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Glossary

Term	Definition
Application Processor 1	A board inside the DL8 module which controls solenoid outputs, monitors function of the unlatch valves for pressure and position, safety checking and diagnostics, reports sensor status, protects outputs against short circuit overload, detects and reports status of the 24V power supply, and provides cross monitoring of the pressure processor board.
Application Processor 2	A board inside the DL8 module which controls Unlatch Valve 2, reports the pressure inside the valve module, and provides cross monitoring of the Application Processor 1.
BF LED	BUS Failure LED; this is a standard Profibus status LED, similar to the DeviceNet Network Status LED.
Clear Errors	An output supplied to the ATI Master DeviceNet node to clear all applicable error conditions
CL-RPC	Connection Less Remote Procedure Call.
DCP	PROFINET Discovery and Configuration Protocol.
EOAT	End Of Arm Tool (end effector).
Error on Latch Output	An input indicating a short circuit overload condition exists with the Latch Output.
Error on Unlatch Output	An input indicating a short circuit overload condition exists with the Unlatch Output.
Ethernet Switch	An Ethernet network component connecting multiple communication partners with each other.
FE	Functional Earth
GSDML File	A special kind of XML-based Device Description File used by PROFINET to automatically obtain the device characteristics.
Latch (Lock)	The output supplied to the ATI Master module to couple the Tool Changer.
LLDP	Link Layer Discovery Protocol
Lock/Unlock Sensor Fault	An input indicating that the Locked and Unlocked inputs are high at the same time.
Locked	A proximity sensor input indicating that the coupling mechanism is in the Locked position.The “LOCKED” bit in the PROFINET bitmap will only be set high if the following conditions are on: • LOCKED sensor input is high • UNLOCKED sensor input is low • TOOL PRESENT input is high
PROFINET	A communication system for Industrial Ethernet designed and developed by PROFIBUS International. It uses some mechanisms similar to those of the PROFIBUS field bus
RTL (Ready To Lock)	A proximity sensor input that senses when the ATI Tool is in close proximity.
SF LED	System Failure LED; this is a standard Profibus status LED, similar to the DeviceNet Module Status LED;it has a red part and a green part.
SNMP	Simple Network Management Protocol
SSO1 and SSO2	Inputs from a safety switch, which are high when the tool changer is in the stand.

Term	Definition
US2 Power Present	An input indicating the presence of Output Power (US2) at the ATI Master module.
Tool Power is On	The “Tool Power is ON” bit is set high when the Arc Prevention Circuit has activated power on the tool side. If this bit is low there will be neither Input/ Logic Power nor Output power available on the tool.
Tool Present	A hard connect input (sourced from the Tool) indicating the Master and Tool are electrically connected to each other.
Tool-ID	An input from the Master node reporting the values from the Tool-ID switch on the Tool module.
Unlatch (Unlock)	The output supplied to the ATI Master module to uncouple the Tool Changer.
Unlatch Enable	Indicates it is safe to proceed with an unlatch request.
Unlocked	A proximity sensor input indicating that the coupling mechanism is in the Unlocked position. The “UNLOCKED” bit in the PROFINET bitmap will only be set high if the following conditions are on: • UNLOCKED sensor input is high • LOCKED sensor input is low
Unsafe Unlatch	An input indicating that an Unlatch command was received which would result in an unsafe tool release and was therefore not processed.
US1 Power Present	An input indicating the presence of Input and Logic Power (US1) at the ATI Master module.
V1Relay and V2Relay	Inputs from relays which should mirror the status of SSO1 and SSO2.

C. Control and Signal Modules

DL8—PROFINET® Control/Signal Module

1. Product Overview

The DL8 modules enable the customer to control and communicate with the Tool Changer through a network using a PROFINET interface.

A PROFINET 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 PROFINET network and power to downstream equipment.

The module is to be used in combination with a valve adapter that has dual double solenoid valves, for Latch/Unlatch control of the Tool Changer. When used in combination with a dual double solenoid valve adapter, the DL8 achieves PLd safety reliability in accordance with ISO standard 13849-1. The user is required to provide a pneumatic supply source to the Tool Changer. Refer to the appropriate manual for specific module and Tool Changer requirements.

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. Refer to *Section 4.3—Error Conditions.*

A standard 5-pin push pull connector is provided on the Master and Tool modules for interfacing with power. The power source for input and output power must be capable of outputting an operating voltage (reverse polarity protected, regulated) of 24 +/- 15% VDC. A standard push pull RJ45 connector is provided on the Master and Tool modules for interfacing with PROFINET. When the Tool Changer is coupled, the Master and Tool modules pass signals via a spring loaded pin block. Flexible rubber V-ring seals surround the pin blocks and are designed to be water resistant but are not water proof. Refer to *Figure 1.1*.

The modules are designed with a safety circuit to allow the Tool Changer to operate as safely as possible. To avoid unintentional Tool release, the unlatch signals to the valves are energized only when a safety rated switch detects that the Tool is nested safely in the tool stand or storage location. The safety switch will activate only when it is within operating distance of a tool stand mounted actuator. Refer to *Section 2.4—Safety System* for detailed information regarding the safety features of the PROFINET control/signal modules.

1.1 Master Module

The Master module has an integrated 4-pin valve signal pin block to provide the latch and unlatch signals to the solenoid valves. The Master module is equipped with (4) 3-pin M8 connectors for the RTL1, RTL2, Lock, and Unlock sensor connections. Refer to *Figure 1.1*.

The Master module has integrated 3-pin M8 valve adapter proximity sensor and 4-pin M8 valve adapter pressure sensor connectors as part of the safety functionality. A 10-pin pig tail connector is provided for measurement connection. PROFINET requires a FE ground, the Master module provides a M8 x 1.25 FE ground terminal that is passes FE ground to the Tool Module through the 7-Pin contact block.

The Master 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 2.2—Arc Prevention Circuit* for additional information regarding the Arc Prevention Circuit.

The Master module provides status LED's to visually indicate its operation. A reset button provides the ability to return to default settings. Refer to *Section 2.1.3—System Failure and Bus Failure LEDs* and *Section 2.1.3—System Failure and Bus Failure LEDs*.

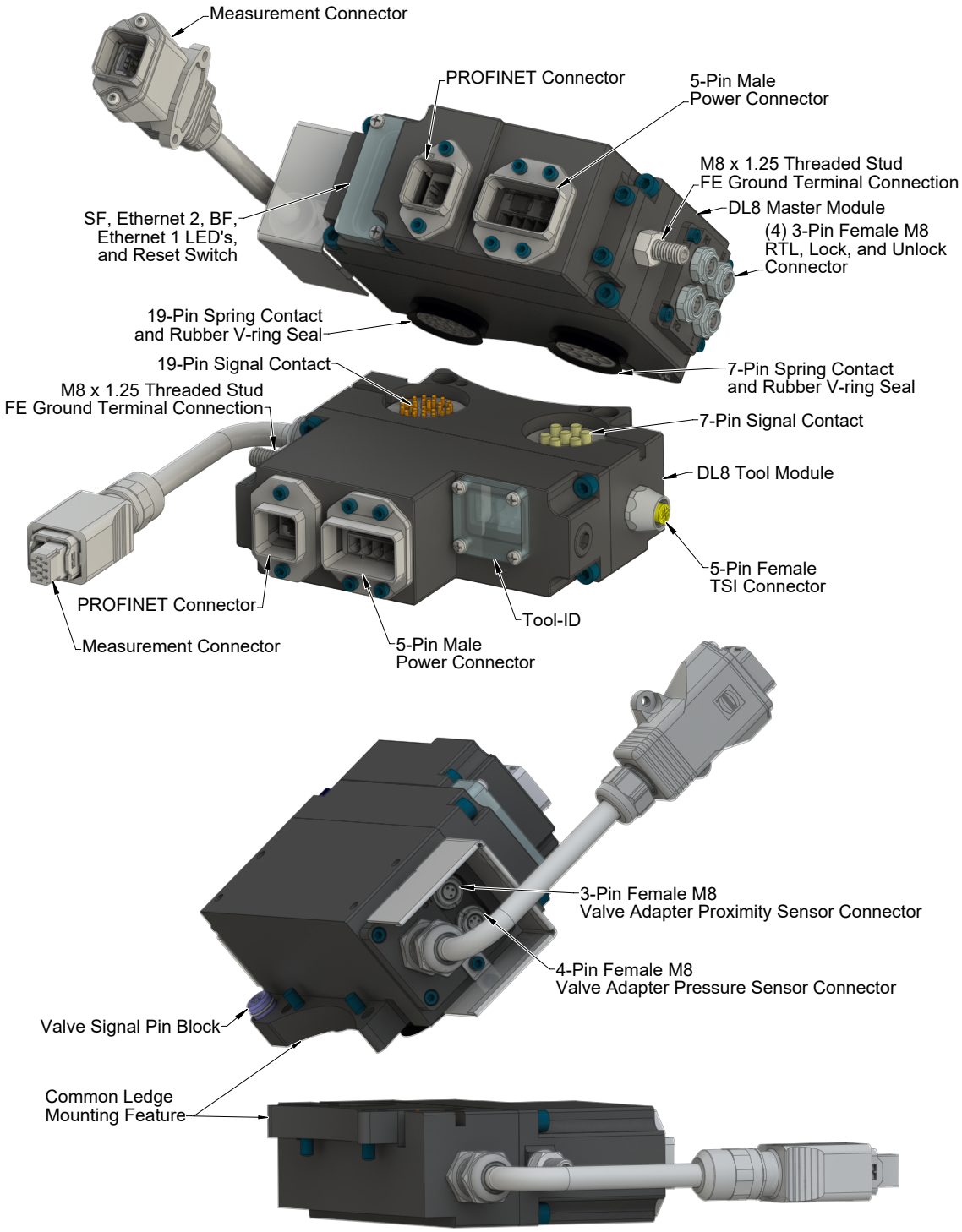
An electrical interface is provided on the Master module for support of two integrated double solenoid valves (DC Voltage, sourcing type). The integrated valve is supplied from ATI as part of a dual double solenoid valve adapter. Refer to the Valve Adapter Manual for more information (9620-20-C-Jxx Valve Adapters with Dual Double Solenoid, Valve Pass-through, Proximity and Pressure Sensors). Electrical interface drawings and connector details are provided in drawings in *Section 9—Drawings*.

1.2 Tool Module

The Tool module requires a JR4-T Tool adapter to align the Master and Tool modules and mounts to the Tool plate of the Tool Changer or Utility Coupler. A 5-pin M12 connector provides connection to the non-contact safety switch that is integrated into the safety circuit. A 10-pin pig tail connector is provided for measurement connection. PROFINET requires a FE ground, the Tool module provides a M8 x 1.25 FE ground terminal that is passes FE ground to the customer tooling. Refer to *Figure 1.1*.

The Tool module has a series of push button switches for setting of the Tool-ID input. Refer to *Figure 2.5*. 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 2.1.1—PROFINET Interface Information* for PROFINET bitmap and detailed I/O information.

Figure 1.1—DL8 Modules



2. Product Information

A PROFINET 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 PROFINET network and power to downstream equipment.

2.1 Master Module

2.1.1 PROFINET Interface Information

Table 2.1 lists the PROFINET interface parameters for the Master module.

Table 2.1—PROFINET Interface Parameters

Parameter	Description
DCP	supported
Fast Startup	supported
Used Protocols (subset)	UDP, IP, ARP, ICMP (Ping)
Topology recognition	LLDP, SNMP V1, MIB2, physical device
VLAN- and priority tagging	yes
Context Management	by CL-RPC
Minimum cycle time	2 ms
Baud rate	100 MBit/s
Data transport layer	Ethernet II, IEEE 802.3

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

(*http://www.ati-ia.com/Products/toolchanger/software/eds_files.aspx?type=profi*) or by email.

Reference the Part Number: 9031-20-1037

Robot input and output bitmaps for the Master node are provided in *Table 2.2* and *Table 2.3*.

2.1.2 Integrated Ethernet Switch

The Master module provides an integrated 2 port Ethernet switch which supports the following:

- Transmission rate 100 MBit/s
- Interface type 100 BASE-TX, isolated
- Half duplex/Full duplex supported
- Auto Negotiation supported
- Auto Crossover supported

Table 2.2—I/O Bit map, Robot Inputs from 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
0	0	Locked	Tool Changer is locked
	1	Unlocked	Tool Changer is unlocked
	2	US1_Power_Present	US1 supply voltage on robot side within the allowable range of 20.4 to 28.8 V
	3	US2_Power_Present	US2 supply voltage on robot side within the allowable range of 20.4 to 28.8V
	4	RTL1	Ready to Lock Prox1 I/P
	5	RTL2	Ready to Lock Prox2 I/P
	6	TOOL_PRESENT	Bit indicating Master and Tool are in electrical contact
	7	Tool Power Is On	Indicates that Arc Prevention Circuit is turned ON and power is provided to the Tool
1	0	Unlatch Enabled	Unlatch Enabled Status Information
	1	SSO_1	Input from safety switch that indicates it is safe to unlatch the Tool Should always agree with SSO_2
	2	SSO_2	Input from safety switch that indicates it is safe to unlatch the Tool Should always agree with SSO_1
	3	SS Pulse Missing	Is high if the SSO_1 input is bypassed or shorted high
	4	V1RELAY	Indicates that safety switch has activated safety relay 1 Should agree with SSO_1
	5	V2RELAY	Indicates that safety switch has activated safety relay 2 Should agree with SSO_2
	6	AP2_COMM_ ERROR	AP1 lost communication to AP2
	7	Unsafe Unlatch	Unlatch Rejected Due to Unsafe Condition Present
2	0	EVERYTHING IS OK	Overall Status Bit. Is high as long as there is no error.
	1	ERROR_ON_ LATCH	Overload or short circuit on Latch Output
	2	ERROR_ON_ UNLATCH1	Overload or short circuit on Unlatch1 Output
	3	ERROR_ON_ UNLATCH2	Overload or short circuit on Unlatch2 Output
	4	Lock/Unlock Sensor Fault	Lock & Unlock Inputs On at the same time, swapped lock & unlock sensors, faulty sensors, or no latch/unlatch motion.
	5	TOOL-ID_ERROR	Tool-ID Communication Timeout
	6	UNSAFE_LATCH	User attempted to latch when unsafe
	7	SYSTEM_IS_ UNSAFE	Any APx_COMM_ERROR, APx_MISMATCH_ERROR, APx_ SAFETY_ERROR sets this bit

Notes:

These bits should be mapped for customer use.

These bits should be mapped for ATI diagnostic use.

The pressure reading is a 10-bit ADC. To convert the ADC counts to PSI, multiply the ADC counts by 0.1173. Example: 692 counts x 0.1173= 80 PSI

Table 2.2—I/O Bit map, Robot Inputs from 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
3	0	Tool-ID Switch2 Bit1	N/A
	1	Tool-ID Switch2 Bit2	
	2	Tool-ID Switch2 Bit4	
	3	Tool-ID Switch2 Bit8	
	4	Tool-ID Switch1 Bit1	
	5	Tool-ID Switch1 Bit2	
	6	Tool-ID Switch1 Bit4	
	7	Tool-ID Switch1 Bit8	
4	0	Tool-ID Switch4 Bit1	
	1	Tool-ID Switch4 Bit2	
	2	Tool-ID Switch4 Bit4	
	3	Tool-ID Switch4 Bit8	
	4	Tool-ID Switch3 Bit1	
	5	Tool-ID Switch3 Bit2	
	6	Tool-ID Switch3 Bit4	
	7	Tool-ID Switch3 Bit8	
5	0	Tool-ID Switch5 Bit1	
	1	Tool-ID Switch5 Bit2	
	2	Tool-ID Switch5 Bit4	
	3	Tool-ID Switch5 Bit8	
	4	VALVE_ERROR	Valve or pressure sensor defect. Logical OR of APx_VALVE_ERROR bits
	5	CROSS_MONITORING_ERROR	Safety System detected mismatch. Logical OR of the APx_INP_MISMATCH, APx_OUTP_MISMATCH, and AP2_COMM_ERROR bits
	6	PRESSURE_TOO_HIGH	Pressure sensor reports an unlatch pressure higher than the maximum system rating.
	7	PRESSURE_TOO_LOW	Pressure sensor report an unlatch pressure lower than the minimum system rating .
6	0	Minor Revision Bit0	uC firmware revision
	1	Minor Revision Bit1	
	2	Minor Revision Bit2	
	3	Minor Revision Bit3	
	4	Major Revision Bit0	
	5	Major Revision Bit1	
	6	Major Revision Bit2	
	7	Major Revision Bit3	

Notes:

These bits should be mapped for customer use.

These bits should be mapped for ATI diagnostic use.

The pressure reading is a 10-bit ADC. To convert the ADC counts to PSI, multiply the ADC counts by 0.1173. Example: 692 counts x 0.1173= 80 PSI

Table 2.2—I/O Bit map, Robot Inputs from 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
7	0	Raw Locked Sensor	Direct mirror of locked proximity sensor
	1	Raw Unlocked Sensor	Direct mirror of unlocked proximity sensor
	2	Valve Proximity Sensor	Shows status of valve position
	3	Reserved	N/A
	4	AP1_VALVE_ ERROR	Valve 2 opening or closing at the wrong time
	5	AP1_OUTP_ MISMATCH	AP1 detects that AP2 has come to a different decision than AP1 regarding a safety-critical motion, or AP1 sees Unlatch_ valve_control_2 is different than expected
	6	AP1_INP_ MISMATCH	AP1 detects that AP2 reports different input values than AP1 sees
	7	MEMORY_FAILURE	N/A
8	0	Reserved	
	1	Reserved	
	2	Reserved	
	3	RTL1/RTL2 mismatch	RTL1/RTL2 sensor inputs mismatched
	4	Firmware Version Mismatch	N/A
	5	Reserved	
	6	Reserved	
	7	Reserved	
9	0	AP2_Mismatch_ Error	
	1	AP2_Comm_Error	
	2	AP2_Memory_ Failure	
	3	AP2_VALVE_ ERROR	Position sensor does not meet expectations
	4	ERROR_ON_ UNLATCH2	Overload on Unlatch 2 output was detected
	5	PRESSURE_ SENSOR_ DISCONNECTED	Internal bit indicating that the pressure sensor is disconnected and/or that there are broken wires in the sensor cable
	6	Memory_Tests_ Complete	N/A
	7	Safe_to_Unlatch_ AP2	

Notes:

These bits should be mapped for customer use.

These bits should be mapped for ATI diagnostic use.

The pressure reading is a 10-bit ADC. To convert the ADC counts to PSI, multiply the ADC counts by 0.1173. Example: 692 counts x 0.1173= 80 PSI

Table 2.2—I/O Bit map, Robot Inputs from 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
10	0	AP2_SSO_2	N/A
	1	V1Relay	
	2	V2Relay	
	3	AP2_SSFAULT	
	4	Unlatch_Valve_ Control_2	
	5	Valve_Position	
	6	AP2_Version_Error	
	7	AP2_Safety_Error	
11	0	Pressure Reading Bit 8	
	1	Pressure Reading Bit 9	
	2	Unused	
	3		
	4		
	5		
	6		
	7		
12	0	Pressure Reading Bit 0	
	1	Pressure Reading Bit 1	
	2	Pressure Reading Bit 2	
	3	Pressure Reading Bit 3	
	4	Pressure Reading Bit 4	
	5	Pressure Reading Bit 5	
	6	Pressure Reading Bit 6	
	7	Pressure Reading Bit 7	

Notes:

☐ These bits should be mapped for customer use.

▭ These bits should be mapped for ATI diagnostic use.

The pressure reading is a 10-bit ADC. To convert the ADC counts to PSI, multiply the ADC counts by 0.1173. Example: 692 counts x 0.1173= 80 PSI

Table 2.2—I/O Bit map, Robot Inputs from 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
13	0	Unused	Unused
	1		
	2		
	3		
	4		
	5		
	6		
	7		
14	0	Major Version Number of AP2 [0:4]	AP2 Firmware Revision Number
	1		
	2		
	3		
	4	Minor Version Number of AP2 [0:4]	
	5		
	6		
	7		
15		Reserved	

Notes:

These bits should be mapped for customer use.

These bits should be mapped for ATI diagnostic use.

The pressure reading is a 10-bit ADC. To convert the ADC counts to PSI, multiply the ADC counts by 0.1173. Example: 692 counts x 0.1173= 80 PSI

Table 2.3—I/O Bitmap, Robot Outputs to 9121-DL8-M			
Byte	**Bit#**	**Name**	**Description/Function**
0	0	Latch	Request Lock
	1	Unlatch	Request Unlock
	2	(Unused - Does not need to be mapped)	
	3	Clear Errors	Reset errors, allow affected I/O to be reactivated
	4	Reserved	N/A
	5	(Unused - Does not need to be mapped)	
	6	Direct Power Control Enable	Arc Prevention Override
	7	(Unused - Does not need to be mapped)	
1 to 7	(Unused - Does not need to be mapped)		

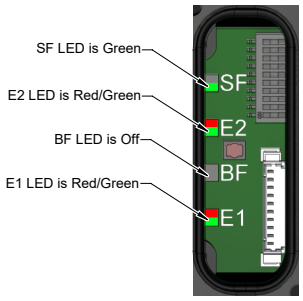
Notes:

These bits should be mapped for customer use.

2.1.3 System Failure and Bus Failure LEDs

When the modules are coupled and communicating properly on the network, the LEDs should display as shown in *Figure 2.1*, with the E1 and E2 LEDs Red (solid) and Green (solid) based on the PROFINET communication.

Figure 2.1—LED Display of Properly Functioning Coupled Modules



The System Failure (SF) status LED is identified on the module as "SF". It provides device status for power and proper operation. Refer to *Table 2.4* for an outline of this LED's operation.

The Bus Failure (BF) status LED is identified on the module as "BF". It provides PROFINET status information. Refer to *Table 2.5* for an outline of this LED's operation.

Table 2.4—SF status LED

Status	LED Function		Note
No Power		Off	No power applied. Check if the voltage is between 20.4 and 28.8VDC.
Operational[1]		Green (solid)	Normal operation.
Fault		Red (solid)	The fault Internal Diagnostic Error has occurred.
Fault		Red (flashing)	Reset To Factory Push Button was pressed or one of the following faults has occurred: - Communication error with tool module - Input power failure

Note:
1. The LED will be green even if no network connection is established.

Table 2.5—BF status LED

Status	LED Function		Note
Operational[1]		Off[1]	No error (Normal operation).
Not OK		Green (solid)	Watchdog timeout; channel, generic or extended diagnosis present; system error.
		Green (flashing)	DCP signal service is initiated via the bus.
		Red (solid)	No configuration.
		Red (flashing)	No data exchange.

Note:
1. If the LED is off it may also indicate the device may be powered off.

2.1.4 Ethernet 1 and Ethernet 2 LEDs

The Ethernet LEDs provide information about link status and activity on the ports of the integrated Ethernet switch.

The Ethernet 1 (E1) LED will display the status of the robot side Ethernet port. The Ethernet 2 (E2) LED will display the status of the Tool side Ethernet port. The module status listed in *Table 2.6* and *Table 2.7* will be indicated by the specified LED color and state.

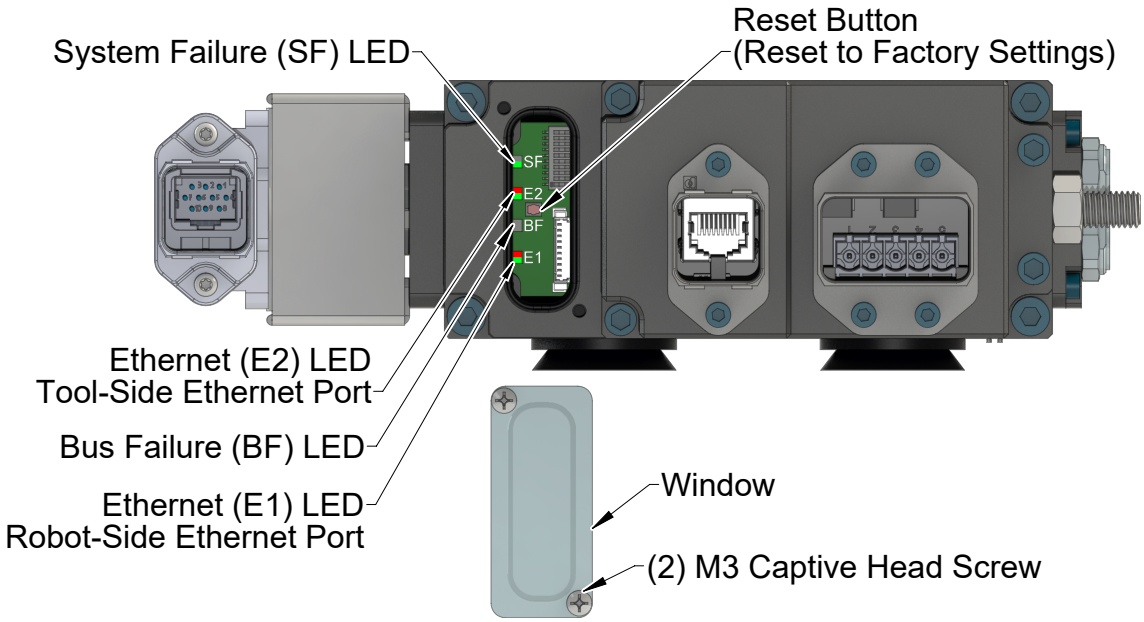
Table 2.6—Ethernet 1 (E1) Robot Side LED

Status	LED Function		Note
No Link		Off	The Master module has no connection to the Ethernet.
Link		Green (solid)	The Master module is connected to the Ethernet but there is currently no data exchange activity.
Active RX/TX		Red (flashing) Green (solid)	There is sporadic data exchange activity with the Ethernet.
PROFINET connection established		Red (solid) Green (solid)	There is continuous data exchange activity with the Ethernet.

Table 2.7—Ethernet 2 (E2) Tool Side LED

Status	LED Function		Note
No Link		Off	The Tool module has no connection to the Ethernet.
Link		Green (solid)	The Tool module is connected to the Ethernet but there is currently no data exchange activity.
Active RX/TX		Red (flashing) Green (solid)	There is sporadic data exchange activity with the Ethernet.
PROFINET connection established		Red (solid) Green (solid)	There is continuous data exchange activity with the Ethernet.

Figure 2.2—DL8 Master Module LED and Reset Button



2.1.5 Reset To Default Push Button

A push button, located under the LED window cover between the E2 and BF LED allows the user to perform a "Reset To Default" function which clears the PROFINET Name Of Station and the module's IP address. This is useful when already configured devices get swapped or a broken device gets replaced by an already configured device. See *Section 6.2.2—Master Module Replacement Procedures* for a detailed device replacement procedure.

After the push button is pressed the SF LED will blink red, indicating that with the next power cycle the Name of Station and IP address will be cleared.

Make sure to re-apply the LED window cover after access to the push button is not needed anymore.

2.2 Arc Prevention Circuit

The DL8 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 DL8 module, the Arc Prevention Circuit controls the ON/OFF status of the following two power signals:

-Input and Logic power US1+

-Output power US2+

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

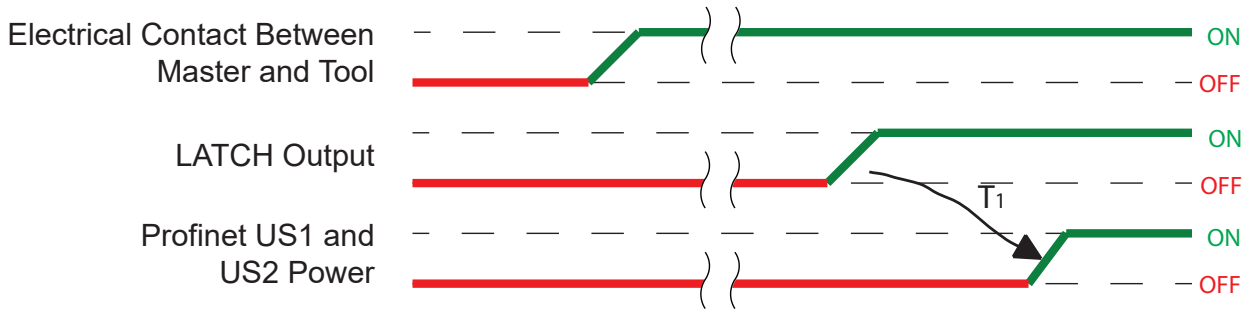
2.2.1 Arc Prevention Circuit Behavior during Coupling

The behavior of the Arc Prevention circuit during coupling can be more clearly understood by referring to *Figure 2.3*.

When the robot and Master approach the Tool for pick up, electrical contact between the Master and Tool pin contacts occurs. Soon after the Latch command is turned ON, the Arc Prevention Circuit will turn on US1 and US2 power. The time delay between when the LATCH output is turned ON to when power is actually available to the EOAT (time T_1 in the diagram) is less than 100 ms.

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.

Figure 2.3—Power On Timing



T_1 = Power Switch ON-delay (Less than 100 ms)

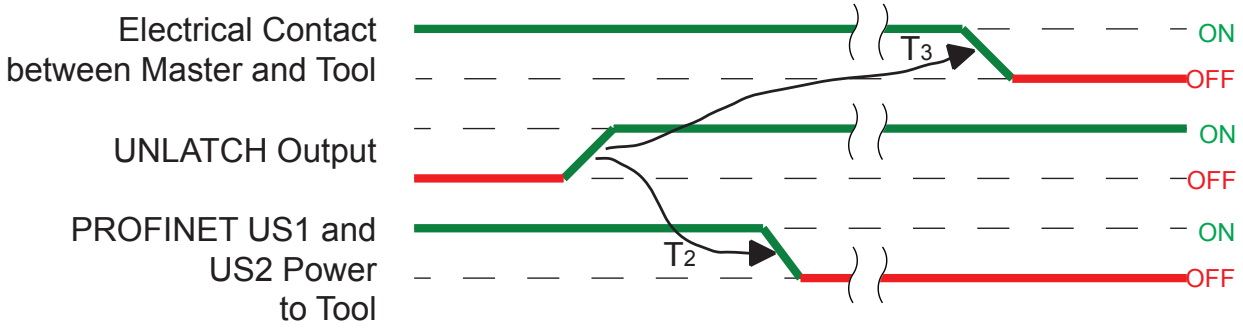
2.2.2 Arc Prevention Circuit Behavior during Uncoupling

The behavior of the Arc Prevention Circuit during uncoupling can be more clearly understood by referring to *Figure 2.4*.

Immediately after the UNLATCH command is issued, the Arc Prevention Circuit will turn off US1 and US2 power. The power off time delay between the UNLATCH command and the switching off of power (designated T_2 in the diagram) is less than 50 ms.

Some time after power is turned off and the Master and Tool begin to separate, electrical contact between Master and Tool pin contacts will be lost. This occurs with a delay, designated T_3 in the diagram, after the UNLATCH command is issued. The magnitude of time T_3 is a function of many factors, including the weight of the EOAT, the friction between Master and Tool alignment pins, etc. but is usually not shorter than 100 ms.

Figure 2.4—Power-Off Timing



T_2 = Power Switch OFF-delay
T_3 = Tool Changer Unlock Time

2.3 Tool Module

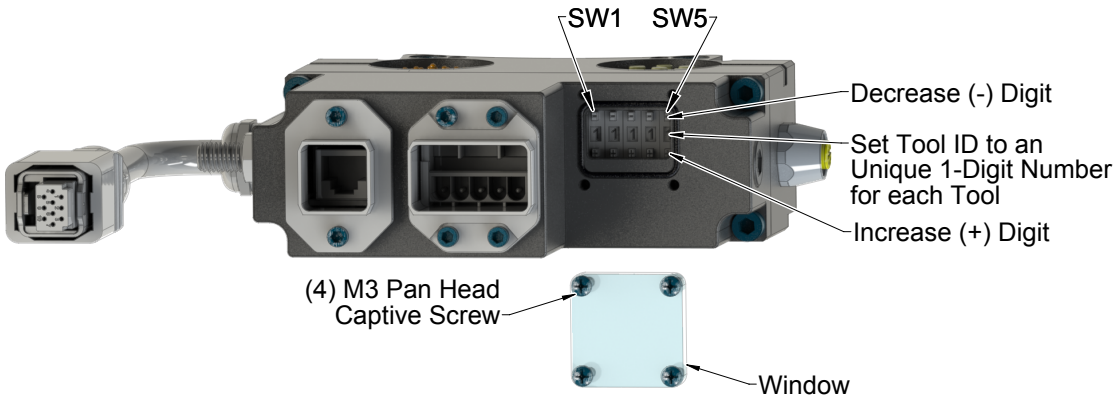
The Tool module utilizes a rapid communication method to report the Tool-ID information from the push button switches to the Master module as soon as the Tool Changer is coupled. Typically the Tool-ID information is available to the Master within 250 ms from the time the Tool Changer is coupled.

(5) push button switches are provided on the Tool module for setting of a Tool-ID number.

If the plastic window and seal above the Tool-ID switches are removed, ensure the seal and window are re-positioned correctly to prevent a leakage path to the module inside.

The Tool-ID is available to the Master within 250 ms from the time the changer is coupled; otherwise a Tool-ID_Error will be set in the bit map. If a Tool is not present the Tool-ID is set to FFFFF. If the Master and Tool are coupled and the Tool-ID fails to be reported, a Tool-ID_Error will be set.

Figure 2.5—Tool-ID Switch Settings

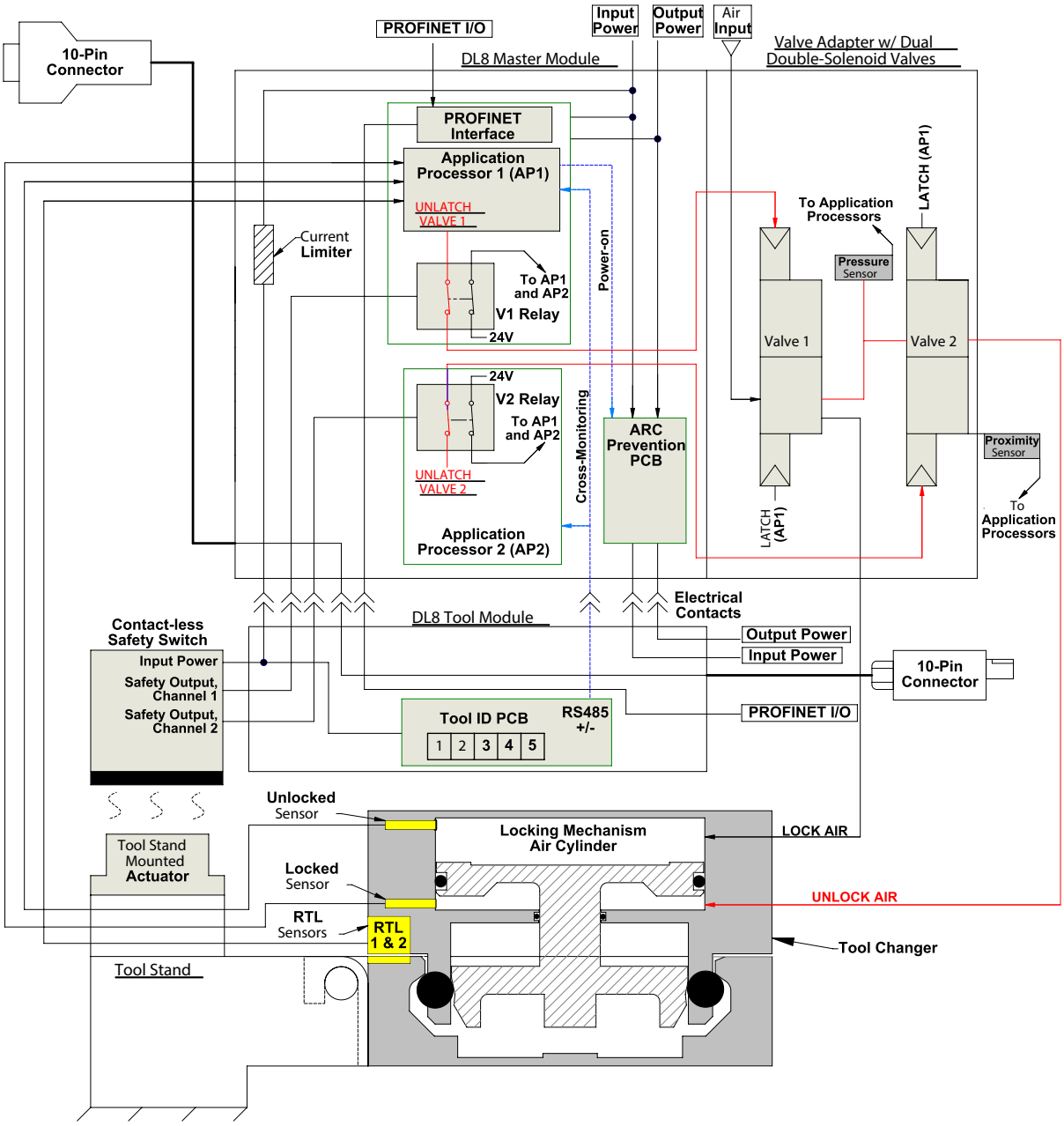


2.4 Safety System

The Master module in conjunction with a dual double solenoid valve adapter has special features to achieve a PLd safety reliability level in accordance with ISO standard 13849-1. The safety system is designed to avoid unintentional Tool release, integrating the non-contact safety switch, two pneumatically interconnected solenoid valves, dual relays, and two cross monitoring processors into the safety circuit. Refer to the dual double solenoid valve adapter manual for detailed information on the dual double solenoid valve functionality.

The two cross monitoring processors in the Master module will determine, based on the status of all the safety related inputs and outputs, when it is safe to execute an Unlatch command. The processors are linked by hardwired I/O. If one processor detects a condition that differs from the other processor, its control logic will declare a fault preventing the unlatch output. When the Tool is positioned safely in the tool stand or storage location, the safety switch outputs will close the V1 and V2 relays allowing the Unlatch command to pass from the Application Processors to the solenoid valves.

Figure 2.6—Safety Circuit Diagram

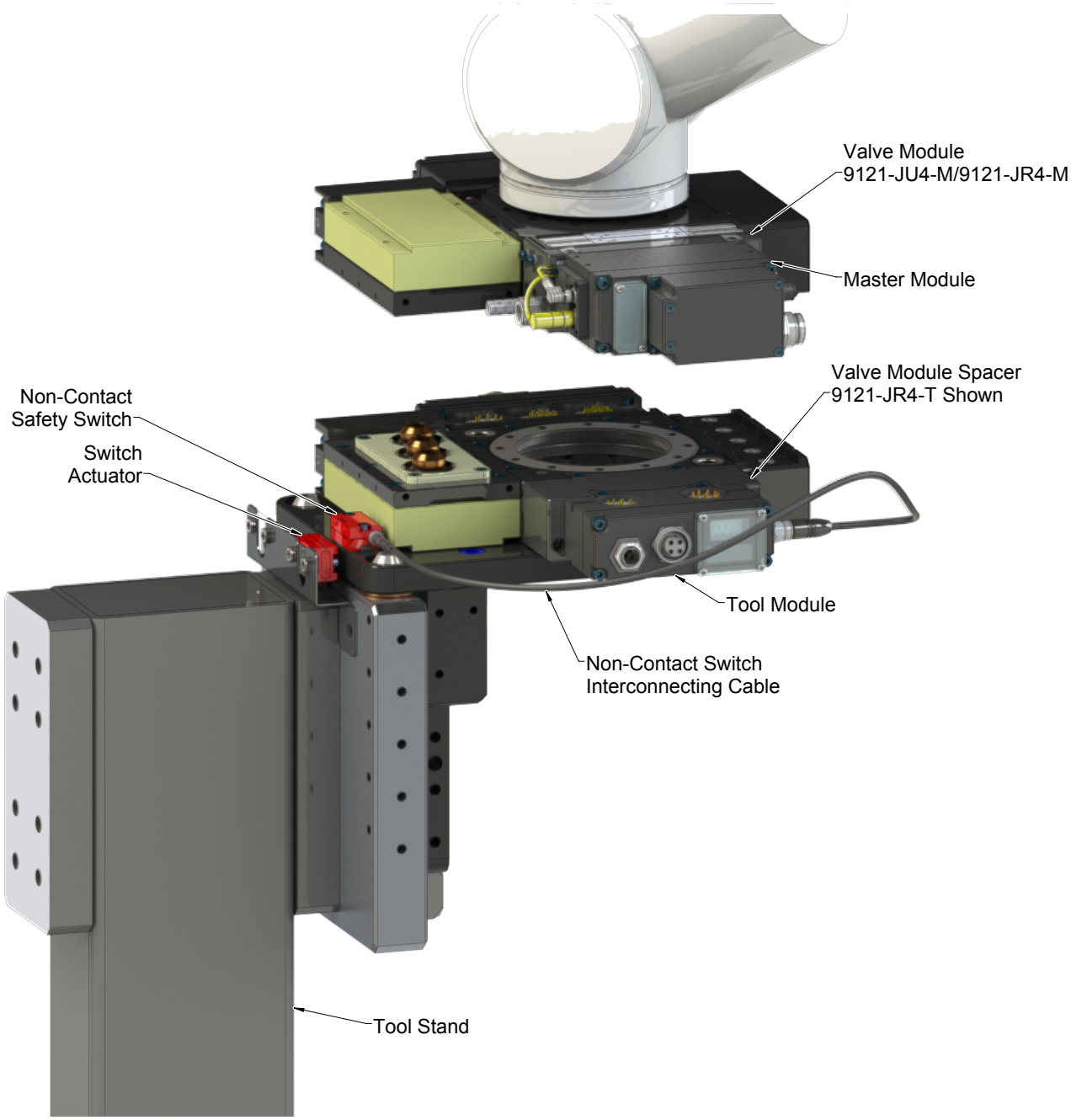


A second set of contacts on the V1 and V2 relays also provide diagnostics to the Application Processors. A dual double solenoid valve adapter is equipped with two double solenoid valves. Pressure and proximity sensor outputs provided by the valve adapter are evaluated by the Application Processors for diagnostic purposes.

The safety switch (not included with module) is mounted tool interface plate or customer tooling. The actuator is mounted to the tool stand. The safety switch is connected to the Tool module by a (5) conductor M12 cable.

CAUTION: It is required to use a PLe rated non-contact safety switch such as the CES-AP with the DL8 module. Use of unapproved switches will void the PLd safety rating. Contact ATI before using another safety rated switch.

Figure 2.7—Safety Switch (Modules Shown for Reference Only)



3. Installation

The control/signal modules are typically installed by ATI prior to shipment. The steps below outline the field installation or removal as required. For wiring information refer to *Section 9—Drawings*.

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

CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

3.1 Master Module Installation

NOTICE: If module being installed is not new “out of the box” and has been previously commissioned refer to *Section 6.2.2—Master Module Replacement Procedures* for instructions.

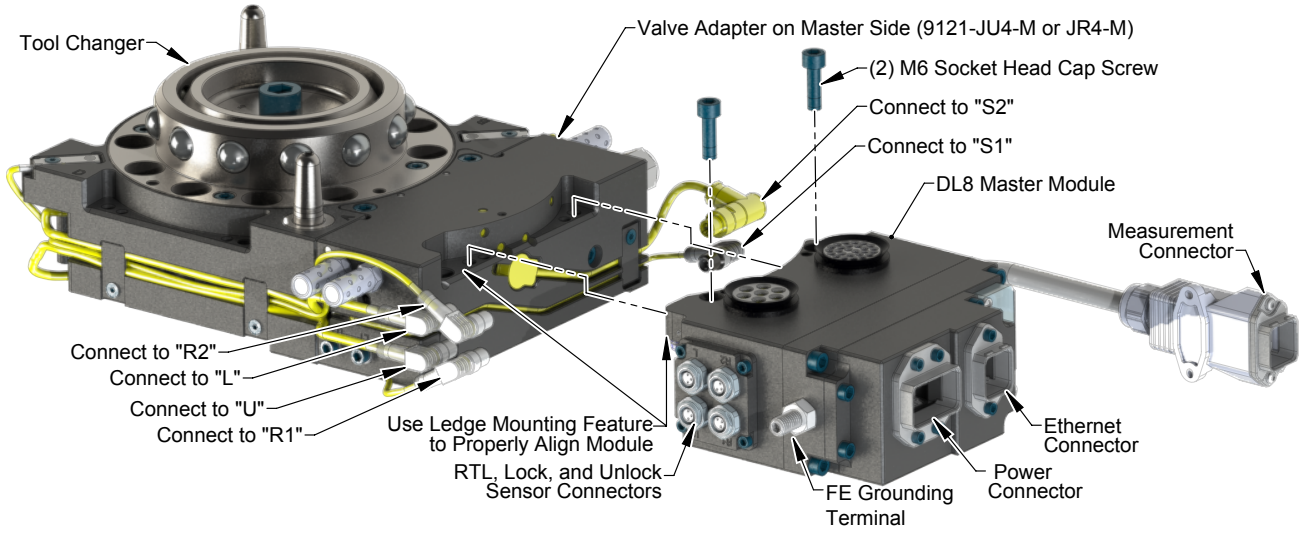
Refer to *Figure 3.1*

Tools required: *5 mm hex key*

Supplies required: *Clean rag, Loctite® 242*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Wipe down the mounting surfaces with a clean rag.
5. Using the ledge feature, place the module into the appropriate location on the valve adapter. Align the module with the valve adapter using the dowels in the bottom of the ledge feature.
6. Apply Loctite 242 to the supplied M6 socket head cap screws. Using a 5 mm hex key, install the (2) M6 socket head cap screws securing the module to the valve adapter and tighten to 70 in-lbs (7.9 Nm).
7. Connect the valve adapter proximity sensor cable to (S1) and valve adapter pressure sensor cable to (S2) connections on the module.
8. Connect the (L) Lock, (U) Unlock, and (R1 and R2) RTL sensor cable connectors to the module.
9. Connect the 5-pin power cable, measurement cable, and PROFINET cable connectors to the module.
10. Connect ground to FE grounding terminal.
11. The module will automatically get the name and IP address assigned.
12. After a few seconds, it should be operating on the network.
13. Safely resume normal operation.

Figure 3.1—Master Module Installation



3.2 Master Module Removal

Tools required: *5 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Disconnect the (L) Lock, (U) Unlock, and (R1 and R2) RTL sensor cable connectors from the module.
5. Disconnect the 5-pin power cable, measurement cable, and PROFINET cable connectors from the module.
6. Disconnect the valve adapter proximity sensor cable from (S1) and valve adapter pressure sensor cable from (S2) connections on the module.
7. Disconnect ground from FE grounding terminal.
8. Support the control/signal module and remove the (2) M6 socket head cap screws using a 5 mm hex key and lower the module until it clears the guide pin.

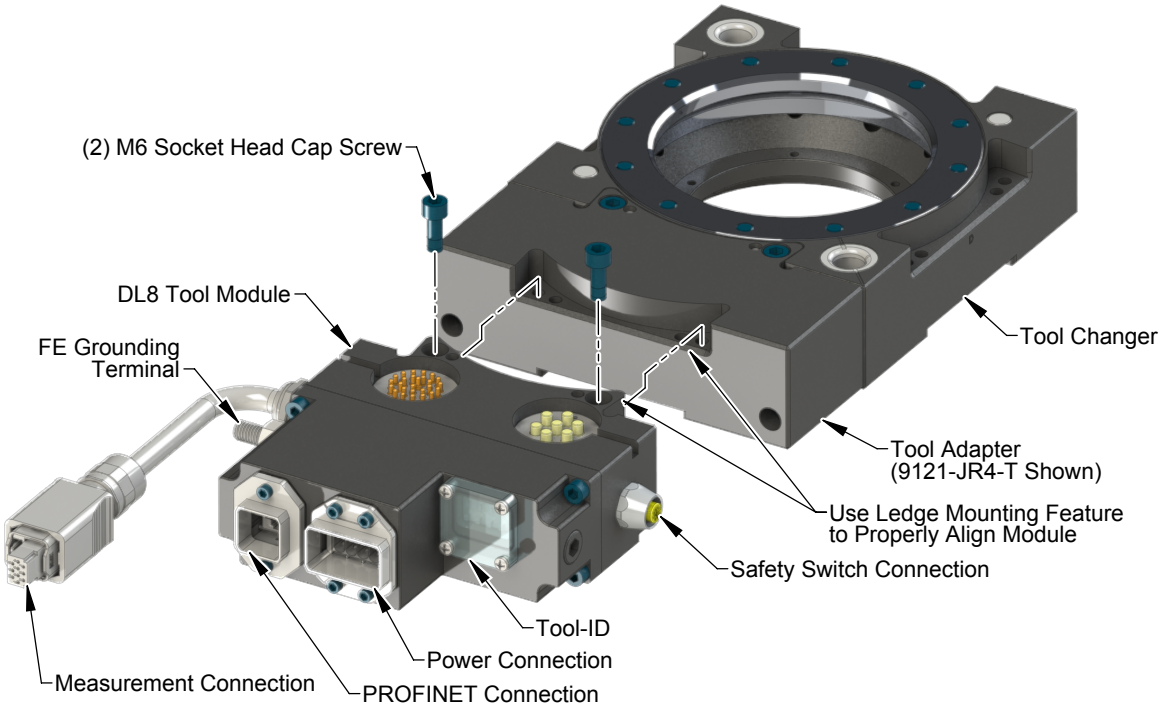
3.3 Tool Module Installation

Tools required: *5 mm hex key*

Supplies required: *Clean rag, Loctite 242*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Wipe down the mounting surfaces with a clean rag.
5. Using the ledge feature, place the module into the appropriate location on the tool adapter. Align the module with the tool adapter using the dowels in the bottom of the ledge feature. Refer to *Figure 3.2*.
6. Apply Loctite 242 to the supplied M6 socket head cap screws. Using a 5 mm hex key, install the (2) M6 socket head cap screws securing the module to the tool adapter and tighten to 70 in-lbs (7.9 Nm).
7. Connect the safety switch cables to the module.
8. Connect the 5-pin power cable, measurement cable, and PROFINET cable connectors to the module.
9. Connect ground to FE grounding terminal.
10. Set the Tool-ID. Refer to *Section 3.8—Setting the Tool-ID.*
11. Safely resume normal operation.

Figure 3.2—Tool Module Installation



3.4 Tool Module Removal

Refer to *Figure 3.2*

Tools required: *5 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Disconnect the safety switch cables from the module.
5. Disconnect the 5-pin power cable, measurement cable, and PROFINET cable connectors from the module.
6. Disconnect ground from FE grounding terminal.
7. Support the module and remove the (2) M6 socket head cap screws using a 5 mm hex key and lift up on the module until it clears the guide pin.

3.5 PROFINET Interface

The PROFINET interface parameters and I/O bitmaps used in the modules are found in *Section 2.1.1—PROFINET Interface Information* of the manual. These should be thoroughly understood prior to operating the Tool Changer. A detailed operational sequence is provided in *Section 4.4—Recommended Sequence of Operation.*

3.6 Utility Schematic

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

3.7 Electrical Connections

Refer to drawings in *Section 9—Drawings* of this manual for electrical connection and pin/signal information.

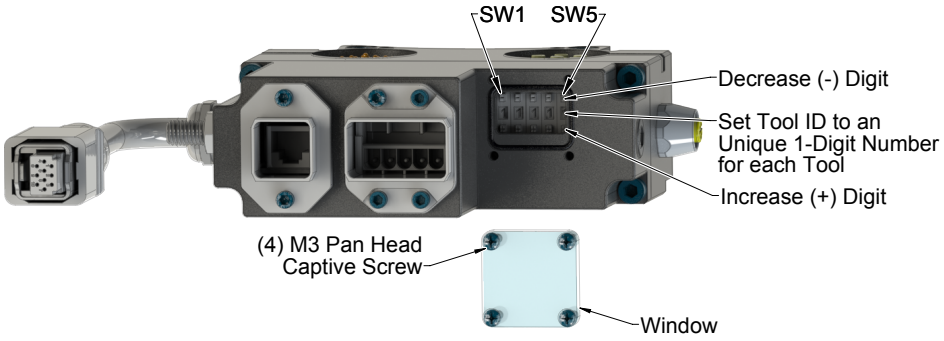
3.8 Setting the Tool-ID

(5) push button switches are provided on the Tool module for setting of a Tool-ID number. Each Tool must have an unique 5 digit Tool-ID number.

Tools required: *Phillips head screw driver, plastic stylus*

1. Loosen the (4) M3 pan head captive screws using a Phillips head screw driver and remove Tool-ID window.
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.
3. Install the Tool-ID window and tighten the (4) M3 pan head captive screws.

Figure 3.3—Setting the Tool-ID



4. Operation

A thorough understanding of the advanced diagnostic and fault reporting capability is required to proficiently operate this product. The following information is provided to help define the behavior of the modules.

Refer to the specific Tool Changer Manual for conditions for coupling of the Tool Changer and *Section 4.4—Recommended Sequence of Operation*. When coupled, the Tool module can be communicated with, Tool-ID can be read (if equipped), and attached end-effectors can be used.

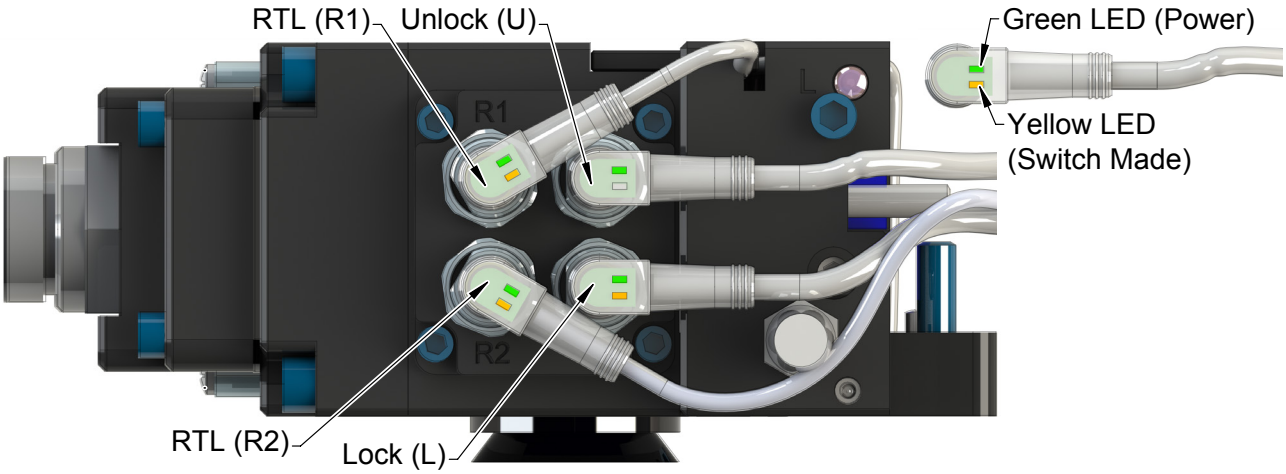
4.1 Lock, Unlock, and RTL Sensor Cable LED Behavior

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

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

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

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



(Control module shown for reference only)

4.2 Inputs

The following describes the most critical inputs from the ATI Master module.

4.2.1 Locked

An input indicating that the coupling mechanism is in the Lock position. The “LOCKED” bit in the PROFINET bitmap will only be set high if the following conditions are on:

- LOCKED sensor input is high
- UNLOCKED sensor input is low
- TOOL PRESENT input is high

4.2.2 RTL1 and RTL2

Proximity sensor inputs that indicate the Tool Changer Master is close to the Tool. The lack of these inputs does not prevent latching. It is recommended that these inputs be programmed to indicate when it is okay to couple the Tool Changer. These proximity sensors are installed in the Master body and sense targets in the Tool body that indicate the Master is adjacent to the Tool (within ~ 0.06” or 1.5 mm).

4.2.3 SSO 1 and SSO 2

Discrete inputs from the safety switch, which are high when the Tool Changer is in the stand.

4.2.4 Tool Present

An input indicating the Master module is electrically connected to the tool.

4.2.5 Unlocked

A proximity sensor input indicating that the coupling mechanism is in the Unlocked position. The “UNLOCKED” bit in the PROFINET bitmap will only be set high if the following conditions are on:

- UNLOCKED sensor input is high
- LOCKED sensor input is low

4.2.6 US1 Power Present

An input indicating the presence of Input and Logic Power (US1) at the ATI Master module. US1 power must be between 20.4V and 28.8V otherwise the Tool Changer will NOT latch or unlatch.

4.2.7 US2 Power Present

An input indicating the presence of Output Power (US2) at the ATI Master module. US1 power must be between 20.4V and 28.8V otherwise the Tool Changer will NOT latch or unlatch.

4.2.8 V1 Relay and V2 Relay

V1 Relay is a normally open relay driven to closure by Channel 1 of the Safety Switch (SSO1). Similarly, the V2 Relay is driven to closure by Channel 2 of the Safety Switch (SSO2). Both of these inputs must be high when the Tool Changer is in the tool stand, otherwise the Tool Changer will NOT unlatch.

4.2.9 EVERYTHING IS OK

This is an overall status bit that indicates if there is an error condition that will block an unlatch request. This bit is ON as long as the following conditions are meet:

- No safety errors reported by either micro controller (Byte 2 bit 7)
- Unsafe Unlatch is not on (Byte 1 bit 7)
- Unsafe Latch is not on (Byte 2 bit 6)
- Latch not completed is not on (Byte 2 bit 4, which is a logical-or of "latch not completed," lock/unlock sensor fault, and "unlatch motion not completed")
- Pressure too high is not on (Byte 5 bit 6)
- Pressure too low is not on (Byte 5 bit 7)
- No communication error with tool board (Byte 2 bit 5)
- US1 power is good (Byte 0 bit 2)
- Switched power is good (Byte 0 bit 7)

Safety errors are triggered by:

- Memory test errors (Byte 7 bit 7)
- The micro controllers disagree on the value of safety-critical inputs, such as the SSO inputs (Byte 7 bit 6)
- The micro controllers disagree on what the critical safety outputs, such as the unlatch signal should be (Byte 7 bit 5)
- A valve error was detected, e.g valve prox error or pressure failure during unlatch sequence (Byte 7 bit 4, also logical-ored into Byte 5 bit 4)
- Communication errors between two safety micro controllers (Byte 1 bit 6, also logical-ored into byte 5 bit 5)
- The two safety micro controllers are not running the same firmware version (Byte 8, bit 4)
- Unlatch motion not verified (Byte 2 bit 4, which is a logical-or of "latch not completed," "lock/unlock sensor fault," and "unlatch motion not completed."
- Pressure does not enter the expected range (between max and min allowed pressure) during unlatch sequence. In this case, the pressure-too-high or pressure-too-low bit will be set as appropriate. This could be because they are not providing proper pressure, or a failure in the valve.

4.2.10 Tool Power Is On

The Tool Power Is On bit indicates that the Arc Prevention circuit has turned power on to the Tool side.

4.2.11 Unlatch Enabled

The Unlatch Enabled bit indicates when the preconditions for unlatching the Tool Changer have been met. The preconditions include:

- No Errors
- US1 and US2 Power within operating range
- Air pressure within operating range
- UNLOCKED bit is low
- LATCH bit is low
- The Tool is in the tool stand as indicated by SSO1, SSO2, V1RELAY, and V2RELAY bits being high

4.3 Error Conditions

The following describes the reported error conditions and explains how to reset the condition.

4.3.1 AP2 COMM ERROR

This bit indicates that the (2) Application Processors in the Master module have stopped communicating. The error condition can be reset with Clear Errors bit. If this error is re-occurring, contact ATI for service.

4.3.2 CROSS MONITORING ERROR

The (2) Application Processors monitor the various safety related inputs and outputs. If the processors are not in agreement on the status of these inputs and outputs the CROSS_ MONITORING_ERROR bit will be set.The error condition can be reset with the Clear Errors bit.

4.3.3 ERROR ON LATCH

This bit indicates that a short circuit or overload condition on the LATCH output has been detected. The error condition can be reset with the Clear Errors bit.

4.3.4 ERROR ON UNLATCH1

This bit indicates that a short circuit or overload condition on the UNLATCH output to Valve 1 has been detected.

The error condition can be reset with the Clear Errors bit.

4.3.5 ERROR ON UNLATCH2

This bit indicates that a short circuit or overload condition on the UNLATCH output to Valve 2 has been detected. The error condition can be reset with the Clear Errors bit.

4.3.6 Lock/Unlock Sensor Fault

This error bit will be set if the Locked and Unlocked Sensors are on at the same time. If the condition is not on anymore then the bit will be automatically reset.

4.3.7 PRESSURE TOO HIGH

If the module detects the air pressure above 100 psi (6.9 Bar) then the PRESSURE_TOO_HIGH bit is set. The error can be reset by supplying air at the correct pressure and then applying the Clear Errors. See the Notes section of *Table 2.2* for pressure determination.

4.3.8 PRESSURE TOO LOW

If the module detects the air pressure below 60 psi (4.1 Bar) then the PRESSURE_TOO_LOW bit is set. The error can be reset by supplying air at the correct pressure and then applying the Clear Errors. See the Notes section of *Table 2.2* for pressure determination

4.3.9 TOOL-ID ERROR

The Tool-ID will be available to the Master within 250 ms from the time the changer is coupled; otherwise a TOOL-ID ERROR is set in the bit map. If the Master and Tool are coupled and the Tool-ID fails to be reported, a TOOL-ID ERROR is set. The error condition can be reset with a rising edge of TOOL PRESENT or the Clear Errors bit.

4.3.10 UNSAFE LATCH

A LATCH command will only be performed if the following conditions are met:

- LATCH command is received
- UNLATCH bit is low
- US1 and US2 Power Present are on
- PRESSURE_TOO_LOW and PRESSURE_TOO_HIGH are off
- SYSTEM_IS_UNSAFE bit is low

If the LATCH command is received and the above conditions are not all met, the UNSAFE_ LATCH error bit will be set. This error condition will be reset when a new LATCH command is recieved and the LATCH_ENABLE conditions are met.

4.3.11 UNSAFE UNLATCH

An UNLATCH command will only be performed if the following conditions are met:

- SSO1, SSO2, V1RELAY, and V2RELAY must be high indicating that the Tool Changer is nested safely in the Tool Stand.
- Everything is OK bit must be high indicating no errors.
- The LATCH bit must be low.
- The UNLOCKED bit must be low.
- US1_Power_Present bit must be high.
- US2_Power_Present bit must be high.

The UNSAFE_UNLATCH bit will be set when the user sends an unsafe unlatch command. This condition is monitored immediately after an UNLATCH command and will disable the Unlatch and turn off Unlatch immediately. If UNLATCH is inadvertently held high during a power cycle the UNSAFE_UNLATCH error will be generated. This error bit will be reset when a new UNLATCH command is received (UNLATCH command removed and reapplied) and the UNLATCH_ ENABLE conditions are met or with the rising edge of the Clear Errors bit.

4.3.12 VALVE ERROR

If the module detects an error in the function of either valve, a VALVE_ERROR bit will be set. Reference the 9620-20-C-Jxx Valve Adapters with Dual Double Solenoid, Valve Pass-through, Proximity and Pressure Sensors for potential valve failure modes. Valve errors set the SYSTEM_ IS_UNSAFE bit so the Clear Errors bit required to clear.

4.3.13 SS Pulse Missing

A bit indicating the TSI Safety Switch is bypassed or SSO_1 is shorted to 24 volts. This bit will clear when the bypass is removed or the SSO_1 short is fixed. This bit does not prevent latching or unlatching.

4.3.14 PRESSURE DISCONNECTED

The PRESSURE_DISCONNECTED bit indicates that the pressure sensor is disconnected and/or that there are broken wires in the sensor cable.

If the pressure sensor is left disconnected then a SYSTEM_IS_UNSAFE error will be generated. The error condition can be reset with the Clear Errors bit.

4.3.15 SYSTEM IS UNSAFE

Any safety related error (Application Processor communication errors, input/output mismatch errors, safety switch error, valve error, etc.) will set the SYSTEM_IS_UNSAFE error. If the SYSTEM_IS_UNSAFE error bit is set the UNLATCH and LATCH outputs will be frozen. Refer to *Table 4.2* for the errors that will trigger a SYSTEM_IS_UNSAFE error. The error condition can be reset with the Clear Errors bit.

Table 4.2—Error Conditions

Error Bit	Error Description	TRIGGERS SYSTEM_IS_ UNSAFE ERROR	Reset with
AP2_COMM_ERROR	Communication failure between Application Processor 1 and 2	Yes	Clear Errors Bit
CROSS_MONITORING_ ERROR	Application Processor safety related inputs and outputs do not match	Yes	Clear Errors Bit
ERROR_ON_LATCH	Short circuit detection on LATCH output	No (Yes only during Latch)	Clear Errors Bit
ERROR_ON_ UNLATCH1	Short circuit detection on UNLATCH output to Valve 1.	No (Yes only during Unlatch)	Clear Errors Bit
ERROR_ON_ UNLATCH2	Short circuit detection on UNLATCH output to Valve 1.	No (Yes only during Unlatch)	Clear Errors Bit
LOCK/UNLOCK Sensor Fault	LOCKED and UNLOCKED Sensor on at the same time	No (Yes only during Unlatch)	Correct error or Clear Errors Bit
PRESSURE_ DISCONNECTED	Pressure Sensor not connected	Yes	Clear Errors Bit
PRESSURE_TOO_HIGH	Air supply to valve adapter too high	No (Yes only during Unlatch)	Clear Errors Bit
PRESSURE_TOO_LOW	Air supply to valve adapter too low	No (Yes only during Unlatch)	Clear Errors Bit
RTL1/RTL2 mismatch	RTL1/RTL2 sensor inputs do not match	No	Rising edge of UNLATCH or Clear Errors Bit
TOOL_ID_ERROR	TOOL-ID timeout error	No	Rising edge of TOOL_ PRESENT; Clear Errors Bit
UNSAFE_LATCH	Latch requested under unsafe conditions	No	Rising edge of LATCH or Clear Errors Bit
UNSAFE_UNLATCH	Unlatch requested under unsafe conditions	No	Rising edge of UNLATCH or Clear Errors Bit
VALVE_ERROR	Valve module pressure and/or position error	Yes	Clear Errors Bit

4.3.16 Error Recovery Sequence

If the Tool is unable to be unlatched due to a fault condition it can be reset either by a power cycle or following the steps in the recovery sequence.

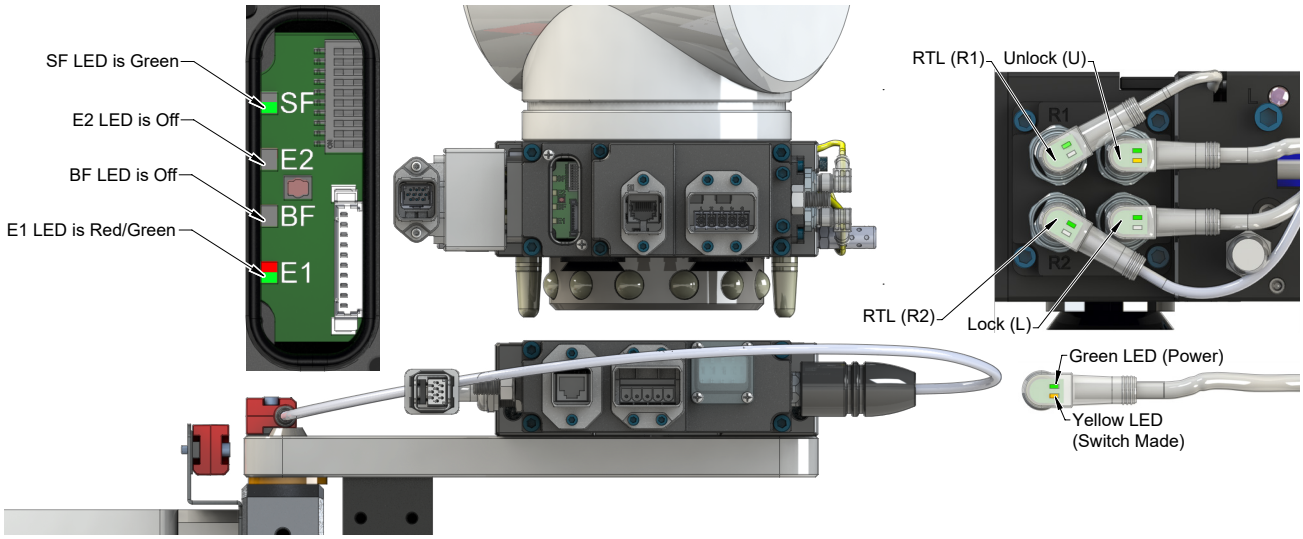
1. Turn off Latch and Unlatch commands.
2. Pulse Clear Errors for minimum 50ms
3. Wait for Latch Enabled or Unlatch Enabled
4. If error does not reset, troubleshoot.

4.4 Recommended Sequence of Operation

The following conditions have to be met before the programing can take place:

- Input and Output Auxiliary 24VDC power is available and within acceptable range (20.4 - 28.8VDC).
- Air is supplied to the integrated valve and within acceptable range: 60 - 100 psi.

Figure 4.2—Master Free with Tool In the Tool Stand



NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.3—System Failure and Bus Failure LEDs* or *Section 2.1.4—Ethernet 1 and Ethernet 2 LEDs* for possible issues.

1. The robot and Tool Changer Master are free of the stand or storage location, the Tool Changer is uncoupled and the Tool Changer locking mechanism is fully retracted (unlocked condition). The Tool is by itself in the Tool stand. No error or fault conditions exist.

   a. The following inputs are ON:
      i. **Unlocked**
      ii. **US1 Power** Input Power and **US2 Power** Output Power (Must remain on at all times).
      iii. **Tool-ID invalid (all 1→ 0xFFFF)**
      iv. **Everything is OK**

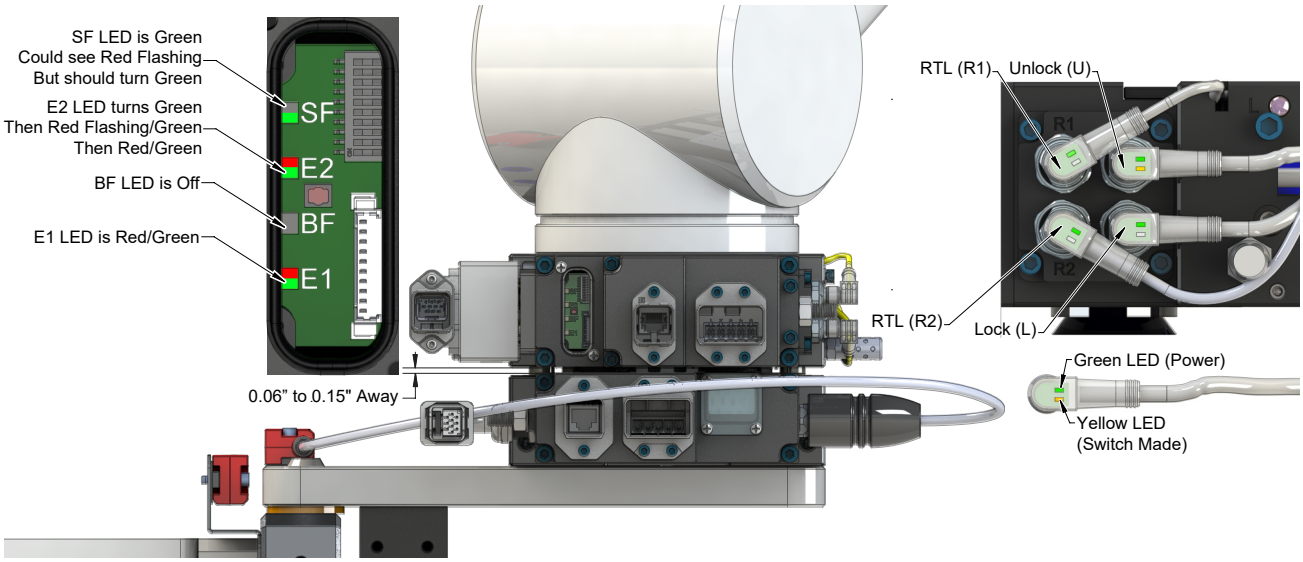
   b. The following inputs are OFF:
      i. **Unlatch Enabled**
      ii. **Locked**
      iii. **RTL1 and RTL2**
      iv. **Tool Present**
      v. **SSO_1 and SSO_2**
      vi. **V1RELAY** and **V2RELAY**
      vii. **Tool Power is On**

   c. The following outputs are OFF:
      i. **Unlatch**
      ii. **Latch**

   d. The ATI Tool and any downstream PROFINET device(s) are offline.

CAUTION: The Master locking mechanism must be fully retracted prior to the Master entering the Tool. Failure to do so will cause ball bearings to damage the Tool Bearing Race. If the Tool Changer is locked or in a missed Tool condition, use the solenoid valve manual override procedure (refer to the valve adapter manual) to unlock the Tool Changer before attempting to latch Master with Tool.

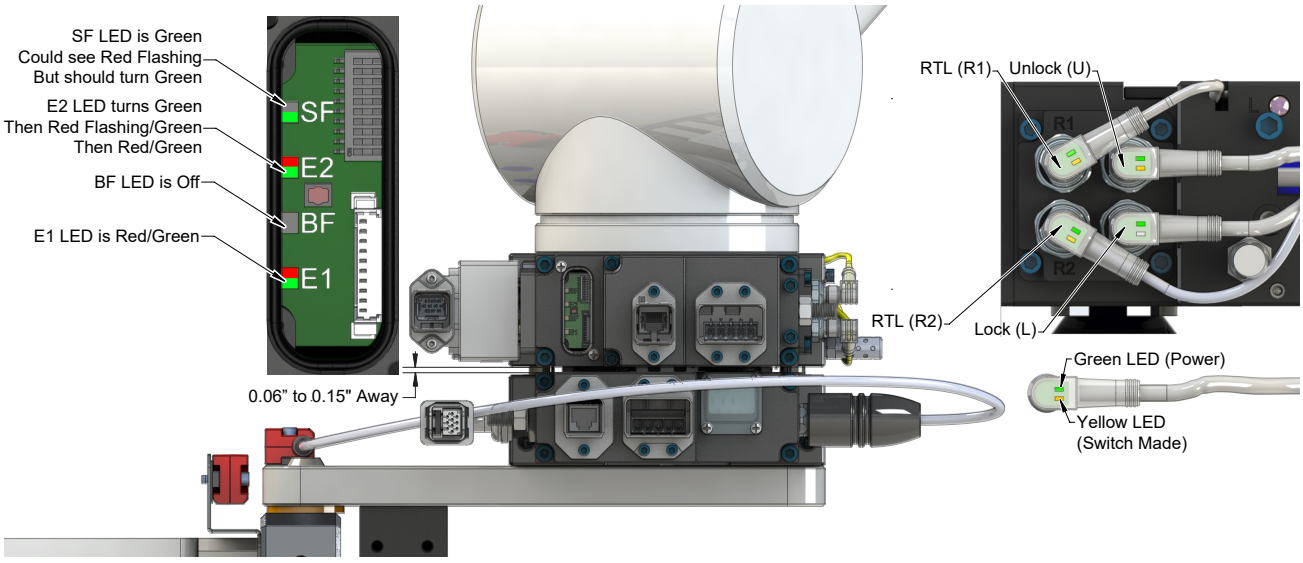
Figure 4.3—Master Moves into Tool and is parallel within 0.06” to 0.15”



NOTICE: If the LEDs don’t match what is shown, refer to *Section 2.1.3—System Failure and Bus Failure LEDs* or *Section 2.1.4—Ethernet 1 and Ethernet 2 LEDs* for possible issues.

2. Robot with Master move into the Tool and are parallel within 0.06” to 0.15” of the Tool. The module contact pins are touching (electrical connection has been made between the Master and the Tool) but the **RTL** sensors have not sensed the targets on the Tool.

Figure 4.4—Master Moves into Tool and is parallel at 0.06”



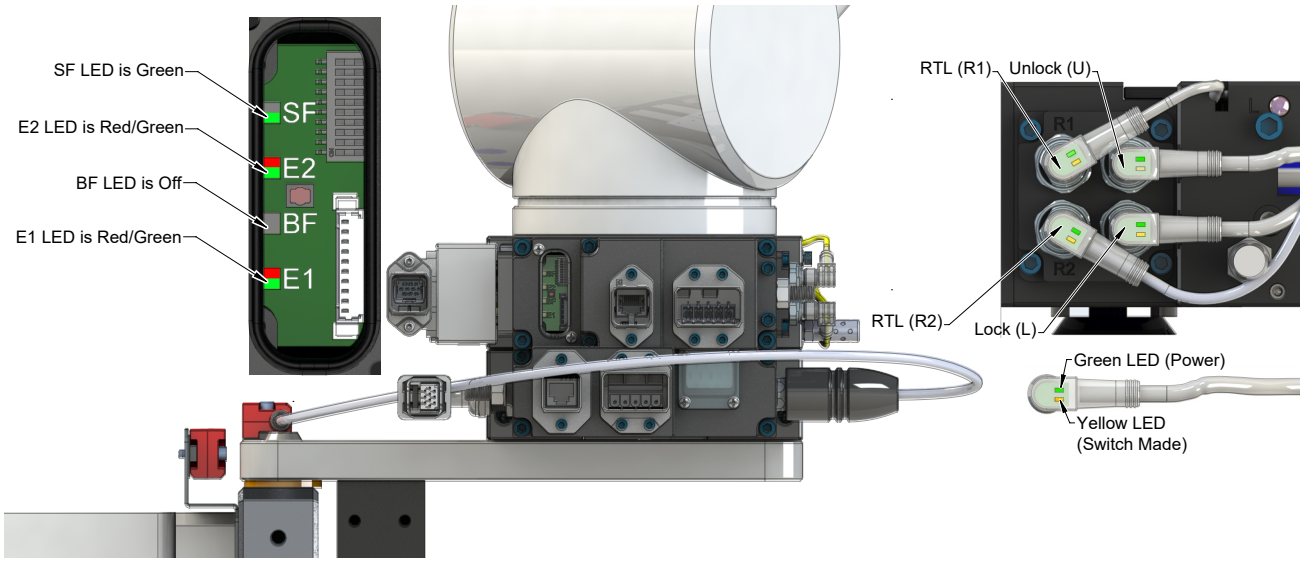
3. Robot and Master move within 0.06” of the Tool and safety switch is within range.

   a. The **RTL1 and RTL2** inputs are ON, indicating that it is ok to couple the Tool.

   b. The **Tool Present input** turns ON, indicating that the Master and Tool are in close proximity of each other.

   c. Everything is OK bit is ON.

Figure 4.5—Master Coupled with Tool

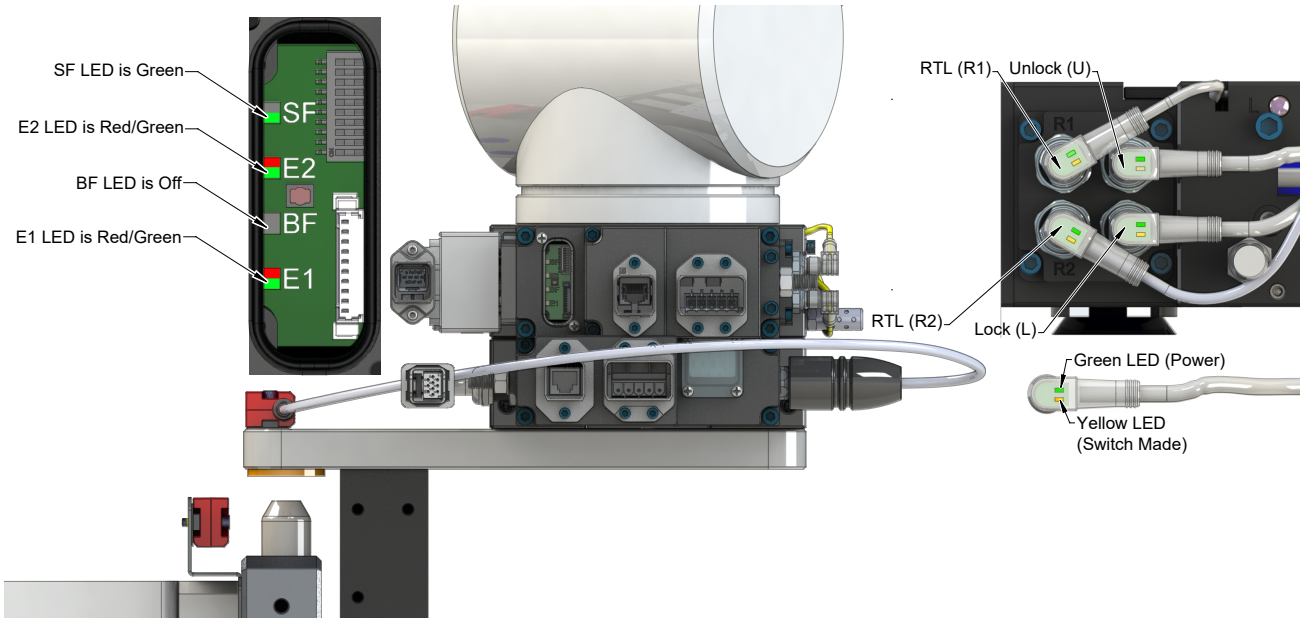


NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.3—System Failure and Bus Failure LEDs* or *Section 2.1.4—Ethernet 1 and Ethernet 2 LEDs* for possible issues.

4. Couple the Tool Changer.

   a. Pulse the **Latch** ON minimum 500 ms.
   b. The **Unlocked** input turns OFF a short time later, indicating piston travel. Subsequently, the **Locked** input turns ON, indicating that the coupling operation is complete.
   c. Power becomes available on the Tool and the **Tool Power is On** bit becomes ON.
   d. Everything is OK input is ON.
   e. Tool-ID becomes available.
   f. Shortly thereafter, communications should be established with downstream devices.
   g. The **SSO_1, SSO_2, V1RELAY, and V2RELAY** are ON (Subsequently **Unlatch Enable** is ON).

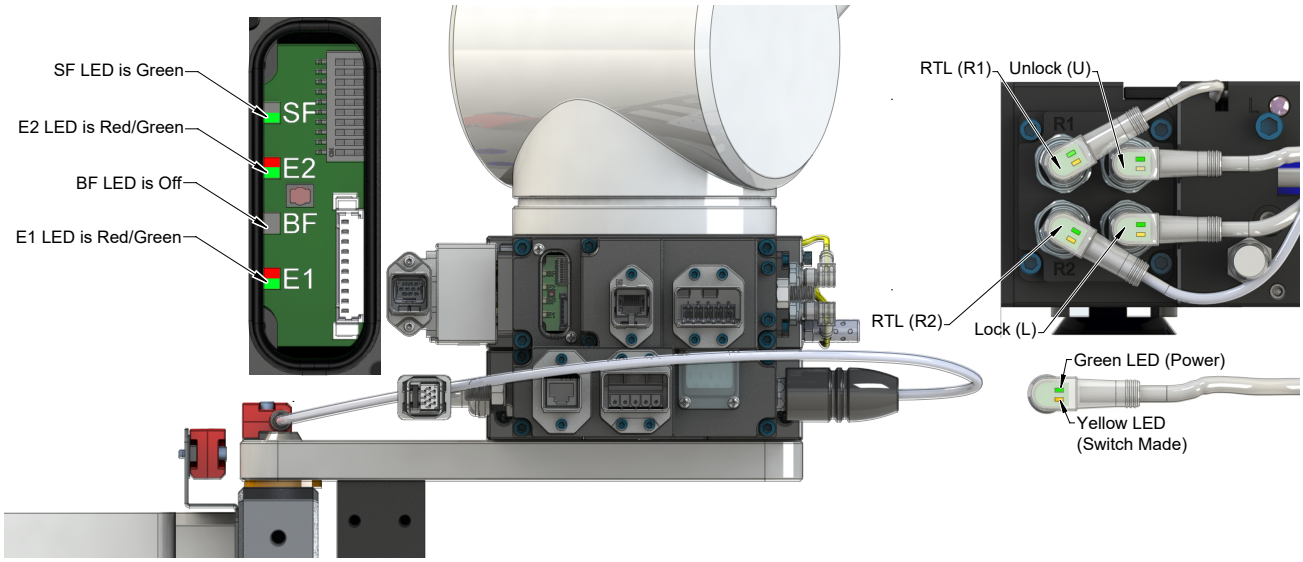
Figure 4.6—Master Coupled with Tool Moves Out of the Stand



NOTICE: If the LEDs don't match what is shown, refer to *Section 2.1.3—System Failure and Bus Failure LEDs* or *Section 2.1.4—Ethernet 1 and Ethernet 2 LEDs* for possible issues.

5. Robot moves away from the Tool stand with the Tool Changer coupled.
   a. The **Safety Switch** becomes deactivated, and the **SSO_1, SSO_2, V1RELAY, and V2RELAY** inputs turn OFF.
   b. **Unlatch Enabled** input turns OFF.
   c. Everything is OK bit is ON.
6. Normal operation (with Tool attached)
   a. The following inputs are ON:
      i. Locked
      ii. US1 Power (Input Power) and **US2 Power** (Output Power)
      iii. RTL1 and RTL2
      iv. Tool Power is On
      v. Tool Present
      vi. Everything is OK
   b. The following inputs are OFF:
      i. Unlocked
      ii. SSO_1 and **SSO_2**
      iii. **V1RELAY** and **V2RELAY**
      iv. Unlatch Enabled
   c. The following outputs are OFF:
      i. Unlatch
      ii. Latch

Figure 4.7Master Coupled with Tool



7. Robot moves into the Tool stand with the Tool Changer coupled. **Everything is OK** bit is ON.

   a. When the Tool is returned to the stand, the **Safety Switch** becomes activated and the **SSO_1, SSO_2, V1RELAY, and V2RELAY** inputs turn ON.

   b. **Unlatch Enabled** turns ON, indicating that it is safe to uncouple the Tool Changer.

8. Uncouple the Tool Changer.

   a. Pulse **Unlatch** ON minimum 500 ms.

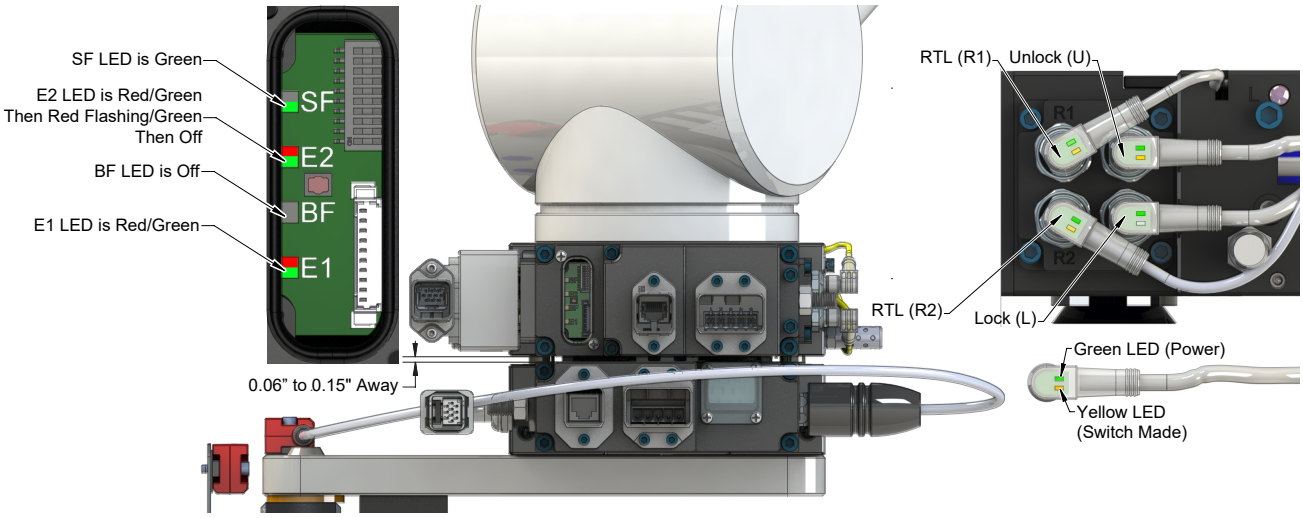
   b. The **Tool Power is On** bit turns OFF.

   c. Communication is lost with downstream device(s).

   d. The **Locked** input turns OFF a short time later and subsequently the **Unlocked** input goes ON, indicating that the uncoupling operation is complete.

   e. **Everything is OK** input is ON.

Figure 4.8—Master Uncoupled with Tool in Stand



9. Robot and Master move away from the Tool, are parallel and at a distance of 0.06” to 0.15” away.

    a. The **Safety Switch** becomes deactivated, and the **SSO_1, SSO_2, V1RELAY, and V2RELAY** inputs turn OFF.

    b. Everything is OK input is ON.

10. Normal operation (With Tool In stand)

    a. The following inputs are ON:
    - **i. Unlocked**
    - **ii. US1 Power** Input Power and **US2 Power** Output Power (Must remain on at all times).
    - **iii. Tool-ID invalid (all 1→ 0xFFFF)**
    - **iv. Everything is OK**

    b. The following inputs are OFF:
    - **i. Unlatch Enabled**
    - **ii. Locked**
    - **iii. RTL1 and RTL2**
    - **iv. Tool Present**
    - **v. SSO_1 and SSO_2**
    - vi. **V1RELAY** and **V2RELAY**
    - **vii. Tool Power is On**

    c. The following outputs are OFF:
    - **i. Unlatch**
    - **ii. Latch**

    d. The ATI Tool and any downstream PROFINET device(s) are offline.

5. Maintenance

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

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

If the Tool Changer is being used in dirty environments (e.g., welding or deburring applications), care should be taken to limit the exposure of the Tool Changer. Idle Tool assemblies should be covered to prevent debris from settling on the mating surface. Also, the Master assembly should be exposed for only a short period of time during tool change and down time.

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

- Inspect mounting fasteners to verify they are tight and if loose, then tighten to the proper torque. Refer to *Section 3—Installation*.
- Cable connections should be inspected during maintenance periods to ensure they are secure. Loose connections should be cleaned and retightened. Inspect cable sheathing for damage, repair or replace damaged cabling. Loose connections and/or damaged cabling are not expected and may indicate improper routing and/or strain relieving.
- Inspect the Master and Tool pin blocks for any pin damage, debris, or darkened pins. Refer to *Section 5.1—Pin Block Inspection and Cleaning*.
- Inspect V-ring seals for wear, abrasion, and cuts. If worn or damaged, replace. Refer to *Section 6.2.1—Seal Replacement*.

5.1 Pin Block Inspection and Cleaning

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

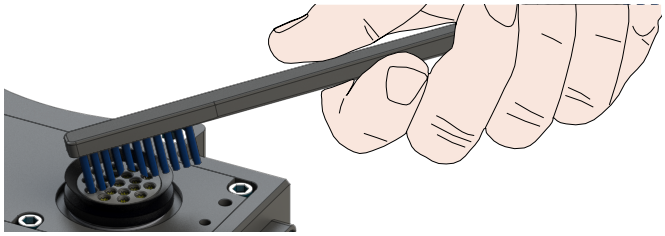
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Inspect the Master and Tool pin blocks for debris or darkened pins.

Figure 5.1—Inspect Master and Tool Pin Blocks

5. If debris or darkened pins are present, use a vacuum to remove the debris, and clean using a nylon brush (ATI Part Number 3690-0000064-60).

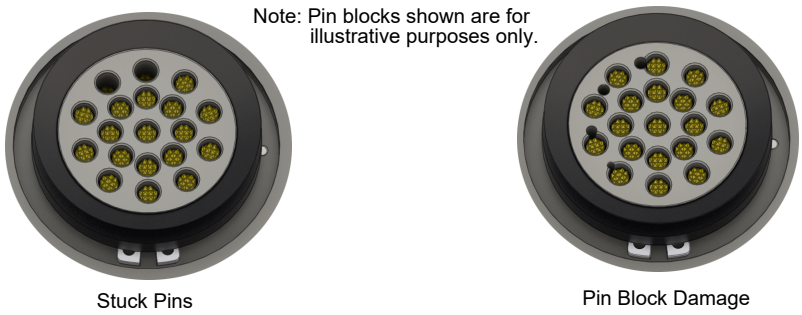
NOTICE: Do not use an abrasive media and/or cleaners or solvents to clean the contact pins. Using abrasive media and/or cleaners or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI Part Number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

Figure 5.2—Clean Pin Blocks with a Nylon Brush



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

Figure 5.3—Stuck Pin and Pin Block Damage



7. If pins become stuck or if there is damage to the pin block, contact ATI for either a possible pin replacement procedure or module replacement.
8. Safely resume normal operation.

6. Troubleshooting and Service Procedures

The following section provides troubleshooting information to help diagnose conditions with the Tool Changer and service procedures to help resolve these conditions.

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

6.1 Troubleshooting

Troubleshooting information is provided in the following table.

Table 6.1—Troubleshooting

Symptom	Possible Cause	Correction
Unit will not lock or unlock.	Debris caught between the Master and Tool plates.	Clean debris from between Master and Tool plates. Verify mounting fasteners is secure and does not protrude above the mating surfaces.
	Ball bearings are not moving freely.	Verify 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 Pneumatic Connection section of the Tool Changer Manual for specifications.*
	Exhaust port is not properly vented.	Check that exhaust port is properly vented. *Refer to Pneumatic Connection section of the 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.*
	Signals are mapped incorrectly.	Verify that signals are mapped and are communicating properly. Refer to *Section 9—Drawings* for electrical schematic.
	Master and Tool are within the specified No-Touch zone.	Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock. *Refer to the Operation Section of the Tool Changer manual for specifications.*
Sensors not operating properly (but PROFINET is operating correctly).	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 Changer manual.*
	Sensors are not 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 Pneumatic Connection section of the Tool Changer Manual for valve requirements.*
Loss of communication.	Robot Output bit set incorrectly.	Check to make sure Robot Output Bit #4 is set to OFF, If Bit #4 is ON set bit to OFF..
	Damaged signal cabling.	Check/replace signal cabling upstream and downstream of Tool Changer modules.
	Worn or damaged contact pins.	Inspect module contact pins for debris/wear/damage. Contact ATI for contact pin replacement.
	Product upstream and downstream of Tool Changer failed or damaged.	Check product upstream and downstream of Tool Changer for failure. This failure can “appear” to be caused by the Tool Changer or affect Tool Changer performance.

Table 6.1—Troubleshooting		
Symptom	**Possible Cause**	**Correction**
No power on the Tool side.	Latch command not issued.	Verify that the Latch command has been issued.
	Tool Power is On bit.	Verify that the **Tool Power is On** bit is **HIGH**.
	Tool Present bit.	Verify that the **Tool Present** bit is **HIGH**.
Loss of auxiliary power on the Tool side.	US1 power loss.	Loss of US1 (Logic) power on the Master side will cause loss of US2 (Auxiliary) power to the Tool. The Arc Prevention Circuit relies on US1 power to operate. Restore US1 power to the Master to restore US2 power to the Tool.

6.2 Service Procedures

The following service procedures provide instructions for inspection, adjustment, test or replacement of components.

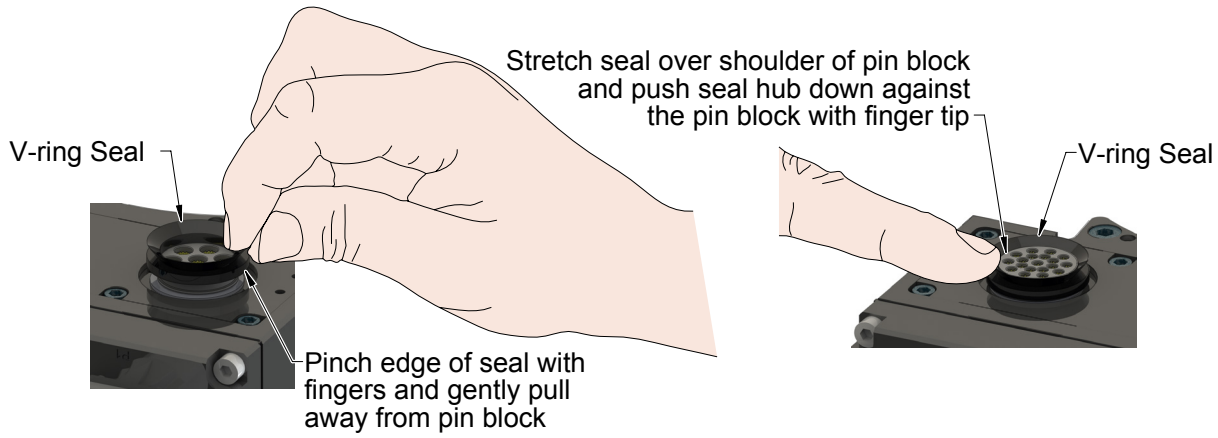
6.2.1 Seal Replacement

Parts required: *Refer to Section 9—Drawings.*

The seal protects the electrical connection between the Master and Tool module. Replace the seal if it becomes worn or damaged.

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. To remove the existing seal, pinch the edge of the seal and pull the seal away from the pin block on the Master module.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal hub down against the pin block.
7. Safely resume normal operation.

Figure 6.1—V-ring Seal Replacement



6.2.2 Master Module Replacement Procedures

The device replacement procedures are based on the following assumptions:

- The topology of the PROFINET network was properly defined with the PROFINET engineering tool.
- The PROFINET controller supports automatic device replacement.

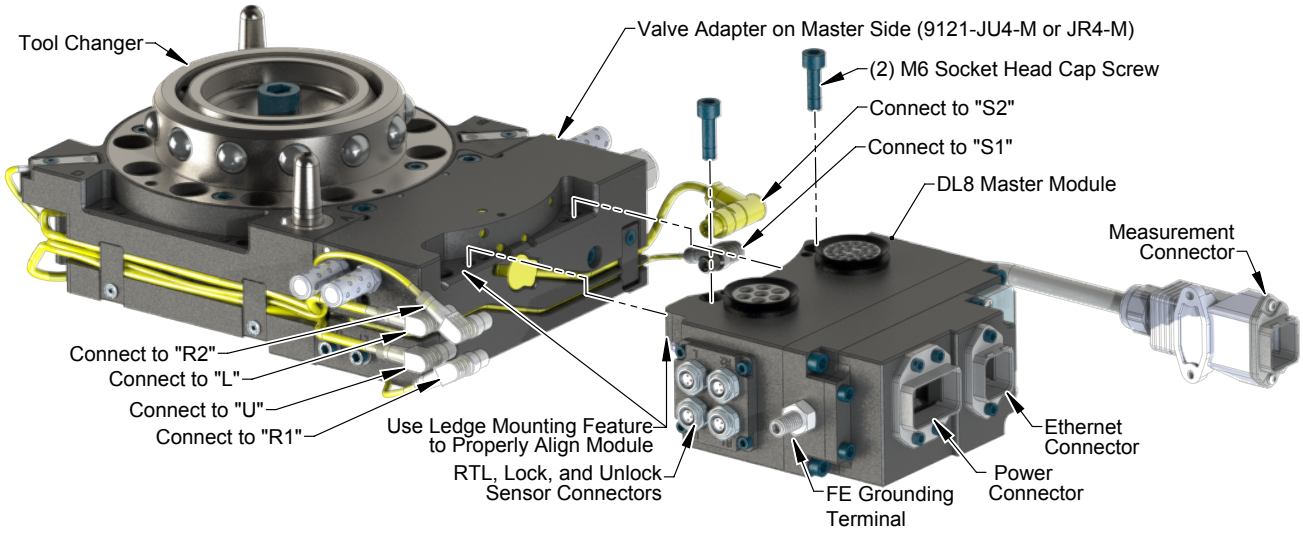
6.2.2.1 Master Module Replacement Procedures

1. Remove the “old” module from the Tool Changer, refer to *Section 3.2—Master Module Removal* for removal procedure.
2. Install new module on Tool Changer, refer to *Section 3.1—Master Module Installation* for installation procedure.

6.2.2.2 Replace Master Module with an Already Commissioned Master Module

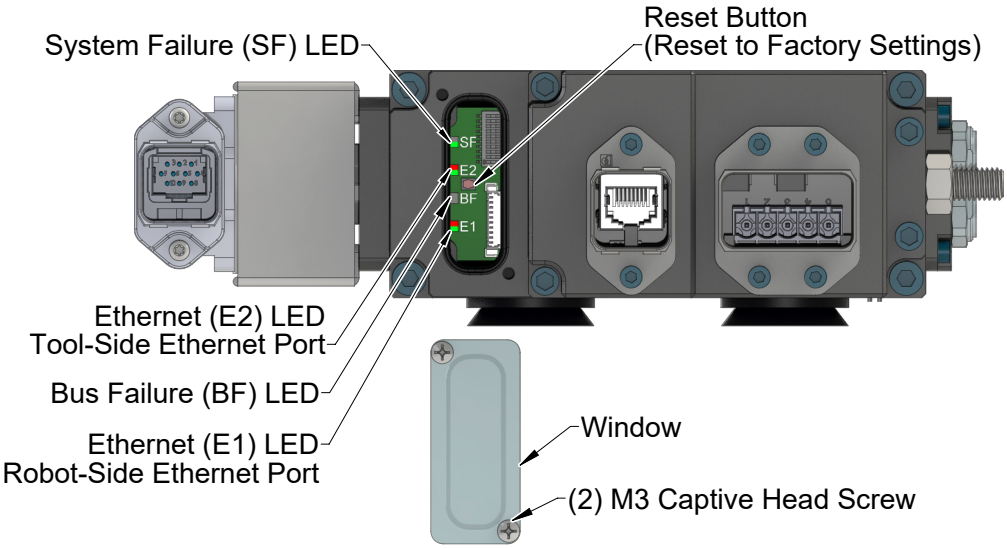
1. Remove the “old” module from the Tool Changer, refer to *Section 3.2—Master Module Removal* for removal procedure.
2. Wipe down the mounting surfaces with a clean rag.
3. Using the ledge feature, place the Master module to a dual double solenoid valve adapter mounting surface. Align the control/signal module with the valve adapter using the dowels in the bottom of the ledge feature.
4. 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 cap screws securing the control/signal module to the valve adapter and tighten to 70 in-lbs (7.9 Nm).
5. Connect the pressure sensor and proximity sensor cables to the connectors on the module.
6. Connect the RTL1, RTL2, Lock, and Unlock sensor cables to the connectors on the module.
7. Connect the 5-pin power cable to the connectors on the module.

Figure 6.2—Master Module Installation



8. Loosen the (2) M3 pan head captive screws and remove LED window.
9. Locate reset button between BF and E2 LED.
10. Use a non-conductive tool (e.g. plastic stylus) to press on the reset button -> the SF LED will change from GREEN to blinking RED, indicating that the module will clear its name and IP address after the next power cycle.

Figure 6.3—Reset Button



11. Re-install the window and tighten the (2) M3 pan head captive screws.
12. Disconnect the 5-pin power cable to the connectors on the module.
13. Connect the RJ45 Ethernet cable, measurement cable, and the 5-pin Power cable to the connectors on the module.
14. The new module may be found using the default PROFINET station name and configured to the appropriate station name for your application, or the network controller may be configured to automatically rename the module when it detects the default name.
15. Within a few seconds after configuring, it should be operating on the network.
16. The SF and BF LED should be GREEN when the network is operating without errors.
17. Safely resume normal operation.

7. Serviceable Parts

Refer to *Section 9—Drawings.*

7.1 Master Module Mounting Fasteners

Table 8.1—Master module Mounting Fasteners	
Part Number	**Description**
3500-1066020-21A	M6 x 20 Socket Head Cap Screw, SS, ND Microspheres, 0-3 uncoated lead thds. 5-7 coated thds. IFI525

7.2 Tool Module Mounting Fasteners

Table 8.2—Tool module Mounting Fasteners	
Part Number	**Description**
3500-1066016-21A	M6 x 16 Socket Head Cap Screw, DIN 912 A4 S/S (316) ND Ind. Microspheres Epoxy, Yellow. 0-3 uncoated lead thds. 5-7 coated thds.

7.3 Accessories

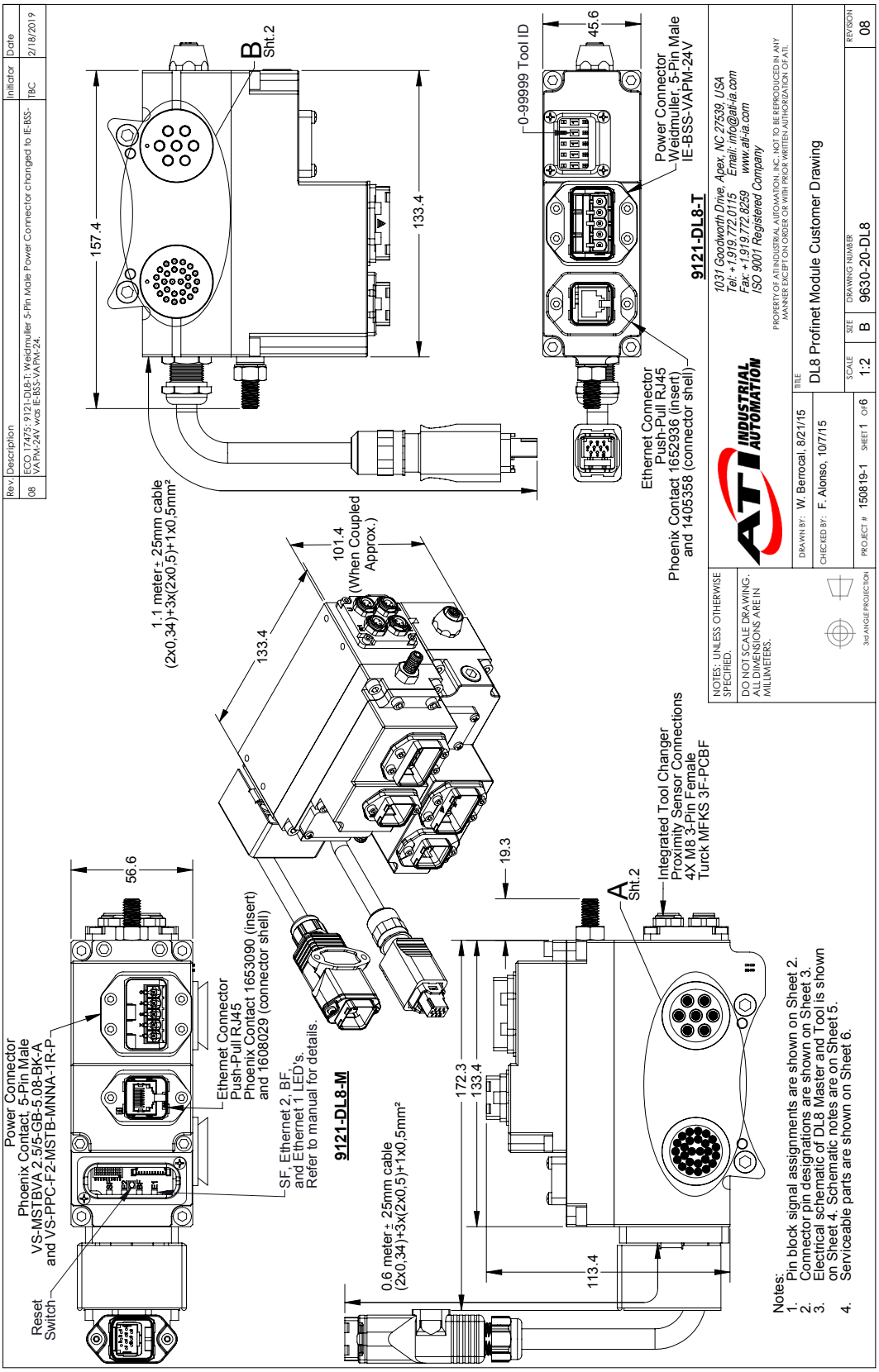
Table 8.3—Accessories	
Part Number	**Description**
3690-0000064-60	Brush, Blue Nylon All Purpose (Contact Pin Cleaning)

8. Specifications

Table 9.1—Master Specifications	
9121-DL8-M	PROFINET Master module with integrated Ethernet switch, RJ45 Push-Pull connector for Ethernet communication, 5-Pin Push-Pull Connector for US1 and US2 power, 10-Pin Push-Pull Hybrid Connection, TSI on the Tool, Arc Prevention applied to US1 and US2 power. Lock, Unlock, and RTL sensing with LED cables on the Master. 5-digit Tool-ID from the Tool module also supported. Mates with DL8-T. Safety circuit meets ISO13849 PLd.
Connector(s)	Power: (1) 5-pin Push Pull PROFINET: (1) RJ45 Push Pull Integrated Tool Changer I/O: (4) 3-pin femaleM8 connectors supporting Tool Changer Locked, Unlocked, and Ready to Lock proximity sensors. "Measurement" Connection (1) 10-pin male Push Pull Hybrid Connector Integrated Connection to valve adapter Diagnostic Sensors: (1) 3-pin female M8 connectors supporting Valve Adapter proximity sensor (1) 4-pin female M8 connectors supporting Valve Adapter pressure sensor Integrated Connection to Valve Adapter: (1) 4-pin Pin Block supporting Latch and Unlatch signals
Electrical Rating	Power: US1+ and US2+ Power: 10 A Note: The power source for input and output power must be capable of outputting an operating voltage (reverse polarity protected, regulated) of 20 to 29VDC. Signal: 3A, 30VDC maximum
Current Draw	US1: Coupled, safety switch on and activated: 0.28 A Coupled, safety switch deactivated: 0.24 A Coupled, safety switch disconnected: 0.22 A Uncoupled: 0.14 A US2: Latching and Unlatching are the same: 0.48 A(peak)
Enclosure	IP65
Temperature	32°F to 120°F (0 to 49°C).
Weight	2.69 lbs (1.22 kg)

Table 9.2—Tool Specifications	
9121-DL8-T	PROFINET Tool module provides one Ethernet port and supports 5-digit Tool-ID through the Master module. RJ45 Push-Pull connector for Ethernet, 5-Pin Push-Pull Connector for US1 and US2 power, 10-Pin Push-Pull Hybrid Connection, 5-Pin M12 to support TSI on the Tool, Tool-ID 0-99999 adjustable with thumbwheel switches. Supports Arc Prevention on the Master. Mates with DL8-M.
Default Configuration	(5) Independent Tool-ID switches, each reading a (0–9) position (all set to Tool Position 1)
Connector(s)	Power: (1) 5-pin Push Pull PROFINET: (1) RJ45 Push Pull “Measurement” Connection (1) 10-pin female Push-Pull Hybrid Connector Connection to Switch: (1) 5-pin female M12 connector supporting connection to RFID based Safety Switch
Electrical Rating	Power: US1+ and US2+ Power: 10 A Signal: 3A, 30VDC maximum
Enclosure	IP65
Temperature	32°F to 120°F (0 to 49°C).
Weight	2.37 lbs (1.08 kg)

9. Drawings


Rev. | Description | Initiator | Date
08 | ECO 17475: 9121-DL8-T: Weidmuller 5-Pin Male Power Connector changed to IE-BSS-VA PM-24V wgs IE-BSS-VAPM-24. | TBC | 2/18/2019
157.4
133.4
B Sht.2
0-99999 Tool ID
45.6
Power Connector
Weidmuller, 5-Pin Male
IE-BSS-VAPM-24V
9121-DL8-T
Ethernet Connector
Push-Pull RJ45
Phoenix Contact 1652936 (insert)
and 1405358 (connector shell)
1.1 meter± 25mm cable
(2x0,34)+3x(2x0,5)+1x0,5mm²
101.4
(When Coupled
Approx.)
133.4
19.3
A Sht.2
Integrated Tool Changer
Proximity Sensor Connections
4X M8 3-Pin Female
Turck MFKS 3F-PCBF
56.6
Power Connector
Phoenix Contact, 5-Pin Male
VS-MSTBVA 2,5/5-GB-5,08-BK-A
and VS-PPC-F2-MSTB-MNNA-1R-P-
Ethernet Connector
Push-Pull RJ45
Phoenix Contact 1653090 (insert)
and 1608029 (connector shell)
SF, Ethernet 2, BF,
and Ethernet 1 LED's.
Refer to manual for details.
9121-DL8-M
172.3
133.4
0.6 meter ± 25mm cable
(2x0,34)+3x(2x0,5)+1x0,5mm²
113.4
Reset
Switch
Notes:
1. Pin block signal assignments are shown on Sheet 2.
2. Connector pin designations are shown on Sheet 3.
3. Electrical schematic of DL8 Master and Tool is shown on Sheet 4. Schematic notes are on Sheet 5.
4. Serviceable parts are shown on Sheet 6.
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
DRAWN BY: W. Berrocal, 8/21/15
CHECKED BY: F. Alonso, 10/7/15
PROJECT # 150819-1 SHEET 1 OF 6
TITLE
DL8 Profinet Module Customer Drawing
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-20-DL8
REVISION 08
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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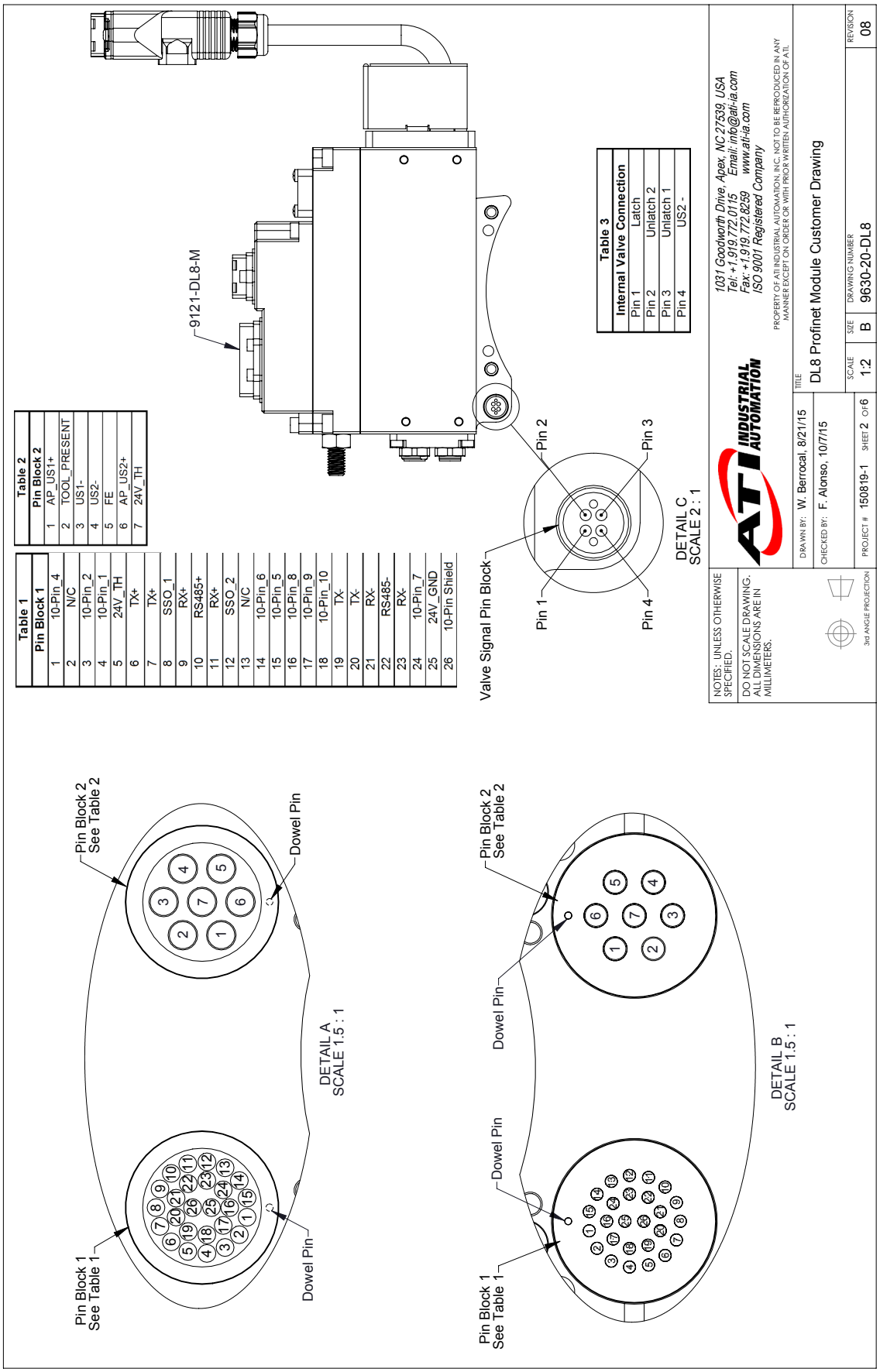
9121-DL8-M
Table 1
Pin Block 1
1 10-Pin_4
2 N/C
3 10-Pin_2
4 10-Pin_1
5 24V_TH
6 TX+
7 TX+
8 SSO_1
9 RX+
10 RS485+
11 RX+
12 SSO_2
13 N/C
14 10-Pin_6
15 10-Pin_5
16 10-Pin_8
17 10-Pin_9
18 10-Pin_10
19 TX-
20 TX-
21 RX-
22 RS485-
23 RX-
24 10-Pin_7
25 24V_GND
26 10-Pin Shield
Table 2
Pin Block 2
1 AP_US1+
2 TOOL_PRESENT
3 US1-
4 US2-
5 FE
6 AP_US2+
7 24V_TH
Table 3
Internal Valve Connection
Pin 1 Latch
Pin 2 Unlatch 2
Pin 3 Unlatch 1
Pin 4 US2 -
Valve Signal Pin Block
Pin 1
Pin 2
Pin 3
Pin 4
DETAIL C
SCALE 2 : 1
Pin Block 2
See Table 2
Dowel Pin
Pin Block 1
See Table 1
Dowel Pin
DETAIL A
SCALE 1.5 : 1
Pin Block 2
See Table 2
Dowel Pin
Dowel Pin
Pin Block 1
See Table 1
DETAIL B
SCALE 1.5 : 1
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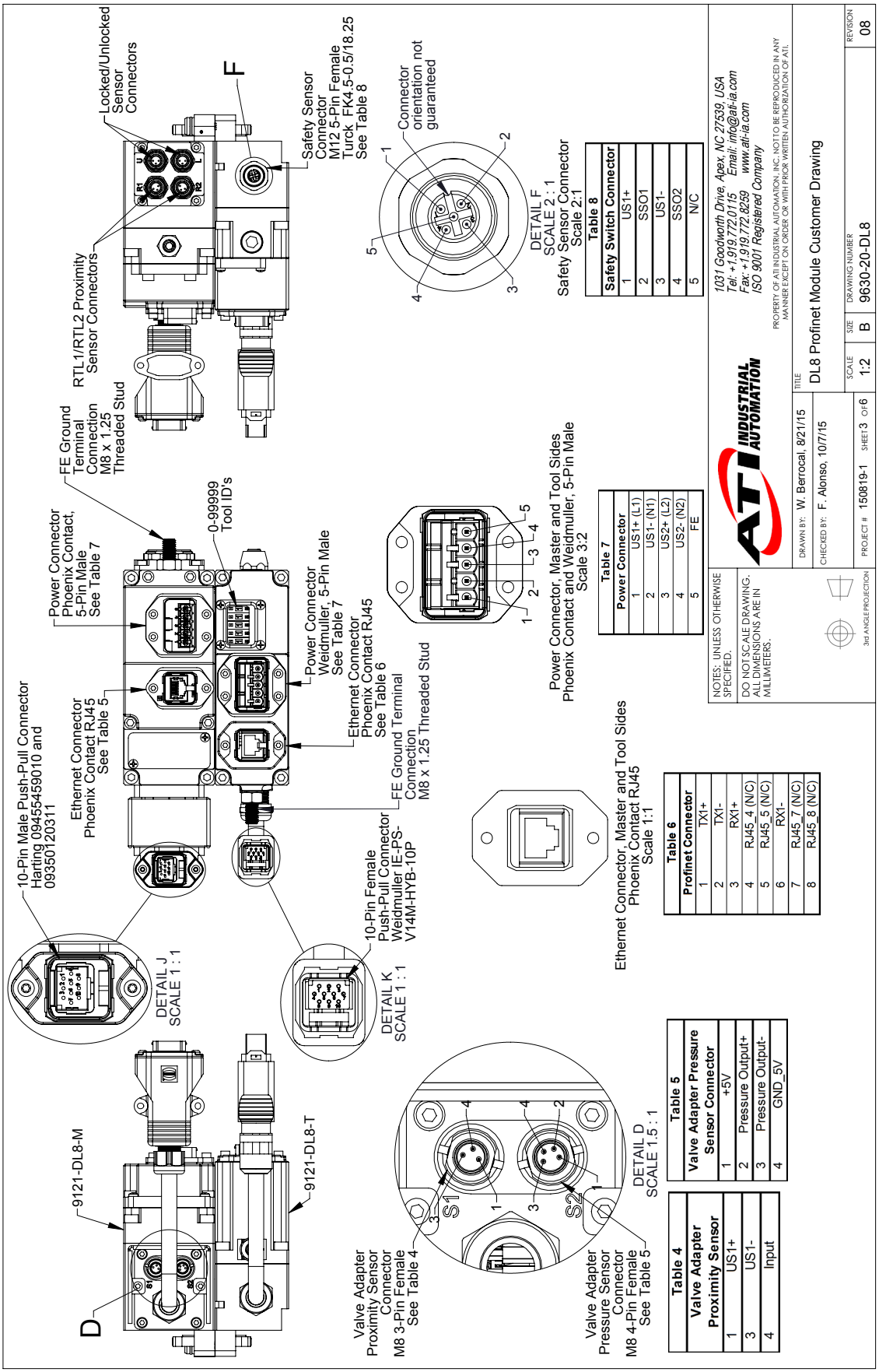
Locked/Unlocked Sensor Connectors
RTL1/RTL2 Proximity Sensor Connectors
Safety Sensor Connector M12 5-Pin Female Turck FK4.5-0.5/18.25 See Table 8
Connector orientation not guaranteed
DETAIL F SCALE 2 : 1
Safety Sensor Connector Scale 2:1
Table 8
Safety Switch Connector
1 US1+
2 SSO1
3 US1-
4 SSO2
5 N/C
FE Ground Terminal Connection M8 x 1.25 Threaded Stud
Power Connector Phoenix Contact, 5-Pin Male See Table 7
0-99999 Tool ID's
Power Connector Weidmuller, 5-Pin Male See Table 7
Ethernet Connector Phoenix Contact RJ45 See Table 6
Ethernet Connector Phoenix Contact RJ45 See Table 5
10-Pin Male Push-Pull Connector Harting 09455459010 and 09350120311
FE Ground Terminal Connection M8 x 1.25 Threaded Stud
Power Connector, Master and Tool Sides Phoenix Contact and Weidmuller, 5-Pin Male Scale 3:2
Table 7
Power Connector
1 US1+ (L1)
2 US1- (N1)
3 US2+ (L2)
4 US2- (N2)
5 FE
10-Pin Female Push-Pull Connector Weidmuller IE-PS-V14M-HYB-10P
DETAIL J SCALE 1 : 1
DETAIL K SCALE 1 : 1
Ethernet Connector, Master and Tool Sides Phoenix Contact RJ45 Scale 1:1
Table 6
Profinet Connector
1 TX1+
2 TX1-
3 RX1+
4 RJ45_4 (N/C)
5 RJ45_5 (N/C)
6 RX1-
7 RJ45_7 (N/C)
8 RJ45_8 (N/C)
9121-DL8-M
9121-DL8-T
D
Valve Adapter Proximity Sensor Connector M8 3-Pin Female See Table 4
Valve Adapter Pressure Sensor Connector M8 4-Pin Female See Table 5
DETAIL D SCALE 1.5 : 1
Table 5
Valve Adapter Pressure Sensor Connector
1 +5V
2 Pressure Output+
3 Pressure Output-
4 GND_5V
Table 4
Valve Adapter Proximity Sensor
1 US1+
3 US1-
4 Input
NOTES: UNLESS OTHERWISE SPECIFIED.
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3rd ANGLE PROJECTION
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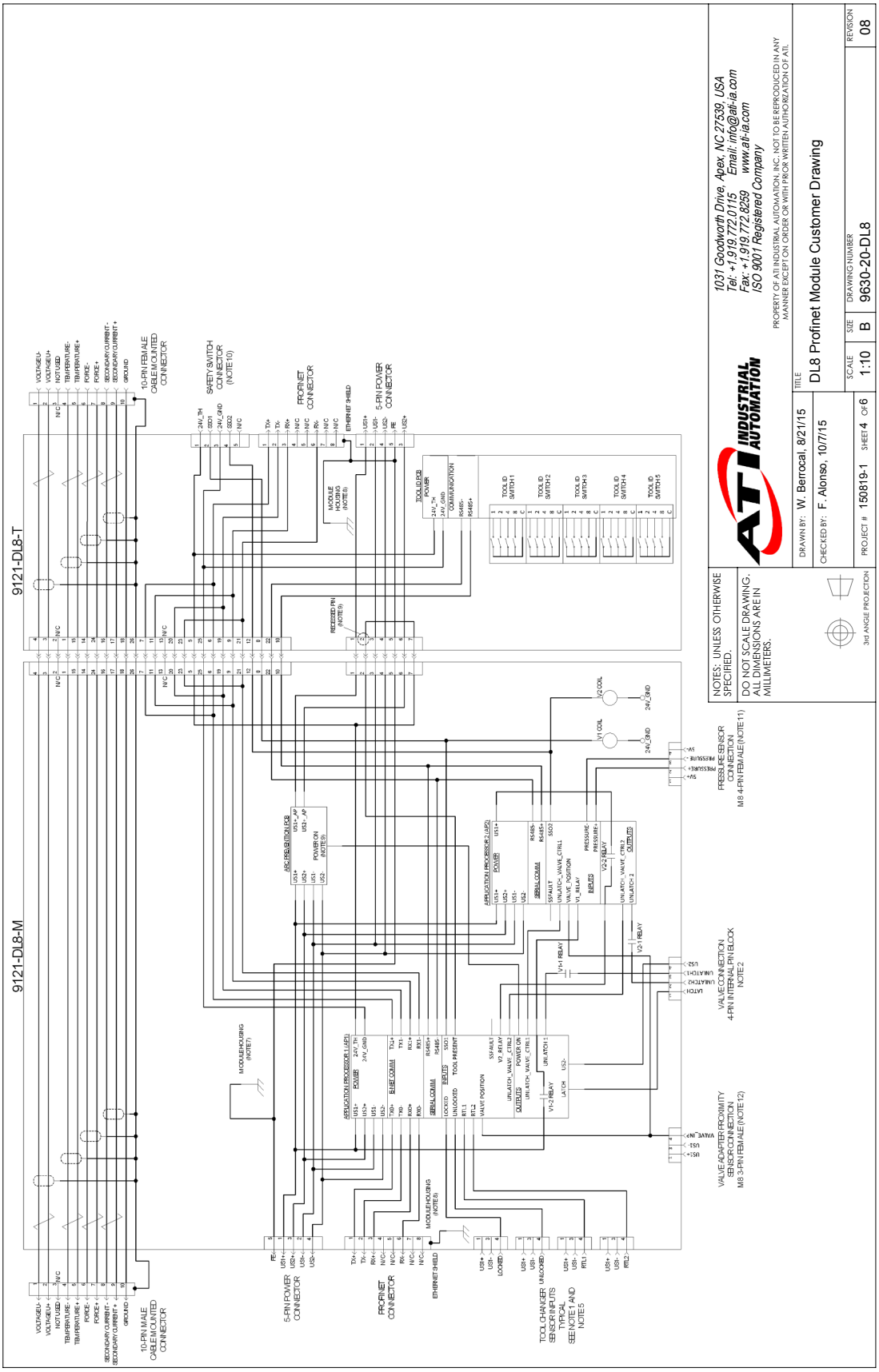
9121-DL8-T
9121-DL8-M
1031 Goodworth Drive, Apex, NC 27539, USA
Tel: +1.919.772.0115
Fax: +1.919.772.8259
ISO 9001 Registered Company
Email: info@ati-ia.com
www.ati-ia.com
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DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: W. Berrocal, 8/21/15
CHECKED BY: F. Alonso, 10/7/15
TITLE
DL8 Profinet Module Customer Drawing
3rd ANGLE PROJECTION
SCALE 1:10
SIZE B
DRAWING NUMBER 9630-20-DL8
REVISION 08
PROJECT # 150819-1
SHEET 4 OF 6

Schematic Notes:

1. The complete tool changer package comes equipped with external cables that are connected to the sensors. The DL8 modules must be used with Valve Adapters employing two valves and diagnostic monitoring via pressure and proximity sensors (ex. 9121-JR4-M, 9121-JU4-M, etc.).
2. An internal pin block is used to connect the Latch/Unlatch signal to the Valve Adapter.
3. Power, Ethernet, and Safety Switch cables for the DL8 Modules are supplied by the customer.
4. The Tool ID I/O is reported in the DL8 Master Bitmap. Refer to the product manual for more information.
5. Note that the R1, R2, L, and U sensors are powered by unswitched (US1) Profinet Power. The common US1+ and US1- connections are not shown here.
6. The Ethernet (TX and RX) signals are transmitted over twisted pairs.
7. FE is connected directly to the Module housings.
8. The RJ45 Shield is connected directly to the Module housings.
9. The Arc Prevention Board turns off US1+ and US2+ 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" circuit is used to ensure that the spring/contact pins are touching when power is turned on. Refer to the product manual for additional information.
10. The 9121-DL8-M module requires the use of a two channel, PL e rated contactless Safety Sensor, specifically, Euchner CES-AP-C01-CH-SB-106798 or CES-I-AP-M-C04-USB-117324 (reference Figures 1 and 2). The Safety Sensor is not included with the DL8 but is available from ATI. The Safety Sensor is powered by 24V US1 current limited (24V_TH) Profinet power.
11. The Valve Adapter pressure sensor is supplied 5V (unswitched) from AP2. The pressure sensor provides an analog input to the DL8.
12. The Valve Adapter proximity sensor is powered from unswitched (US1) Profinet power.
13. The DL8 module employs a dual channel safety circuit to prevent an unsafe tool unlatch. An extensive description of the safety system is provided in the DL8 Operation Manual: 9620-20-C-DL8.

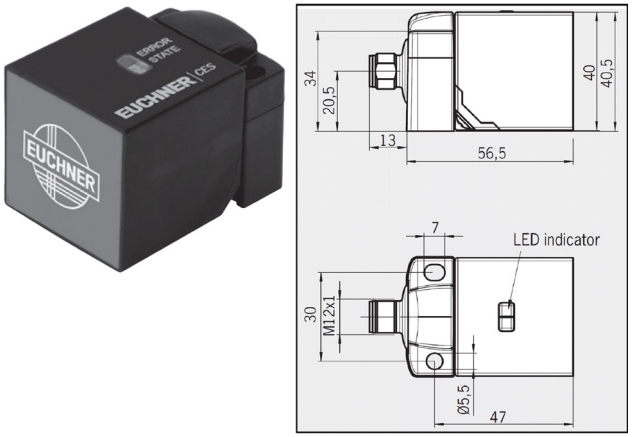
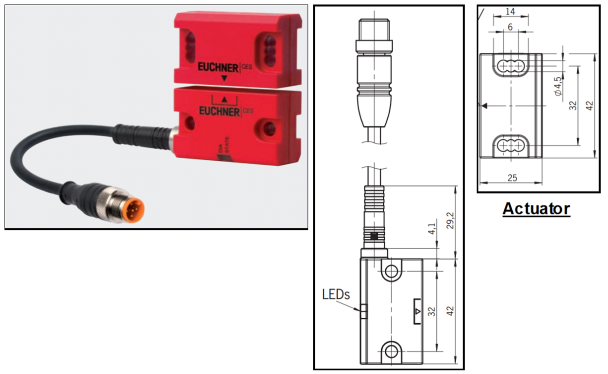


Figure 1: Euchner CES-AP-C01 Series Safety Sensor



Actuator

Sensor

Figure 2: Euchner CES-AP-C04 Series Safety Sensor

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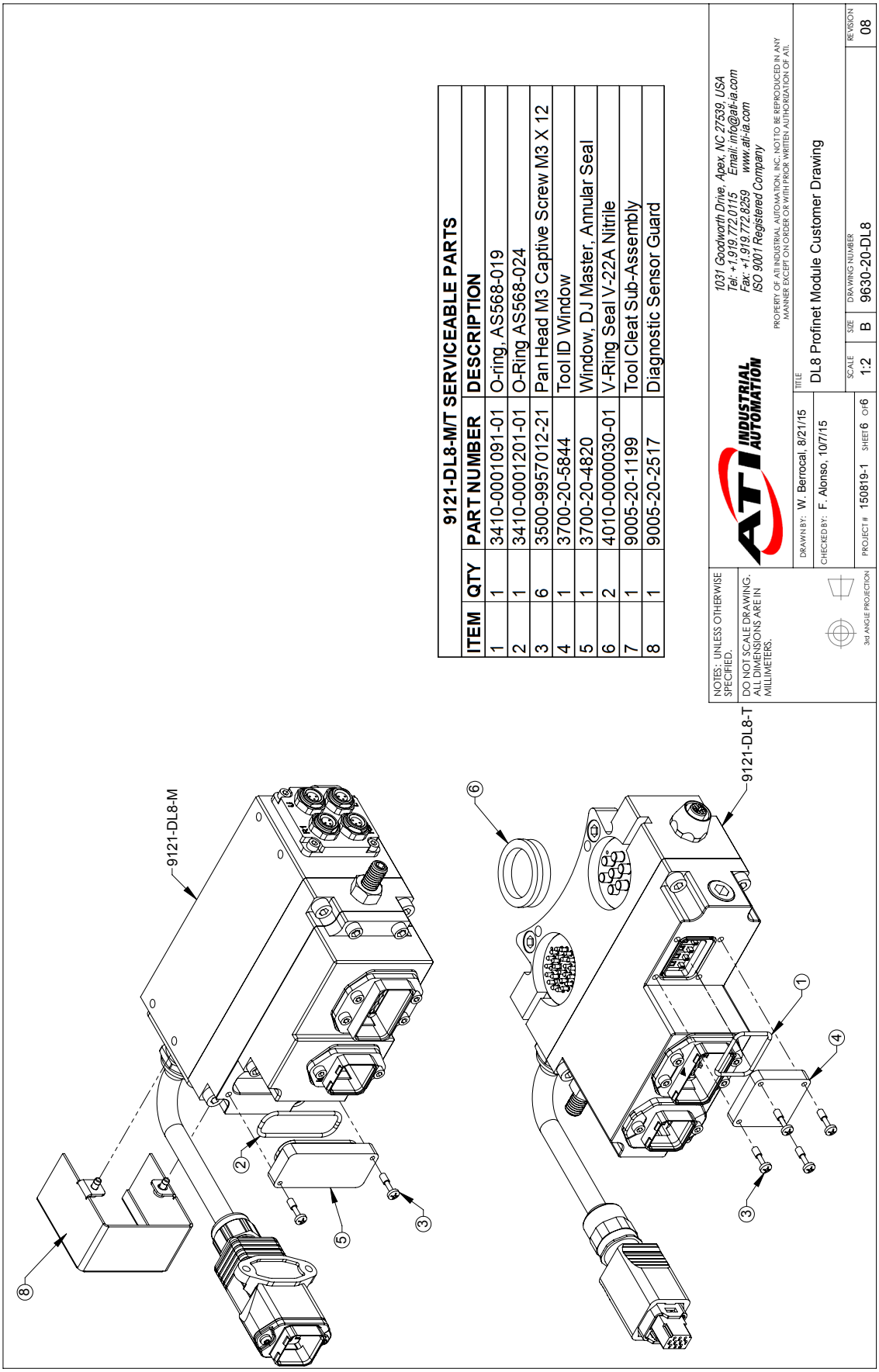
3rd ANGLE PROJECTION	CHECKED BY: F. Alonso, 10/7/15				
	PROJECT # 150819-1 SHEET 5 OF 6	SCALE: 1:10	SIZE: B	DRAWING NUMBER: 9630-20-DL8	REVISION: 08



9121-DL8-M/T SERVICEABLE PARTS

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	3410-0001091-01	O-ring, AS568-019
2	1	3410-0001201-01	O-Ring AS568-024
3	6	3500-9957012-21	Pan Head M3 Captive Screw M3 X 12
4	1	3700-20-5844	Tool ID Window
5	1	3700-20-4820	Window, DJ Master, Annular Seal
6	2	4010-0000030-01	V-Ring Seal V-22A Nitrile
7	1	9005-20-1199	Tool Cleat Sub-Assembly
8	1	9005-20-2517	Diagnostic Sensor Guard

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3rd ANGLE PROJECTION

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CHECKED BY: F. Alonso, 10/7/15
PROJECT # 150819-1 SHEET 6 OF 6

TITLE: DL8 Profinet Module Customer Drawing

SCALE: 1:2
SIZE: B
DRAWING NUMBER: 9630-20-DL8
REVISION: 08

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