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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).
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.
Tool Present	A hard-connect input (sourced from the tool) indicating the Master and tool are electrically connected to each other.
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

DU2—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.

The DU2-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.

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 *Figure 1.1*).

1.1 DU2 Master

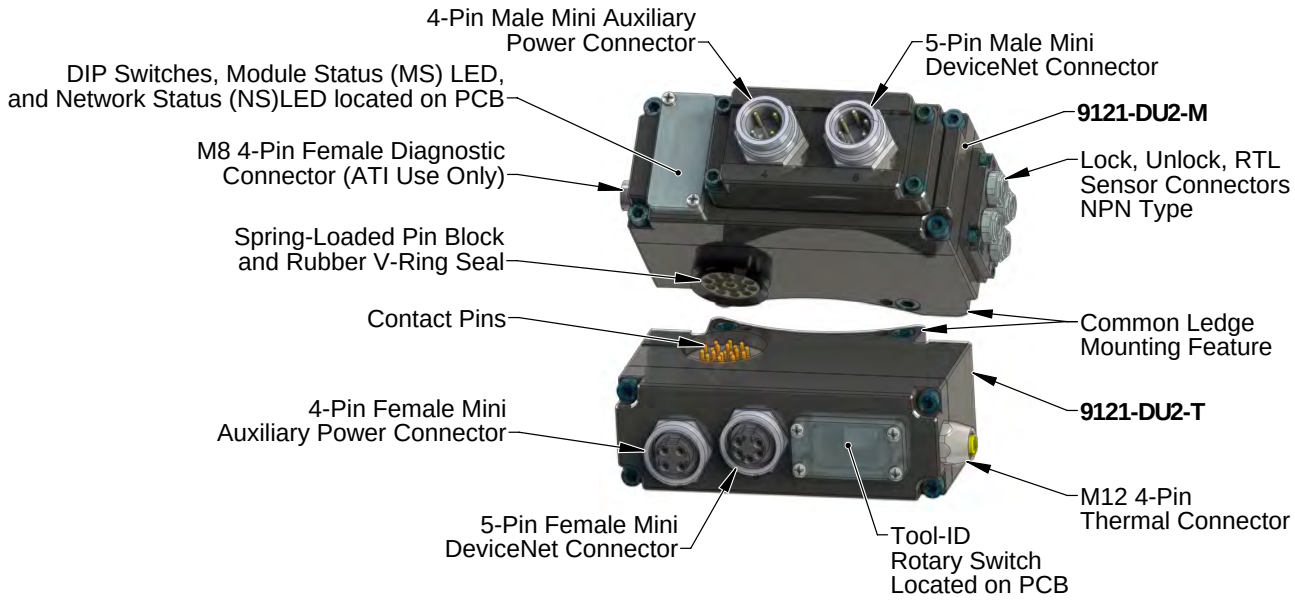
The DU2 modules are designed with NPN Tool Changer input signals (Locked, Unlocked, and Ready-to-Lock proximity sensors). The Ready-to-Lock (RTL1 and RTL2) sensors are connected in series. Refer to *Section 3—Product Information* and *Section 4—Operation* for more information on these attributes. The Master module has an M8 4-Pin female diagnostic connector for ATI use only.

The DU2-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.

1.2 DU2 Tool

The Tool module employs a rotary switch 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. *Section 3.4—Software* for DeviceNet bitmap and detailed I/O information. A M12 4-Pin female connector supports Thermal 1 and Thermal 2 discrete NPN inputs.

Figure 1.1—DU2 Modules



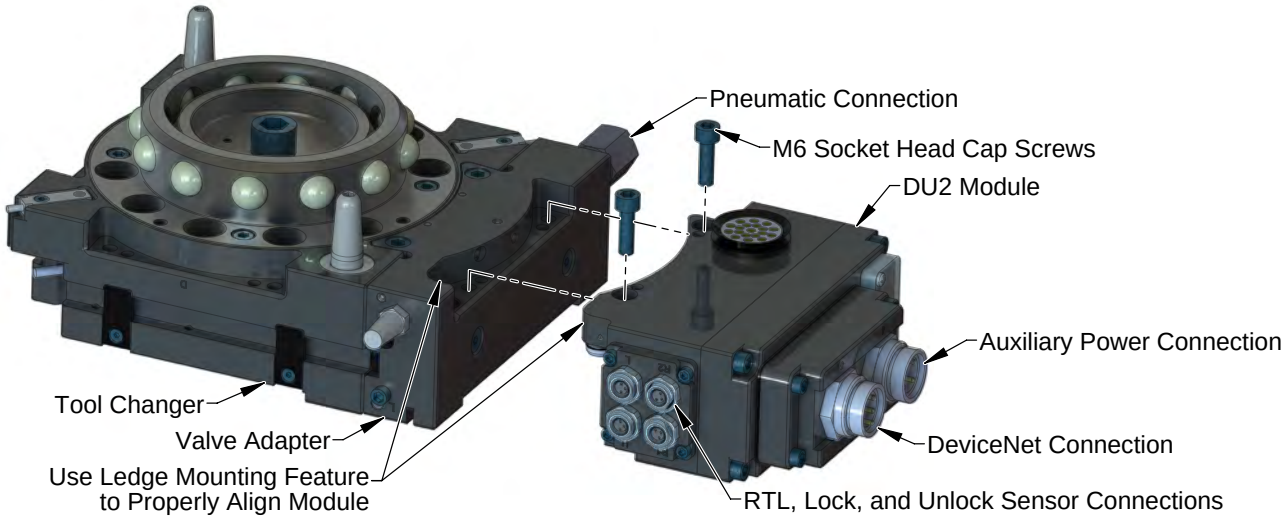
2. Installation

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*.

2.1 Module Installation

1. 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.
2. Using the ledge feature as a guide, place the module into the appropriate location on the Air Adapter. Align the module with the Air Adapter 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 socket head cap screws. Install the two (2) M6 socket head cap screws securing the module to the Air Adapter and tighten to 70 in-lbs.
4. Customer interface, auxiliary power, DeviceNet, and sensor cables can be connected to the module after attaching the module to the Valve Adapter. Ensure that the connectors are cleaned prior to being secured as appropriate.

Figure 2.1—Module Installation



2.2 Module Removal

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.

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. Also, proximity sensor and valve cables 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—Product Information* 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 DU2 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 DU2 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's 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 DU2 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 Messaging, Polled, Strobe and Change of State/Cyclic communications for the predefined Master/Slave Connection set. The Master Node does not support the Unconnected Message Manager (UCMM).

MAC ID and Baud Rate settings for the Master Node are configured through a series of DIP switches. On board termination resistance is not supported and must be provided externally. LED's are integral to the module and report network and module status.

3.1.1 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

3.1.2 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, 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 3.2* for detailed information on DIP switch setup. The default MAC ID setting from the factory for the Master Node is 54.

3.1.3 Baud Rate

Baud Rate is set by either hardware or software configuration. The possible settings are 125, 250 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. The default Baud Rate setting from the factory for the Master Node is 500Kbps.

3.1.4 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

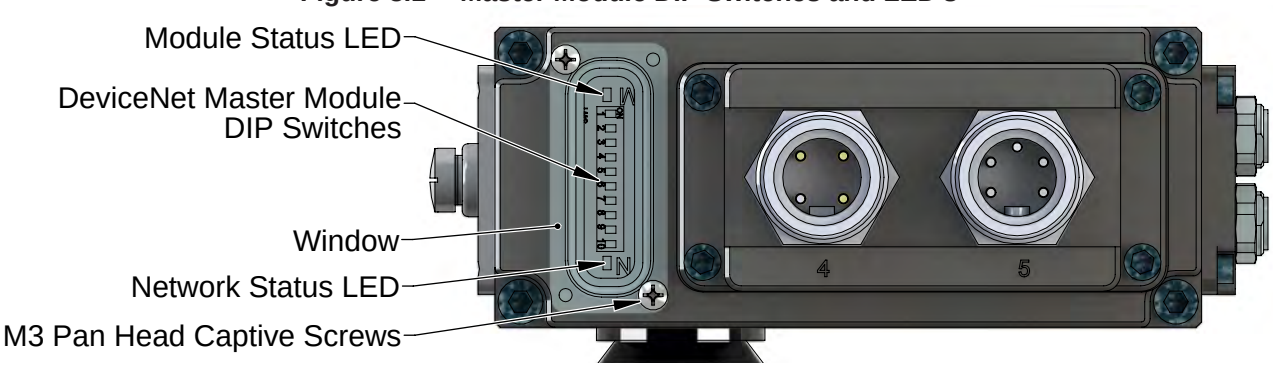
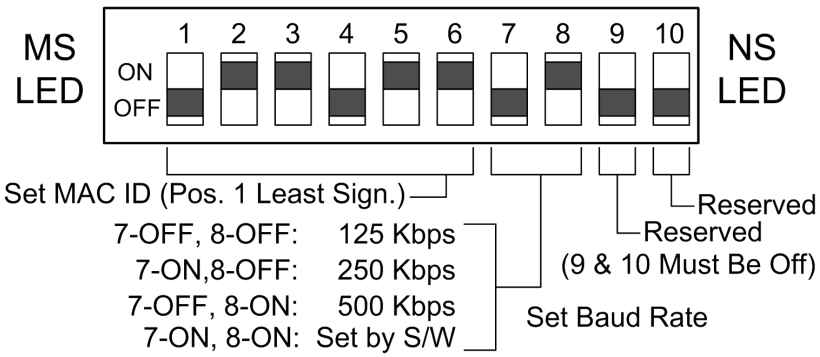


Figure 3.2—DeviceNet Master Module DIP Switch Settings
SHOWN IN FACTORY DEFAULT SETTING, NODE 54



3.1.5 Termination Resistor

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

3.1.6 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

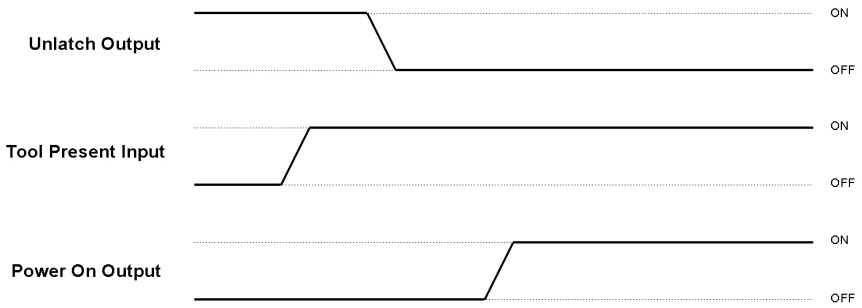
The DU2 Module incorporates ATI's exclusive Arc Prevention Circuit. The Arc Prevention Circuit extends the life of all electrical power contacts by eliminating arcing caused by inductive loads and high inrush current during coupling/uncoupling. The Arc Prevention Circuit makes it possible to couple/uncouple without switching power off and prevents damage to the contacts. In the DU2 Module, the Arc Prevention Circuit controls the ON/OFF status of the Device Net 24V power (CAN V+) and auxiliary power (P1, N1) and (P2, N2). The DU2 module provides an option for the Soft Start feature to prevent the large current spikes associated with a hard power on signal.

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 Circuit. The Power On Output will be off until the Tool Present Input turns on and the Unlatch Output is turned off.

Important: The Arc Prevention Circuit will only allow power to pass to the Tool after the Unlatch Output has been turned off and the Tool Present Input has been turned on.

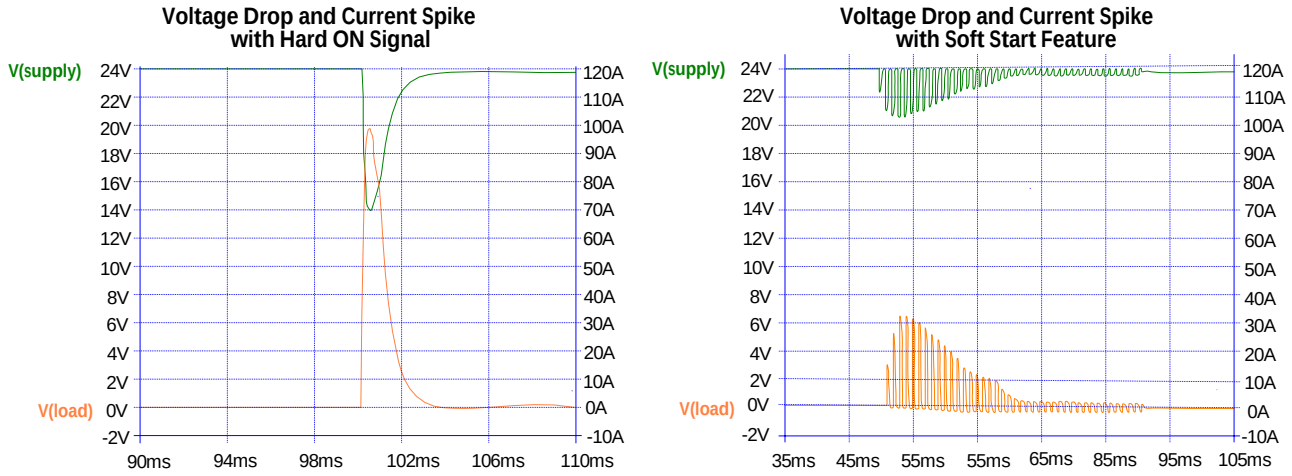
Figure 3.3—Arc Prevention Circuit Power-On Timing



3.2.2 Soft Start during Coupling

High current spikes can cause voltage drops on the power supply and potentially may lead to network faults. The Arc Prevention Circuit has an ATI exclusive Soft Start feature that pulses the power on gradually in the beginning, preventing the large current spike that would otherwise occur if there were only one hard on signal. This results in a series of much smaller current spikes and prevents significant voltage drops on the network power. *Figure 3.4* shows how the Soft Start feature effectively reduces the voltage drop on network power. To implement the Soft Start feature, the Soft_Start_Enable bit (Bit 4) must be turned on, Refer to *Table 3.4*.

Figure 3.4—Soft Start Feature

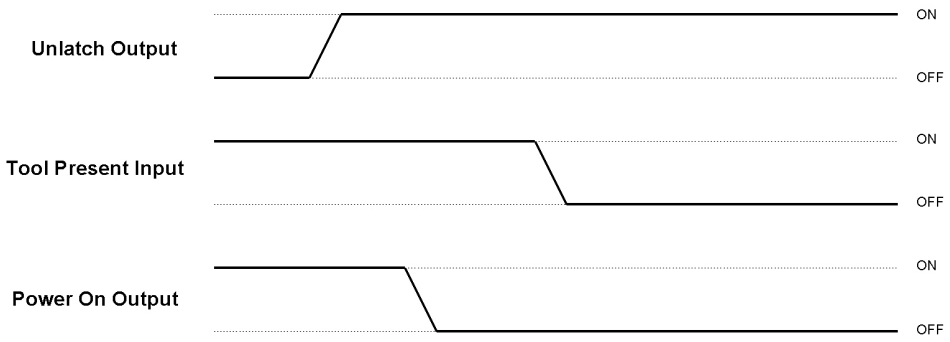


3.2.3 Arc Prevention Circuit Behavior during Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to *Figure 3.5* which shows the power-off timing diagram for the Arc Prevention Circuit. Starting from right to left of the diagram, the Unlatch Output command is issued thus initiating uncoupling of the Master and Tool.

Immediately after the Unlatch Output is turned on, the Arc Prevention Circuit will turn off the Power On Output. 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 and the Tool Present Input will go off.

Figure 3.5—Arc Prevention Circuit Power-Off Timing



3.3 Tool Module

In addition to providing Tool-ID, the Tool module also functions as a pass-through for DeviceNet and Auxiliary Power signals to downstream equipment, refer to *Section 9—Drawings*.

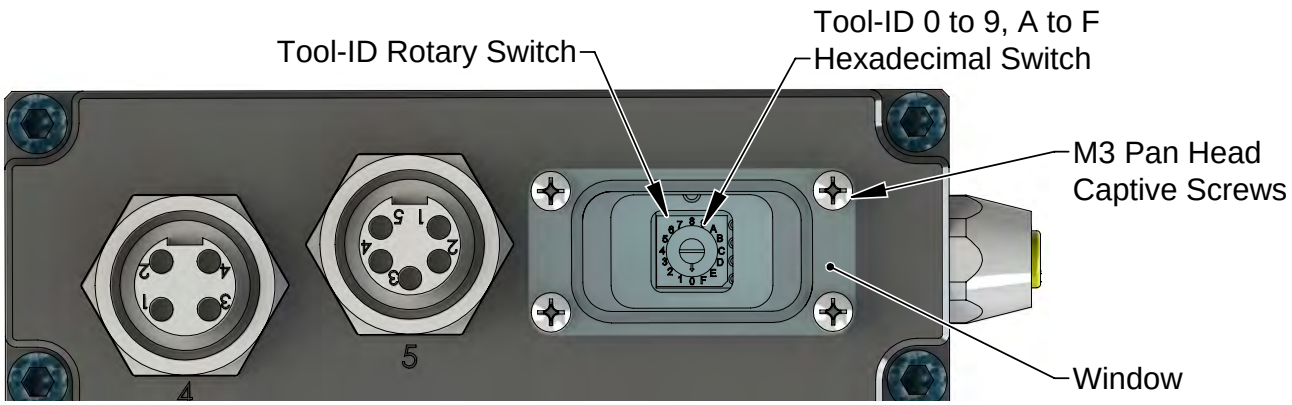
3.3.1 Tool-ID Switches

A rotary switch is provided on the Tool module for setting the Tool-ID number. There are 16 possible Tool-ID values available.

NOTICE: When there is no Tool mated to the Master, the Tool Presence bit will become low and each Tool-ID bit will be assigned a value of 1, which translates to a Tool-ID of 15.

Figure 3.6 shows the location of the Tool-ID rotary switch. After adjustment is completed, ensure that the seal and window are re-positioned correctly to prevent a leakage path to inside the module

Figure 3.6—Tool Module Tool-ID Rotary Switch



3.3.1.1 Setting the Tool-ID

The rotary switch is provided on the Tool module for setting of a Tool-ID number. Each Tool should be set to unique number from 0-F.

1. Loosen the four M3 Pan head Captive Screws and remove the window.
2. Use a flat head screw driver to turn rotary switch to the digit value from 0 to F. Set the Tool-ID to the desired unique number 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 window and tighten the M3 Pan Head Captive Screws.

3.4 Software

A working EDS file for the Master node is available from our website:

(www.ati-ia.com/download/edsfiles) or by e-mail, reference the part number given below.

DU2-M Node EDS file 9031-20-1038

An I/O bitmap for the Master node is provided in the *Table 3.3* and *Table 3.4*.

Table 3.3—Robot Input From ATI Master, (Node 54)

Byte	Bit#	Name	Description/Function
1	0	Locked	Tool Changer Locked Proximity Sensor Input
	1	Unlocked	Tool Changer Unlocked Proximity Sensor Input
	2	Input and Logic Power Good	Input and Logic Power Present Input
	3	Valve Power Available	Valve Power Present Input
	4	RTL	Ready-to-Lock Proximity Sensor Input (Series R1 and R2)
	5	Thermal 1	Thermal 1 Input
	6	Thermal 2	Thermal 2 Input
	7	-	(Reserved)
2	0	Tool-ID 1	Tool-ID
	1	Tool-ID 2	Tool-ID
	2	Tool-ID 4	Tool-ID
	3	Tool-ID 8	Tool-ID
	4	Tool Present	Hard-Connect Tool Present Input
	5	Error on Unlatch Output	Unlatch output overload
	6	Lock/Unlock Sensor Fault	Lock & Unlock Inputs True at the same time
	7	Tool Power Is ON	Indicates that Arc Prevention Circuit is turned ON and power is provided to the Tool

Table 3.4—Robot Outputs to ATI Master, (Node 54)

Byte	Bit#	Name	Description/Function
1	0	Unlatch	Unlatch Solenoid Valve Output
	1	--	(Reserved)
	2	--	(Reserved)
	3	Clear Errors	Reset errors, allow affected I/O to be reactivated
	4	Soft Start Enable	Enables the Arc Prevention soft start functionality.
	5	Arc Prevention Override	Bit employed to facilitate end-of-line testing. FOR ATI USE ONLY.
	6	-	(Reserved)
	7	-	(Reserved)

4. Operation

A procedure in *Section 4.2—Recommended Sequence of Operations* is to be used as a general guide when programming a robot or PLC for use with a Tool Changer and DU2 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.

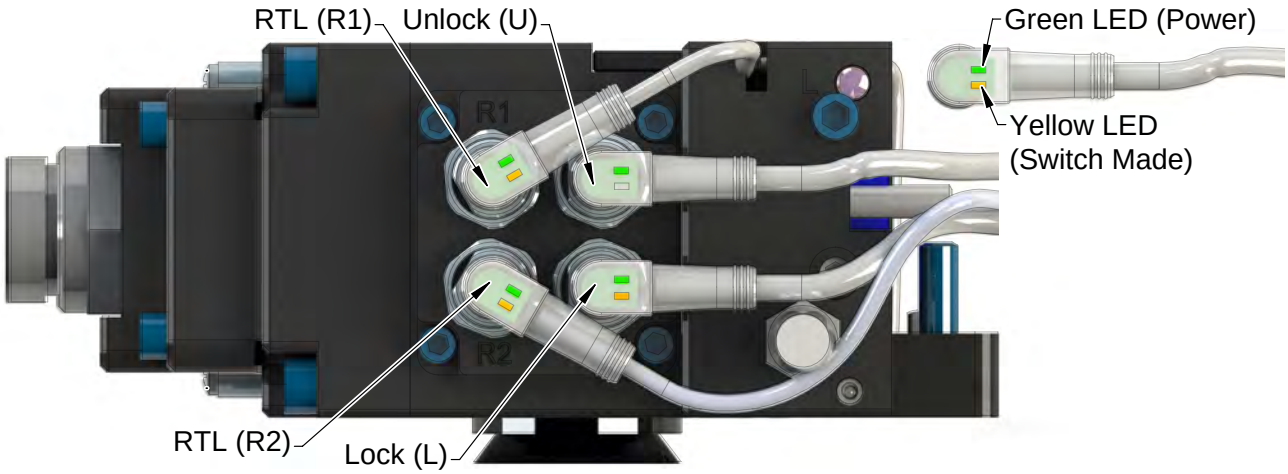
4.1 Lock, Unlock, and RTL Sensor Cable LED Behavior

The Lock, Unlock, and RTL sensor cables are equipped with two LEDs. The Green LED indicates the sensor has power and the yellow LED indicates the switch has been made, The LED behavior is affected by the DU2 Control and Signal module. The behavior shown in *Table 4.1* is specific for the Tool Changer with normally open NPN type sensors and equipped with a DU2 Control and Signal Module.

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

Tool Changer Position	Sensor Cable LED Behavior			
Unlocked	RTL (R1)	OFF OFF	ON ON	Unlock (U)
	RTL (R2)	ON OFF	ON OFF	Lock (L)
When RTL Sensor Inputs go True (Master and Tool Plates parallel and at a distance of 1.22 mm or less from each other)	RTL (R1)	ON ON	ON ON	Unlock (U)
	RTL (R2)	ON ON	ON OFF	Lock (L)
Locked	RTL (R1)	ON ON	ON OFF	Unlock (U)
	RTL (R2)	ON ON	ON ON	Lock (L)
Missed Tool)	RTL (R1)	OFF OFF	ON OFF	Unlock (U)
	RTL (R2)	ON OFF	ON OFF	Lock (L)

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



4.2 Recommended Sequence of Operations

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 **RTL** input is false.
   b. The ATI Tool and any downstream DeviceNet node(s) are offline.
   c. The **DeviceNet Power Good** and **Auxiliary Power Available** inputs are true and must remain so at all times.
   d. **Tool-ID** (all bits are 1)
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 **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 0.15” to 0.06” of the Tool (i.e.; the module contact pins are touching, but the **RTL** sensors have not yet sensed the targets on the Tool)
4. Robot and Master move within 0.06” of the Tool.
   a. The **RTL** input is true, indicating that it is okay to couple the Tool.
   b. The **Tool Present** goes true, indicating that the Master and Tool are in close proximity of each other.
   c. The **Arc Prevention circuit turns power on** to the end-of-arm tooling.
   d. 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.
   e. Shortly thereafter, communications should be established with the downstream DeviceNet nodes.
5. Couple the Tool Changer.
   a. The **Unlatch** output is made false.
   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.
6. Robot moves away from the Tool Stand with the Tool Changer coupled.
7. Normal operation
   a. The following inputs are true:
      i. **Locked**
      ii. **DeviceNet Power Good**
      iii. **Auxiliary Power Available**
      iv. **RTL**
      v. **Tool Present**
   b. The following inputs are false:
      i. **Unlocked**
   c. The following outputs are false:
      i. **Unlatch**
8. Robot moves into the Tool Stand with the Tool Changer coupled.

US Patent No.: 7,027,893 B2
US Patent No.: 6,840,895 B2

9. Uncouple the Tool Changer.
    a. The **Unlatch** output is made true.
    b. The **Locked** input goes false a short time later and subsequently the **Unlocked** input goes true, indicating that the uncoupling operation is complete.
10. Robot and Master move away from the Tool, are parallel and a distance >0.125” from the Tool
    a. The **RTL** input becomes false.
    b. **Arc Prevention circuit turns power off** to the end-of-arm tooling.
    c. Communication is lost with the ATI Tool and downstream nodes.
    d. The **Tool Present** is false.
    e. **Tool-ID** (all bits are 1)
11. 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**
    b. The following inputs are false:
        i. **Locked**
        ii. **RTL**
        iii. **Tool Present**
        iv. **Tool-ID** (all bits are 1)

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.

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.

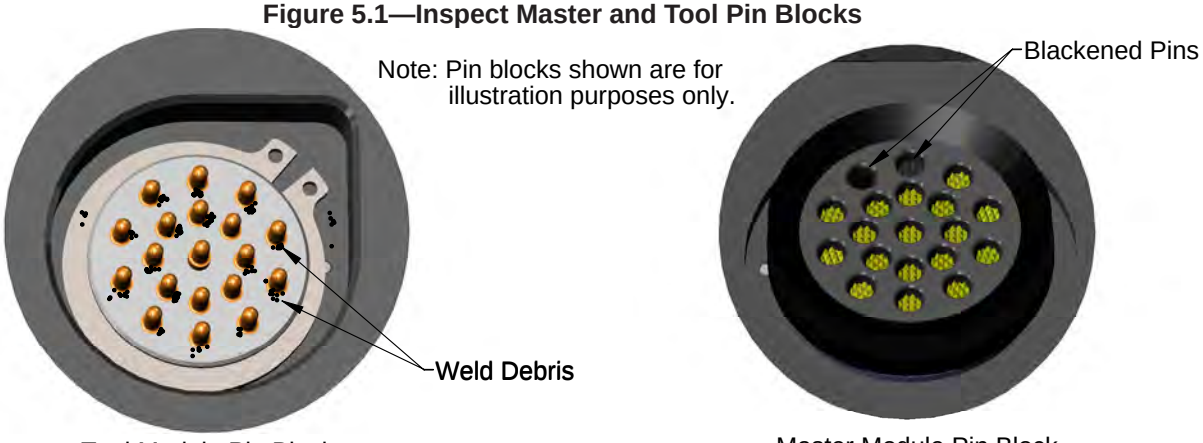
Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred. Perform the following visual inspection monthly:

- 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.

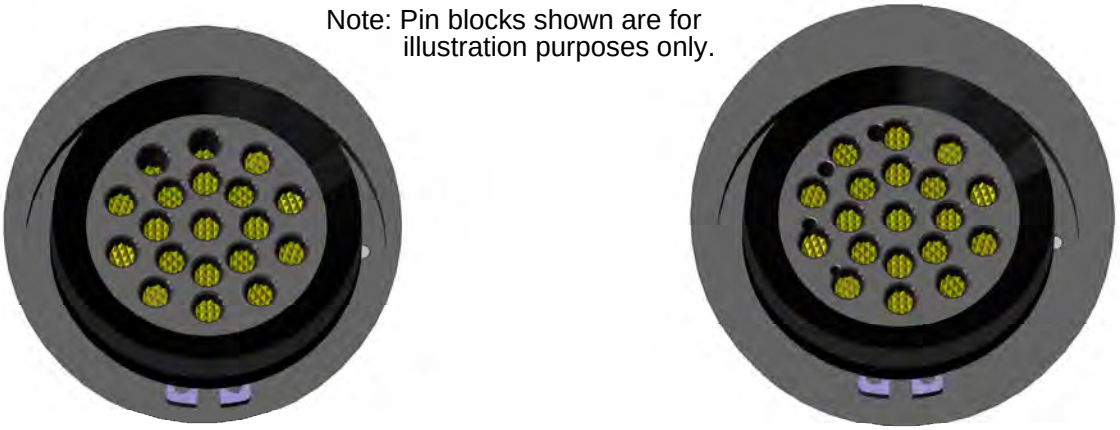
Figure 5.1—Inspect Master and Tool Pin Blocks



2. If debris or darkened pins exist, remove debris using a vacuum, and clean using a nylon brush (ATI part number 3690-0000064-60).
3. Inspect the Master and Tool pin blocks for stuck pins or severe pin block damage.

Figure 5.2—Stuck Pin and Pin Block Damage

Note: Pin blocks shown are for illustration purposes only.



Stuck Pins

Severe Pin Block Damage

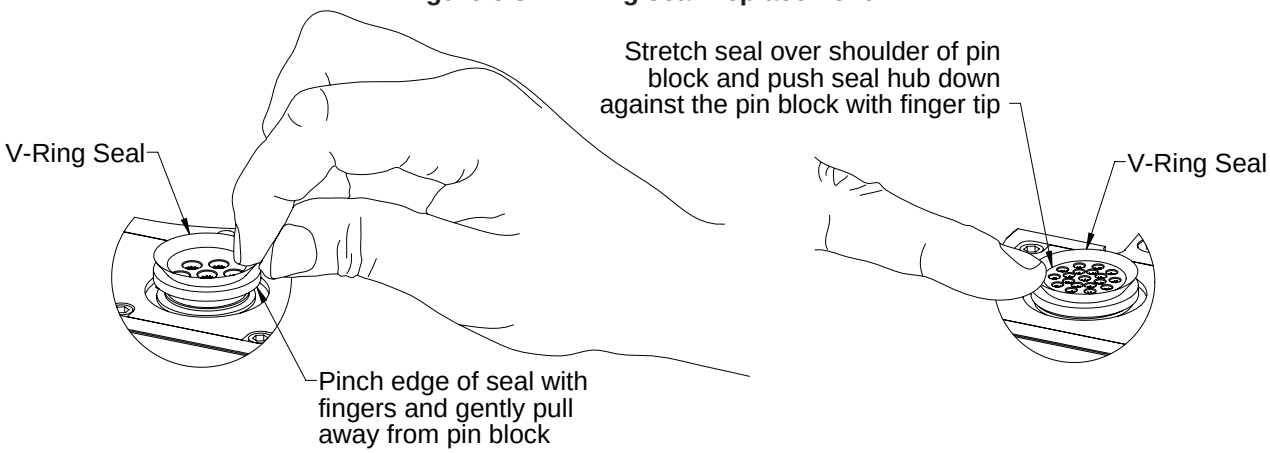
4. If stuck pins or severe pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.

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 5.3—V-Ring seal Replacement



6. Troubleshooting

Refer to the table below for trouble shooting information.

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 **Unlatch** output is **LOW.** 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.

7. Serviceable Parts

See *Section 9—Drawings* for spare parts directly associated with the DU2 modules

Description	Part Number
DU2 Master Module Assembly	9121-DU2-M
DU2 Tool Module Assembly	9121-DU2-T
DeviceNet Termination Resistor for Female Mini Receptacle	9120-5MM-TR
Closure Cap for Female Mini Receptacles	3690-0000049-00
Brush, Blue Nylon All Purpose (Contact Pin Cleaning)	3690-0000064-60

8. Specifications

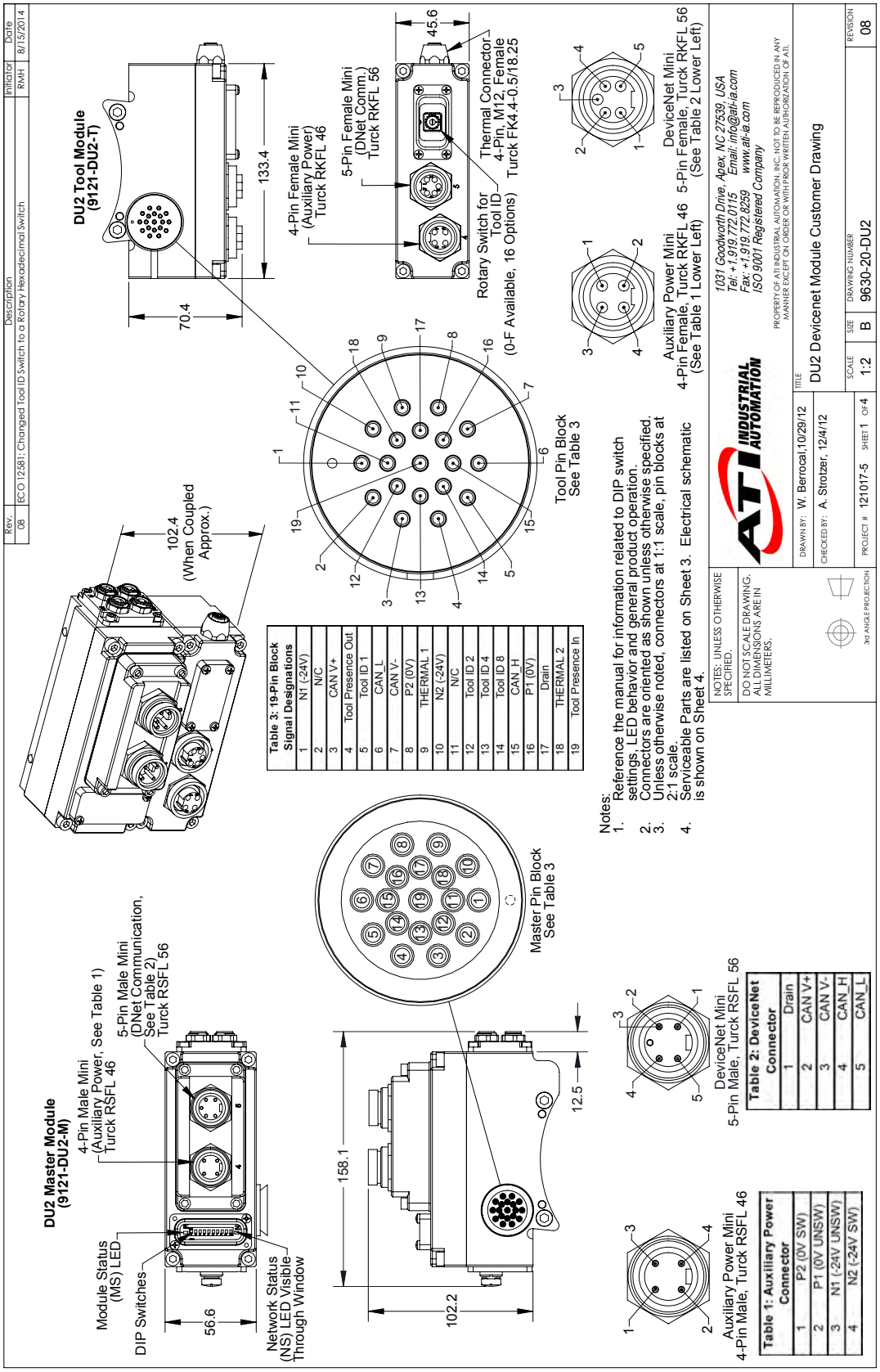
DU2 DeviceNet Master Module	
Factory Default Configuration	MAC ID 54, Baud Rate 500 Kbps. The DU2 modules conform to the DeviceNet Specification Volume 3, Edition 1.2 (Reference Conformance Case #10423).
Interface Connectors	Auxiliary Power: Mini, 4-Pin Male supporting two Auxiliary Power Circuits DeviceNet: 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. RTL Sensors are NPN sensor in series. • 1X M8, 4-pin female connector for (ATI Diagnostics use only).
Electrical Rating	Power Pass-Thru: • N1 and N2 Auxiliary Power: 5A, -19 to -29 V P1 and P2 Auxiliary Power: 0 V Note: Arc prevention is applied to P1 and P2 Auxiliary Power. • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC Note: Arc prevention is applied to CANV+ power.
	Signal Pass-Thru: 3 Amp, 30V maximum.
	Tool Changer Control: • Lock, Unlock, and Ready-to-Lock sensors: 10-30 V operational voltage Note: CAN V- Power provides power to the L, U, and RTL sensors. • Latch/Unlatch integrated solenoid valve: -19 to -29 V operational voltage Note: N2 Power provides power to the Latch/Unlatch solenoid valve..
Current Draw[1]	220mA @ 24V, 250 mA @ 15 V: Master and Tool (Locked and RTL sensors “on”)
Weight	2.28 lbs (1.03 kg)

Note:

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.

DU2 DeviceNet Tool Module	
Factory Default Configuration	(1) Independent Tool-ID switch, reading a (0 to F(15)) position (factory set to Tool Position 1)
Interface Connectors	Auxiliary Power: Mini, 4-Pin Female DeviceNet: Mini, 5-Pin Female TSI connectors: M12, 4-Pin, Female
Electrical Rating	Power Pass-Thru: • N1 and N2 Auxiliary Power: 5A, -19 to -29 V P1 and P2 Auxiliary Power: 0 V • CAN V+ (DeviceNet) Power: 5A, 12-30 VDC
	Signal Pass-Thru: 3 Amp, 30V maximum.
Weight	1.40 lbs (0.63 kg)

9. Drawings


DU2 Tool Module
(9121-DU2-T)
70.4
133.4
4-Pin Female Mini
(Auxiliary Power)
Turck RKFL 46
5-Pin Female Mini
(DNet Comm.)
Turck RKFL 56
45.6
Rotary Switch for
Tool ID
(0-F Available, 16 Options)
Thermal Connector
4-Pin, M12, Female
Turck FK4.4-0.5/18.25
Tool Pin Block
See Table 3
Auxiliary Power Mini
4-Pin Female, Turck RKFL 46
(See Table 1 Lower Left)
DeviceNet Mini
5-Pin Female, Turck RKFL 56
(See Table 2 Lower Left)
102.4
(When Coupled
Approx.)
Master Pin Block
See Table 3
DU2 Master Module
(9121-DU2-M)
4-Pin Male Mini
(Auxiliary Power, See Table 1)
Turck RSFL 46
5-Pin Male Mini
(DNet Communication,
See Table 2)
Turck RSFL 56
Module Status
(MS) LED
DIP Switches
56.6
Network Status
(NS) LED Visible
Through Window
158.1
102.2
12.5
Auxiliary Power Mini
4-Pin Male, Turck RSFL 46
DeviceNet Mini
5-Pin Male, Turck RSFL 56
Table 3: 19-Pin Block
Signal Designations
1 N1 (-24V)
2 N/C
3 CAN V+
4 Tool Presence Out
5 Tool ID 1
6 CAN_L
7 CAN V-
8 P2 (0V)
9 THERMAL 1
10 N2 (-24V)
11 N/C
12 Tool ID 2
13 Tool ID 4
14 Tool ID 8
15 CAN_H
16 P1 (0V)
17 Drain
18 THERMAL 2
19 Tool Presence In
Table 1: Auxiliary Power
Connector
1 P2 (0V SW)
2 P1 (0V UNSW)
3 N1 (-24V UNSW)
4 N2 (-24V SW)
Table 2: DeviceNet
Connector
1 Drain
2 CAN V+
3 CAN V-
4 CAN_H
5 CAN_L
Notes:
1. Reference the manual for information related to DIP switch settings, LED behavior and general product operation.
2. Connectors are oriented as shown unless otherwise specified.
3. Unless otherwise noted, connectors at 1:1 scale, pin blocks at 2:1 scale.
4. Serviceable Parts are listed on Sheet 3. Electrical schematic is shown on Sheet 4.
Rev. 08
Description: ECO 12581: Changed Tool ID Switch to a Rotary Hexadecimal Switch
Initator: RMH
Date: 8/15/2014
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
ATI INDUSTRIAL AUTOMATION
1031 Goodworth Drive, Apex, NC 27539, USA
Tel: +1.919.772.0115 Email: info@ati-ia.com
Fax: +1.919.772.8259 www.ati-ia.com
ISO 9001 Registered Company
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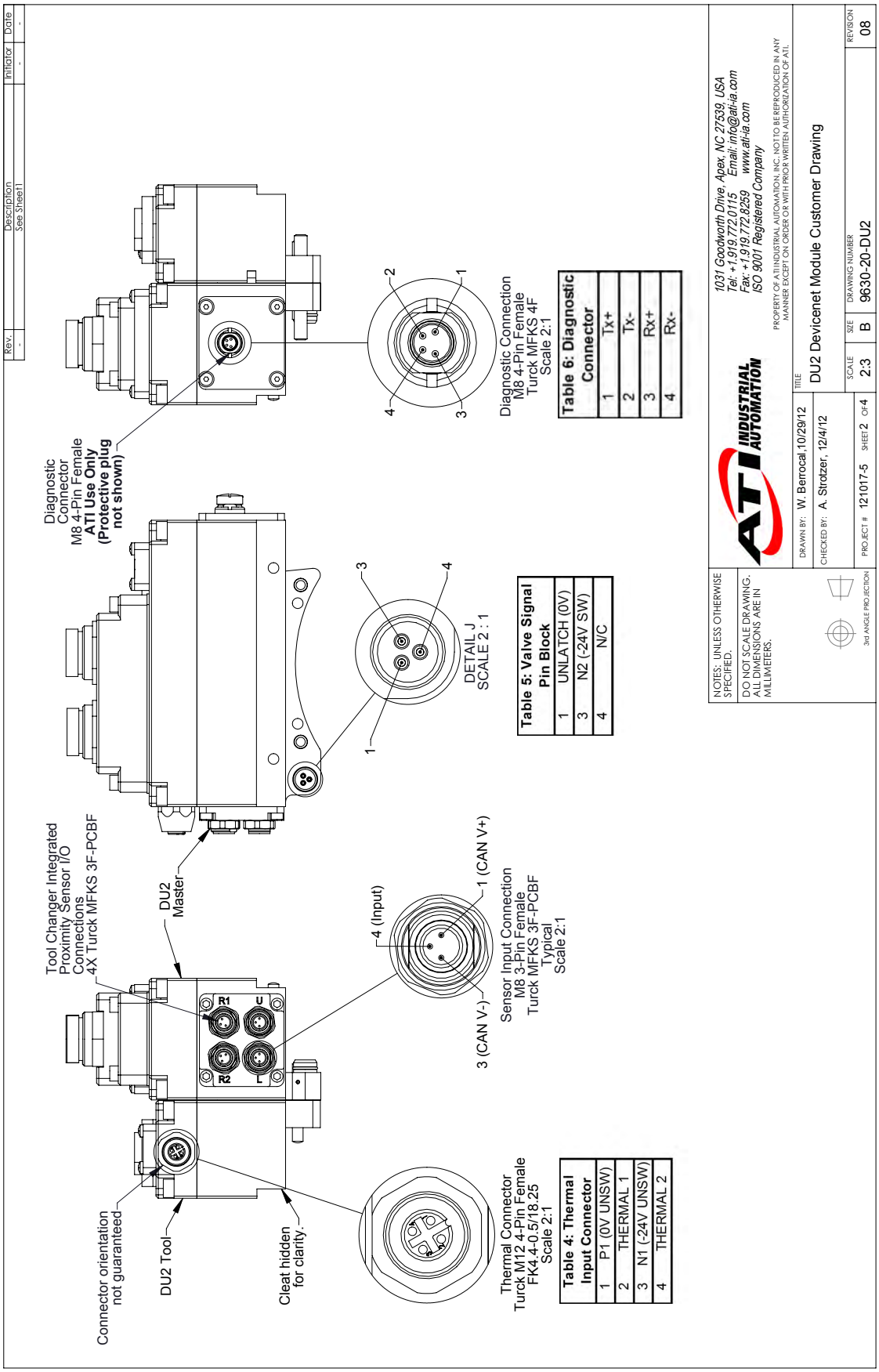
DRAWN BY: W. Berrocal, 10/29/12
CHECKED BY: A. Strotzer, 12/4/12
PROJECT # 121017-5 SHEET 1 OF 4
TITLE: DU2 Devicenet Module Customer Drawing
SCALE: 1:2
SIZE: B
DRAWING NUMBER: 9630-20-DU2
REVISION: 08


Rev.
Description
See Sheet1
Initials
Date
Diagnostic Connector M8 4-Pin Female ATI Use Only (Protective plug not shown)
Diagnostic Connection M8 4-Pin Female Turck MFKS 4F Scale 2:1
Table 6: Diagnostic Connector
1 Tx+
2 Tx-
3 Rx+
4 Rx-
DETAIL J SCALE 2 : 1
Table 5: Valve Signal Pin Block
1 UNLATCH (0V)
3 N2 (-24V SW)
4 N/C
Tool Changer Integrated Proximity Sensor I/O Connections 4X Turck MFKS 3F-PCBF
DU2 Master
R1
U
R2
L
4 (Input)
1 (CAN V+)
3 (CAN V-)
Sensor Input Connection M8 3-Pin Female Turck MFKS 3F-PCBF Typical Scale 2:1
Connector orientation not guaranteed
DU2 Tool
Cleat hidden for clarity
Thermal Connector Turck M12 4-Pin Female FK4.4-0.5/18.25 Scale 2:1
Table 4: Thermal Input Connector
1 P1 (0V UNSW)
2 THERMAL 1
3 N1 (-24V UNSW)
4 THERMAL 2
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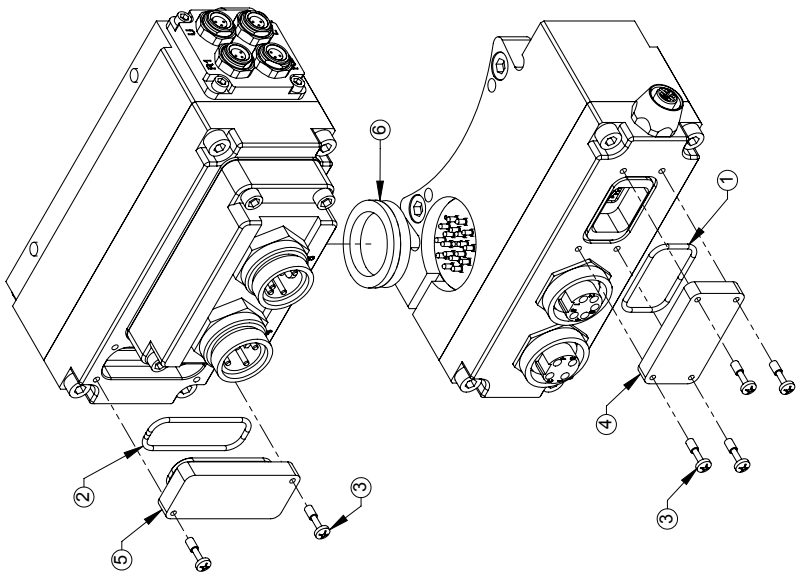
INDUSTRIAL AUTOMATION
DRAWN BY: W. Berrocal,10/29/12
CHECKED BY: A. Stratzer, 12/4/12
PROJECT # 121017-5 SHEET 2 OF 4
3rd ANGLE PROJECTION
TITLE
DU2 Devicenet Module Customer Drawing
SCALE 2:3
SIZE B
DRAWING NUMBER 9630-20-DU2
REVISION 08

Rev.	Description	Initiator	Date
-	See Sheet1	-	-

9121-DU2-M/T SERVICEABLE PARTS

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	3410-0001092-01	O-ring, Buna N 70D, AS568-023
2	1	3410-0001201-01	O-Ring AS568-024
3	6	3500-9957012-21	Pan Head M3 Captive Screw M3 X 12
4	1	3700-20-2696	Device Net Master Window, Thick
5	1	3700-20-4820	Window, DJ Master, Annular Seal
6	1	4010-0000030-01	V-Ring Seal V-22A Nitrile
7	1	9005-20-1198	Master Cleat Sub-Assembly
8	1	9005-20-1199	Tool Cleat Sub-Assembly



NOTES: UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

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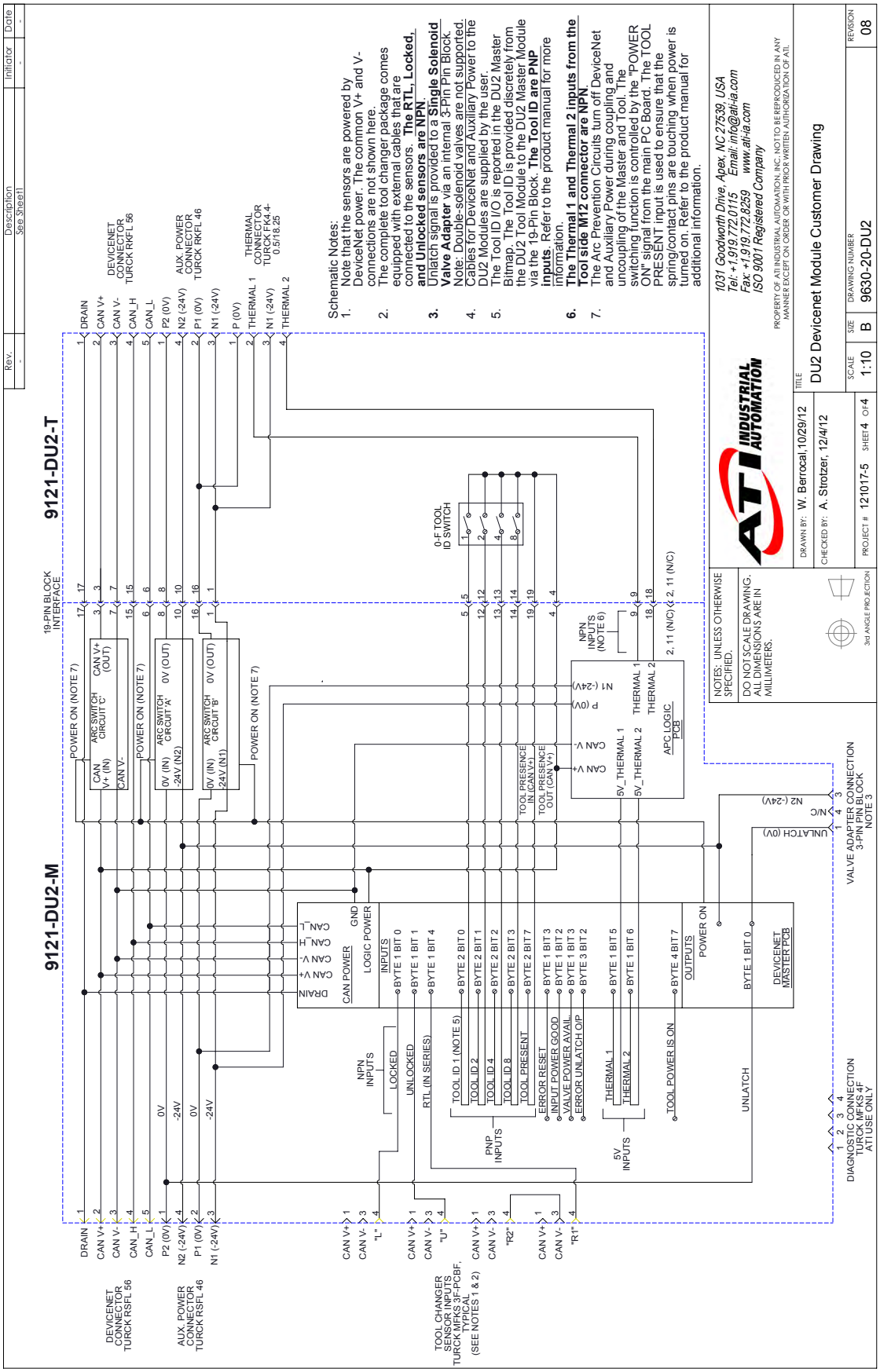
ATI INDUSTRIAL AUTOMATION

DRAWN BY: W. Berrocal 10/29/12
CHECKED BY: A. Stratzer, 12/4/12
PROJECT # 121017-5 SHEET 3 OF 4

TITLE: DU2 Devicenet Module Customer Drawing

SCALE: 2:3
SIZE: B
DRAWING NUMBER: 9630-20-DU2
REVISION: 08


9121-DU2-M
9121-DU2-T
19-PIN BLOCK INTERFACE
DEVICENET CONNECTOR TURCK RSFL 56
AUX. POWER CONNECTOR TURCK RSFL 46
TOOL CHANGER SENSOR INPUTS TURCK MK5-S-PFOBF, TYPICAL (SEE NOTES 1 & 2)
DEVICENET CONNECTOR TURCK RKFL 56
AUX. POWER CONNECTOR TURCK RKFL 46
THERMAL CONNECTOR TURCK FKA4-0.5/18.25
0-F TOOL ID SWITCH
NPN INPUTS (NOTE 6)
APC LOGIC PCB
DEVICENET MASTER PCB
VALVE ADAPTER CONNECTION 3-PIN PIN BLOCK NOTE 3
DIAGNOSTIC CONNECTION TURCK MFKS 4F ATI USE ONLY
Schematic Notes:
1. Note that the sensors are powered by DeviceNet power. The common V+ and V- connections are not shown here.
2. The complete tool changer package comes equipped with external cables that are connected to the sensors. **The RTL, Locked, and Unlocked sensors are NPN.**
3. Unlatch signal is provided to a **Single Solenoid Valve Adapter** via an internal 3-Pin Pin Block. Note: Double-solenoid valves are not supported.
4. Cables for DeviceNet and Auxiliary Power to the DU2 Modules are supplied by the user.
5. The Tool ID I/O is reported in the DU2 Master Bitmap. The Tool ID is provided discretely from the DU2 Tool Module to the DU2 Master Module via the 19-Pin Block. **The Tool ID are PNP inputs**. Refer to the product manual for more information.
6. **The Thermal 1 and Thermal 2 inputs from the Tool side M12 connector are NPN.**
7. The Arc Prevention Circuits turn off DeviceNet and Auxiliary Power during coupling and uncoupling of the Master and Tool. The switching function is controlled by the "POWER ON" signal from the main PC Board. The TOOL PRESENT input is used to ensure that the spring/contact pins are touching when power is turned on. Refer to the product manual for additional information.
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DRAWN BY: W. Berrocal, 10/29/12
CHECKED BY: A. Strotzer, 12/4/12
PROJECT # 121017-5 SHEET 4 OF 4
TITLE
DU2 Devicenet Module Customer Drawing
SCALE 1:10
SIZE B
DRAWING NUMBER 9630-20-DU2
REVISION 08
Rev. - Description See Sheet1 Initiator - Date -