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C. Control and Signal Modules

DE45-M/DE90-T—DeviceNet Module

1. Product Overview

1.1 DeviceNet Module

The DeviceNet modules are required to provide a means for the customer to communicate with and control the tool changer. See Figure 1.1 and also *Section 3—Operation* of this manual for detailed DeviceNet programming information. A double-acting solenoid valve is attached to the DeviceNet Master module for control of the locking mechanism.

Two (2) standard “Mini” style power and signal connectors are provided for DeviceNet interfacing on the Master and Tool modules. When the tool changer is coupled, the Master and Tool DeviceNet modules communicate using a spring loaded pin block. A flexible boot surrounds the pin block to seal the connection from moisture and liquid while coupled.

The DeviceNet Master module is outfitted with a Tool Stand interlock connector that is wired directly into the unlock solenoid valve circuit. Using this connector, a switch can be integrated that will allow the solenoid valve to uncouple the tool changer only when the Tool is in the Tool Stand. A teach plug is factory-supplied with the connector to close the solenoid valve circuit when not used (see Figure 1.2).

The DeviceNet Tool module uses a series of rotary switches for setting Tool ID. This allows the customer to distinguish between the different Tools that are being utilized in a robotic cell or on a production line.

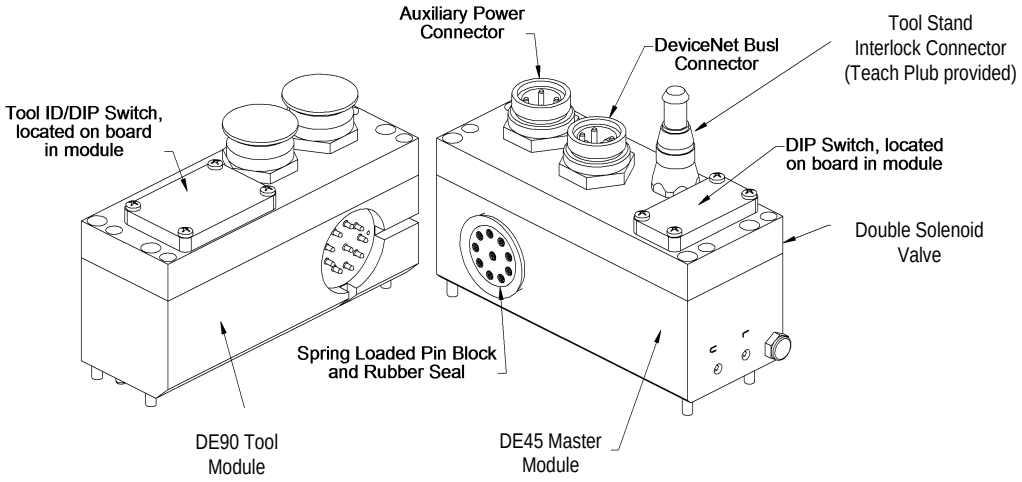


Figure 1.1—DE45-M/DE90-T DeviceNet Module

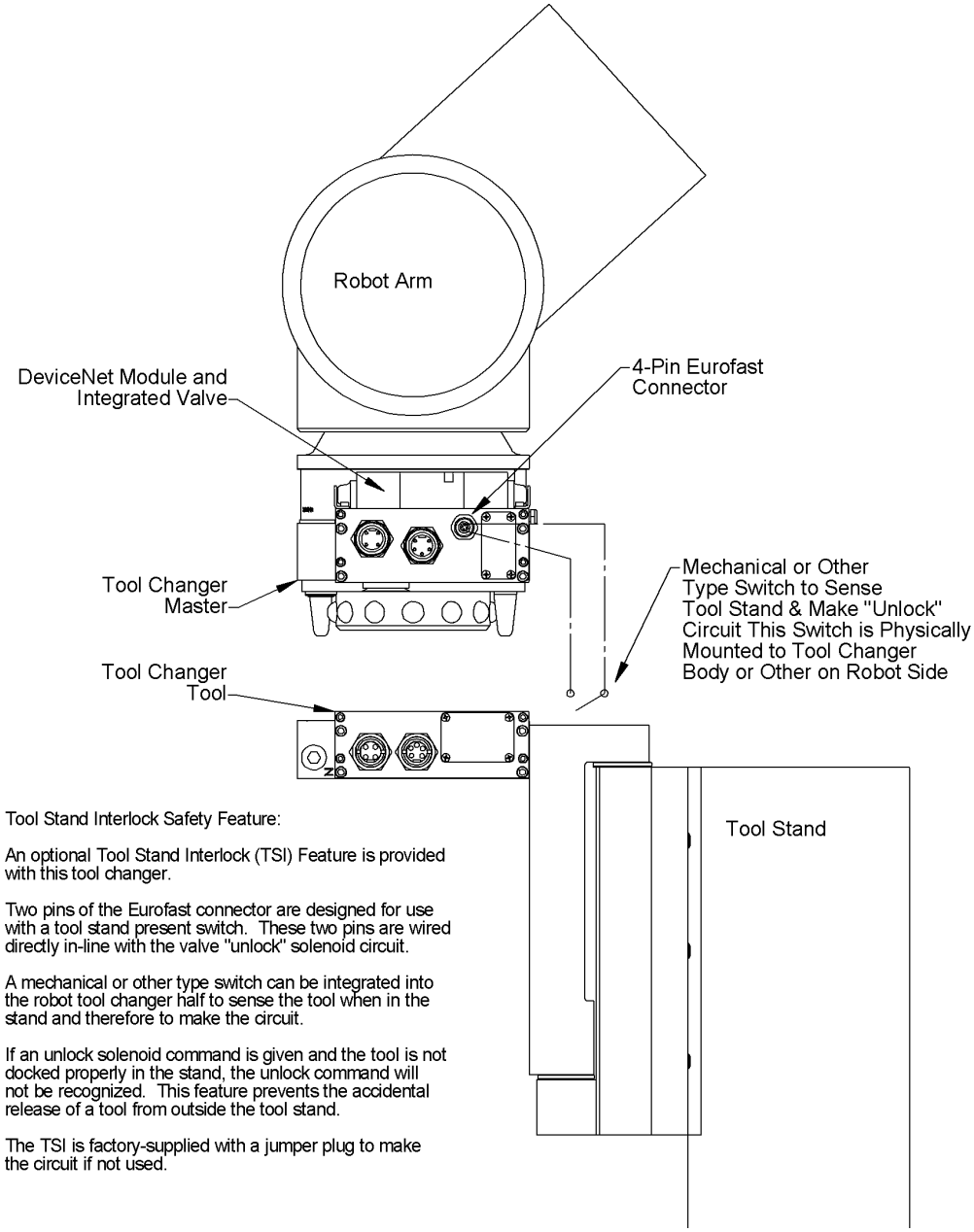


Figure 1.2—Tool Stand Interlock

CAUTION: This Tool Changer is equipped with a Tool Stand Interlock (TSI) feature that physically breaks the unlock solenoid circuit. Use of the TSI will prevent any unwanted unlock software commands from being recognized until the circuit is made.

2. Installation

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

> **WARNING:** Do not perform maintenance or repair on Tool Changer or modules with power or air on. Injury or equipment damage can occur with power or air on. Turn off power and air before performing maintenance or repair on Tool Changer or modules.

2.1 Installing

1. It may be necessary to clean the mounting surface on the tool changer prior to installing the module in order to remove any debris that may be present.
2. Typically, a proximity sensor cable assembly is connected to the Master side control module. This connection needs to be made prior to fastening the module to the Master Plate.
3. (3) Small o-rings should be seated in slots on the mounting face of the Master side module housing. These o-rings should be lightly lubricated with Magna-Lube (or similar) and in place prior to attachment.
4. Align the module to the holes in the tool changer mounting surface using the dowels that are pressed into the module housing. Push the module up flush with the tool changer surface.
5. Apply Loctite-242® (or similar) thread locker to the socket head cap screws and tighten using a hex key.

2.2 Removal

1. All customer connections up to the module need to be disconnected.
2. Remove the socket head cap screws and pull the module off the tool changer.
3. Disconnect the proximity sensor cable from the Master module as appropriate.

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—Operation* of this manual for detailed information on installation and operation of the DeviceNet modules.

2.4 Utility Schematic

> **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.

Refer to drawings in *Section 8—Drawings* of this manual for customer interface and wiring details for the DE45-M, DE90-T modules.

3. Operation

The DeviceNet modules enable the customer to control and communicate with the tool changer through a network using standard DeviceNet (ODVA v2.0) protocol. DeviceNet nodes are established on the Master and Tool side modules. The modules employ standard DeviceNet "mini" style connectors, 5-pin for signal and 4-pin for auxiliary power. Wiring diagrams for the DeviceNet connectors are provided in *Section 8—Drawings* of this manual.

Prior to use of 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 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 Explicit 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. To configure the DIP switch remove the plastic window and seal as shown in the drawing in *Section 8—Drawings*. **When replacing the window, ensure that the seal is positioned correctly to prevent fluid leakage.**

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, all DIP switch positions must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to Figure 3.1 for detailed information on DIP switch setup.

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.

3.1.3 Termination Resistor

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

3.1.4 Module Status LED

The module status LED is identified on the device board as "module". It provides device status such power-on and proper operation. The following table outlines this LED's functions:

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

Table 3.1—Master Module Status LED

3.1.5 Network Status LED

The network status LED is identified on the device board as “network”. It provides communication status such as connected or not connected. The following table outlines this LED’s functions:

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

Table 3.2—Master Module Network Status LED

3.2 Tool Node

The Tool Node operates as a Group 2-Only Server on the DeviceNet network. The Tool Node supports Explicit Messages, Polled and Strobe of the predefined Master/Slave Connection set. The Tool Node does not support the Explicit Unconnected Message Manager (UCMM). The MAC ID, Baud Rate, and Termination Resistor settings for the Tool Node are configured through a DIP switch. Tool ID is set using (5) rotary switches. (2) LED’s provide network and module status. To configure the rotary switches remove the plastic window and seal as shown in the drawing in *Section 8—Drawings*. **When replacing the window, ensure that the seal is positioned correctly to prevent fluid leakage.**

3.2.1 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, all DIP switch positions must be on. If the MAC ID is set by software, the Baud Rate must also be set by software. Refer to Figure 3.2 for detailed information on DIP switch setup.

3.2.2 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 3.2 for DIP switch setup.

3.2.3 Termination Resistor

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

3.2.4 Tool ID (Tool Node Only)

The Tool ID for a particular tool is established from the setup of 5 rotary switches.

The first three switches, SW1, SW2 and SW3 set the tool number within a range from 0-255. The fourth switch, SW4 sets the Robot Number from 0-9. The fifth switch, SW5 sets the Line Number from 0-9. Refer to Figure 3.3 for detailed information on Tool ID rotary switch setup for this configuration.

3.2.5 Module Status LED

The module status LED is identified on the device board as “D5”. It provides device status such power-on and proper operation. Table 3.1 also outlines the tool module status LED’s functions.

3.2.6 Network Status LED

The network status LED is identified on the device board as “D4”. It provides communication status such as connected or not connected. Table 3.2 also outlines the tool module network status LED’s functions.

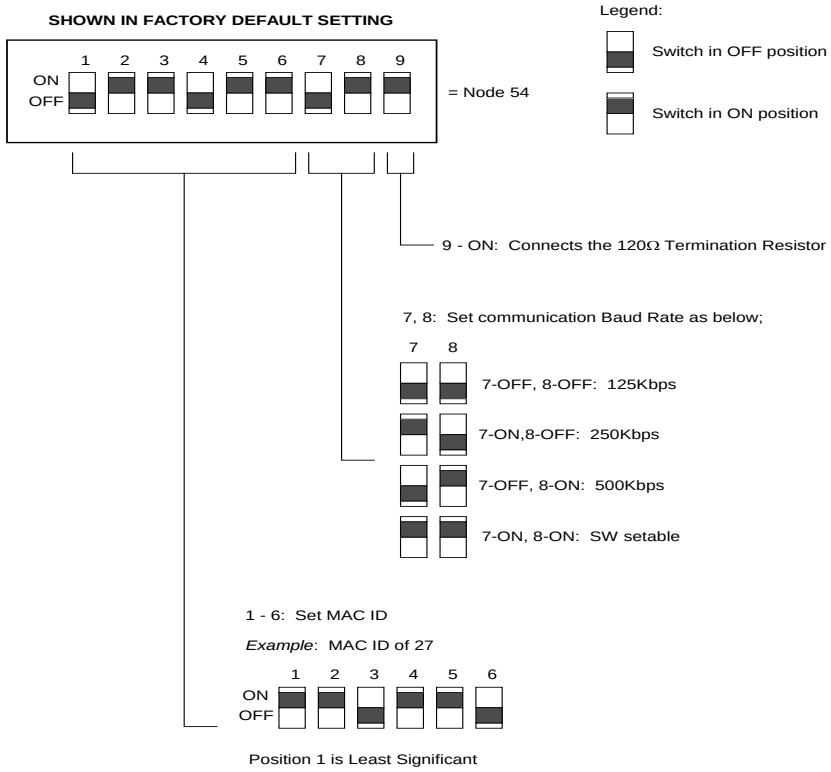
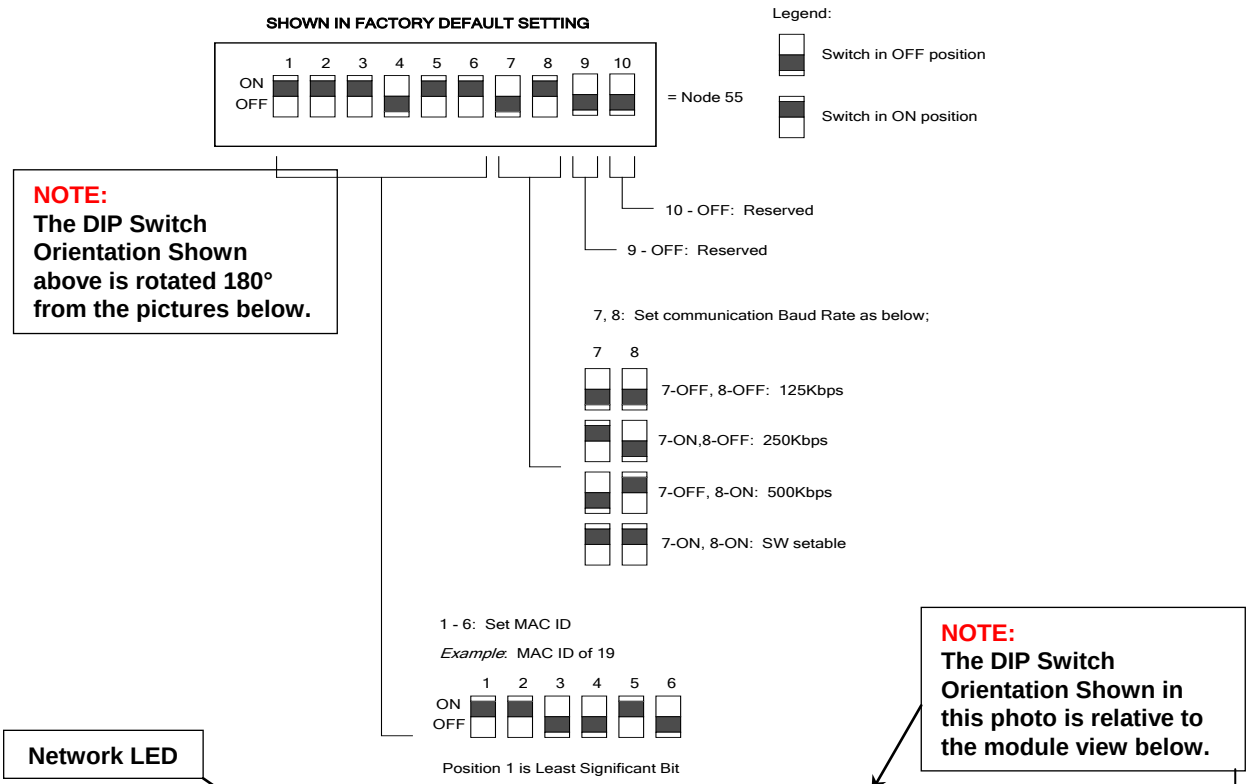


Figure 3.1—DeviceNet Master Module DIP Switch Settings



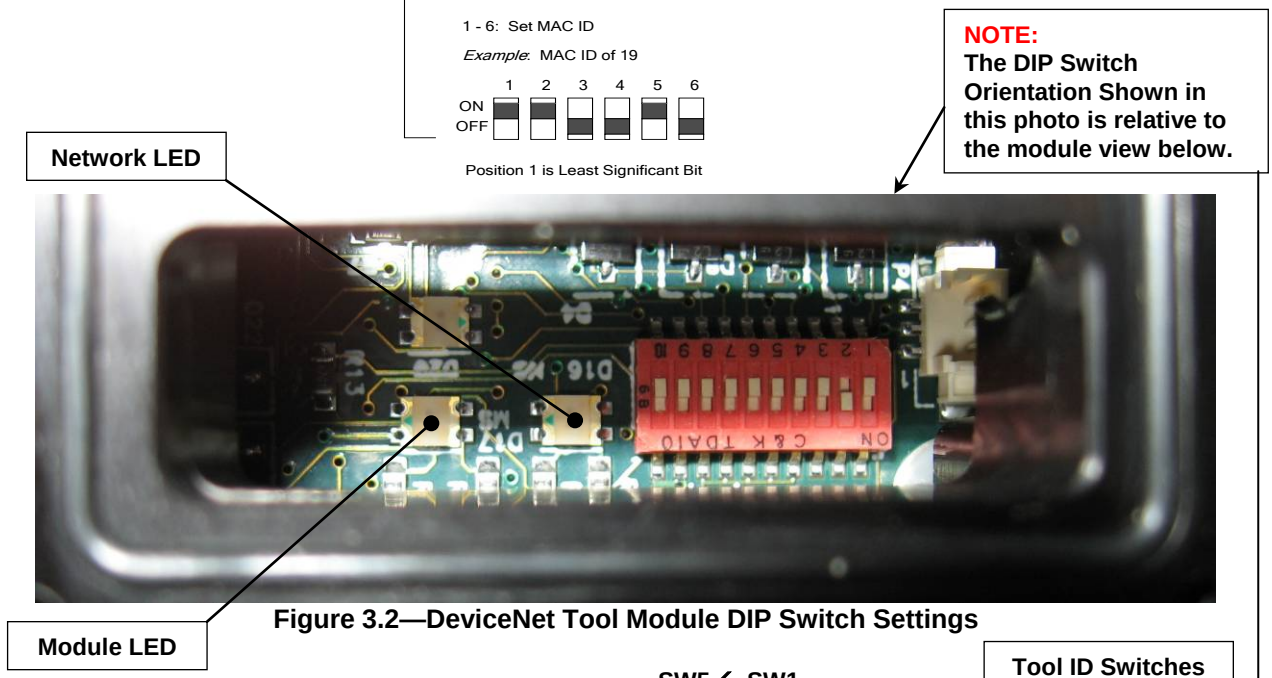


Figure 3.2—DeviceNet Tool Module DIP Switch Settings

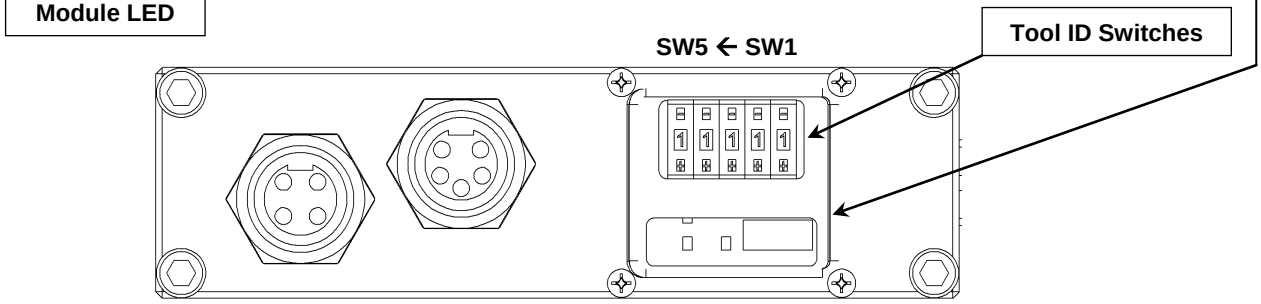


Figure 3.3—DE90 Tool Module, Tool ID Switch Settings

3.3 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:

DE45-M Node EDS file 9030-20-1002-02

DE90-T Node EDS file 9030-20-1001-01

I/O maps for the DeviceNet nodes are provided in the tables below. This information allows user DeviceNet programming to translate DeviceNet interface to discrete I/O. MAC ID Nodes are switch-selectable by user. Default settings are shown (Node 54 and Node 55) but can be changed by user. Robot Inputs and Outputs are user-assigned and may be programmed as discrete bits or in 8-bit bytes.

Robot Input From Master DeviceNet Module (Node 54)		
Bit #	**Name**	**Description**
1	"Tool Plate Latched"	Locked
2	"Tool Plate Unlatched"	Unlocked
3	"Unlatch Solenoid Energized"	Unlatched
4	"Auxiliary Power Available"	Aux. Power
5	"Tool Plate Found"	RTL
6	"Secondary Module Locked"	KB2
7	"Latch Solenoid Energized"	Latched
8		N/A

Table 3.3—I/O Bitmap, Robot Input Node 54 (DE45-M Module)

Robot Output To Master DeviceNet Module (Node 54)		
Bit #	**Name**	**Description**
1	"Latch Tool Plate"	Lock
2	"Unlatch Tool Plate"	Unlock
3		N/A
4		N/A
5		N/A
6		N/A
7		N/A
8		N/A

Table 3.4—I/O Bitmap, Robot Output Node 54 (DE45-M Module)

Robot Input from Tool DeviceNet Module (Node 55)			
Node	**Bit**	**Description**	**Example Setting for Figure 7.3**
1	Low Bit	Tool Number Bit 1	Low
2		Tool Number Bit 2	Low
3		Tool Number Bit 4	High
4		Tool Number Bit 8	Low
5		Tool Number Bit 16	Low
6		Tool Number Bit 32	Low
7		Tool Number Bit 64	Low
8	High Bit	Tool Number Bit 132	High
9	Low Bit	Robot Number Bit 1	Low
10		Robot Number Bit 2	High
11		Robot Number Bit 4	Low
12		Robot Number Bit 8	Low
13		Line Number Bit 1	High
14		Line Number Bit 2	Low
15		Line Number Bit 4	High
16	High Bit	Line Number Bit 8	Low

Table 3.5—I/O Bitmap, Robot Input Node 55 (DE90-T Module)

3.4 Operation

Please refer to the flow chart in Figure 3.4 for a logical description of the DeviceNet commands, lock/unlock procedure and diagnostic checks.

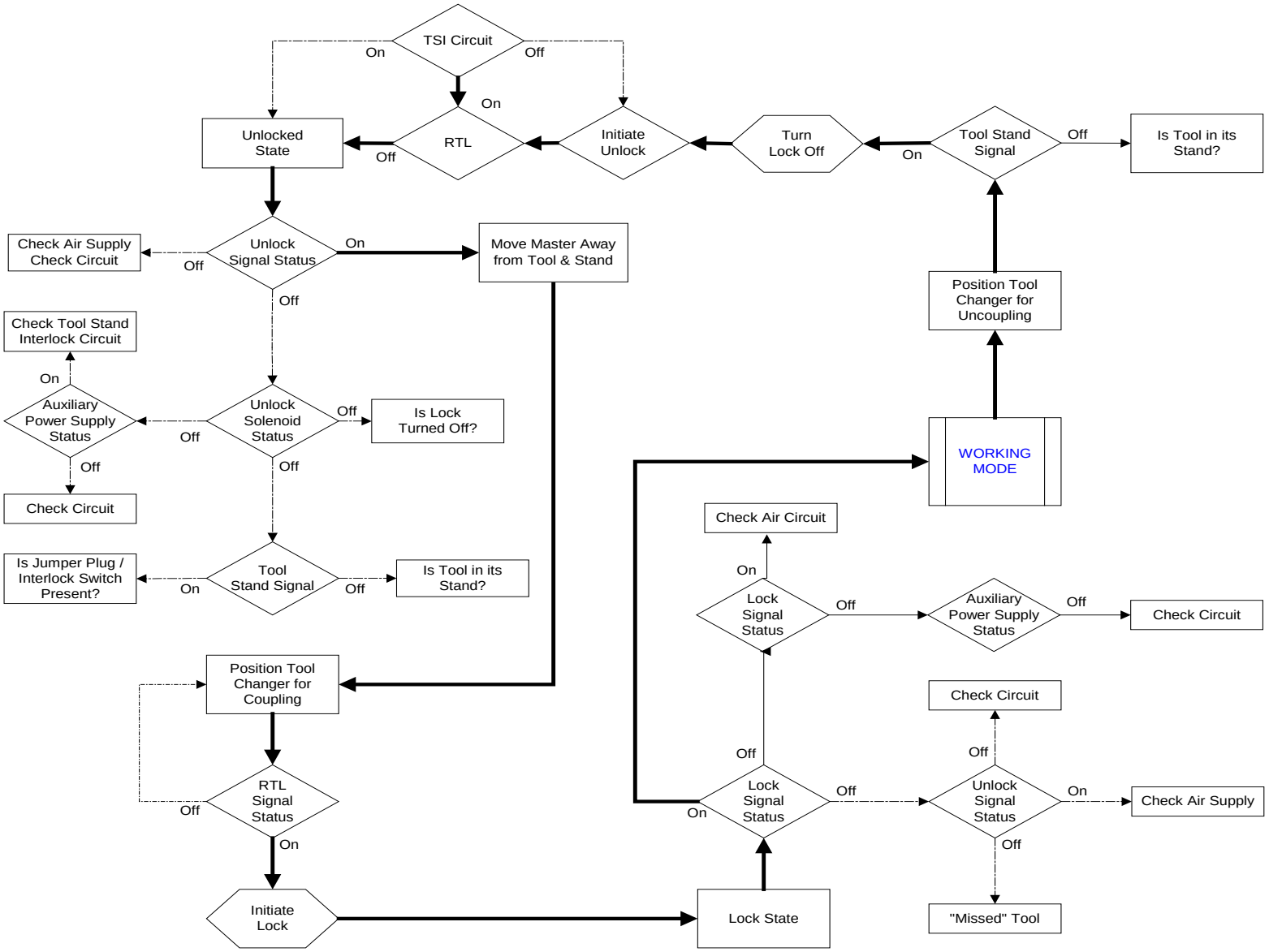


Figure 3.4—DeviceNet Logical Operation and Diagnostic (DE45-M, Double Solenoid Valve)

4. Maintenance

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

Contact pins on the DeviceNet Tool module should be inspected and cleaned periodically to ensure electrical contact is maintained. Care should be taken not to bend or pull out the contacts when cleaning. Do not use an abrasive media to clean the contact pins as erosion may occur to the contact surface.

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. Unused 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. In this instance the customer should determine a suitable inspection schedule.

Detailed assembly drawings are provided in *Section 8—Drawings* of this manual.

5. Troubleshooting

Refer to the flow chart in figure 3.4 for troubleshooting information, as well as the table below:

Symptom	Possible Cause / Correction
Unit will not lock or unlock	Verify that ball bearings are not moving freely. Clean and lubricate as needed (see *Section 4—Maintenance*). Check air supply Check that exhaust port is properly vented (check muffler) Verify that DeviceNet and DeviceNet signals are operating correctly. Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock.
Sensors not operating properly (but DeviceNet is operating correctly).	Verify that cables are connected correctly Verify that the sensors are set correctly (Refer to SIP Kit Installation). Ensure that the Tool Plate is securely held to the Master Plate, that nothing is trapped between their surfaces, and that there is no air trapped in the Unlock (U) air port.
Loss of DeviceNet Communication	Check/replace DeviceNet cabling up- and down-stream of Tool Changer modules Inspect DeviceNet Module contact pins for debris/wear Check nodes up- and down-stream of Tool changer nodes for failures. These failures can “masquerade” as Tool Changer node faults. Verify DeviceNet network and cabling is properly tuned Lower Baud Rate if communication problems persist.

6. Recommended Spare Parts

Assembly	Part Number	Description
DeviceNet Master	9120-DE45-M	Complete Master DeviceNet Module
	9120-Gasket-M-Kit-DE45	DE45 Master DeviceNet Module Gasket Kit (Includes (3) 3410-0001052-01 AS568-008 o-ring Buna N70, (1) 3410-0001092-01 o-ring AS568-023 Buna-N D70, and (1) 3700-20-2694 adhesive-backed gasket)
	9120-DE45-PLUG	Yellow Teach Plug w/ Lanyard and Caution Tags
	3425-0000002-01	Double Solenoid Valve, Detented
	3500-9957012-21	Captive Screw, SS M3 x 12
	3505-1010001-00	Brass Muffler
	3700-20-2696	Clear Window
	4010-0000030-01	V-ring
DeviceNet Tool	9120-DE90-T	Complete Tool DeviceNet Module
	9120-Gasket-T-Kit-DE45	DE45/90 Tool DeviceNet Module Gasket Kit (Includes (1) 3410-0001020-01 o-ring AS568030 Buna-N D70 and (1) 3700-20-2693 adhesive-backed gasket)
	3500-9957012-21	Captive Screw, SS M3 x 12
	3700-20-2695	Clear Window

7. Specifications

DeviceNet Module — ODVA, v2.0 Certified. Refer to the ODVA manual for detailed DeviceNet specifications.

Master Node

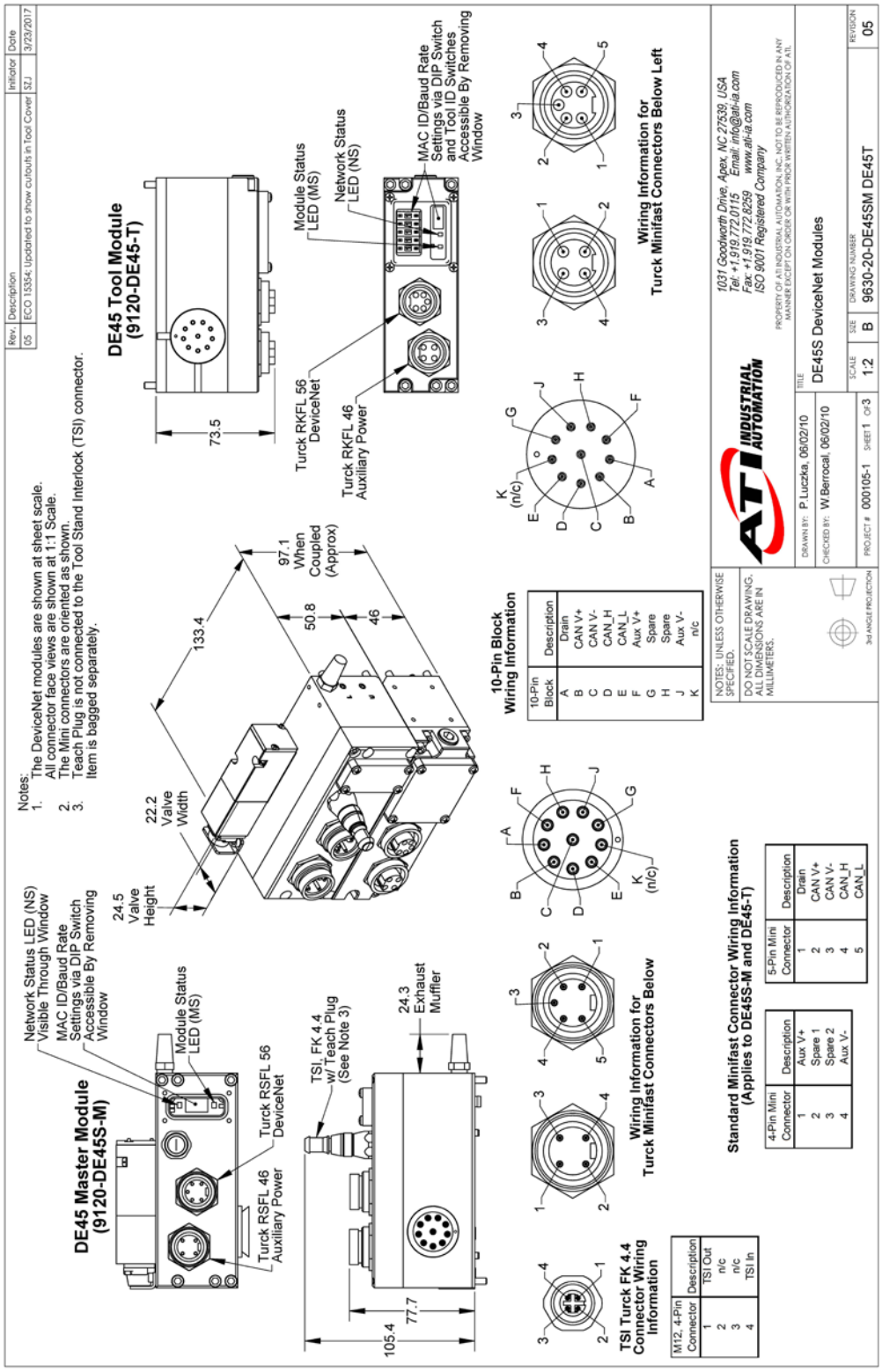
Factory configuration	DE45-M	MAC ID 54, Baud 500 Kbps, termination resistance “on”, “Mini” style Bus, Auxiliary Power connectors (male).
Current Draw	40mA typical	Does not include solenoid, which uses Aux Power.
	DE45-M	Double Solenoid, Detented Valve

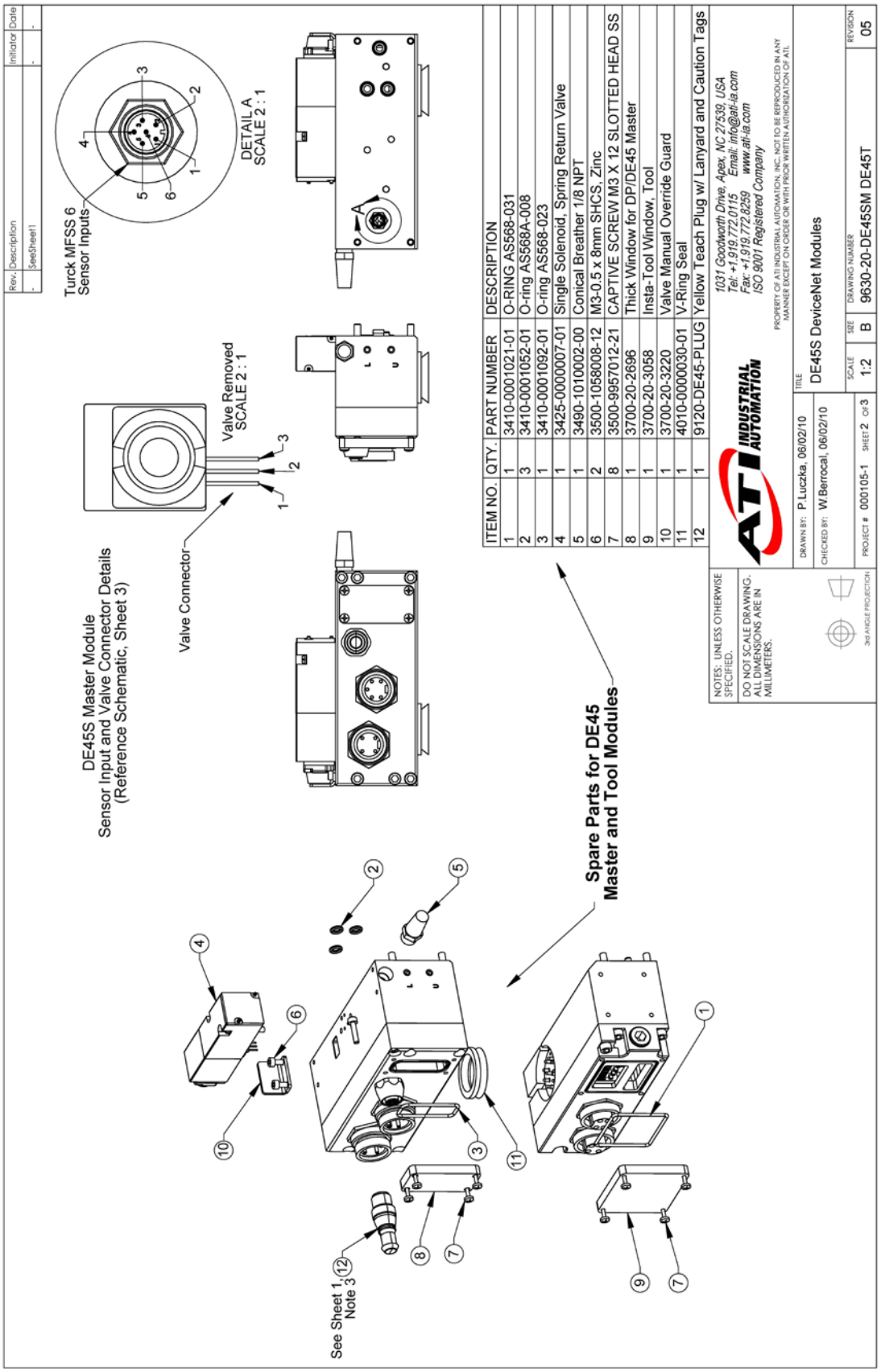
Tool Node

Factory configuration	DE90-T	MAC ID 55, Baud 500Kbps, No termination resistance. “Mini” style Bus, and Aux. Power connectors (female).
Current Draw	20mA typical	
	DE90-T	Switches 1-3 return a tool number 0-255. Switch 4 returns a robot number 0-9 and Switch 5 returns a line number 0-9.

8. Drawings

8.1 DE45-M/DE90-T DeviceNet Module




Rev. Description Initiator Date
- SeeSheet1 - -
Turck MFSS 6
Sensor Inputs
DETAIL A
SCALE 2 : 1
Valve Removed
SCALE 2 : 1
Valve Connector
DE45S Master Module
Sensor Input and Valve Connector Details
(Reference Schematic, Sheet 3)
Spare Parts for DE45
Master and Tool Modules
See Sheet 1,
Note 3
ITEM NO. QTY. PART NUMBER DESCRIPTION
1 1 3410-0001021-01 O-RING AS568-031
2 3 3410-0001052-01 O-ring AS568A-008
3 1 3410-0001092-01 O-ring AS568-023
4 1 3425-0000007-01 Single Solenoid, Spring Return Valve
5 1 3490-1010002-00 Conical Breather 1/8 NPT
6 2 3500-1058008-12 M3-0.5 x 8mm SHCS, Zinc
7 8 3500-9957012-21 CAPTIVE SCREW M3 X 12 SLOTTED HEAD SS
8 1 3700-20-2696 Thick Window for DP/DE45 Master
9 1 3700-20-3058 Insta-Tool Window, Tool
10 1 3700-20-3220 Valve Manual Override Guard
11 1 4010-0000030-01 V-Ring Seal
12 1 9120-DE45-PLUG Yellow Teach Plug w/ Lanyard and Caution Tags
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
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
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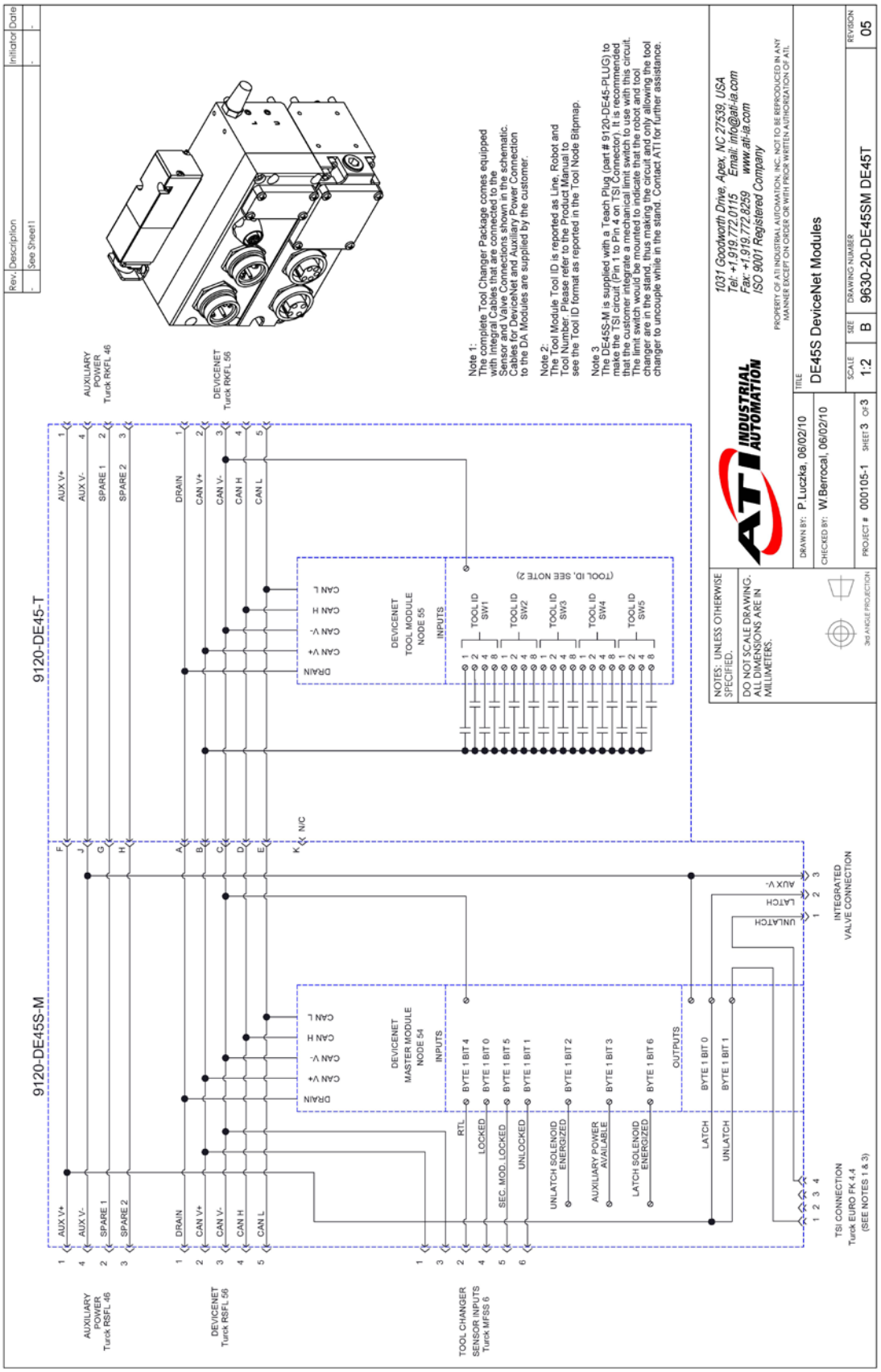
DRAWN BY: P.Luczka, 06/02/10
CHECKED BY: W.Berrocal, 06/02/10
TITLE
DE45S DeviceNet Modules
PROJECT # 000105-1 SHEET 2 OF 3
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-20-DE45SM DE45T
REVISION 05
3rd ANGLE PROJECTION


Rev. Description Initiator Date
See Sheet1
Note 1:
The complete Tool Changer Package comes equipped with Integral Cables that are connected to the Sensor and Valve Connections shown in the schematic. Cables for DeviceNet and Auxiliary Power Connection to the DA Modules are supplied by the customer.
Note 2:
The Tool Module Tool ID is reported as Line, Robot and Tool Number. Please refer to the Product Manual to see the Tool ID format as reported in the Tool Node Bitmap.
Note 3
The DE45S-M is supplied with a Teach Plug (part # 9120-DE45-PLUG) to make the TSI circuit (Pin 1 to Pin 4 on TSI Connector). It is recommended that the customer integrate a mechanical limit switch to use with this circuit. The limit switch would be mounted to indicate that the robot and tool changer are in the stand, thus making the circuit and only allowing the tool changer to uncouple while in the stand. Contact ATI for further assistance.
9120-DE45-T
9120-DE45S-M
AUXILIARY POWER Turck RKFL 46
DEVICENET Turck RKFL 56
AUX V+
AUX V-
SPARE 1
SPARE 2
DRAIN
CAN V+
CAN V-
CAN H
CAN L
DEVICENET TOOL MODULE NODE 55 INPUTS
TOOL ID SW1
TOOL ID SW2
TOOL ID SW3
TOOL ID SW4
TOOL ID SW5
(TOOL ID, SEE NOTE 2)
DEVICENET MASTER MODULE NODE 54
INPUTS
OUTPUTS
BYTE 1 BIT 4
BYTE 1 BIT 0
BYTE 1 BIT 5
BYTE 1 BIT 1
BYTE 1 BIT 2
BYTE 1 BIT 3
BYTE 1 BIT 6
RTL
LOCKED
SEC. MOD. LOCKED
UNLOCKED
UNLATCH SOLENOID ENERGIZED
AUXILIARY POWER AVAILABLE
LATCH SOLENOID ENERGIZED
LATCH
UNLATCH
INTEGRATED VALVE CONNECTION
UNLATCH
LATCH
AUX V-
TSI CONNECTION Turck EURO FK 4.4 (SEE NOTES 1 & 3)
TOOL CHANGER SENSOR INPUTS Turck MFSS 6
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
1031 Goodworth Drive, Apex, NC 27539, USA
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Fax: +1.919.772.8259 www.ati-ia.com
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DRAWN BY: P.Luczka, 06/02/10
CHECKED BY: W.Berrocal, 06/02/10
PROJECT # 000105-1 SHEET 3 OF 3
TITLE
DE45S DeviceNet Modules
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-20-DE45SM DE45T
REVISION 05

8.2 DeviceNet Proximity Cable Drawing