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## C. Control and Signal Modules

### VB7-M, VBx-T—Discrete Control Module Supporting Integrated Valve

#### 1. Product Overview

The Discrete Control modules are required to provide a means for the customer to communicate with and control the Tool Changer.

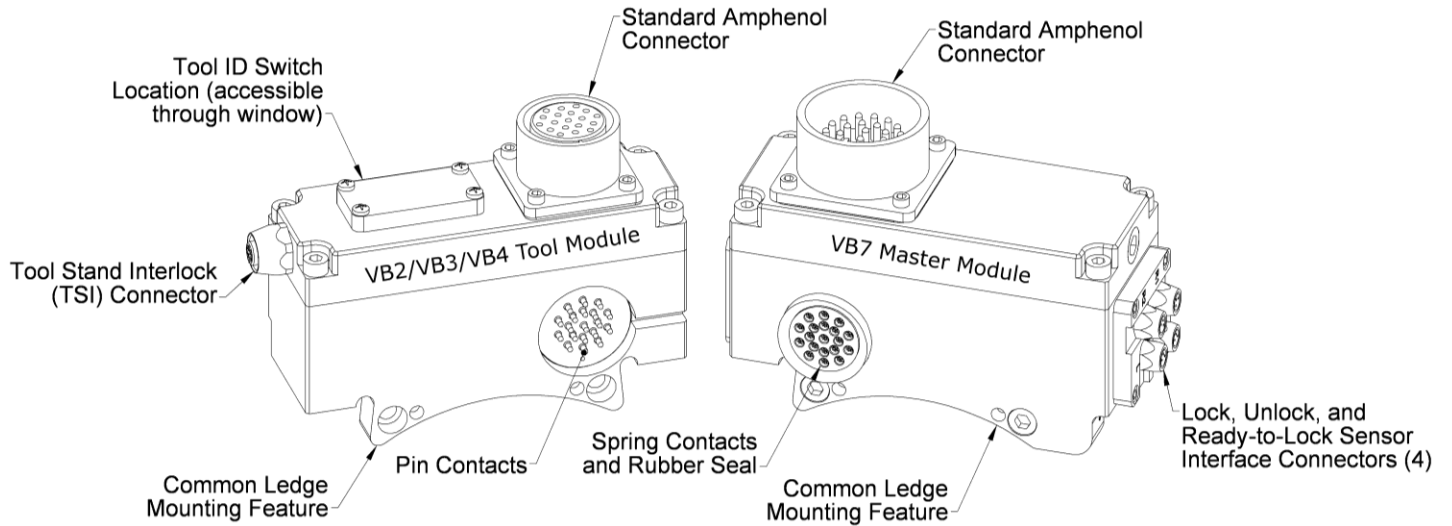
MS-style connectors are provided for interfacing on the Master and Tool modules. When the Tool Changer is coupled, the Master and Tool modules communicate across their interface using a spring-loaded pin block. A flexible boot surrounds the pin block to seal the connection from moisture and liquid while coupled. Several module configurations are available in order to provide the customer with Tool Changer I/O and various pass-through signal capabilities. Refer to *Section 7—Specifications* for the specifications of each available module.

An electrical interface is provided on the Master module for support of an integrated solenoid valve (DC Voltage). The integrated valve can be supplied from ATI as part of the valve adapter block, 9121-Jxx-M. Refer to the valve adapter block manual for more information (9620-20-C-Jxx Air and Valve Adapters with Valve Signal Pass Thru). Electrical interface drawings and connector details are provided in drawings in *Section 8—Drawings*.

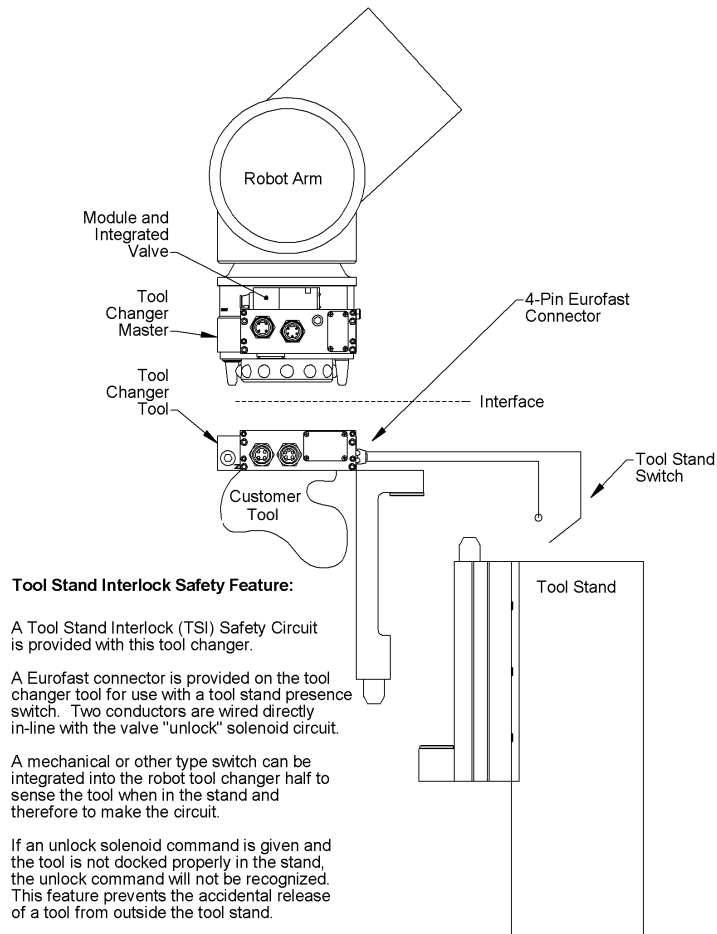
The VB7 modules are designed with special features to afford the user the opportunity to operate the Tool Changer in the safest manner possible. In addition to providing the standard Lock, Unlock, and Ready-to-Lock sensor inputs the VB7 modules are outfitted with patented Tool Stand Interlock (TSI) technology. The TSI feature consists primarily of a physical break in the unlock solenoid valve circuit. The broken circuit is made available to the customer via a TSI connector on the Tool module. Using this connector, a mechanical switch, and trip dog can be integrated by the customer to allow the unlock solenoid valve circuit to be completed only when the Tool is in the Tool Stand (see Figs. 1.1 and 1.2). A momentary action single-pole, double-throw switch is suggested.

In order to allow the Tool Changer to uncouple when a Tool is not present, a Relay circuit in parallel with the TSI circuit is utilized. This Relay circuit is located in the Master module and is triggered by the RTL sensor. If the RTL sensor is low, indicating no Tool presence, then the Relay circuit is closed, thus allowing the unlock solenoid valve circuit to be completed. If the RTL sensor is high, indicating Tool presence, then the Relay circuit is open and the TSI circuit on the Tool-side must be closed in order to complete the unlock solenoid valve circuit.


Monitoring of the Relay circuit is achieved through the RTL V input. Refer to Table 3.1 for suggested fault monitoring conditions.



**Figure 1.1—VB7-M, VBx-T Modules**



**Figure 1.2—Tool Stand Interlock (TSI)**

 **CAUTION:** This Tool Changer is equipped with Tool Stand Interlock (TSI). Special procedures are required to uncouple the Tool Changer.

## 2. Installation

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

For wiring information refer to the drawings in *Section 8—Drawings*.



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

### 2.1 Installing

1. It may be necessary to clean the mounting surface on the Tool Changer prior to installing the module in order to remove any debris that may be present.
2. 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 flush with the Tool Changer surface.
3. Apply Loctite-222<sup>®</sup> (or similar) thread locker to the socket head cap screws and tighten using a hex key.
4. Typically, proximity sensor cables are connected to the Master control module. These connections need to be made once the module has been attached to the Tool Changer body.

### 2.2 Removal

1. All customer connections and proximity sensor cables up to the Master module need to be disconnected.
2. Remove the socket head cap screws and pull the module off the Tool Changer. Retain the fasteners for re-installation.

### 3. Operation

Various Tool Changer I/O is provided to the customer through the military-style Amphenol connector on the control/signal Master module. Lock, Unlock, and Ready-to-Lock proximity sensor inputs are provided for confirmation of Tool Changer and locking mechanism positions. Other, customer-assigned discrete I/O points are also available through the connector.

Output signals need to be provided to the discrete control module to actuate the solenoid valve in order to provide pneumatic pressure to lock or unlock the Tool Changer.

Note that 0 and 24 VDC supply lines are required to be on certain pin locations of the customer interface connector. Reference drawings in *Section 8—Drawings* for pin out information and location of the I/O signals.

Refer to the specific Tool Changer manual for details on the operation of the Tool Changer and recommended procedure for coupling.

When coupled, the discrete module Tool can be communicated with, Tool-ID can be read, and attached end-effectors can be used.

Table 3.1 is provided below with suggested fault monitoring conditions for the TSI circuitry.

Sensor/Input1	State1	Sensor/Input2	State2	Comment
RTL	Low	Slave Module	Present*	**RTL Not Operating Properly.
RTL	Low	RTLTV	High	**Relay or RTL Not Operating Properly.
RTL	High	RTLTV	Low	Relay or RTL Not Operating Properly.

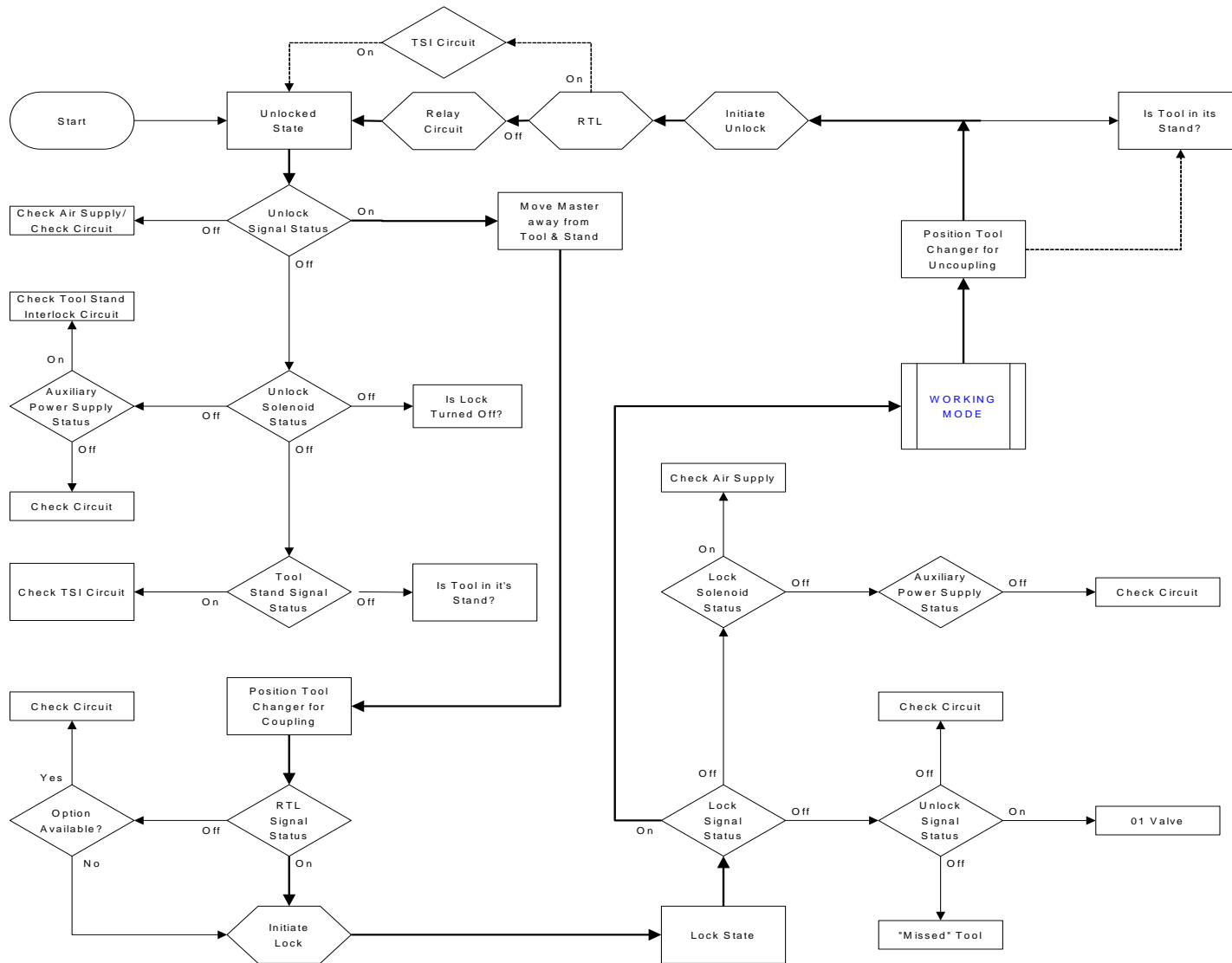
\* Slave Module Present as evidenced by Node online or ability to read Tool-ID

\*\* Dangerous situation where an unintentional Unlock command could result in Tool release.

**Table 3.1—Fault Monitoring**

#### 3.1 Operation Flow Chart

Refer to the flow chart Figure 3.1 for a logical description of the Tool Changer lock/unlock procedure and diagnostic checks.



**Figure 3.1—Logical Operation and Diagnostics**

## 4. Maintenance

Contact pins on the control module should be inspected and cleaned periodically to ensure electrical continuity 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 drawings are provided in *Section 8—Drawings* of this manual.

## 5. Troubleshooting

Symptom	Possible Cause / Correction
Unit will not lock or unlock	Verify that ball bearings are moving freely. Clean and lubricate as needed.  Check air supply.  Check that exhaust port is properly vented (check muffler).  Verify that discrete 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	Verify that cables are connected correctly.  Verify that the sensors are set correctly.  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 Communication	Check/Replace signal cabling up- and down-stream of Tool Changer modules.  Inspect module contact pins for debris/wear/damage.

## 6. Recommended Spare Parts

See Drawings in *Section 8—Drawings*.

## 7. Specifications

<b>9121-VB7-M</b>	Discrete Signal Master Module with 26-Pin Amphenol, 19-pin Block, Supports L/U/R1/R2 Sensors w/ Integrated Valve Pass Through (Uses Single or Double Solenoid Valve). Supports Tool Stand Interlock on Tool Side and Works w/VB Series Tools.
Connector(s)	Amphenol MS3102E28-12P 26-pin Connector. 13A maximum current rating.
Weight	1.5 lbs (0.7 kg).
Pass-Through Signals	Nineteen (19) Rhodium-plated, spring-loaded, No-Touch contact pins. 5A Maximum current rating, 250V.

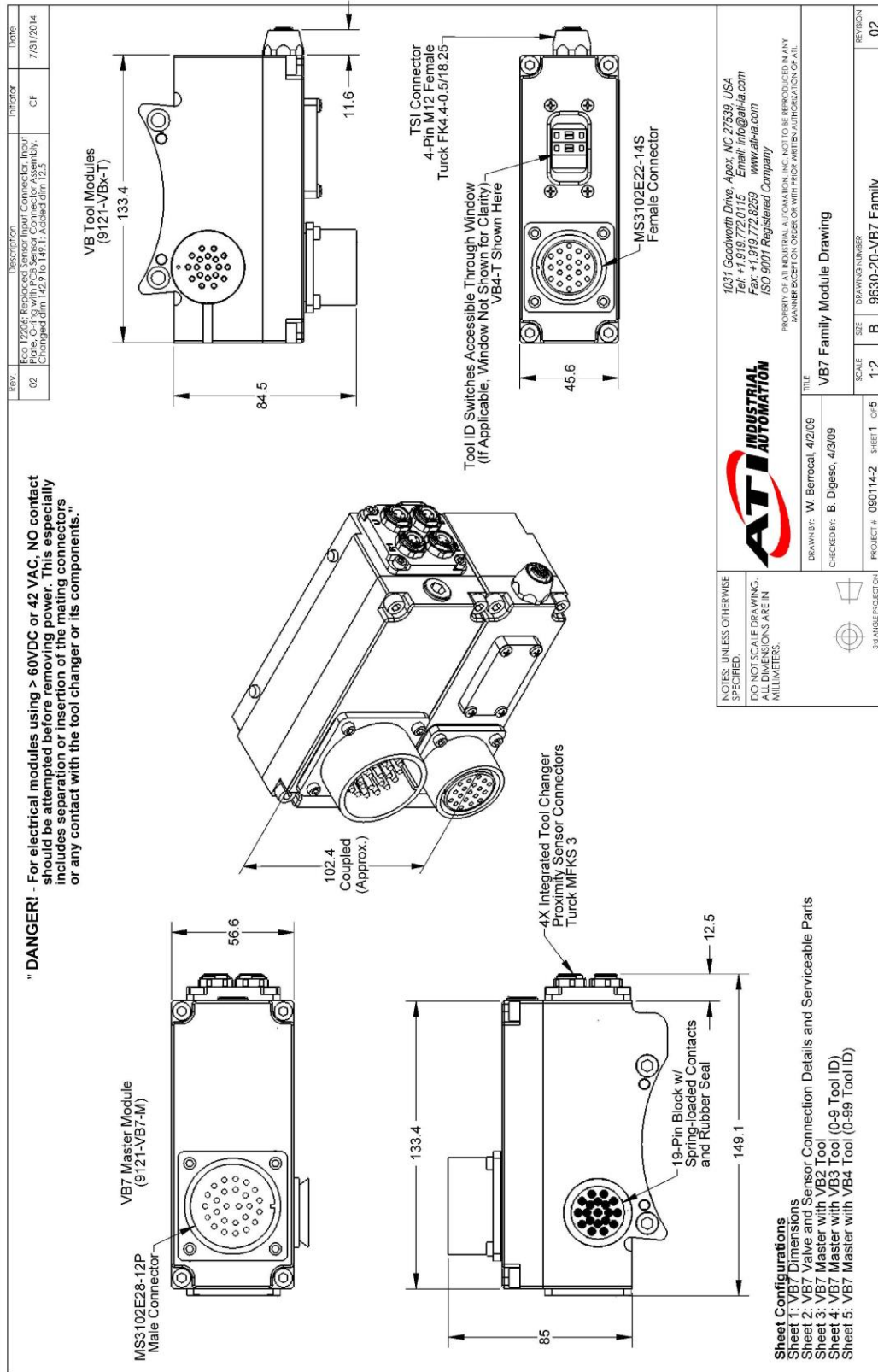
<b>9121-VB2-T</b>	Tool Discrete signal module with 16-pin pass-through, Signal module with NO internal Tool-ID. Mates with VB2-M. Supplied with TSI Connector with pins 2 to 3 breaking solenoid circuit. Red Teach Plug (1700-0545501-01) sold separately.
Connector	Amphenol MS3102E22-14S 19-Socket Connector. 13A maximum current rating.
Weight	1.3 lbs (0.6 kg).
Pass-Through Signals	Sixteen (16) available pass-through signals. Rhodium-plated contacts w/ first mate ground pin.

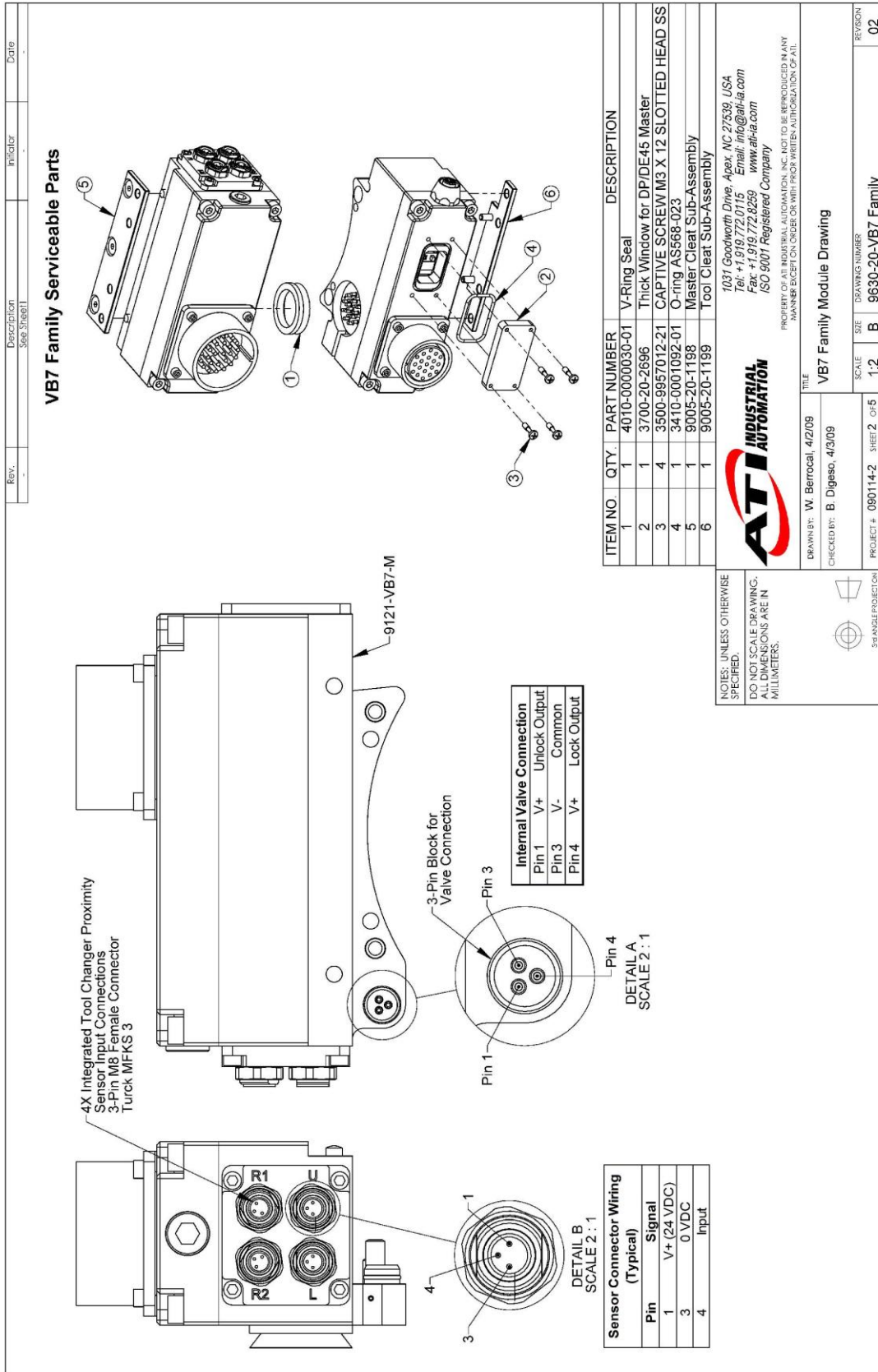
<b>9121-VB3-T</b>	Tool Discrete signal module with 12-pin pass-through, Signal module w/ internal Tool-ID, 0-9. Mates with VB2-M. Supplied with TSI Connector with pins 2 to 3 breaking solenoid circuit. Red Teach Plug 1700-0545501-01, sold separately.
Connector	Amphenol MS3102E22-14S 19-Socket Connector. 13A maximum current rating.
Weight	1.3 lbs (0.6 kg).
Pass-Through Signals	Twelve (12) available pass-through signals. Rhodium-plated contacts w/ first mate ground pin.

<b>9121-VB4-T</b>	Tool Discrete signal module with 8-pin pass-through, Signal module w/ internal Tool-ID, 0-99. Mates with VB2-M. Supplied with TSI Connector with pins 2 to 3 breaking solenoid circuit. Red Teach Plug 1700-0545501-01, sold separately.
Connector	Amphenol MS3102E22-14S 19-Socket Connector. 13A maximum current rating.
Weight	1.3 lbs (0.6 kg).
Pass-Through Signals	Eight (8) available pass-through signals. Rhodium-plated contacts w/ first mate ground pin.



### 8. Drawings





Rev. _____	Description See Sheet 1	Instructor _____	Date _____
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### VB7 Master with VB2 Tool

VB7 to VB2 Pin Out

<p>VB7 Master MS3102E28-12P Male Connector</p> <p>A .....&gt;&gt;&gt; 0 VDC Reference                  B .....&gt;&gt;&gt; +24 VDC                  C .....&gt;&gt;&gt; available                  D .....&gt;&gt;&gt; available                  E .....&gt;&gt;&gt; available                  F .....&gt;&gt;&gt; available                  G .....&gt;&gt;&gt; available                  H .....&gt;&gt;&gt; available                  J .....&gt;&gt;&gt; available                  K .....&gt;&gt;&gt; available                  L .....&gt;&gt;&gt; available                  M .....&gt;&gt;&gt; available                  N .....&gt;&gt;&gt; available                  P .....&gt;&gt;&gt; available                  R .....&gt;&gt;&gt; available                  S .....&gt;&gt;&gt; available                  T .....&gt;&gt;&gt; not available                  U .....&gt;&gt;&gt; not available                  V .....&gt;&gt;&gt; not available</p>	<p>VB2 Tool MS3102E22-14S Female Connector</p> <p>A .....&gt;&gt;&gt; 0 VDC Reference                  B .....&gt;&gt;&gt; available                  C .....&gt;&gt;&gt; available                  D .....&gt;&gt;&gt; available                  E .....&gt;&gt;&gt; available                  F .....&gt;&gt;&gt; available                  G .....&gt;&gt;&gt; available                  H .....&gt;&gt;&gt; available                  J .....&gt;&gt;&gt; available                  K .....&gt;&gt;&gt; available                  L .....&gt;&gt;&gt; available                  M .....&gt;&gt;&gt; available                  N .....&gt;&gt;&gt; available                  P .....&gt;&gt;&gt; available                  R .....&gt;&gt;&gt; available                  S .....&gt;&gt;&gt; available                  T .....&gt;&gt;&gt; not available                  U .....&gt;&gt;&gt; not available                  V .....&gt;&gt;&gt; not available</p>
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Pin	Signal	Description
A	0 VDC	Voltage Reference
B	+24 VDC	Voltage Supply
X	24 VDC	Unlock Solenoid Supply
W	24 VDC	Lock Solenoid Supply (Double Solenoid)

Pin	Signal	Description
Y	RTL V	RTL Verify Input
Z	RTL #1	Ready-To-Lock Input #1
a	RTL #2	Ready-To-Lock Input #2
b	Lock	Tool Changer Lock Input
d	Unlock	Tool Changer Unlock Input

**Notes:**

- Pin "A" on the MS connector is First-to-Mate Last-to-Break at the tool changer interface. This pin is recommended for use as 0 VDC / ground reference.
- Large views of connectors are 1.5:1 scale.

VB7-M  
Master Side  
(MS3102E28-12P)

VB2-T  
Tool Side  
(MS3102E22-14S)

TSI Connector  
VB2 Tool Side  
Turck FK4-4.0.5/18.25

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TITLE  
VB7 Family Module Drawing

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 CHECKED BY: B. Digeos, 4/3/09

PROJECT # 090114-2 SHEET 3 OF 5  
 SCALE 1:2  
 DRAWING NUMBER 9630-20-VB7 Family  
 REVISION 02

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3/8 ANGLE PROJECTION

Rev: \_\_\_\_\_

Description: 500 Sheet 1

Initiator: \_\_\_\_\_

Date: \_\_\_\_\_

### VB7 Master with VB3 Tool (0-9 Tool ID)

VB7 to VB3 Pin Out

VB7 Master MS3102E28-12P Male Connector	VB3 Tool MS3102E22-14S Female Connector
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
J	J
K	K
L	L
M	M
N	N
P	P
R	R
S	S
T	T
U	U
V	V

0 VDC Reference	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	
+24 VDC	available	available	available	available	available	available	available	available	available	available	available	available	available	not available	not available	not available	not available	not available	not available	not available

Tool ID, Bit Value 8	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	
available	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tool ID, Bit Value 4	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	
available	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tool ID, Bit Value 1	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	
available	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tool ID, Bit Value 0	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	
available	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tool ID Output	Pin	Pin	Pin	Pin
Switch 1	"N"	"P"	"R"	"S"
0	0	0	0	0
1	0	0	0	1
2	0	0	0	1
3	0	0	0	1
4	0	0	1	0
5	0	0	1	0
6	0	1	0	0
7	0	1	1	0
8	1	0	0	0
9	1	0	0	1

Pin	Signal	Description
A	0 VDC	Voltage Reference
B	24 VDC	Voltage Supply
X	24 VDC	Unlock Solenoid Supply
W	24 VDC	Lock Solenoid Supply (Double Solenoid)

Pin	Signal	Description
N	Tool ID	Bit Value 8 (See Table)
P	Tool ID	Bit Value 4 (See Table)
R	Tool ID	Bit Value 2 (See Table)
S	Tool ID	Bit Value 1 (See Table)
Y	RTL#1	RTL Verify Input
Z	RTL#2	Ready-To-Lock Input #1
a	RTL#1	Ready-To-Lock Input #2
b	Lock	Tool Changer Lock Input
d	Unlock	Tool Changer Unlock Input

Pin	Signal	Description
4	NC	
3	TSI Out	
2	TSI In	
1	NC	

**TSI Connector**  
**4-Pin Eurofast Female**

**Notes:**

- Pin "a" on the MS connector is First-to-Mate Last-to-Break at the tool changer interface. This pin is recommended for use as 0 VDC / ground reference.
- The common for Tool ID is tied into the 24VDC line (Pin B). The Tool ID switches are Rated for service at 50V and 100 mA max. Refer to the Tool ID table for switch setup information.
- Large views of connectors are 1.5:1 scale.

VB7-M  
Master Side  
(MS3102E28-12P)

VB3-T  
Tool Side  
(MS3102E22-14S)

TSI Connector  
VB3 Tool Side  
Turck FK4.4-0.5/18.25

**Tool Stand Interlock (TSI) Operation:**

- A hard-wired break in the Valve Unlock Output is provided on the tool module via the 4-pin Eurofast connector. It is suggested that the customer integrate a single throw, double pole (NO, spring return) limit switch to work with this feature. The limit switch should be mounted to the end effector in such a way that the switch is "made" only when the tool is in the stand or storage location.
- The RTL sensor is very important to this TSI feature and therefore should be monitored for failure. RTL#1 input is available for fault monitoring of this circuit. Please consult the product manual for operation and fault monitoring suggestions.
- Limit switches, trip dogs and cabling are also available from ATI.

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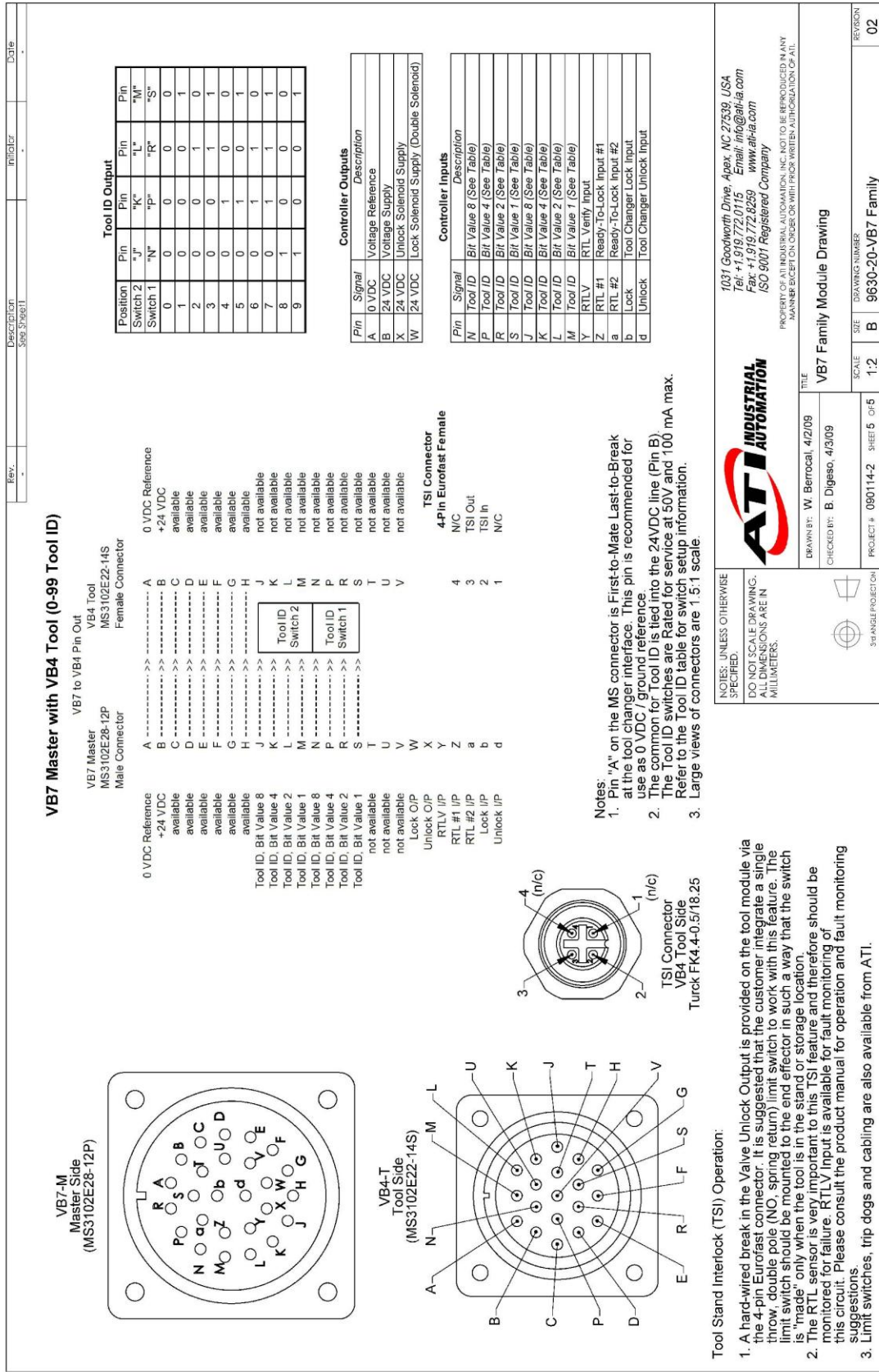
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C - 12



Rev.	Description	Initials	Date
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 CHECKED BY: B. Digeso, 4/3/09  
 TITLE: VB7 Family Module Drawing  
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 DRAWING NUMBER: 9630-20-VB7 Family  
 PROJECT #: 090114-2 SHEET 5 OF 5

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