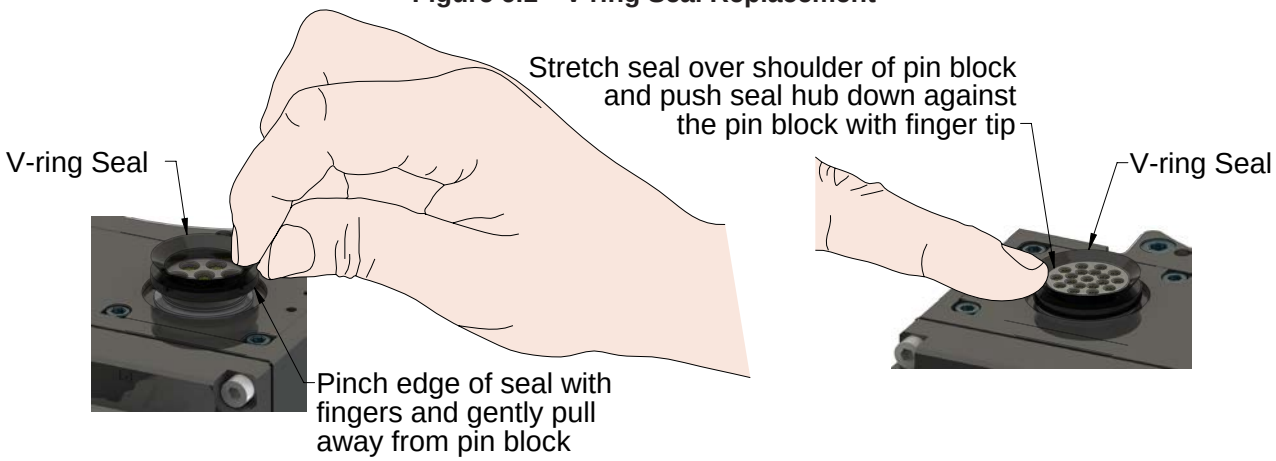
The following service procedures provide instructions for component replacement and adjustment.

6.3 Seal Replacement

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

1. For a Tool Changer, place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. To remove the existing seal, pinch edge of seal with fingers and gently pull the seal away from the pin block on the Master.
4. Pull the seal off the pin block.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal's hub down against the pin block using finger tip.
7. If repairs are complete, return circuits to normal operation.

Figure 6.1—V-ring Seal Replacement



7. Serviceable Parts

Figure 7.1—Master Module

Table 7.1—DJ8 Master Module			
ITEM NO.	**QTY**	**PART NUMBER**	**DESCRIPTION**
1	1	9121-DJ8-M	DJ8 Master Module Assembly
2	1	4010-0000030-01	V-ring Seal
3	2	3500-1066020-15A	M6 x 20mm SHCS Blue Dyed Magni ND Microspheres
4	2	3500-9957012-21	Captive Screw M3 X 12 Slotted Head SS
5	1	3700-20-4820	Window, Master, DJ Module, Anular Seal
6	1	3410-0001201-01	O-Ring

Figure 7.2—Tool Module

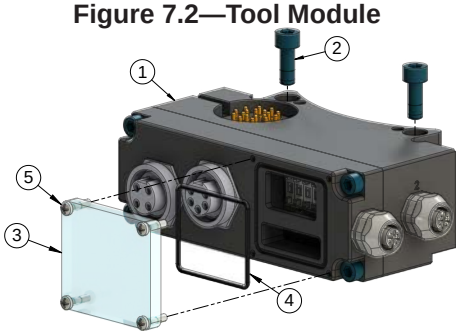


Table 7.2—DJ8 Tool Module			
ITEM NO.	**QTY**	**PART NUMBER**	**DESCRIPTION**
1	1	9121-DJ8-T	DJ8 Tool Module Assembly
2	2	3500-1066016-15A	M6 x 16mm SHCS Blue Dyed Magni ND Microspheres
3	1	3700-20-3058	Insta-Tool Window, Tool
4	1	3410-0001021-01	O-Ring
5	4	3500-9957012-21	Captive Screw M3 X 12 Slotted Head SS

Table 7.3—Accessories			
ITEM NO.	**QTY**	**PART NUMBER**	**DESCRIPTION**
*	*	3690-0000064-60	Brush, Blue Nylon All Purpose (Contact Pin Cleaning)
*	*	9120-DC45-Plug	TSI Teach Plug
*	*	9120-C-4EM-4EF-010	TSI Cable (1 Meter length)
*	*	9120-C-4EM-4EF-020	TSI Cable (2 Meter length)
*	*	9120-C-4EM-4EF-040	TSI Cable (4 Meter length)
*	*	9120-5MM-TR	DeviceNet Termination Resistor for Female Mini Receptacle
*	*	3690-0000049-00	Closure Cap for Female Mini Receptacles

8. Specifications

Table 8.1—DJ8 DeviceNet Master Module	
Factory Default Configuration	MAC ID 54, Baud Rate 500 Kbps. The DJ8 modules conform to the DeviceNet Specification Volume 3, Edition 1.2 (Reference Conformance Case #10423).
Interface Connectors	Auxiliary Power: Mini, 4-Pin Male supporting two Auxiliary Power Circuits 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.
Electrical Rating	Power Pass-Thru: • Aux1 V+ and Aux2 V+ Power: 5A, 12-30 VDC Note: Arc prevention is applied to Aux1 V+ and Aux2 V+ power. • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC Note: Arc prevention is applied to CANV+ power.
	Signal Pass-Thru: 3 Amp, 30VDC maximum.
	Tool Changer Control: • Lock, Unlock, and Ready-to-Lock sensors: 10-30 VDC operational voltage Note: CAN V+ Power provides power to the L, U, and RTL sensors. • Latch/Unlatch integrated solenoid valve: 19-29 VDC operational voltage Note: Aux1 V+ Power provides power to the Latch/Unlatch solenoid valve.
Current Draw[1]	220mA @ 24VDC, 250 mA @ 15 VDC: Master and Tool (Locked, RTL1, and RTL2 sensors “on”, Limit Switches/ TSI Circuits made, i.e.; TSIV1, TSIV2, TSRV1, and TSRV2 “on”)[2]
Weight	2.10 lbs (0.95 kg)

Notes:

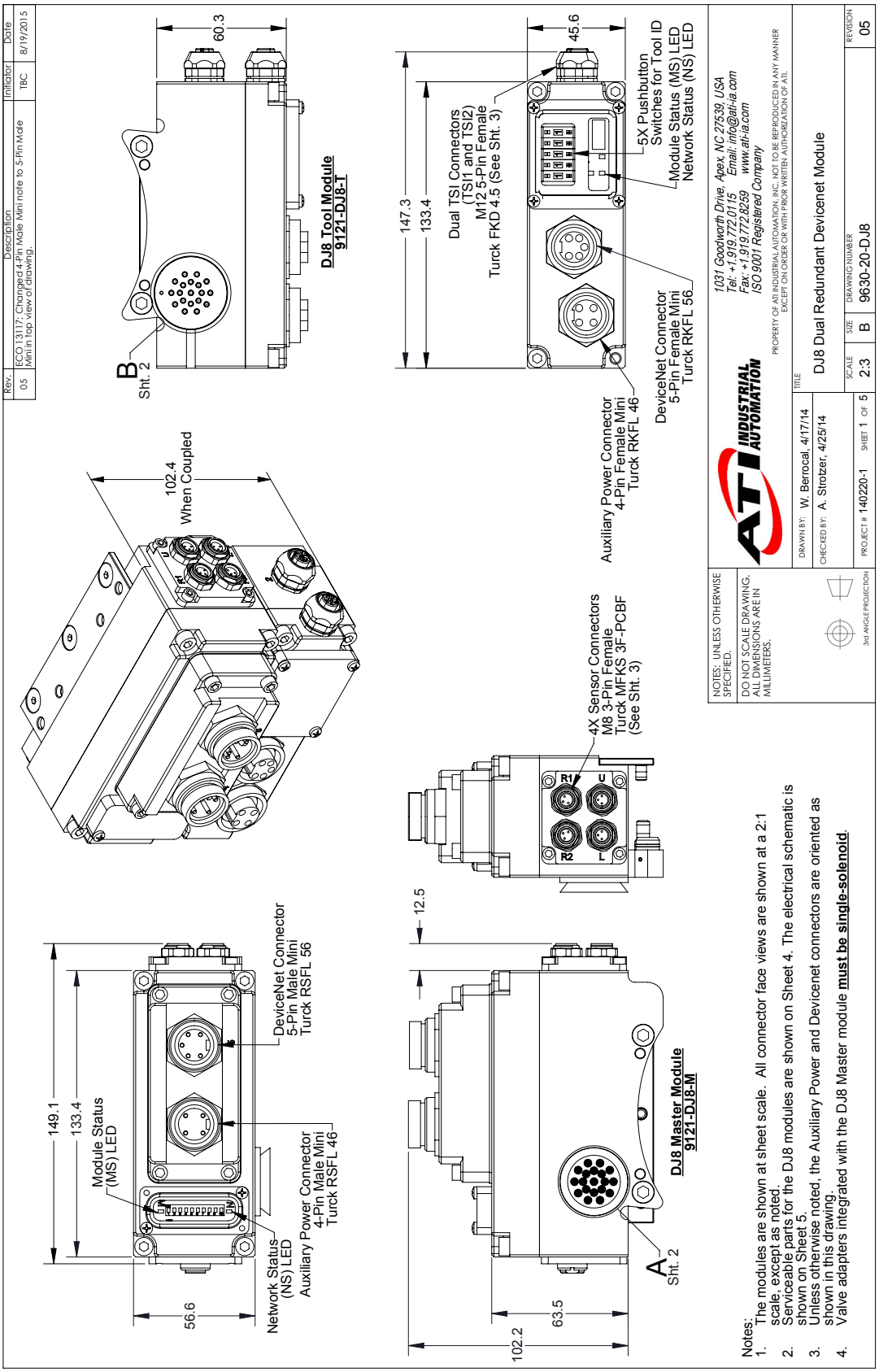
1. Current Draw totals for DeviceNet-powered circuits, not including downstream I/O devices and Auxiliary powered valves. Please refer to the module manufacturer for these specifications.
2. Does not include solenoid, which uses Auxiliary Power

Table 8.2—DJ8 DeviceNet Tool Module	
Factory Default Configuration	(5) Independent Tool-ID switches, each reading a (0–9) position (all factory set to Tool Position 1)
Interface Connectors	Auxiliary Power: Mini, 4-Pin Female DeviceNet: Mini, 5-Pin Female TSI connectors: 2X M12, 4-Pin, Female
Electrical Rating	Power Pass-Thru: • Aux1 V+ and Aux2 V+ Power: 5A, 12-30 VDC • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC
	Signal Pass-Thru: 3 Amp, 30VDC maximum.
Current Draw[1]	220mA @ 24VDC, 250 mA @ 15 VDC: Master and Tool (Locked, RTL1, and RTL2 sensors “on”, Limit Switches/ TSI Circuits made, i.e.; TSIV1, TSIV2, TSRV1, and TSRV2 “on”)
Weight	1.4 lbs (0.64 kg)

Notes:

1. 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


Rev.
Description
Initiator
Date
05
ECO 13117: Changed 4-Pin Male Mini note to 5-Pin Male Mini in top view of drawing.
TBC
8/19/2015
60.3
B
Sht. 2
DJ8 Tool Module
9121-DJ8-T
45.6
147.3
133.4
Dual TSI Connectors
(TSI1 and TSI2)
M12 5-Pin Female
Turck FKD 4.5 (See Sht. 3)
5X Pushbutton
Switches for Tool ID
Module Status (MS) LED
Network Status (NS) LED
Auxiliary Power Connector
4-Pin Female Mini
Turck RKFL 46
DeviceNet Connector
5-Pin Female Mini
Turck RKFL 56
102.4
When Coupled
4X Sensor Connectors
M8 3-Pin Female
Turck MFKS 3F-PCBF
(See Sht. 3)
R1
U
R2
L
12.5
149.1
133.4
Module Status
(MS) LED
DeviceNet Connector
5-Pin Male Mini
Turck RSFL 56
Auxiliary Power Connector
4-Pin Male Mini
Turck RSFL 46
Network Status
(NS) LED
56.6
A
Sht. 2
DJ8 Master Module
9121-DJ8-M
63.5
102.2
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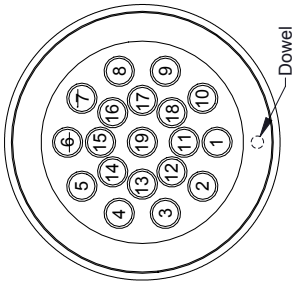
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: W. Berrocal, 4/17/14
CHECKED BY: A. Strotzer, 4/25/14
PROJECT # 140220-1
SHEET 1 OF 5
3rd ANGLE PROJECTION
TITLE
DJ8 Dual Redundant Devicenet Module
SCALE 2:3
SIZE B
DRAWING NUMBER 9630-20-DJ8
REVISION 05
Notes:
1. The modules are shown at sheet scale. All connector face views are shown at a 2:1 scale, except as noted.
2. Serviceable parts for the DJ8 modules are shown on Sheet 4. The electrical schematic is shown on Sheet 5.
3. Unless otherwise noted, the Auxiliary Power and Devicenet connectors are oriented as shown in this drawing.
4. Valve adapters integrated with the DJ8 Master module must be single-solenoid.

Rev.	Description	Initiator	Date
-	See Sheet1	-	-

Table 1: Pin Designations	
1	AUX2 V+_AP
2	AUX1 V+_AP
3	CAN V+_AP
4	Drain
5	TSI IN
6	CAN V-
7	AUX1 V-
8	TSI OUT
9	DRx
10	CAN V+ (TSI)
11	TSRV2
12	TSIV1
13	TSRV1
14	CAN_L
15	CAN_H
16	AUX2 V-
17	DTx
18	TSIV2
19	Tool Presence



Master Pin Block (See Table 1) DETAIL A

Tool Pin Block (See Table 1) DETAIL B

NOTES: UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

3rd ANGLE PROJECTION

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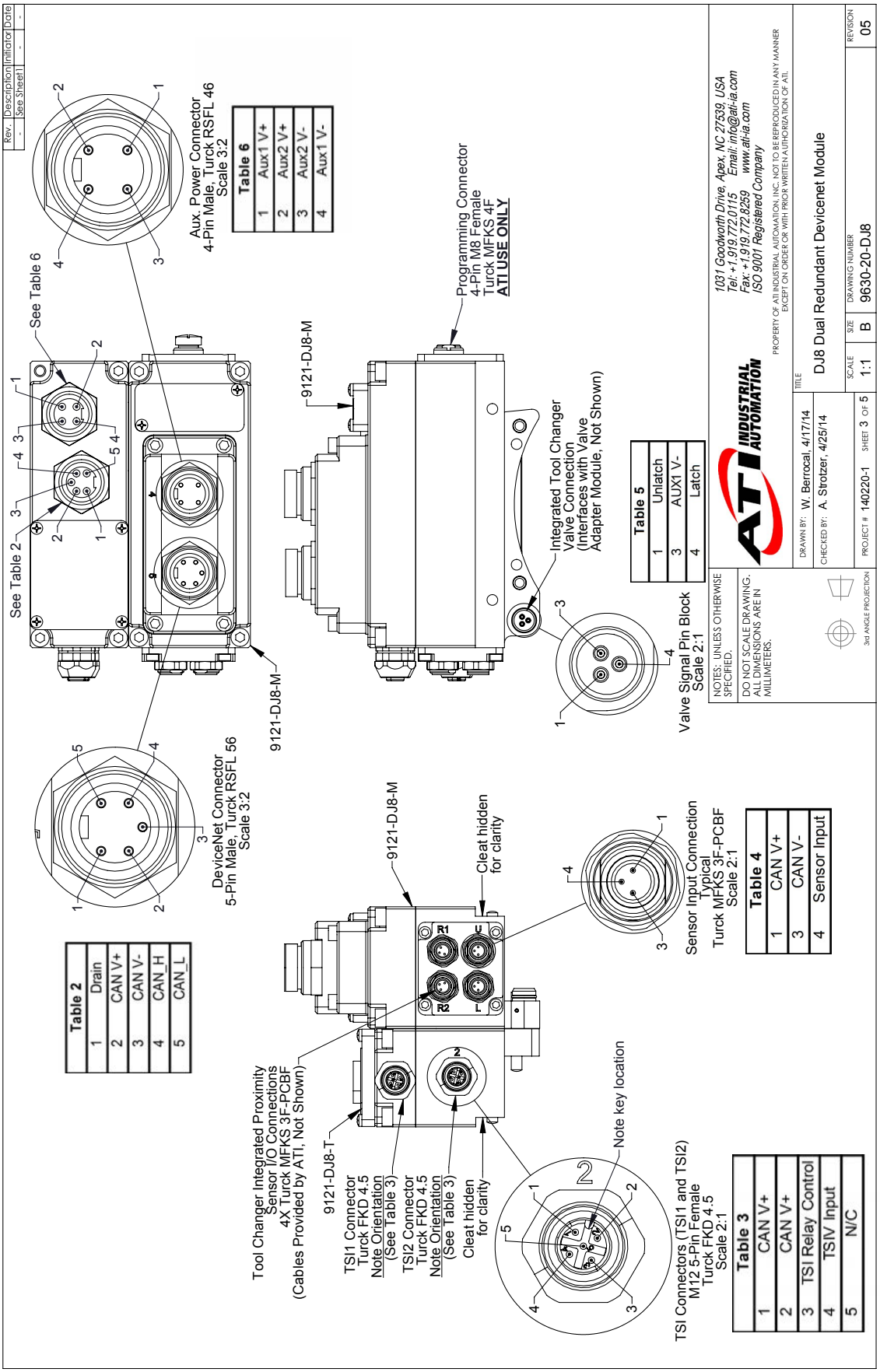
ISO 9001 Registered Company

DRAWN BY: W. Berrocal, 4/17/14
CHECKED BY: A. Stroltzer, 4/25/14

TITLE: DJ8 Dual Redundant Devicenet Module

PROJECT # 140220-1 SHEET 2 OF 5

SCALE 2:3 SIZE B DRAWING NUMBER 9630-20-DJ8 REVISION 05


Rev. | Description | Initiator | Date
- | See Sheet1 | - | -
Aux. Power Connector
4-Pin Male, Turck RSFL 46
Scale 3:2
Table 6
1 Aux1 V+
2 Aux2 V+
3 Aux2 V-
4 Aux1 V-
See Table 6
See Table 2
9121-DJ8-M
Programming Connector
4-Pin M8 Female
Turck MFKS 4F
ATI USE ONLY
Integrated Tool Changer
Valve Connection
(Interfaces with Valve
Adapter Module, Not Shown)
Table 5
1 Unlatch
3 AUX1 V-
4 Latch
Valve Signal Pin Block
Scale 2:1
DeviceNet Connector
5-Pin Male, Turck RSFL 56
Scale 3:2
Table 2
1 Drain
2 CAN V+
3 CAN V-
4 CAN_H
5 CAN_L
Tool Changer Integrated Proximity
Sensor I/O Connections
4X Turck MFKS 3F-PCBF
(Cables Provided by ATI, Not Shown)
9121-DJ8-T
TSI1 Connector
Turck FKD 4.5
Note Orientation
(See Table 3)
TSI2 Connector
Turck FKD 4.5
Note Orientation
(See Table 3)
Cleat hidden
for clarity
Note key location
TSI Connectors (TSI1 and TSI2)
M12 5-Pin Female
Turck FKD 4.5
Scale 2:1
Table 3
1 CAN V+
2 CAN V+
3 TSI Relay Control
4 TSIV Input
5 N/C
Sensor Input Connection
Typical
Turck MFKS 3F-PCBF
Scale 2:1
Table 4
1 CAN V+
3 CAN V-
4 Sensor Input
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
DRAWN BY: W. Berrocal, 4/17/14
CHECKED BY: A. Strotzer, 4/25/14
PROJECT # 140220-1 SHEET 3 OF 5
TITLE
DJ8 Dual Redundant Devicenet Module
SCALE 1:1
SIZE B
DRAWING NUMBER 9630-20-DJ8
REVISION 05
1031 Goodworth Drive, Apex, NC 27539, USA
Tel: +1.919.772.0115 Email: info@ati-ia.com
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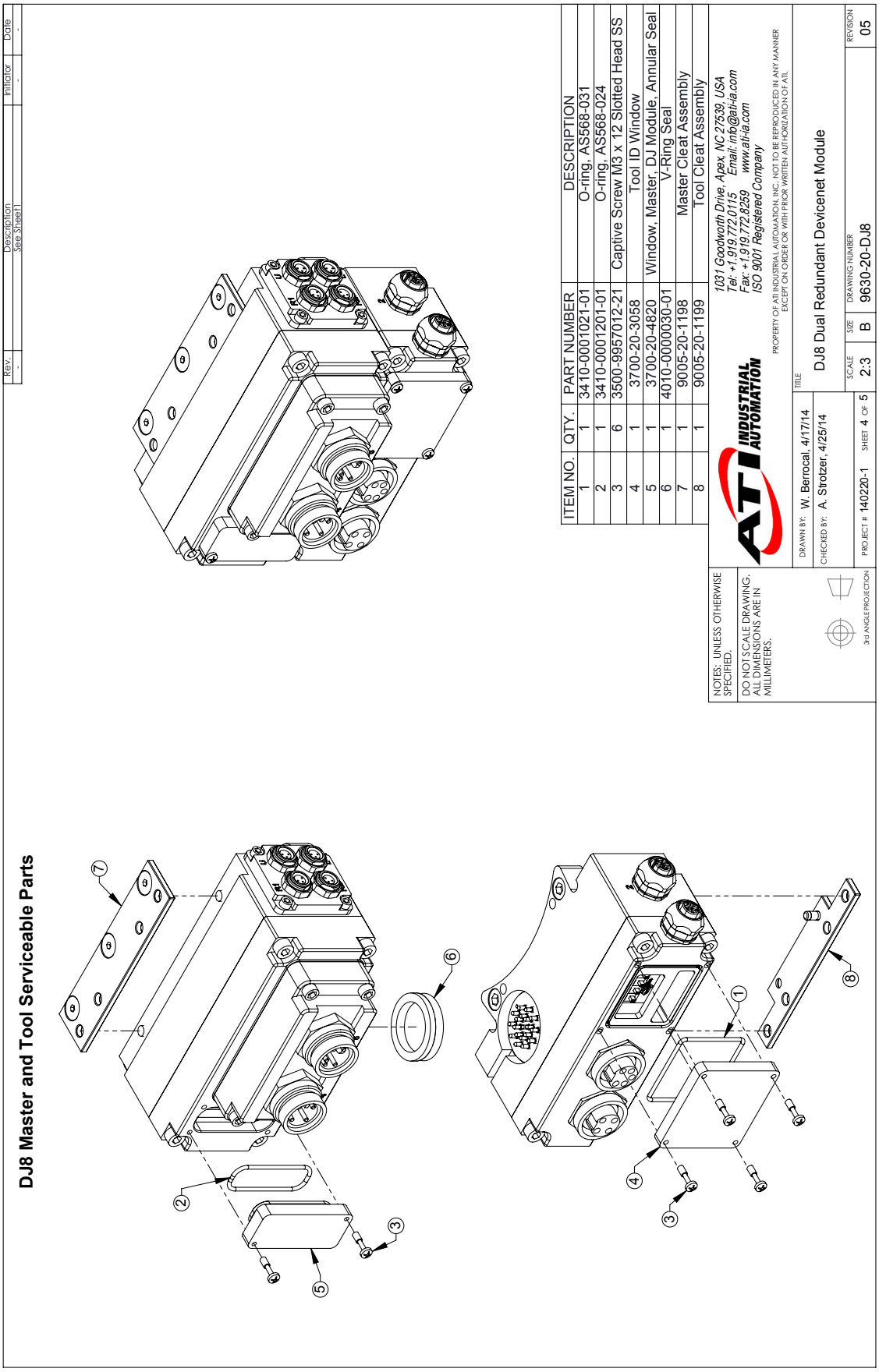
Rev.
Description
Initiator
Date
-
See Sheet1
-
-
DJ8 Master and Tool Serviceable Parts
ITEM NO. | QTY. | PART NUMBER | DESCRIPTION
1 | 1 | 3410-0001021-01 | O-ring, AS568-031
2 | 1 | 3410-0001201-01 | O-ring, AS568-024
3 | 6 | 3500-9957012-21 | Captive Screw M3 x 12 Slotted Head SS
4 | 1 | 3700-20-3058 | Tool ID Window
5 | 1 | 3700-20-4820 | Window, Master, DJ Module, Annular Seal
6 | 1 | 4010-0000030-01 | V-Ring Seal
7 | 1 | 9005-20-1198 | Master Cleat Assembly
8 | 1 | 9005-20-1199 | Tool Cleat Assembly
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
DRAWN BY: W. Berrocal, 4/17/14
CHECKED BY: A. Strotzer, 4/25/14
PROJECT # 140220-1
SHEET 4 OF 5
TITLE
DJ8 Dual Redundant Devicenet Module
SCALE 2:3
SIZE B
DRAWING NUMBER 9630-20-DJ8
REVISION 05
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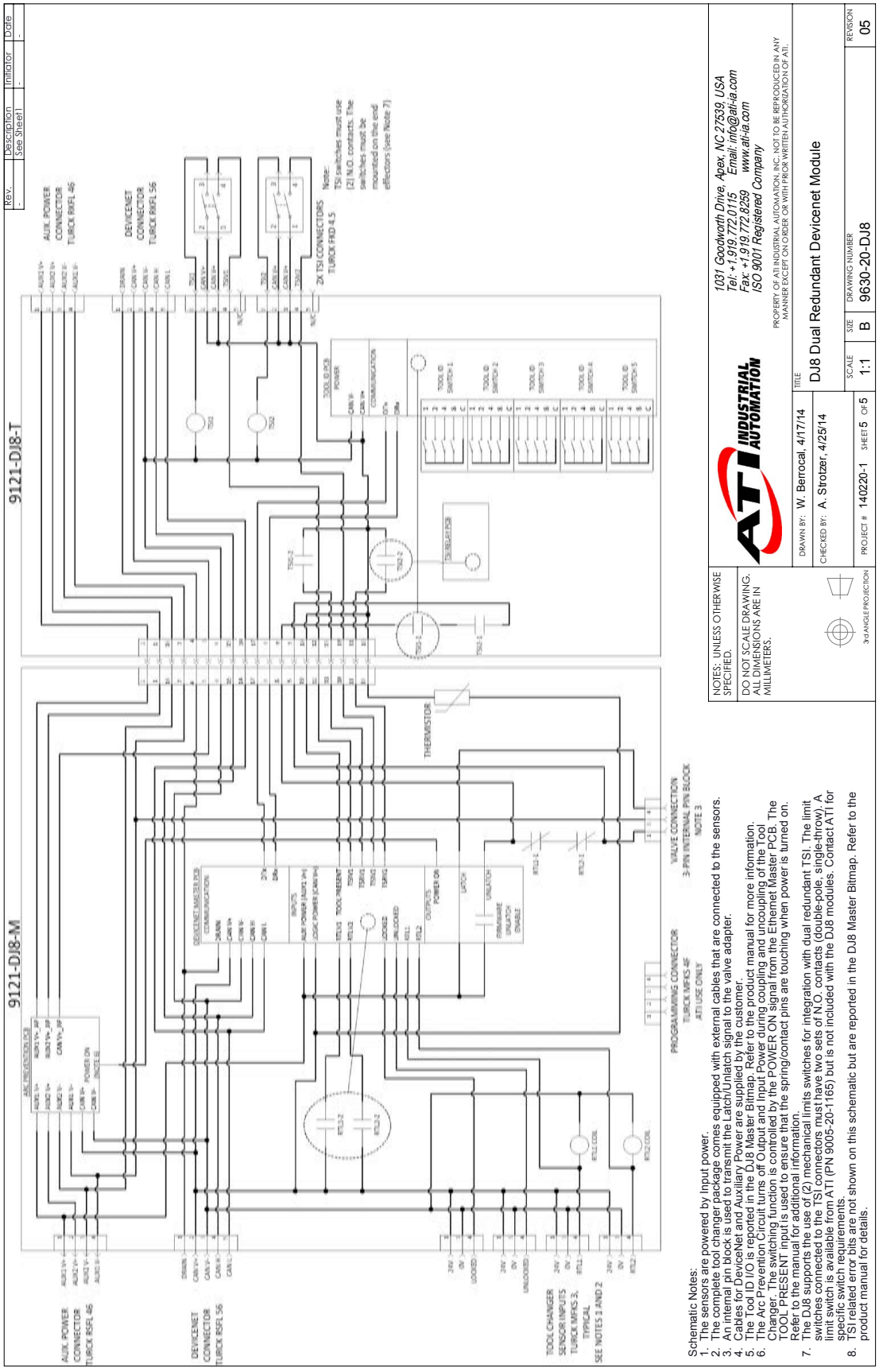
9121-DJ8-T
9121-DJ8-M
AUX. POWER CONNECTOR TURCK RSFL 46
DEVICENET CONNECTOR TURCK RSFL 56
2X TSI CONNECTORS TURCK FKD 4.5
Note: TSI switches must use (2) N.O. contacts. The switches must be mounted on the end effectors (see Note 7)
TOOL CHANGER SENSOR INPUTS TURCK MPKS 3, TYPICAL SEE NOTES 3 AND 2
PROGRAMMING CONNECTOR TURCK MPKS 4F ATI USE ONLY
VALVE CONNECTION 3-PIN INTERNAL PIN BLOCK NOTE 3
THERMISTOR
TOOL ID SWITCH 1
TOOL ID SWITCH 2
TOOL ID SWITCH 3
TOOL ID SWITCH 4
TOOL ID SWITCH 5
Rev. | Description | Initiator | Date
- | See Sheet1 | - | -
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INDUSTRIAL AUTOMATION
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DRAWN BY: W. Berrocal, 4/17/14
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DJ8 Dual Redundant Devicenet Module
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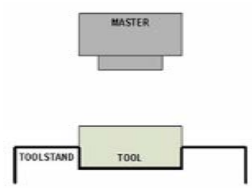
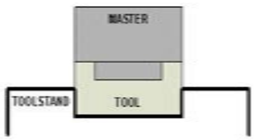
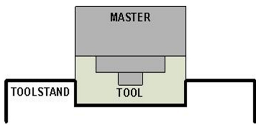
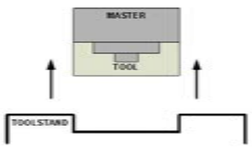
SIZE B
DRAWING NUMBER 9630-20-DJ8
REVISION 05
PROJECT # 140220-1 SHEET 5 OF 5
Schematic Notes:
1. The sensors are powered by Input power.
2. The complete tool changer package comes equipped with external cables that are connected to the sensors.
3. An internal pin block is used to transmit the Latch/Unlatch signal to the valve adapter.
4. Cables for DeviceNet and Auxiliary Power are supplied by the customer.
5. The Tool ID I/O is reported in the DJ8 Master Bitmap. Refer to the product manual for more information.
6. The Arc Prevention Circuit turns off Output and Input Power during coupling and uncoupling of the Tool Changer. The switching function is controlled by the POWER ON signal from the Ethernet Master PCB. The TOOL PRESENT input is used to ensure that the spring/contact pins are touching when power is turned on. Refer to the manual for additional information.
7. The DJ8 supports the use of (2) mechanical limits switches for integration with dual redundant TSI. The limit switches connected to the TSI connectors must have two sets of N.O. contacts (double-pole, single-throw). A limit switch is available from ATI (PN 9005-20-1165) but is not included with the DJ8 modules. Contact ATI for specific switch requirements.
8. TSI related error bits are not shown on this schematic but are reported in the DJ8 Master Bitmap. Refer to the product manual for details.

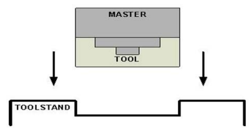
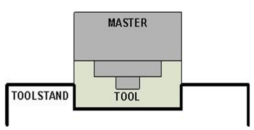
Appendix A – Error Handling

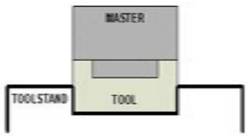
Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
ANY POSITION (Continuous Monitoring Required)	AUX Power Available = high	low	see robot positions		no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors"
 **0** Robot arm in free air without tool at pounce position before picking up new tool Outputs: **UNLATCH = high** **LATCH = low** **OUT OF NEST = low**	AUX Power Available = high	low	yes	Unlatch not completed	no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle UNLATCH output bit to clear "Unlatch not completed" error, Cycle "Clear Errors" bit
	LOCK = low	high	yes	Lock/Unlock sensor fault	Lock sensor is on, should be off	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/tool pin blocks, check Lock sensor adjustment and cable connections	Cycle UNLATCH output bit to clear "Unlatch not completed" error
	UNLOCK = high	low	yes	Lock/Unlock sensor fault	TC Master not unlocked: Unlock sensor is off, should be on	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/tool pin blocks, check Unlock sensor adjustment and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	Tool Presence = low	high	yes		Tool Presence signal is high, should be low	check master pin block for debris, replace master module	
	Error on Unlatch output = low	high	yes	Unlatch not completed	Short circuit or overload on Unlatch solenoid output	check valve cable, check master pin block for debris, replace master module	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	RTL/RTLV mismatch = low	high	yes	Unlatch not completed	DeviceNet power low or error on Master module	Check DeviceNet Power, replace master module	Cycle "Clear Errors" output bit
	TSIV/TSRV mismatch = low	high	yes	Unlatch not completed	TSI limit signals fault: TSIV/TSRV mismatch	check pin block on master module for debris	Cycle "Clear Errors" output bit
	Lock/Unlock sensor fault = low	high	yes		Lock sensor fault	check Lock and Unlock sensor adjustment and cable connections	
	Unlatch not completed = low	high	yes	all errors that disable Unlatch:	Tool changer is not unlocked	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/tool pin blocks, check, Unlock sensor adjustment and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	RTL fault = low	high	yes	Unlatch not completed	Error on RTL sensor (one of the RTL sensors is high but should be low)	check RTL sensor and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error

Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
 **1a** **TC master is moved into tool, pin blocks are connected, RTL sensors are in range, Robot is ready to pick up tool.** **Outputs:** **UNLATCH = high** **LATCH = low** **OUT OF NEST = low**	AUX Power Available = high	low	no	Unlatch not completed	no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle UNLATCH output bit to clear "Unlatch not completed" error; Cycle "Clear Errors" bit
	RTL1, RTL2 =high	one or both low	yes		tool not positioned properly: RTLx input is low but should be high	check tool positioning, check RTL sensors and wiring	
	TSIV1, TSIV2 = high	one or both low	yes		TSI limit switch fault: TSIV is low but should be high	check limit switches and cables, check tool positioning	
	Tool Presence = high	low	yes	RTL fault, tool ID FFFF, Unlatch not completed	Tool is not positioned properly or not present	check tool positioning, manually override UNLOCK solenoid to check master/tool pin block	Cycle "Clear Errors" bit for RTL fault and "Unlatch not completed" error;
	Lock/Unlock Sensor Fault = low	high	yes		Lock sensor is on, should be off	check Lock and Unlock sensor adjustment and cable connections	
	Comm Error = low	high	no	tool ID FFFF	Communication error between Master and Tool module	check tool module status LEDs, check master and tool pin blocks	
	Error on Unlatch output = low	high	yes	Unlatch not completed	Short circuit or overload on Unlatch solenoid output	check valve cable, check valve module, check master pin block for debris, replace master module	Cycle "Clear Errors" output bit
	RTL/RTLV mismatch = low	high	yes	Unlatch not completed	DeviceNet power low or error on Master module	Check DeviceNet Power, replace master module	Cycle "Clear Errors" output bit
	TSIV/TSRV mismatch = low	high	yes	Unlatch not completed	TSI limit switch fault: TSIV/TSRV mismatch	check limit switches and cables, check master/tool pin blocks	Cycle "Clear Errors" output bit
	Unlatch not completed = low	high	yes		TC Master not unlocked: Unlock sensor is off, should be on	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/tool pin blocks	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error

Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
 **1b** Robot has issued Latch command but robot arm has not moved yet. Outputs: **UNLATCH = low** **LATCH = high** **OUT OF NEST = low**	AUX Power Available = high	low	no	Unlatch not completed	no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors" bit
	UNLOCK = low	high	yes	Lock/Unlock sensor fault	tool is not locked	check valve operation and cabling, check Unlock sensor adjustment and cable connections	
	LOCK = high	low	yes	"Latch not completed error" after 3 seconds	tool is not locked	check air supply, check valve operation and cabling, check, Lock sensor adjustment and cable connections, check for mechanical binding of locking mechanism, check for debris on tool changer interface	
	Lock/Unlock Sensor Fault = low	high	yes		Unlock sensor fault	check Lock and Unlock sensor adjustment and cable connections	

Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
 **2a** **Robot arm in free air with tool at pounce position. Ready to use tool** **Outputs: UNLATCH = low LATCH = high OUT OF NEST = high**	AUX Power Available = high	low	yes		no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors" bit
	RTL1, RTL2 =high	one or both low	yes		RTLx is low but should be high	check RTL sensors and cables, check air supply, check for gapping	
	UNLOCK = low	high	yes	Lock/Unlock sensor fault	Unlock sensor error: Unlock is high but should be low	check Lock/Unlock sensor adjustment and cable connections	
	LOCK = high	low	yes		tool is not completely locked: Lock sensor is low but should be high	check air supply, check for gapping, check Lock/Unlock sensor adjustment and cable, check piston for binding	
	TSIV1, TSV2 = low	one or both high	yes	TSIV fault	TSI limit switch fault	check limit switches and cables, check pin blocks	
	Tool Presence = high	low	no	tool ID FFFF, RTL fault	Tool Presence is low but should be high.	check master/tool pin block	
	RTL/RTLV mismatch = low	high		no, wait until tool is returned to tool stand, unlatch will be disabled	DeviceNet power low or error on Master module	Check DeviceNet Power, Cycle Clear Errors bit; if this does not help then unplug RTL sensors and cycle power (or manually override solenoid), then replace master module	Cycle "Clear Errors" bit
	TSIV/TSRV mismatch = low	high	yes		TSIV/TSRV mismatch error	check limit switches and cables, check pin blocks	Cycle "Clear Errors" bit
	Lock/Unlock Sensor Fault = low	high	yes		Unlock sensor error: Unlock is high but should be low	check Unlock sensor adjustment and cable connections	
	TSIV fault = low	high	yes		TSI limit switch fault: TSIVx is stuck high	check limit switches and cables, check pin blocks	Cycle "Clear Errors" bit

Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
 2b Robot arm in free air with tool at pounce position. Robot is ready to place tool back into tool stand Outputs: UNLATCH = low LATCH = high OUT OF NEST = low	AUX Power Available = high	low	yes		no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors" bit
	RTL1, RTL2 =high	one or both low	yes		RTLx is low but should be high	check RTL sensors and cables, check air supply, check for gapping	
 3a Robot is ready to release tool Outputs: UNLATCH = low LATCH = high OUT OF NEST = low	AUX Power Available = high	low	yes		no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors" bit
	TSIV1, TSV2 = high	one or both low	yes	TSIV1/TSIV2 mismatch if only one low	Tool is not properly positioned in tool stand: TSIVx is low but should be high	check tool positioning, check limit switches and cables, check pin blocks	
	RTL/RTLV mismatch = low	high	yes		DeviceNet power low or error on Master module	Check DeviceNet Power, Cycle Clear Errors bit; if this does not help then unplug RTL sensors and cycle power (or manually override solenoid), then replace master module	Cycle "Clear Errors" bit
	TSIV/TSRV mismatch = low	high	yes		TSIV/TSRV mismatch error	check limit switches and cables, check pin blocks	Cycle "Clear Errors" bit

Robot Position/Tool Changer Mode	Signals To Monitor	Potential Error Condition	Inhibit Robot Move-ment	Other Errors	Suggested Error Message	How To Recover	Reset With;
 3b Robot has unlatched the tool but robot arm has not moved yet Outputs: UNLATCH = high LATCH = low OUT OF NEST = low	AUX Power Available = high	low	yes	Unlatch not completed	warning: tool may not be completely unlocked: no or unstable AUX power	apply AUX power (min. 21.6V), make sure that AUX power does not drop below 21.6V at any time	Cycle "Clear Errors" bit
	UNLOCK = high	low	yes	Unlatch not completed	Warning: tool is not completely unlocked: Unlock is low but should be high	check air supply, check valve, check piston for binding, check Unlock sensor adjustment and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	LOCK = low	high	yes	Lock/Unlock sensor fault	Warning: tool is not completely unlocked: Lock sensor is high but should be low	check air supply, check valve, check piston for binding, check Unlock sensor adjustment and cable connections	
	Tool Presence = high	low	yes	RTL Fault, Tool ID FFFF, Unlatch Not Completed	Warning: if process is continued, tool could be drug from stand. Tool Presence is low but should be high	Manually override UNLOCK solenoid to check master/tool pin block	Cycle "Clear Errors" bit for RTL Fault and "Unlatch Not Completed" error
	Unsafe Unlatch Command received = low	high	yes	Lock/Unlock sensor fault, TSIV1/TSIV2 mismatch or RTL1/RTL2 mismatch	warning: unsafe to unlatch - tool is not unlocked	check other error bits (TSIV1/TSIV2 mismatch, RTL1/RTL2 mismatch), make sure that all RTL and TSIV signals are high	correct error, cycle "Clear Errors" bit then cycle UNLATCH output bit
	TSIV1/ TSIV2 mismatch = low	high	yes	Unlatch not completed, Unsafe Unlatch Command received	TSI limit switch fault: TSIVx is low but should be high	check tool positioning, check limit switches and cables	correct error, cycle "Clear Errors" bit then cycle UNLATCH output bit
	RTL1/RTL2 mismatch = low	high	yes	Unlatch not completed, Unsafe Unlatch Command received	RTL sensor fault: RTLx is low but should be high	check RTL sensors and cables, check air supply, check for gapping, check piston for binding	correct error, cycle "Clear Errors" bit then cycle UNLATCH output bit
	Unlatch not completed = low	high	yes	other errors that disable Unlatch	TC Master not unlocked: Unlock sensor is off, should be on	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/tool pin blocks	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	Lock/Unlock Sensor Fault = low	high	yes			check valve operation and cabling, check master/tool pin blocks, check Unlock sensor adjustment and cable connections	
	Error on Unlatch output = low	high	yes	Unlatch not completed	Short circuit or overload on Unlatch solenoid output	check valve cable, check valve module, check master pin block for debris, replace master module	Cycle "Clear Errors" output bit

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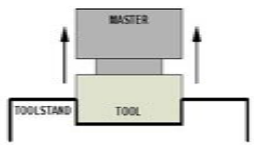 transition from 3b - 0	RTL fault = low while tool is being removed from tool stand	high	yes - tool could not be unlock-ed properly	RTL1 or RTL2 could be low	RTL sensor fault (stuck high), warning: tool may not be completely unlocked	check RTL sensor and cable connections, check for gapping, check for parallel positioning	
	LOCK = low	high	yes	Lock/Unlock sensor fault	Lock sensor is on, should be off	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/ tool pin blocks, check Lock sensor adjustment and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error
	UNLOCK = high	low	yes	Lock/Unlock sensor fault	TC Master not unlocked: Unlock sensor is off, should be on	check valve operation and cabling, possible overload (check "Error on Unlatch Output" bit), check master/ tool pin blocks, check Unlock sensor adjustment and cable connections	Cycle UNLATCH output bit or Cycle "Clear Errors" bit to clear "Unlatch not completed" error