VICI

Valco Instruments Co. Inc.

Serial Valve Interface Instruction Manual

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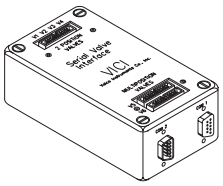
General Description

The Valco Serial Valve Interface (SVI) is a device that converts commands from a computer, via a serial port, into positional control for our two position and multiposition valve actuators. Each SVI can control up to four air or electrically actuated two position valves and two electrically actuated multiposition valves. The SVI has two serial port connections (one male, one female) which allow daisy-chaining of up to eight SVI's on a single serial communication port. In addition to controlling valves, the SVI can be used to control other devices which require logic level BCD or single line inputs.

The SVI is a packaged unit which includes an external 12 VDC 200 MA wall-mount power supply. There is no need to open the computer to connect the SVI, because its DB-9 to DB-9 RS-232 cable connects to any available serial port on the back of the computer. It also includes an interface cable for Valco two position actuators, and two 20-pin IDC connectors for installation on the interface cable which comes as part of the multiposition standard electric actuator. For air actuated valves, optional interface cables are available for the Valco Digital Valve Interface (DVI), which converts electrical signals to pneumatic pulses. (Valco product number I-22239).

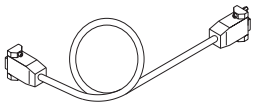
While the SVI can be operated by virtually any computer with an RS-232 port, the software supplied with this package is written for PC's. The SVI is supplied with Vcom software.

Installation

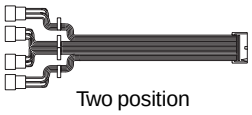


Serial Valve Interface

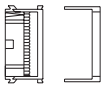
Power supply



RS-232 cable



Two position interface cable



20-pin IDC connector

Software CD

The Serial Valve Interface can be easily installed by the user with the following items as supplied with the SVI:

- One wall-mount power supply
- One RS-232 cable, to interface the SVI to any PC/AT compatible serial communications port with a DB-9 connector
- One two-position interface cable for connecting up to four two-position electric actuators or Digital Valve Interfaces for use with air actuators
- Two 20-pin IDC connectors, to adapt the external interface cables supplied with Valco multiposition electric actuators for use with the SVI
- One CD with Vcom software.

NOTE: The jumpers referred to several times in the installation instructions are small plastic connectors on the circuit boards which can be easily pulled off and reinstalled on different pins.

SVI Setup

The SVI can operate in one of two different modes, determined by the position of the jumper on connector CO14 on the SVI main board during power up. In the Option 1 position (the factory setting) the Single Device Mode is selected; in the Option 2 position, the Multiple Device Mode is selected. See Drawing 22110, page 14 for a complete list of the SVI jumper options and the factory settings.

Single Device Mode

The single device mode, which is the factory-preset mode, requires a dedicated Serial Communications Port on the host computer for each SVI. Three optional baud rates can be selected by jumpers on the SVI main board, with a factory setting of 9600 baud. See Drawing 22110, page 14.

Multiple Device Mode

The multiple device mode allows up to eight SVIs to be daisy-chained from a single serial communications port on the host computer. (**Figure 1**) In this mode the SVI has a fixed 9600 baud rate. Connector CO11 on the SVI main board selects an ID of 0 to 7 which is used to distinguish each device. (Each SVI in the daisy chain must have a different ID.) The communications board connector CO14 jumper must be changed to the PASS THRU position for all SVIs on the daisy chain except for the last device, which should be set to the END MODULE position to properly terminate the daisy-chain. See Drawing 22110, page 14 for a complete list of the SVI jumper options.

CAUTION: For proper startup, make sure that all the jumper settings in the SVI are correct, and that all external devices have been disconnected or are turned off before applying power to the SVI.

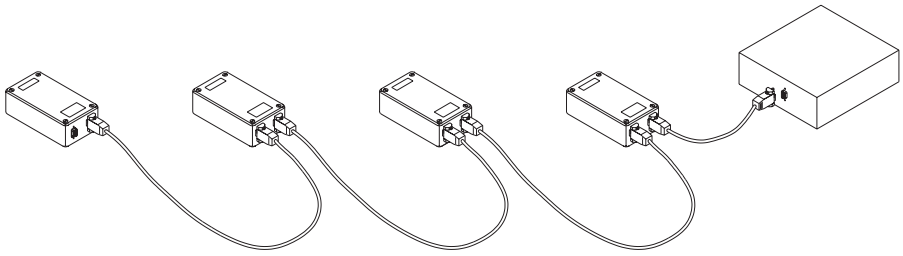


Figure 1: SVIs daisy-chained to a single host computer

Interfacing the SVI to a PC

The SVI has two communication port connectors labeled “COM 1” and “COM 2”. The RS-232 cable provided connects the COM 1 connector on the SVI to the serial port connector on the PC. If the computer serial port connector is a DB-25 connector, then a DB-25 FEMALE to DB-9 MALE adapter connector or cable is required. Most computer or electronic stores carry this adapter.

The RS-232 cable with Male and Female DB-9 connectors must be wired “straight through”, or pin to pin; *i.e.*, Pin 2 to Pin 2, Pin 3 to Pin 3, *etc.* Only Pins 2, 3, and 5 are used by the SVI; they are functionally defined as TRANSMIT, RECEIVE, and GROUND, respectively, *from the SVI perspective.*

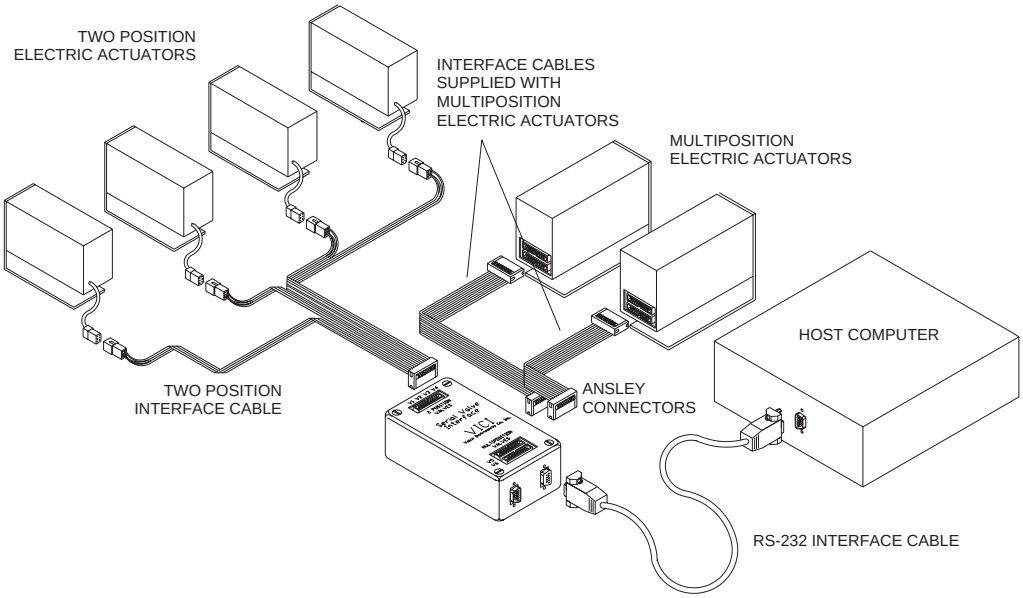


Figure 2: SVI interconnection diagram

Electric Actuator Connections

Standard Two Position Electric Actuators

To connect the SVI to a two position standard electric actuator, use the two position interface cable. Plug one end of this cable into the connector on the top of the SVI which is labeled V1 V2 V3 V4. The other end of the cable has four Molex connectors which are addressed by the SVI as V1 through V4. These Molex connectors plug directly into the remote switching cable on the back of Valco's standard two position electric actuators.

Any Valco two position standard electric actuator with a serial number above 19000 allows the option of positive dual-position feedback to the SVI. To enable this feature:

1. Unplug the actuator. Use a pair of pliers to compress and remove the cable strain relief devices from the back of the actuator cover. Remove them from the cables to allow the cables to travel freely through the holes in the cover.
2. Remove the four phillips screws which secure the actuator cover. (One must be accessed through a hole in the black mounting bracket)
3. Slide the cover back far enough to allow access to the small dipswitch on the board next to the connectors for the manual switching cable, and change the position of the switch.
4. Put the cover back in position, replace the four screws, and reinstall the strain relief devices.

In this mode, the clear wire carries a logic high when the actuator is in Position A (LOAD): the white wire carries a high when it's in Position B (INJECT).

Microelectric Two Position Actuators

Microelectric two position actuators have a built-in serial port, and therefore do not require the SVI for serial port control. However, they can be connected to an SVI if you are upgrading a system from standard electric actuators and don't want to change the existing SVI software.

Cable I-23196 adapts any of the Molex connectors (V1 through V4) on cable I-22041 to the digital input port on a two position microelectric actuator. If only two position microelectric actuators are to be used, then optional cable I-23783, which provides four direct connections to the SVI, can be substituted for cable I-22041.

Standard Multiposition Electric Actuators

Each standard multiposition electric actuator is shipped with an external interface cable. This cable has an IDC 20-wire connector on one end, with the other end unfinished to allow user-selected termination. To connect the multiposition actuator to the SVI, install an IDC 20-wire connector on the unfinished end. Plug one end of the cable into the multiposition electric actuator and the other end into the connector on the SVI labeled either V5 or V6. Two multiposition valves may be used simultaneously.

Two Position Air Actuator Connections

The SVI can be used to control up to four Valco two position air-actuated valves by connecting the SVI to the Valco Digital Valve Interface (DVI). The two position electric actuator cable can be adapted to control a DVI using this procedure:

1. Use a wire cutter to remove the plastic Molex connector from the SVI connecting cable.
2. With a wire stripper, remove insulation from the red, blue, and black wires in each of the DVI ribbon cables and the corresponding SVI ribbon cable.
3. Use solder or crimp-on connectors to join the DVI ribbon cable to the SVI ribbon cable as shown in the table below.

Valve	Signal	SVI wire color	DVI wire color
V1	Pos A	yellow	black
	Pos B	green	blue
	ground	brown	red
V2	Pos A	yellow	black
	Pos B	green	blue
	ground	brown	red
V3	Pos A	yellow	black
	Pos B	green	blue
	ground	brown	red
V4	Pos A	yellow	black
	Pos B	green	blue
	ground	brown	red

SVI Control of Other Electrical Devices

NOTE: *The following information is not intended for users unfamiliar with low power digital circuitry and proper isolation techniques.*

The V1 PosA output on the SVI has special capabilities. While all other two position outputs are transistor devices with 30 volt 50 milliamp (open collector) outputs, the YELLOW wire (pin 4 of the Molex connector) on the V1 output is a relay contact closure to ground. It can be used to drive loads of up to 48 volts at 1/2 amp.

Additionally, the ground reference brown wire (pin 3 of the Molex) can be jumpered on CO12 on the SVI main board for a 12 VDC output which is sufficient to power small solenoids or other devices of up to 100 ma continuous current. (Or 200 ma on short duty cycle applications.) See Drawing 22110, page 14 for detailed information.

CAUTION: When the SVI Valve 1 output is jumpered for 12 VDC output, remove the plastic Molex connector from the SVI cable to insure that damage will not result from an accidental connection to a Valco two position electric actuator or DVI.

Before using the valve outputs to drive any load in excess of 12 VDC, the jumper on connector CO13 must be changed to the OFF position. This effectively removes the internal 12 volt diode clamp on the two position valve outputs, and requires the installation of external reverse diode clamping on all inductive loads driven by these outputs.

The two position valve outputs have a jumper-setable option which allows for the output signal to be continous or to be de-asserted following an actuation command. When this “timeout” is enabled the signal is asserted for 150 milliseconds, unless the valve is configured to require feedback. In that case, the signal will assert until the feedback is received, to a maximum of four seconds. After four seconds, a positioning error will be indicated.

The SVI as received from the factory has all the outputs set for the timeout option. If a valve output is to be used to control something other than a Valco actuator, it may be desireable to disable the timeout function by arranging the jumpers as indicated in Drawing 22110, page 14.

CAUTION: All outputs from the SVI are internally referenced to a common ground; therefore, all external loads should be electrically isolated from high voltage power sources for maximum personal safety and proper equipment operation and protection.

Communicating with the SVI using Vcom

Vcom is a simple serial port utility that can be used to send a sequence of text strings at timed intervals. The times and associated text strings are stored in method (.mth) files. It is also possible to send individual strings, entered using the keyboard, and view any reply.

1. Selecting a serial port

Open a serial port by selecting Utility > Com.Port from the menu.
The next time the program is run, the selected serial port will be opened automatically.

2. Creating a new file

If you are creating a new method file, select File > New from the menu. Enter the times and the command strings into the edit box in the method window as described in "Editing a file," below.

3. Opening a file

If you wish to run an existing method file, open it my selecting File > Open from the menu.

4. Editing a file

If the newly opened file needs to be edited, click the "Edit" checkbox to enter the edit mode.

Entering a time
Times are entered in the hour:minute:second format, using any non-numeric separator.

For example:

20	= 20 seconds into the method run
2.10	= 2 minutes and 10 seconds into the run
1;30.4	= 1 hour, 30 minutes, and 4 seconds
01:30:04	= 1 hour, 30 minutes, and 4 seconds

It is not necessary to enter the times in order. They will be put in order when you exit the edit mode.

Entering a command
The command is entered after the corresponding time, separated from the time by a space or tab. Commands are discussed in the next section.

For example:

20 V1A	Instructs the SVI to move valve 1 to Position A at 20 seconds into the method run
2.10 V1B	Instructs the SVI to move valve 1 to Position B at 2 minutes and 10 seconds into the method run
1;30.4 V68	Instructs the SVI to move valve 6 to Position 8 at 1 hour, 30 minutes, and 4 seconds into the method run

Transmitted Command Types

The following is a list of the command letters for the types of commands available for controlling the SVI. Each letter represents a specific function the SVI will perform. The commands are sub-divided into two groups: commands directed to specific valves, and commands directed to the SVI.

Commands for Specific Valves

V Indicates a **V**alve positional command. It is used to direct the SVI to move a valve to an indicated position.

S Indicates a valve **S**tatus request. It tells the SVI to transmit the current position of the indicated valve to the host.

L Indicates a valve command to **L**imit the number of positions to which the SVI will rotate a multiposition valve.

F Indicates a command to check valve status after a positioning command is completed and to provide **F**eedback as to the functional success or failure of the command.

N Indicates a command to ig**N**ore valve status after the execution of a valve positioning command.

Commands for the SVI

R Represents a command to the SVI to **R**eset, or perform a re-initialization of the device. It is equivalent to turning the power off and back on again.

E Represents an **E**cho control command to the SVI. The echoing of position arrival (closed loop feedback) of all valves on an SVI can be deactivated or reactivated using this command.

/? Causes a command list to be echoed to the serial port.

Transmitted Command Syntax

For the purpose of learning the transmitted command syntax, it is easier to consider only SVIs in the single device mode. It is also helpful to divide the commands into three groups: commands with a command letter, a valve number, and a valve position (three variables); commands with a command letter and a valve number (two variables); and commands with fixed syntax (no variables).

No spaces are allowed between any portion of a single command.

Command Letter/Valve Number/Position

In these commands, valve numbers 1 through 6 are used, depending on the valve to be addressed. For two position valves (1 through 4), the position variables are **A** and **B**. (**L** for Load and **I** for inject may be substituted for A and B, but this creates the potential for confusion between Limit and Load.)

For multiposition valves (5 and 6), positioning is defined using the numbers **1** through **16**, limited by the number of positions of the valve. (If an invalid valve position request is sent, a response of BCMD appears, indicating a command which cannot be executed.)

Examples

Command: **V1A**

Instructs the SVI to move valve 1 to Position A.

The first variable is the command letter, which indicates that this is a **V**alve positioning command. The second variable directs the command to valve **1**, while the third instructs the SVI to move it to Position **A**. This command would function equally well as **V1L**.

Command: **L512**

Instructs the SVI to ignore any command which would move valve 5 to any position past position 12.

The command letter indicates that this is a request for a position **L**imit, which is directed, as the second variable indicates, to valve **5**. The third variable sets that limit at Position **12**.

Command: **V68**

Instructs the SVI to move valve 6 to Position 8.

The first variable indicates that this is another example of a **V**alve positioning command. The second variable directs the command to valve **6**, which is a multiposition valve. This means that the positional variable must be numerical: **A** or **B** will not work. In this example, Position **8** is selected. (A zero may precede a single digit positional command, so this command would also work as **V608**.)

Command Letter/Valve Number

In these commands, valve numbers 1 to 6 are again used, depending on the valve to be addressed.

Examples

Command: **S1**

Requests the SVI to transmit to the host the current sensed status of valve 1. If the valve status cannot be read, it will return an error status. (See page 10)

Command: **F2**

Requests the SVI to verify all attempts to position valve 2, and to provide serial port status feedback to the host.

Command: **N3**

Requests the SVI to ignore the status feedback on valve 3 following any actuation command.

Command: **L5**

Requests the SVI to transmit to the host the current limits set for valve 5. NOTE: This command is only valid for the multiposition actuators, on valves 5 and 6.

Fixed Syntax Commands

These commands are used only with the fixed syntax as they are listed below. There are no valve or position variables.

Command: **R**

Initiates a RESET procedure. Once initiated, the device requires up to four seconds before it responds with a reset acknowledgment.

Command: **EON**

Initiates ECHO ON. After the receipt of this command, the SVI will echo a serial port response to all valve positioning commands.

Command: **EOF**

Initiates ECHO OFF. After the receipt of this command, the SVI will only echo a serial port response for valve functions which are configured for feedback and fail to complete a positional command.

Multiple Device Mode Commands

All commands transmitted to any SVI set for the Multiple Device Mode must be prefaced by the ID of that SVI. Otherwise the syntax conventions exactly parallel those illustrated in the previous examples. The ID is selected on CO11 as described in the section “Multiple Device Mode”, on page 2.

Examples

Command: **7V510**

Instructs SVI 7 to turn valve 5 to Position 10.

The first variable, “**7**”, is the SVI ID. The second variable is the command letter, which tells the SVI that this is a **V**alve positioning command. The third character is the valve number, telling the SVI that valve **5** is to be controlled. The last two characters represent the position to which the valve will be turned.

Command: **2V3A**

Instructs SVI 2 to turn valve 3 to Position A.

In this example, the ID is **2**. The command letter indicates that this is another **V**alve positioning command, for valve number **3**. The position variable indicates that the valve will be turned to Position **A**. This command would function equally well as **2V3L**.

Command: **0S1**

Requests SVI 0 to give the current position status of valve 1.

The first variable indicates that the device which has an ID of **0** is being addressed. The **S** is the command letter for **S**tatus request, and the **1** indicates that valve **1** is to be queried. There is no positional information needed as this command is a query for current valve positional status.

Responses Received from the SVI

The SVI transmits responses to host commands or to perceived changes in valve status. It also echoes commands which are not directed towards itself. While the syntax of the response is identical to that of the transmitted command, the content may differ. This permits differentiation of critical responses from echoed commands.

The SVI responses are listed below:

RST This response always follows an SVI reset. The reset can be the result of a power failure, or the receipt of the **R** command from the host.

EON This is the SVI's response to the identical command from the host. It indicates that all commands to the SVI will generate a serial port response.

EOF This is the SVI's response to the identical command from the host. It indicates the SVI will generate a serial port response only to bad commands, or positioning commands to valves configured for feedback which fail to indicate successful positioning.

BCMD This is the SVI's response to host commands which are directed to the device, but cannot be executed. An example might be a numeric positional command sent to a 2 position valve, or a positional command to a multiposition valve which exceeds its set limit, etc.

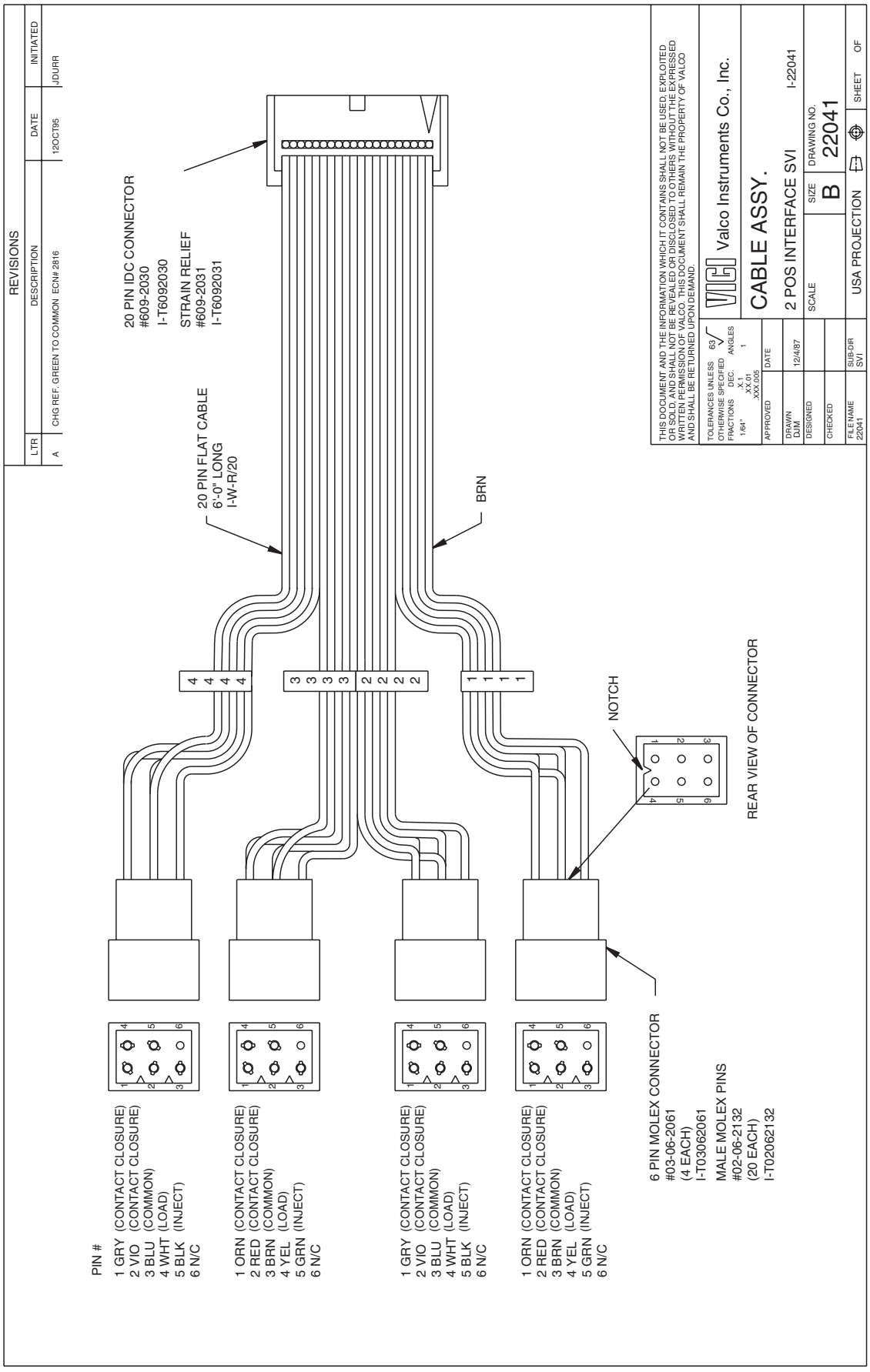
S This letter represents a status response. It may be preceded by the device ID depending on the Mode setting. It in turn always precedes one of the following: (1) a valve number and the sensed position, (2) an error indication (represented by the letter **E**) which results from as invalid position sense, or (3) a motion indication (represented by the letter **M**) which results from the sensing of the run line asserted on the multiposition valves.

This response is initiated by a status request or a valve positioning command (if the echo is enabled) from the host. If feedback is not required, the response following a valve command will reflect the attempted position rather than a sensed status.

L This letter represents a limit command response, and follows a limit request or a limit set command. It may be preceded by a device ID, but is always followed by a multiposition valve number (5 or 6) and the last limit position set for that valve.

Remember, all the responses above may be preceded by the SVI ID number.

Technical Drawings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12OCT95
JDURR
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#609-2030
I-T6092030
STRAIN RELIEF
#609-2031
I-T6092031
20 PIN FLAT CABLE
6'-0" LONG
I-W-R/20
BRN
NOTCH
REAR VIEW OF CONNECTOR
PIN #
1 GRY (CONTACT CLOSURE)
2 VIO (CONTACT CLOSURE)
3 BLU (COMMON)
4 WHT (LOAD)
5 BLK (INJECT)
6 N/C
1 ORN (CONTACT CLOSURE)
2 RED (CONTACT CLOSURE)
3 BRN (COMMON)
4 YEL (LOAD)
5 GRN (INJECT)
6 N/C
1 GRY (CONTACT CLOSURE)
2 VIO (CONTACT CLOSURE)
3 BLU (COMMON)
4 WHT (LOAD)
5 BLK (INJECT)
6 N/C
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4 YEL (LOAD)
5 GRN (INJECT)
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MALE MOLEX PINS
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(20 EACH)
I-T02062132
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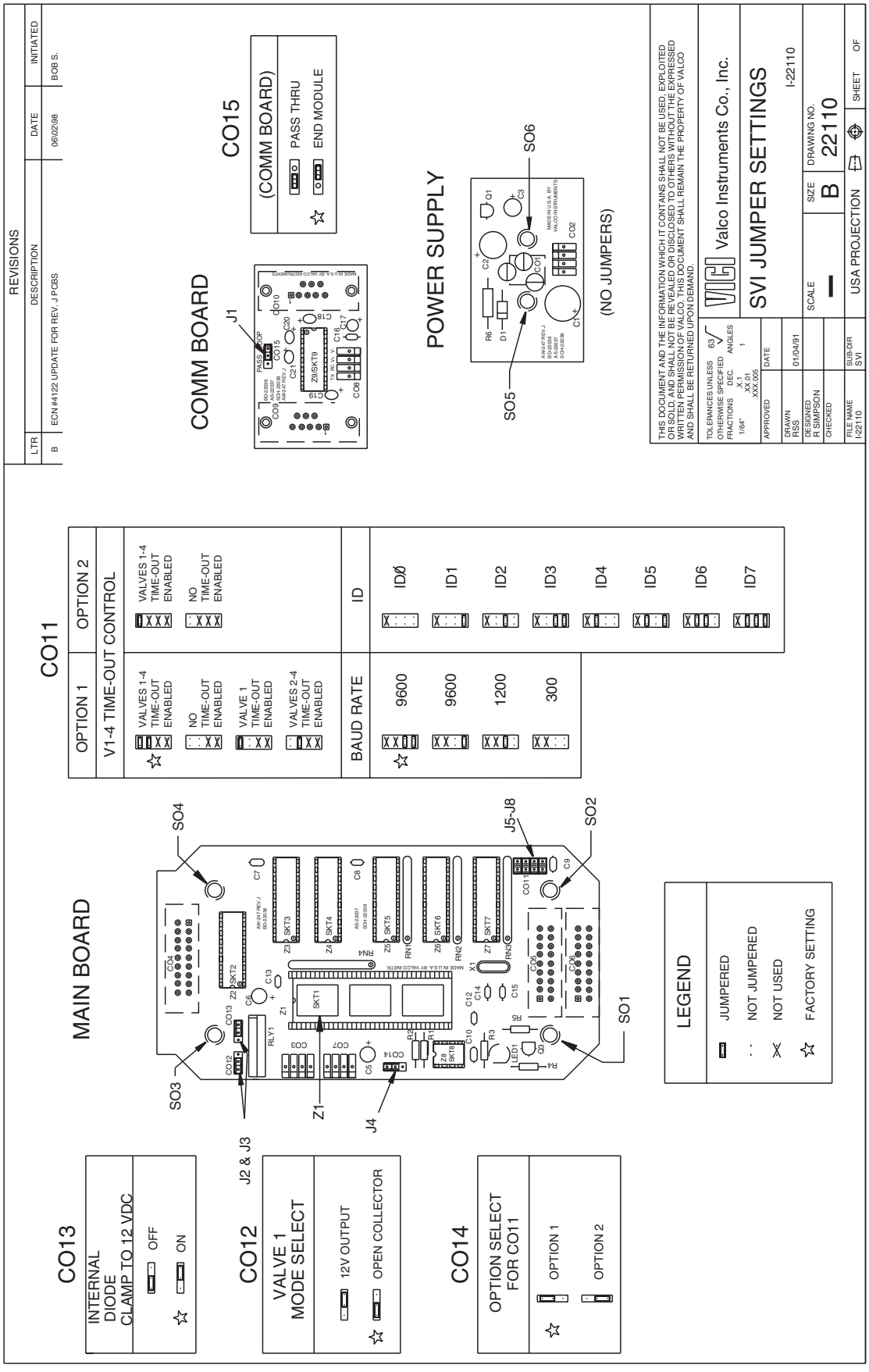
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BOB S.
COMM BOARD
J1
CO15
(COMM BOARD)
PASS THRU
END MODULE
POWER SUPPLY
SO5
SO6
(NO JUMPERS)
CO11
OPTION 1
OPTION 2
V1-4 TIME-OUT CONTROL
VALVES 1-4 TIME-OUT ENABLED
NO TIME-OUT ENABLED
VALVE 1 TIME-OUT ENABLED
VALVES 2-4 TIME-OUT ENABLED
BAUD RATE
ID
9600
1200
300
ID0
ID1
ID2
ID3
ID4
ID5
ID6
ID7
MAIN BOARD
SO4
SO3
SO2
SO1
J5-J8
Z1
J4
J2 & J3
CO13
INTERNAL DIODE CLAMP TO 12 VDC
OFF
ON
CO12
VALVE 1 MODE SELECT
12V OUTPUT
OPEN COLLECTOR
CO14
OPTION SELECT FOR CO11
OPTION 1
OPTION 2
LEGEND
JUMPERED
NOT JUMPERED
NOT USED
FACTORY SETTING
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SVI JUMPER SETTINGS
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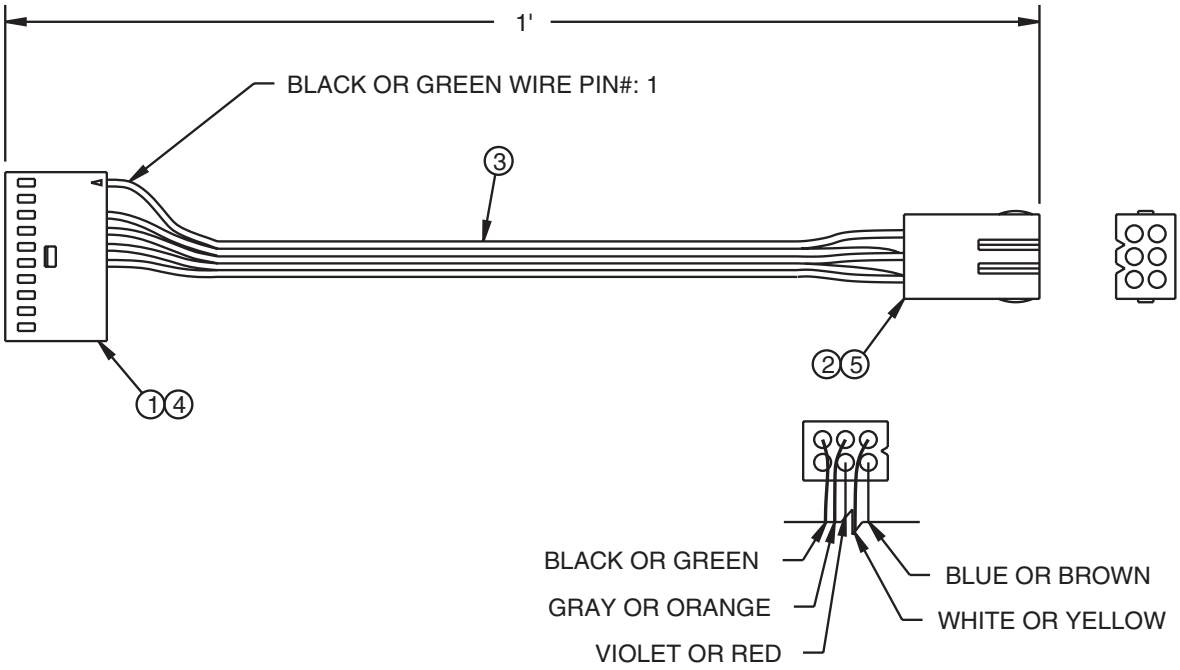

NOTE:

RIP 1 PIECE OF 20 CONDUCTOR
RIBBON CABLE INTO 4 PIECES
5 WIRES EACH FOR BOTH COLOR SETS

AMP PIN#	MOLEX PIN#
1=BLACK OR GREEN	1=WHITE OR YELLOW
2=N/C	2=GRAY OR ORANGE
3=WHITE OR YELLOW	3=BLACK OR GREEN
4=GRAY OR ORANGE	4=BLUE OR BROWN
5=VIOLET OR RED	5=VIOLET OR RED
6=BLUE OR BROWN	6=N/C
7,8,9,10=N/C	

ITEM	DESCRIPTION	VALCO#	QTY.
1	SHELL, 10 POSITION .1" AMP	I-T102241-8	1
2	CONN 6 PIN MALE MOLEX	I-T03061062	1
3	CABLE, RIBBON, 20 COND. 28 GAUGE	I-W-R/20	1
4	TERMINAL, FEMALE, MOLEX	I-T02061132	5
5	PIN: CONTACT, AMP	I-T187756-6	5

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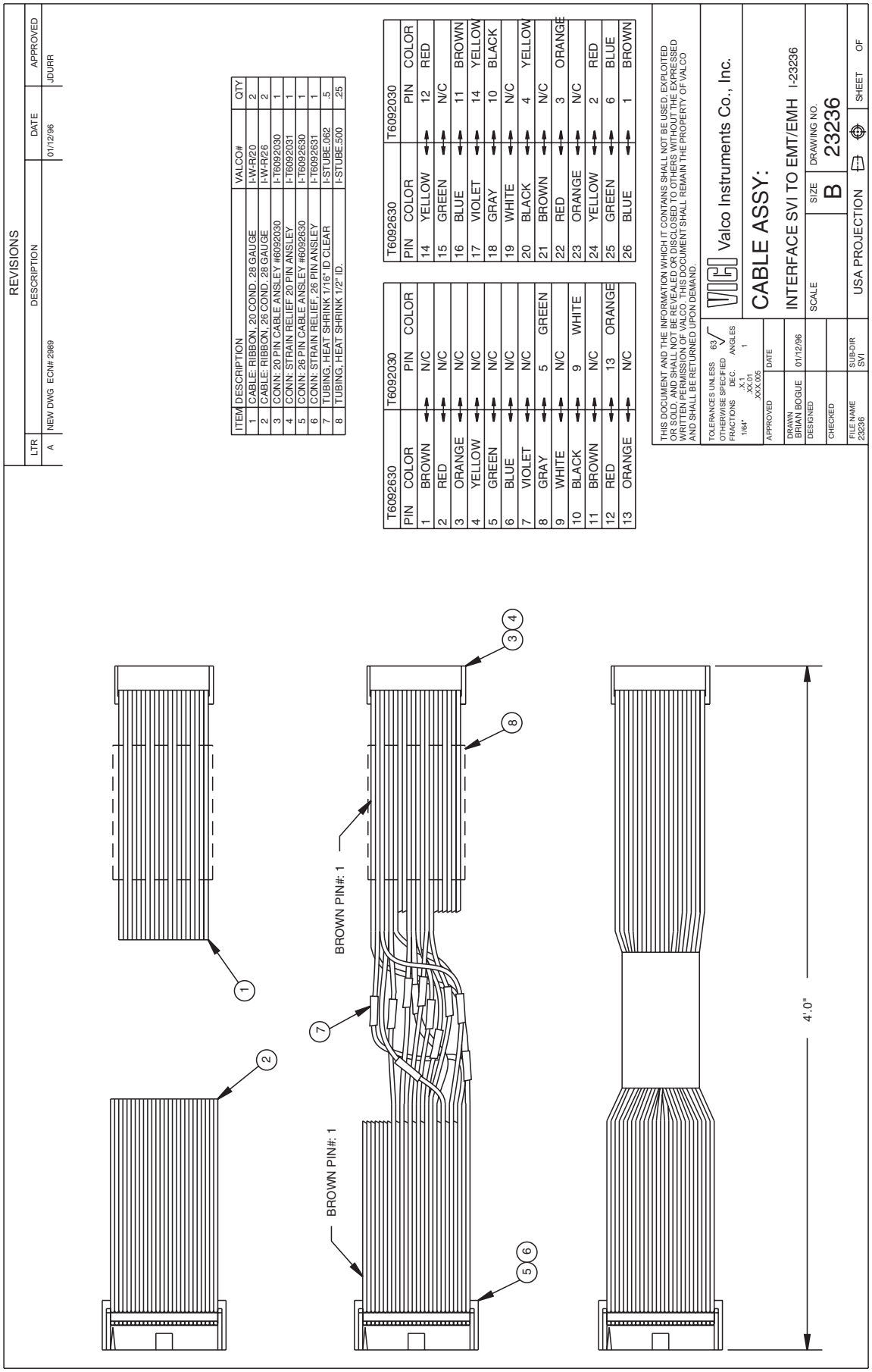
FILE NAME 23196	DRAWN BRIAN BOGUE	10/06/95	FRACTIONS DEC. ANGLES +-1/64" .X.1 .XX.01 .XXX.005 +- 1°
SUB-DIR SVI	DESIGNED		
SCALE 1:1	A	DRAWING NO. 23196	
SHEET OF			

Valco Instruments Co., Inc.

ADAPTOR CABLE

SVI TO 2POS MICRO I-23196


REVISIONS
LTR
DESCRIPTION
DATE
APPROVED
A
NEW DWG ECN# 2989
01/12/96
JDURR
ITEM DESCRIPTION VALCO# QTY
1 CABLE: RIBBON, 20 COND. 28 GAUGE I-W-R/20 2
2 CABLE: RIBBON, 26 COND. 28 GAUGE I-W-R/26 2
3 CONN: 20 PIN CABLE ANSLEY #6092030 I-T6092030 1
4 CONN: STRAIN RELIEF 20 PIN ANSLEY I-T6092031 1
5 CONN: 26 PIN CABLE ANSLEY #6092630 I-T6092630 1
6 CONN: STRAIN RELIEF, 26 PIN ANSLEY I-T6092631 1
7 TUBING, HEAT SHRINK 1/16" ID CLEAR I-STUBE.062 .5
8 TUBING, HEAT SHRINK 1/2" ID. I-STUBE.500 .25
T6092630 T6092030
PIN COLOR PIN COLOR
1 BROWN 1 N/C
2 RED 2 N/C
3 ORANGE 3 N/C
4 YELLOW 4 N/C
5 GREEN 5 N/C
6 BLUE 6 N/C
7 VIOLET 7 N/C
8 GRAY 8 5 GREEN
9 WHITE 9 N/C
10 BLACK 10 9 WHITE
11 BROWN 11 N/C
12 RED 12 13 ORANGE
13 ORANGE 13 N/C
T6092630 T6092030
PIN COLOR PIN COLOR
14 YELLOW 14 12 RED
15 GREEN 15 N/C
16 BLUE 16 11 BROWN
17 VIOLET 17 14 YELLOW
18 GRAY 18 10 BLACK
19 WHITE 19 N/C
20 BLACK 20 4 YELLOW
21 BROWN 21 N/C
22 RED 22 3 ORANGE
23 ORANGE 23 N/C
24 YELLOW 24 2 RED
25 GREEN 25 6 BLUE
26 BLUE 26 1 BROWN
THIS DOCUMENT AND THE INFORMATION WHICH IT CONTAINS SHALL NOT BE USED, EXPLOITED OR COPIED AND SHALL NOT BE DISCLOSED OTHERS WITHOUT EXPRESSED WRITTEN PERMISSION OF VALCO. THIS DOCUMENT SHALL REMAIN THE PROPERTY OF VALCO AND SHALL BE RETURNED UPON DEMAND.
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS 1/64"
DEC. .X ±.1 .XX ±.01 .XXX ±.005
ANGLES ±1
63
APPROVED DATE
DRAWN BRIAN BOGUE 01/12/96
DESIGNED
CHECKED
FILE NAME 23236
SUB-DIR SVI
Valco Instruments Co., Inc.
CABLE ASSY:
INTERFACE SVI TO EMT/EMH I-23236
SCALE
SIZE B
DRAWING NO. 23236
USA PROJECTION
SHEET OF
BROWN PIN#: 1
BROWN PIN#: 1
1
2
3
4
5
6
7
8
4'-0"

Warranty

This Limited Warranty gives the Buyer specific legal rights, and a Buyer may also have other rights that vary from state to state. For a period of 365 calendar days from the date of shipment, Valco Instruments Company, Inc. (hereinafter Seller) warrants the goods to be free from defect in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor, or, at the Seller's option, demand return of the goods and tender repayment of the price. Buyer's exclusive remedy is repair or replacement of defective and nonconforming goods, or, at Seller's option, the repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or for consequential incidental or special damages arising out of, resuiting from, or relating in any manner to these goods

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items. This warranty is VOID when repairs are performed by a nonauthorized service center or representative. For information about authorized service centers or representatives, write Customer Repairs, Valco Instruments Company, Inc, P.O. Box 55603, Houston, Texas 77255, or phone (713) 688-9345. At Seller's option, repairs or replacements will be made on site or at the factory. If repairs or replacements are to be made at the factory, Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed in accordance with the laws of the State of Texas.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supercedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.