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C. Control and Signal Modules

VB2—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 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-Air and Valve Adapters). Electrical interface drawings and connector details are provided in drawings in Section 8.

The Tool ID feature allows the customer to distinguish between the different Tools that are being coupled by the tool changer. Setting of Tool ID is facilitated using push button switches provided on the Tool modules.

The VB2 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 VB2 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 RTLV input. Refer to Table 3.1 for suggested fault monitoring conditions.

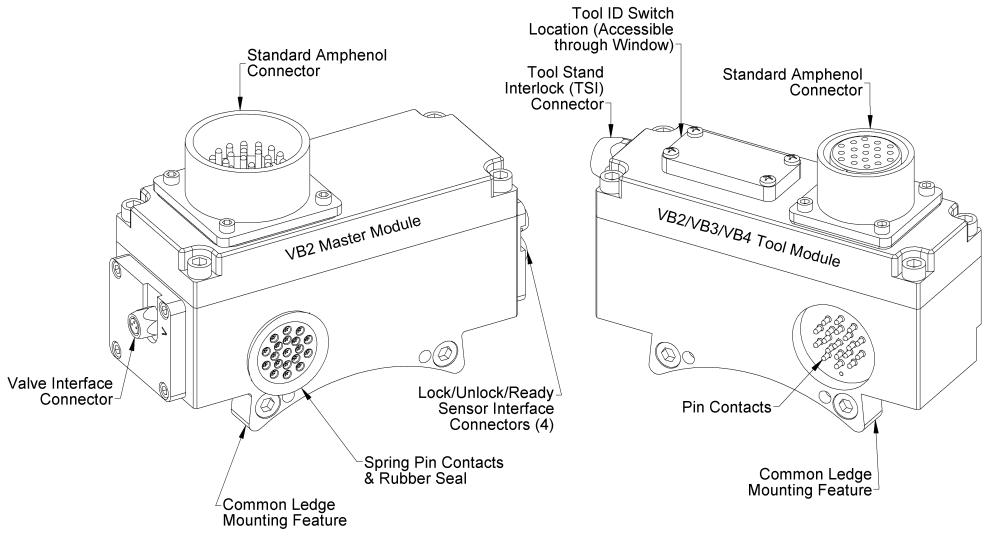


Figure 1.1—VB2 Modules

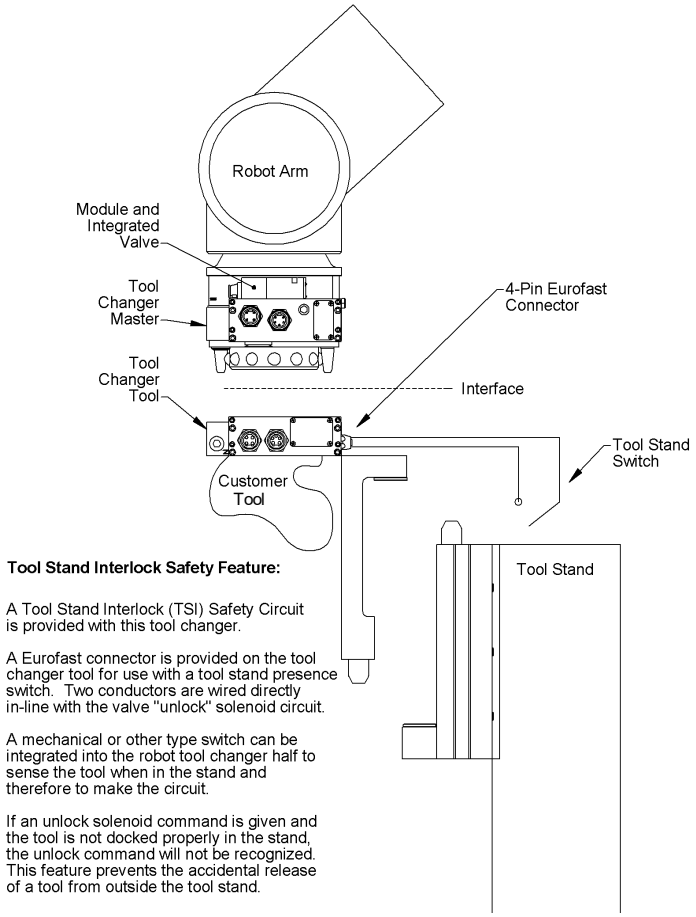


Figure 1.2—Tool Stand Interlock (TSI)

> ⚠ **CAUTION:** This tool changer is equipped with Tool Stand Interlock (TSI). Special procedures are required to unlock 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.

DANGER: Power and air should always be removed prior to maintenance or repair.

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® (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 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	RTLV	High	**Relay or RTL Not Operating Properly.
RTL	High	RTLV	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.

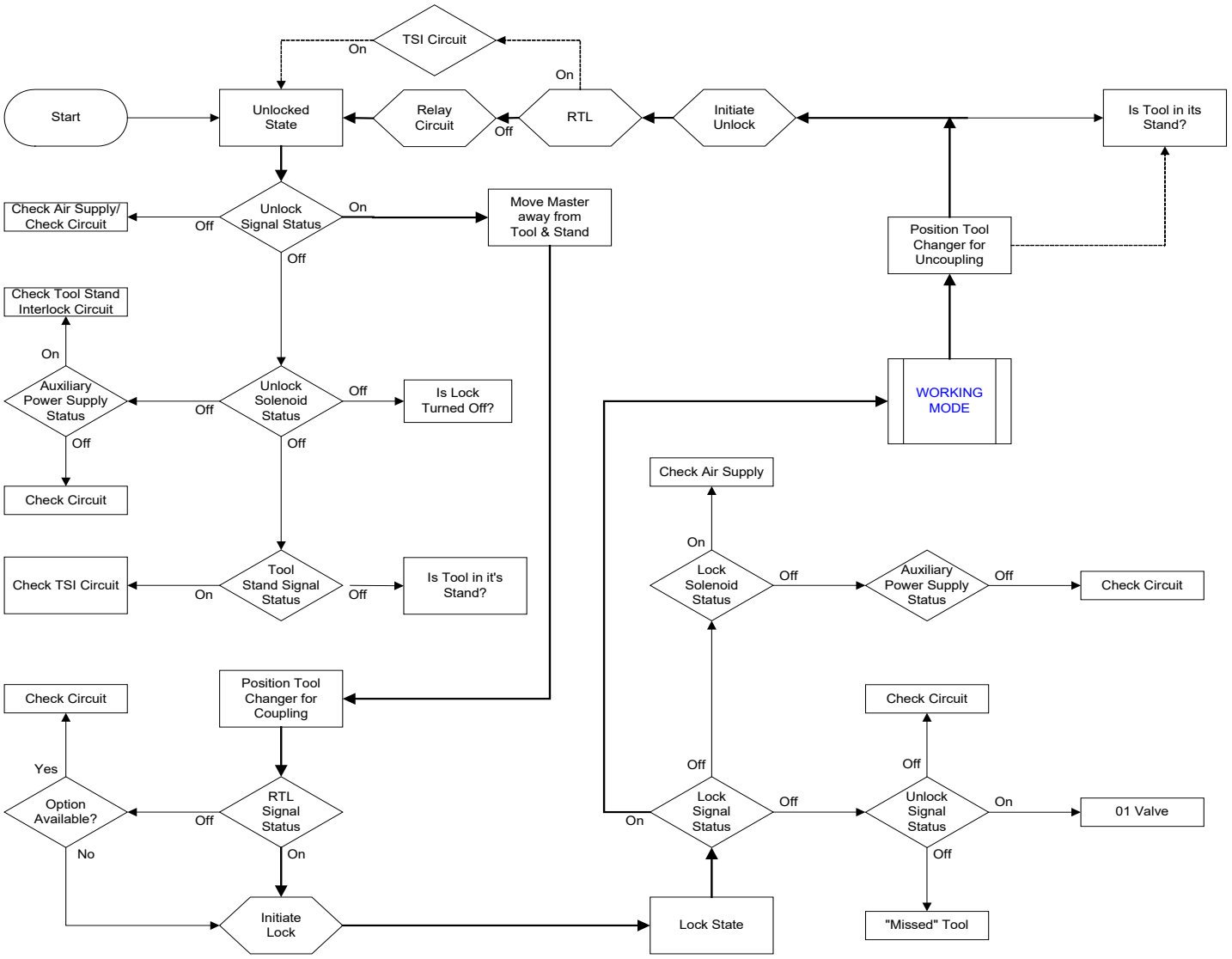


Figure 3.1—Logical Operation and Diagnostics

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 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

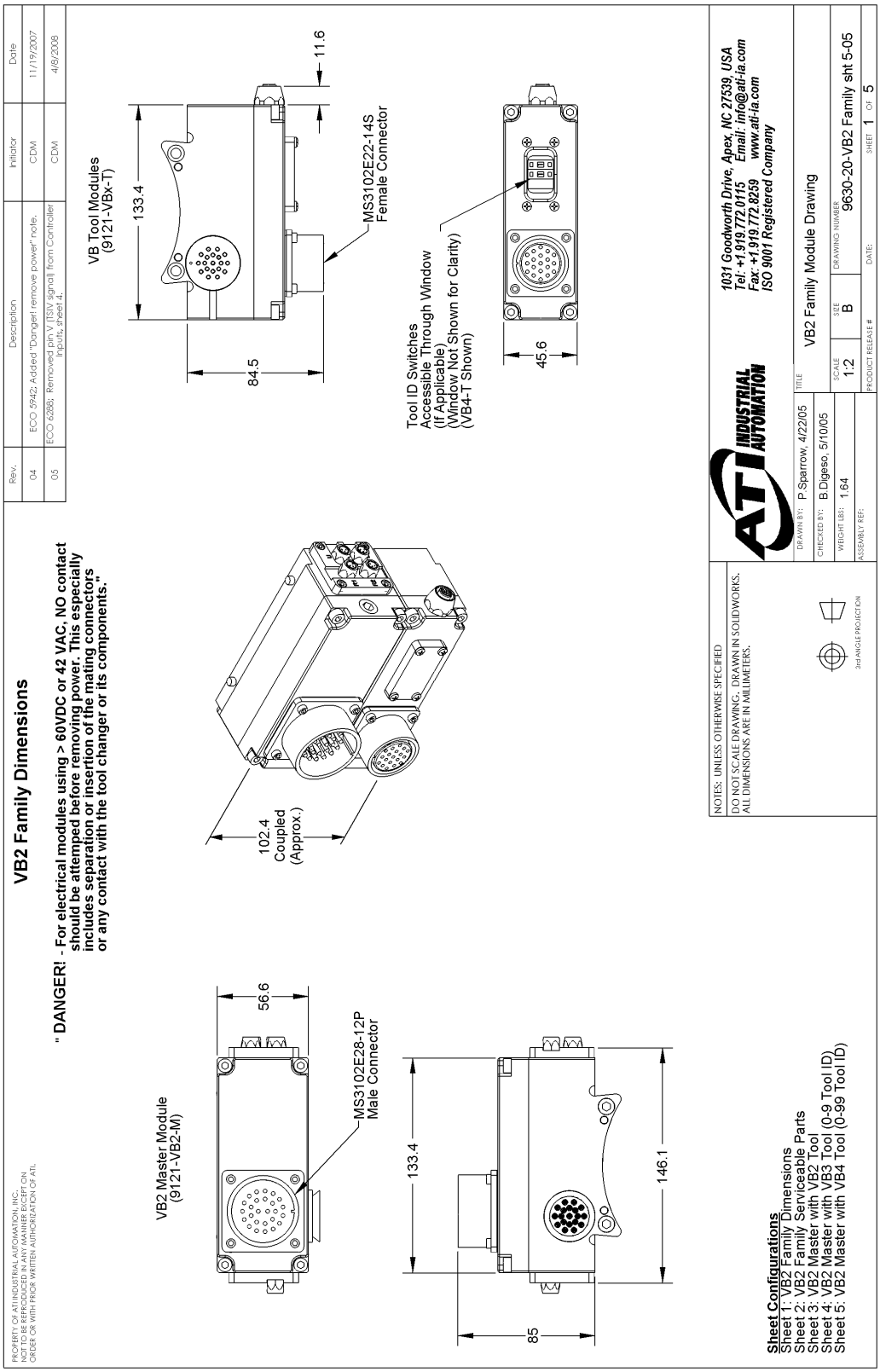
See Drawings in Section 8.

7. Specifications

VB2-M		19-pin Signal Module Supporting Integrated Solenoid Valve (DC Voltage) and TSI. Mates with VB2, VB3, and VB4 Tool Sides.
Connector	MS3102E28-12P	
Weight	1.5 lbs (0.7 kg)	Master side
Pass-Through Signals	19 @ 5 Amp, 250 V	Rhodium-plated, spring-loaded and No-Touch contact pins.
VB2-T		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	MS3102E22-14S	
Weight	1.3 lbs (0.6 kg)	Tool side
Pass-Through Signals	16 @ 5 amp, 250 V	Rhodium-plated contacts w/ first mate ground pin.
VB3-T		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	MS3102E22-14S	
Weight	1.3 lbs (0.6 kg)	Tool side
Electrical Rating:		
Pass-Through Signals	12 @ 5 amp, 250 V	Rhodium-plated contacts w/ first mate ground pin.
Tool-ID	0.1 A, 30 V	

VB4-T		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	MS3102E22-14S	
Weight	1.3 lbs (0.6 kg)	Tool side
Electrical Rating:		
Pass-Through Signals	12 @ 5 amp, 250 V	Rhodium-plated contacts w/ first mate ground pin.
Tool-ID	0.1 A, 30 V	

8. Drawings


VB2 Family Dimensions
" DANGER! - For electrical modules using > 60VDC or 42 VAC, NO contact should be attemped before removing power. This especially includes separation or insertion of the mating connectors or any contact with the tool changer or its components."
Rev. | Description | Initiator | Date
04 | ECO 5942; Added "Danger! remove power" note. | CDM | 11/19/2007
05 | ECO 6286; Removed pin V (15V signal) from Controller Inputs, sheet 4. | CDM | 4/8/2008
VB Tool Modules (9121-VBx-T)
133.4
84.5
11.6
MS3102E22-14S Female Connector
Tool ID Switches Accessible Through Window (If Applicable) (Window Not Shown for Clarity) (VB4-T Shown)
45.6
102.4 Coupled (Approx.)
VB2 Master Module (9121-VB2-M)
56.6
MS3102E28-12P Male Connector
133.4
146.1
85
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DRAWN BY: P Sparrow, 4/22/05
CHECKED BY: B Digeso, 5/10/05
WEIGHT LBS: 1.64
ASSEMBLY REF:
3rd ANGLE PROJECTION
TITLE
VB2 Family Module Drawing
SCALE 1:2
SIZE B
DRAWING NUMBER
9630-20-VB2 Family sht 5-05
PRODUCT RELEASE #
DATE:
SHEET 1 OF 5
Sheet Configurations
Sheet 1: VB2 Family Dimensions
Sheet 2: VB2 Family Serviceable Parts
Sheet 3: VB2 Master with VB2 Tool
Sheet 4: VB2 Master with VB3 Tool (0-9 Tool ID)
Sheet 5: VB2 Master with VB4 Tool (0-99 Tool ID)
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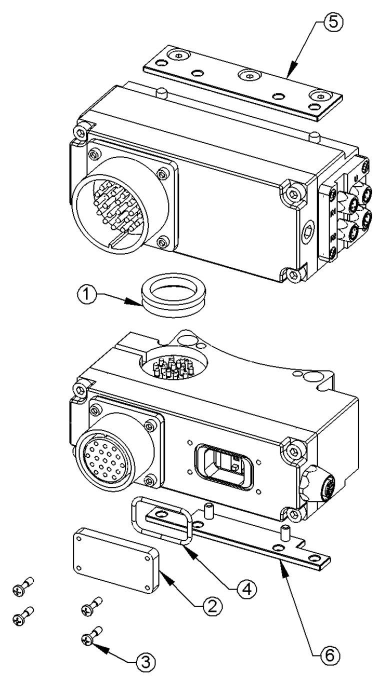
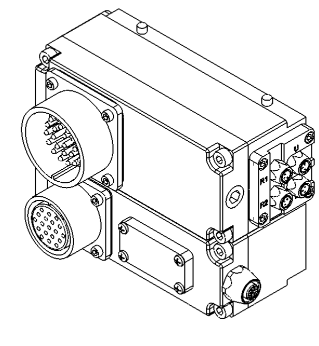
ORDER OR WITH PRIOR WRITTEN AUTHORIZATION OF ATI.

Rev.	Description	Initiator	Date
-	See Sheet1	-	-

VB2 Family Serviceable Parts





ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	4010-0000030-01	V-Ring Seal
2	1	3700-20-2696	Thick Window for DP/DE45 Master
3	4	3500-9957012-21	CAPTIVE SCREW M3 X 12 SLOTTED HEAD SS
4	1	3410-0001092-01	O-ring AS568-023
5	1	9005-20-1198	Master Cleat Sub-Assembly
6	1	9005-20-1199	Tool Cleat Sub-Assembly
49	1	3540-0101062-21	1/16 x 5/8 Dowel Pin SST
50	1	3490-0001039-01	Plug 1/4" NPT Hex, Brass, Pre-Applied Sealer

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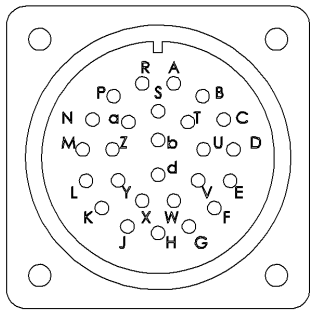
Fax: +1.919.772.8259 www.ati-ia.com
ISO 9001 Registered Company

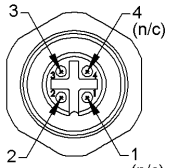
DRAWN BY: P.Sparrow, 4/22/05	TITLE: VB2 Family Module Drawing			
CHECKED BY: B.Digeso, 5/10/05				
WEIGHT LBS: 1.64	SCALE: 1:2	SIZE: B	DRAWING NUMBER: 9630-20-VB2 Family sht 5-05	
ASSEMBLY REF:	PRODUCT RELEASE #:	DATE:	SHEET 2 OF 5	

Rev.	Description	Initiator	Date
-	See Sheet1	-	-

VB2 Master with VB2 Tool

VB2-M
Master Side
(MS3102E28-12P)





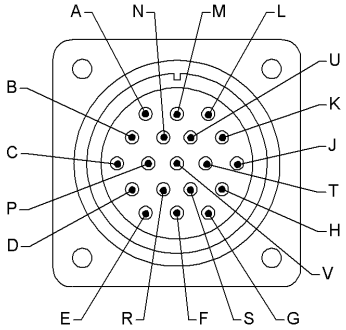
TSI Connector
VB2 Tool Side
(1510-2323001-04)

VB2 Pin Out

	VB2 Master MS3102E28-12P Male Connector		VB2 Tool MS3102E22-14S Female Connector	
0 VDC Reference	A	>>	A	0 VDC Reference
+24 VDC	B	>>	B	+24 VDC
available	C	>>	C	available
available	D	>>	D	available
available	E	>>	E	available
available	F	>>	F	available
available	G	>>	G	available
available	H	>>	H	available
available	J	>>	J	available
available	K	>>	K	available
available	L	>>	L	available
available	M	>>	M	available
available	N	>>	N	available
available	P	>>	P	available
available	R	>>	R	available
available	S	>>	S	available
not available	T		T	not available
not available	U		U	not available
not available	V		V	not available
Lock O/P	W			
Unlock O/P	X			
RTLV I/P	Y			
RTL #1 I/P	Z		4	N/C
RTL #2 I/P	a		3	TSI Out
Lock I/P	b		2	TSI In
Unlock I/P	d		1	N/C

TSI Connector
4-Pin Eurofast Female

VB2-T
Tool Side
(MS3102E22-14S)



Controller Outputs		
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)
Controller Inputs		
Pin:	*Signal:*	*Description:*
Y	RTLV	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:
1. 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.
2. Large views of connectors are 1.5:1 scale.

Tool Stand Interlock (TSI) Operation:

1. 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.
2. The RTL sensor is very important to this TSI feature and therefore should be monitored for failure. RTLV Input is available for fault monitoring of this circuit. Please consult the product manual for operation and fault monitoring suggestions.
3. Limit switches, trip dogs and cabling are also available from ATI.

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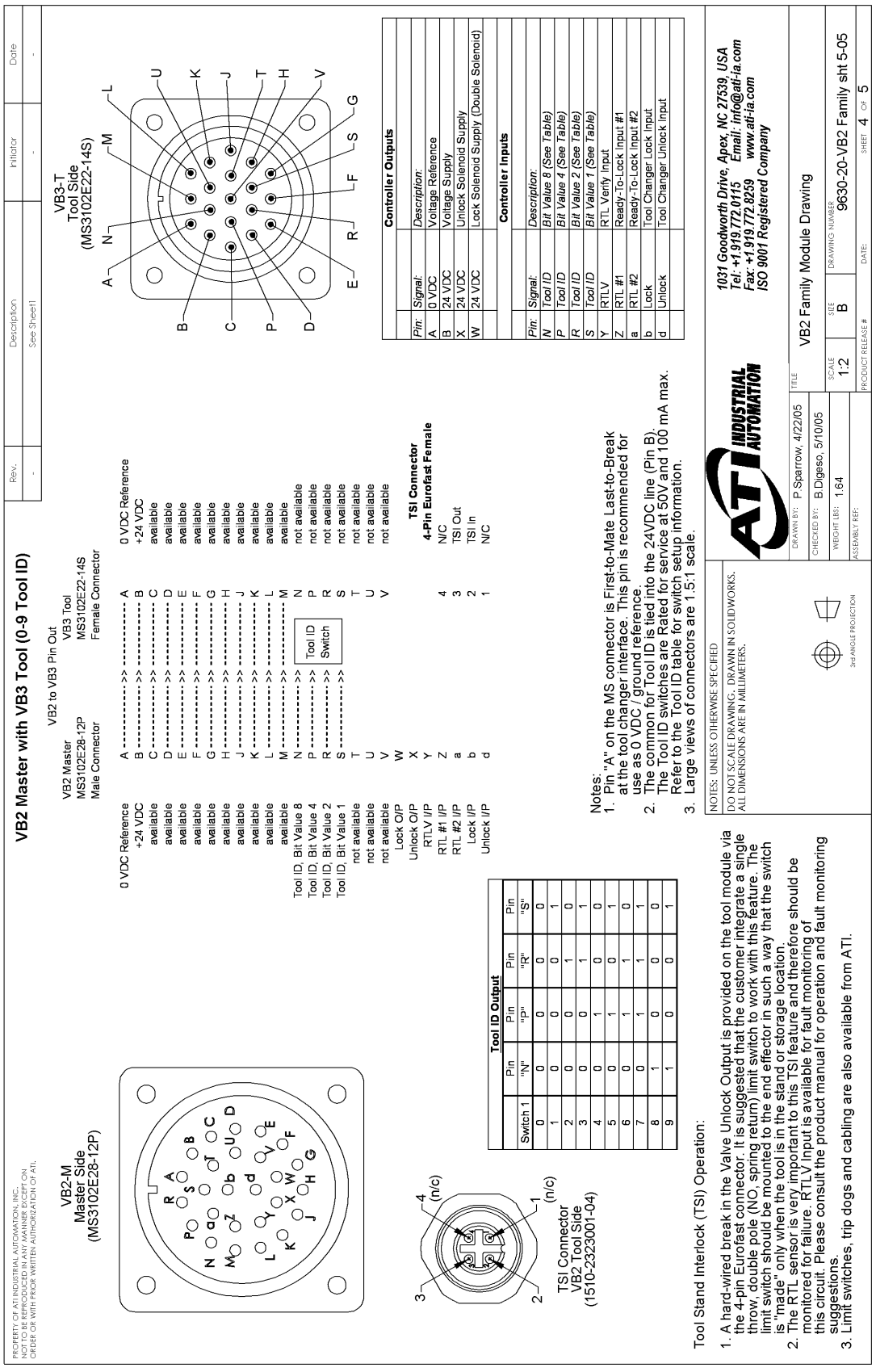
DRAWN BY: P.Sparrow, 4/22/05	TITLE: VB2 Family Module Drawing		
CHECKED BY: B.Digeso, 5/10/05			
WEIGHT LBS: 1.64	SCALE: 1:2	SIZE: B	DRAWING NUMBER: 9630-20-VB2 Family sht 5-05
ASSEMBLY REF:	PRODUCT RELEASE #	DATE:	SHEET 3 OF 5

US Patent No.: 6,840,895 B2


VB2 Master with VB3 Tool (0-9 Tool ID)
VB2 to VB3 Pin Out
VB2 Master
MS3102E28-12P
Male Connector
VB3 Tool
MS3102E22-14S
Female Connector
0 VDC Reference A ---------->> A
+24 VDC B ---------->> B
available C ---------->> C
available D ---------->> D
available E ---------->> E
available F ---------->> F
available G ---------->> G
available H ---------->> H
available J ---------->> J
available K ---------->> K
available L ---------->> L
available M ---------->> M
Tool ID, Bit Value 8 N ---------->> N
Tool ID, Bit Value 4 P ---------->> P
Tool ID, Bit Value 2 R ---------->> R
Tool ID, Bit Value 1 S ---------->> S
not available T ---------->> T
not available U ---------->> U
not available V ---------->> V
Lock O/P W
Unlock O/P X
RTLV I/P Y
RTL #1 I/P Z
RTL #2 I/P a
Lock I/P b
Unlock I/P d
Tool ID
Switch
0 VDC Reference A
+24 VDC B
available C
available D
available E
available F
available G
available H
available J
available K
available L
available M
not available N
not available P
not available R
not available S
not available T
not available U
not available V
not available W
not available X
TSI Connector
4-Pin Eurofast Female
N/C Y
TSI Out Z
TSI In a
N/C b
1
2
3
4
Controller Outputs
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)
Controller Inputs
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 RTLV 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
VB2-M
Master Side
(MS3102E28-12P)
VB3-T
Tool Side
(MS3102E22-14S)
TSI Connector
VB2 Tool Side
(1510-2323001-04)
4 (n/c)
1 (n/c)
Tool ID Output
Switch 1 Pin "N" Pin "P" Pin "R" Pin "S"
0 0 0 0 0
1 0 0 0 1
2 0 0 1 0
3 0 0 1 1
4 0 1 0 0
5 0 1 0 1
6 0 1 1 0
7 0 1 1 1
8 1 0 0 0
9 1 0 0 1
Notes:
1. 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.
2. 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.
3. Large views of connectors are 1.5:1 scale.
Tool Stand Interlock (TSI) Operation:
1. 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.
2. The RTL sensor is very important to this TSI feature and therefore should be monitored for failure. RTLV Input is available for fault monitoring of this circuit. Please consult the product manual for operation and fault monitoring suggestions.
3. Limit switches, trip dogs and cabling are also available from ATI.
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Rev. Description Initiator Date
- See Sheet1 - -
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3rd ANGLE PROJECTION
DRAWN BY: P.Sparrow, 4/22/05
CHECKED BY: B.Digeso, 5/10/05
WEIGHT LBS: 1.64
ASSEMBLY REF:
TITLE
VB2 Family Module Drawing
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-20-VB2 Family sht 5-05
PRODUCT RELEASE #
DATE:
SHEET 4 OF 5
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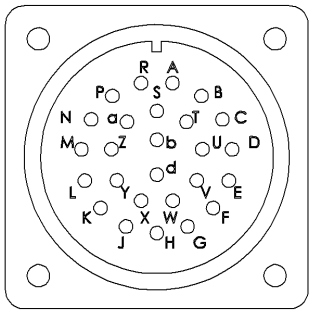
Tel: +1.919.772.0115 Email: info@ati-ia.com
Fax: +1.919.772.8259 www.ati-ia.com
ISO 9001 Registered Company

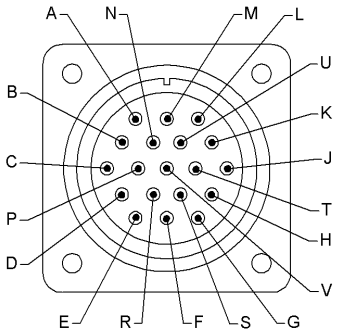
Rev.	Description	Initiator	Date
-	See Sheet1	-	-

VB2 Master with VB4 Tool (0-99 Tool ID)

VB2-M
Master Side
(MS3102E28-12P)



VB4-T
Tool Side
(MS3102E22-14S)



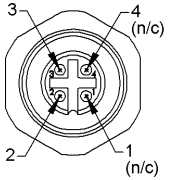
VB2 to VB4 Pin Out

VB2 Master MS3102E28-12P Male Connector			VB4 Tool MS3102E22-14S Female Connector
0 VDC Reference	A	A	0 VDC Reference
+24 VDC	B	B	+24 VDC
available	C	C	available
available	D	D	available
available	E	E	available
available	F	F	available
available	G	G	available
available	H	H	available
Tool ID, Bit Value 8	J	J	not available
Tool ID, Bit Value 4	K	K	not available
Tool ID, Bit Value 2	L	L	not available
Tool ID, Bit Value 1	M	M	not available
Tool ID, Bit Value 8	N	N	not available
Tool ID, Bit Value 4	P	P	not available
Tool ID, Bit Value 2	R	R	not available
Tool ID, Bit Value 1	S	S	not available
not available	T	T	not available
not available	U	U	not available
not available	V	V	not available
Lock O/P	W		
Unlock O/P	X		
RTLV I/P	Y		
RTL #1 I/P	Z	4	N/C
RTL #2 I/P	a	3	TSI Out
Lock I/P	b	2	TSI In
Unlock I/P	d	1	N/C

Tool ID Switch 2

Tool ID Switch 1

TSI Connector
4-Pin Eurofast Female



TSI Connector
VB2 Tool Side
(1510-2323001-04)

Tool ID Output

Position	Pin	Pin	Pin	Pin
Switch 2	"J"	"K"	"L"	"M"
Switch 1	"N"	"P"	"R"	"S"
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

Controller Outputs

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)

Controller Inputs

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)
J	Tool ID	Bit Value 8 (See Table)
K	Tool ID	Bit Value 4 (See Table)
L	Tool ID	Bit Value 2 (See Table)
M	Tool ID	Bit Value 1 (See Table)
Y	RTLV	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:
1. 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.
2. 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.
3. Large views of connectors are 1.5:1 scale.

Tool Stand Interlock (TSI) Operation:

1. 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.
2. The RTL sensor is very important to this TSI feature and therefore should be monitored for failure. RTLV Input is available for fault monitoring of this circuit. Please consult the product manual for operation and fault monitoring suggestions.
3. Limit switches, trip dogs and cabling are also available from ATI.

NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING. DRAWN IN SOLIDWORKS. ALL DIMENSIONS ARE IN MILLIMETERS.

3rd ANGLE PROJECTION

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DRAWN BY: P.Sparrow, 4/22/05	TITLE: VB2 Family Module Drawing		
CHECKED BY: B.Digeso, 5/10/05			
WEIGHT LBS: 1.64	SCALE: 1:2	SIZE: B	DRAWING NUMBER: 9630-20-VB2 Family sht 5-05
ASSEMBLY REF:	PRODUCT RELEASE #:	DATE:	SHEET 5 OF 5

US Patent No.: 6,840,895 B2