



Valco Instruments Co. Inc.

Multiposition Electric Actuator Instruction Manual

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MNL-MEA
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Printed in USA



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General Description

Valco multiposition valves are used to select a flow from a number of different streams in gas and liquid chromatography and in process stream applications. Switching them to the desired position can be done manually, but is best done automatically with either a Valco multiposition air actuator or the random access Valco multiposition electric actuator described in this manual. For most laboratory uses, especially where a laboratory computer is available for control but compressed air is not, the Valco multiposition electric actuator is the best choice for switching multiposition valves.

The Valco multiposition electric actuator is designed around a highly-integrated microcontroller, and is capable of detecting the number of valve positions for which it is configured as well as a number of faults. Actuators are available in 110 VAC or 220 VAC models for any 4, 6, 8, 10, 12, or 16 position Valco multiposition valve. The model numbers of the actuators are respectively E4, E6, E8, E10, E12, and E16. (Or E4-220, etc.) An electric actuator can replace an existing air actuator, and is compatible with most Valco close mount and standoff assembly hardware.

The actuator consists of (a) the actuator itself, (b) a control box with LED display, and (c) a 20 conductor interface cable. An actuator typically takes four seconds to complete 360°; that is, a 4 position valve takes one second to move the 90° from Position 1 to Position 2.

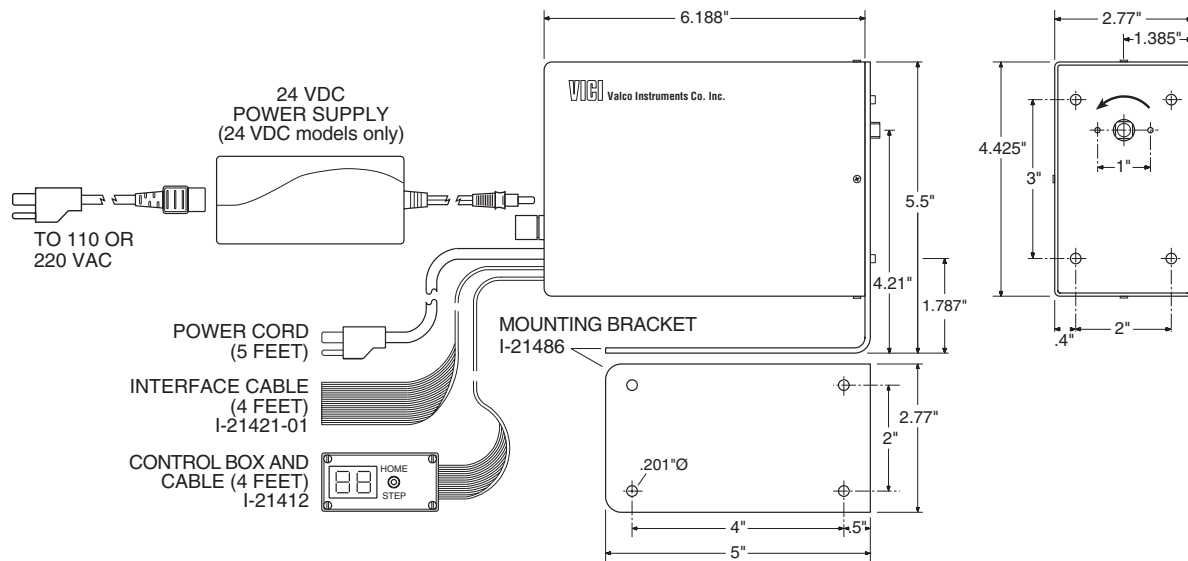
A computer or data system with external event capacity can be used to control the actuator using the supplied interface cable. In such a quickly developing field it would be futile to try to give specifics for each possible application, but the chapter entitled "Controlling the Actuator with a Computer" on page 3 provides some general instructions which will be sufficient for most situations. Consult the factory if additional help is needed.

Manual Use of the Multiposition Valve Actuator

1. Plug the electric actuator into a power outlet (110 VAC or 220 VAC, 50/60Hz, as required). The LED indicator light in the control box (**Figure 1**) will light up and indicate the position of the valve/actuator.
2. Press the control box toggle switch momentarily toward HOME. If the valve is in any position other than Position 1, it will go to HOME (Position 1). If the valve is in Position 1, it will not move.

As the valve moves toward HOME it sequences through each position, allowing the possibility that sample may flow briefly as each position is made. Care must be taken to prevent possible sample loss or contamination.

3. Move the toggle switch momentarily toward STEP and the valve will advance from Position 1 to Position 2. If the switch is moved toward STEP again, the valve will move from Position 2 to Position 3.



Controlling the Actuator with a Computer

The first step in interfacing the Valco multiposition electric actuator to a computer or data system is to consult the user's manual of the control device to determine what kind of outputs are available, and how many there are. There may be relays, open collector transistors, logic level signal outputs, or an RS-232 connector. (These are not cleanly delineated categories; for instance, BCD logic will involve one of the others.)

The second step is to determine how the valve is to be moved. The simplest implementation is for the control device to duplicate the STEP and HOME commands of the manual controller. The other option is to access the positions randomly via BCD-encoded logic level signals. In this mode, the actuator passes through each intermediate position, stopping when it reaches the encoded position. In either case, as the valve sequences through each position it is possible that sample may flow briefly as each position is made.

STEP and HOME Commands

Look at Drawing 21464, page 18, to determine the functions of the different wires in the interface cable. All of the inputs are held at five volts, called a "logic high". When they contact ground, the voltage drop signals the logic circuits in the actuator to direct the motor to the appropriate point.

Locate the violet wire for HOME, the grey wire for STEP, and the white wire for GROUND. After stripping a small amount of insulation from each of the wires, touch the grey wire to the white wire and observe that the actuator advances one position. Touching the violet wire to the white wire causes the actuator to rotate all the way around to Position 1, or HOME. (If the actuator is already in Position 1, nothing happens.) The contact must be maintained for at least 0.2 seconds to be recognized as valid.

These steps demonstrate the goal; that is, getting the control device to emulate the action of touching the two wires together. Nothing else, such as applying a voltage to one of the wires, is involved. For relays or open collector transistors, which are essentially switches, connect the three wires to the proper terminals as indicated by the manual for the control device. **(Figures 2 and 3)**

NOTE: A poor quality relay may cause the unit to step multiple times, due to the relay's excessive contact bounce. If contact bounce lasts longer than 50 ms, the actuator will see this as repeated STEP commands.

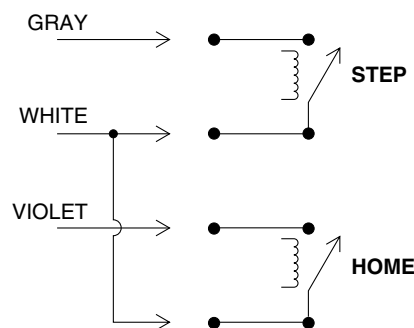


Figure 2: Relay connections

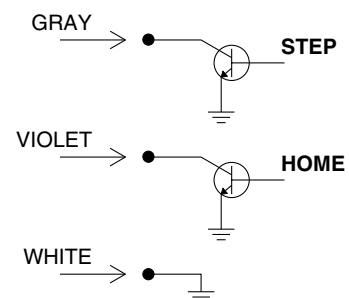


Figure 3: Open collector transistor connections

Random Access

Logic Input

For devices with an RS-232 connector, a simple solution is available in the form of the Valco Serial Valve Interface (SVI). The SVI is a self-contained unit, complete with software, that will convert commands from a computer into positional control for as many as two multiposition and four two position Valco electric actuators. Designing a similar means of control for a computer without a serial port requires a little more thought and effort on the part of the user.

Refer to Drawing 21464 on page 18 to determine the functions of the wires in the interface cable. All of the inputs are held at five volts, called "logic high". When they are pulled to ground potential ("logic low"), the voltage drop signals the logic circuits in the actuator to direct the motor to the appropriate point. Randomly accessing the positions involves two steps: first, a logic low signal must be applied to the proper BCD input lines to tell the actuator which position to go to; then, a logic low signal must be applied to the enable line, telling the motor to turn on and find the specified position.

Locate the inputs which are labelled 1's, 2's, 4's, 8's, and 10's, plus PRESET ENABLE and GROUND. Strip a small amount of insulation from each of these wires. To demonstrate the two steps described in the previous paragraph, first touch the brown wire (1's) to the white wire (ground), loading the code for Position 1. Then, while the brown and white wires are still in contact, touch the green wire (PRESET ENABLE) to the white wire (ground) to execute the move to Position 1.

Position 2, 4, 8, and 10 are just as straightforward, but the other positions involve combinations of two or three wires. To load the code for Position 3, twist the 1's and 2's wires together and touch them to ground. For Position 5, twist together the 4's and the 1's. A complete table appears below.

Position	BCD Combination
1	1's
2	2's
3	1's + 2's
4	4's
5	4's + 1's
6	4's + 2's
7	4's + 2's + 1's
8	8's
9	8's + 1's
10	10's
11	10's + 1's
12	10's + 2's
13	10's + 2's + 1's
14	10's + 4's
15	10's + 4's + 1's
16	10's + 4's + 2's

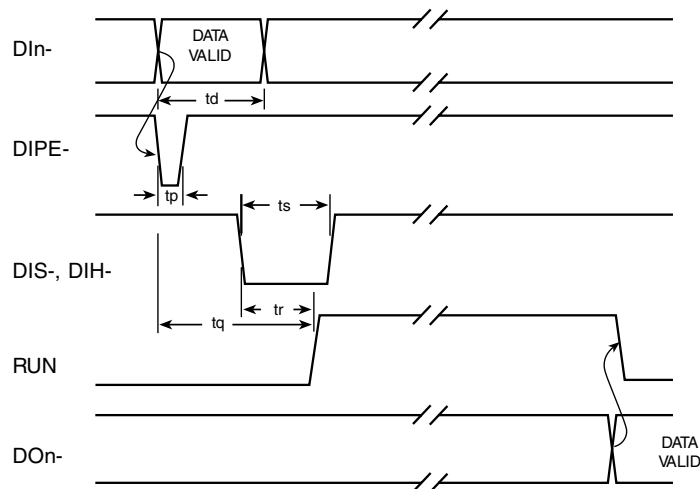


Figure 4: Input/Output Timing
(Not to scale)

To implement the BCD logic, attach the remote cable wires for the PRESET ENABLE, 1's, 2's, etc. to relays or transistor collectors. The white GROUND wire must go to a "common" point on the control device. (However, direct connection to open collector transistor outputs may not be suitable in all environments – the use of opto-isolators may be required. If in doubt, consult an electronics design expert.) Software must then be created which will control the appropriate inputs in accordance with the timing diagram shown in **Figure 4**. The direct BCD position inputs (DI1- for for BCD1's through DI10- for BCD10's) must be valid before the PRESET ENABLE pulse (DIPE-) goes low, and should remain valid for the period, t_d (1.6 milliseconds minimum), after DIPE- goes low. The enabling pulse, DIPE-, should remain low for the period, t_p (5 microseconds minimum). When the STEP (DIS-) or HOME (DIH-) input is used, it must be held low for the period, t_s (200 milliseconds minimum), to be recognized as valid. (STEP and HOME operation may be effected with pulses as short as 50 milliseconds, but it is not guaranteed.)

Logic Output

Some computers have actual BCD logic inputs and outputs, by which the combinations indicated in the table on the previous page are generated by the software. This allows a relatively straightforward setup, but matching the logic sense between the actuator and computer is critical. The input and output of the actuator are low-true, as supplied from the factory. If the computer to be used requires a positive true logic (consult the manual for the computer or interface board being used), the BCD output of the actuator may be reversed by following these steps to change one of the integrated circuits:

1. Unplug the actuator. Remove the four 4-40 x 1/4" phillips head screws which secure the cover to the actuator assembly, and remove the cover from the body of the actuator assembly.
2. Remove the four 4-40 x 1/4" phillips head screws from the rear cover, which allows the removal of the PC board inside the cover.

3. Refer to Drawing 22721 on page 19. Replacing integrated circuit U2 (a 4049) with a 4050 changes the output from negative true to positive true. (Order Valco Product No. I-IC4050.)
4. Reinstall the board in the cover and reassemble the actuator and cover, making sure that all the wires and cables are reconnected to the Encoder Board assembly.

When it is certain that the polarities of the actuator and the control device are compatible, connect the 1's wire of the actuator interface cable to the 1's output, the 2's wire of the cable to the 2's output, etc. If the timing restrictions for logic inputs are followed, timing of the logic outputs will also be in accordance with **Figure 4**. The signal, RUN, indicating actuation of the valve, will go high within the period, t_r (200 milliseconds maximum), after DIS- or DIH-. RUN will remain high until the motor stops, and will then go low. Position data at the outputs, DO1- through DO10- will be valid before RUN returns low.

Error Signaling

Errors or faults detected by the actuator logic are signalled by the display flashing in a coded sequence which indicates the problem. The display will go off briefly once, twice, or three times, followed by a pause before the cycle repeats.

- 1: Indicates a fatal internal failure of the microcontroller.
- 2: BCD position input is invalid; *i.e.*, the position requested cannot be found on the encoder disk. Clear by entering STEP or HOME, or a valid position.
- 3: Indicates motor failure, overheating, or excessive load on the actuator.

Actuator Modifications

Situations occasionally arise when it is desirable to alter an actuator so that the indexing angle is changed, such as when changing from a 6 position to an 8 position valve. Or it may be helpful when changing from air to electric actuation to reverse the rotation so that it will go the same direction as the air actuator. These modifications can be accomplished by following the procedures below.



CAUTION: Before performing any operations on the actuator, make sure the actuator power cord is unplugged.

Changing the Number of Positions (Indexing Angle)

Tools you will need:

1. 9/64 hex driver
2. 7/64 hex driver
3. #1 or #0 phillips screwdriver

You will also need one of the following, depending on the new valve type:

Product No.	Description
I-21536	4 position encoder disc
I-21537	6 position encoder disc
I-21538	8 position encoder disc
I-21539	10 position encoder disc
I-21540	12 position encoder disc
I-21541	16 position encoder disc
I-21543	4 x 2 encoder disc (4 column selection)
I-21542	6 x 2 encoder disc (6 column selection)
I-21978	10 x 2 encoder disc (10 column selection)

Disassembly

1. Switch the actuator to its HOME position and then unplug the power cord.
2. Remove the valve and its mounting hardware from the actuator.

For a closemount valve: (Figure 5) Use the 7/64 hex driver to loosen the socket head screw (6-32 x 5/8") in the CR11 clamp ring between the valve and the actuator. This allows the valve to be taken off the actuator.

For a valve on a standoff: (Figure 6) Use the 9/64 hex driver to loosen the socket head screw (8-32 x 5/8") in the black-anodized CR3 clamp ring on the actuator. Pull off the standoff with the valve attached.
3. Remove the four 4-40 x 1/4" phillips head screws which secure the actuator cover. (One is accessed through the hole in the black right-angle mounting bracket.) Slide the cover back far enough to allow the power cord and the ribbon cable to be disconnected from the circuit board. Carefully note how they are attached so that they can be reconnected later. Now remove the cover completely.

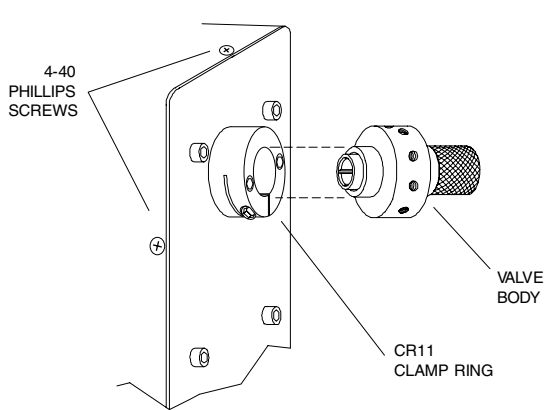


Figure 5: Closemount assembly connecting actuator and valve

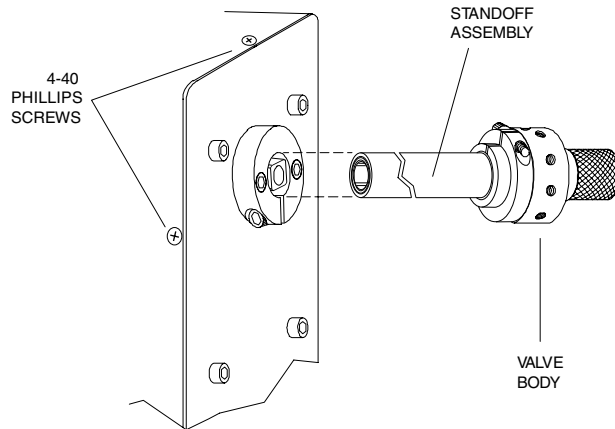


Figure 6: Standoff assembly connecting actuator and valve

4. Disconnect the motor from the board. (Refer to Drawing No. 22835 on page 29.)
5. Loosen but do not remove the two 8-32 x 1-1/4" hex head (9/64) screws which hold the boards to the gearbox. Remove the board/spacer assembly as a unit, lifting it straight up to clear the thin metal encoder disc.
6. Removing the boards exposes the encoder disc, which is the component that must be changed. Use the 9/64 hex driver to remove the screw and washer which secure the disc, and then remove the disc, avoiding its sharp edges. Handle the disc gently so it does not get bent.

Description of the Encoder Discs

The encoder disc provides a means of signalling the position of the actuator and relaying that information to the logic circuit. If the disc is thought of as consisting of five concentric bands, (like an archery target) the outside band contains the "strobe bits." (See **Figure 7**) These slots signal the logic circuit to read the position information and to stop the motor when the information conforms to the input command. The next bands, in order toward the center, denote units of one, two, four, and eight.

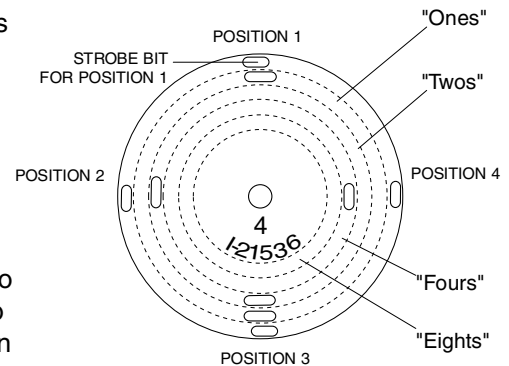


Figure 7: Four position encoder disc

In the 4-position disc illustrated in **Figure 7**, the location that corresponds to the strobe bit for Position 1 contains only a slot in the "ones" band, so it registers as "one". Moving counterclockwise to the next strobe bit, the slot is in the "twos" band and is read as "two" for Position 2. Since there is no "threes" band, the information for Position 3 requires a slot which fills the "ones" band and the "twos" band, registering as 2 + 1, or 3. Position 4 has simply the one slot in the "fours" band. The 4-position disc affords the clearest illustration of the principles involved, which are the same all the way up to the 16-position. To continue the examples, Position 5 has slots in "fours" and "ones", Position 9 has slots in "eights" and "ones", and Position 15 uses the whole range, 8 + 4 + 2 + 1. The last position location on a 16-position disc utilizes the last option – no slots at all.

The 4 x 2, 6 x 2, and 10 x 2 are slightly different. The 4 x 2 is essentially an 8-position actuator, but instead of reading out Position 1 through Position 8 it goes from Position 1 to Position 4 and then repeats the succession. Likewise, the 6 x 2 does two sequences of Positions 1 through 6 and the 10 x 2 does two sequences of Positions 1 through 10.

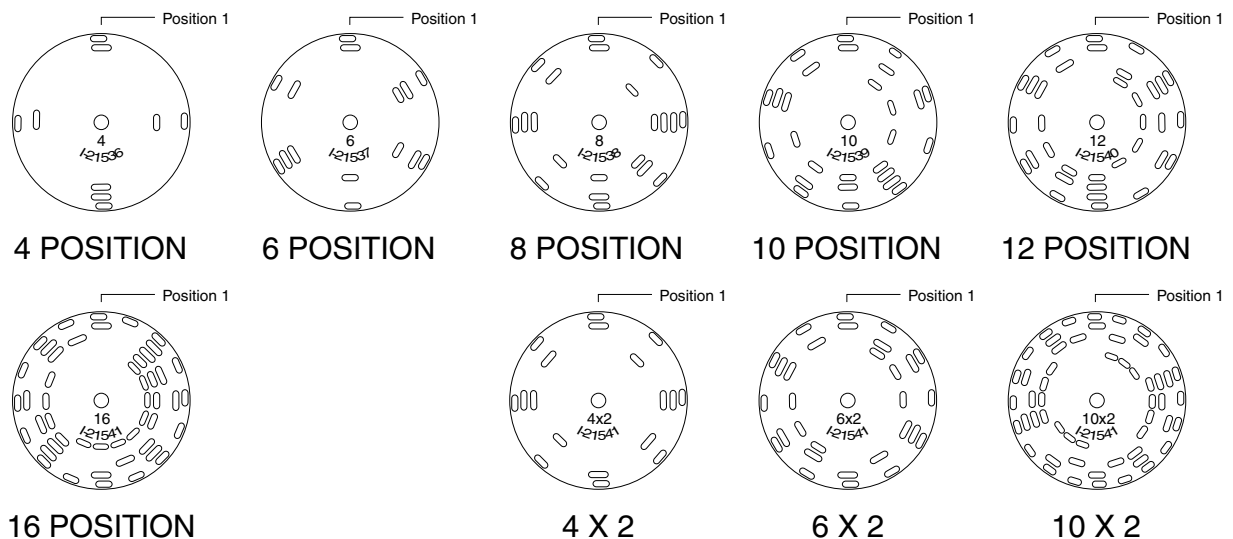


Figure 8: Encoder discs

Reassembly

1. Using **Figure 8** and the preceding description, identify the slot on the replacement encoder disc which determines Position 1. With the motor toward you and the casting away, install the new encoder disc oriented as in **Figure 8**, with the strobe bit of Position 1 vertical. (The part number should be facing you. In the case of the “x 2’s”, either Position 1 bit may be vertical.) Be sure to use the correct number of washers between the disc and shaft, so that the disc is positioned midway between the emitter and the encoder boards.
2. Position the circuit board assembly and reinstall it with the two 8-32 x 3/4” screws.



NOTE: If the assembly has come apart, make sure the spacers are in the proper arrangement: The two shorter spacers go between the assembly and the gearbox. Also check at this point to make sure that the disc is not bent in such a way that it will come into contact with the board as it revolves.

3. Change the label on the cover to reflect the new number of positions. Put the cover partially on and reconnect the ribbon and power cables to the board in the motor assembly. It is necessary that they cross inside the cover.
4. Hold the ribbon and power cables out of the way against the transformer as the cover is repositioned over the motor assembly. Put in the four 4/40 x 1/4" phillips head screws which hold the cover in place.
5. Plug in the actuator and step it through all its positions to see that it works properly.
6. Consult the section entitled “Alignment Procedure” on page 13 for help in properly installing and aligning the new valve on the actuator.

Consult the factory if additional help is needed.

Reversing the Direction of Rotation

Tools you will need:

1. 9/64 hex driver
2. 7/64 hex driver
3. #1 or #0 phillips screwdriver

Disassembly

Follow the steps for disassembly on page 7. However, before removing the encoder disc as described in Step 6, use a felt pen to mark the point on its radius that is at 12 o'clock. If Step 1 was observed and the actuator was switched to HOME, this will be at the notch (strobe bit) that denotes Position 1.

Reassembly

- 1 Reinstall the encoder disc with the same point at 12 o'clock but with its opposite face out. If there is any question about the orientation of the disc, refer to **Figure 8**. But remember that once Position 1 has been located according to that illustration, the disc must be flipped over (on an axis from 12 o'clock to 6 o'clock, so that the opposite face is out) to function properly when the direction of the motor is reversed.
2. Locate the three leads (yellow, gray, and black) that form the connection from the motor to the circuit board. Looking at the connector, observe the three small metal tines, one for each wire. Depressing the high point of the tine with a ball point pen or something similar will allow the wire to be extracted from the connector. See **Figure 9**. Reverse the positions of the yellow and gray wires, making sure the wires are pushed back in far enough to fully engage the tines.
3. Follow the steps for reassembly in the previous section.

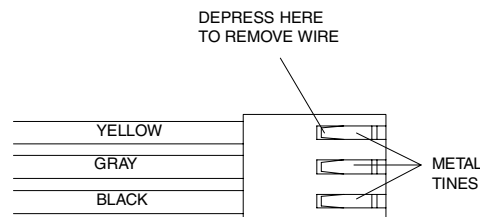


Figure 9: Motor connector

Valve Alignment

When the valve arrives from the factory installed on an actuator, it is accurately aligned and ready for use. However anytime the clamp ring on the actuator is loosened, as when removing the valve from the actuator for mounting through an instrument panel or oven wall, the valve and actuator must be realigned so that the internal ports and flow passages on the rotor intersect properly.



CAUTION: Before removing the valve from the actuator, mark the factory alignment position of the valve.

CLOSEMOUNT: Make temporary registration marks on the face of the valve where it lines up with the slot in the stainless clamp ring on the actuator.

STANDOFF: Make temporary registration marks on the standoff tube where it lines up with the slot in the black anodized clamp ring on the actuator. Do not remove the valve from the standoff assembly.

When this mark is lined up with the slot on reassembly, the factory alignment will be approximately reproduced as long as the valve and the actuator remain in their original positions.

Causes of Misalignment

1. Removal of valve from actuator for mounting

As referred to earlier, mounting valves through a bracket or oven wall requires that the valve or valve/standoff assembly be separated from the actuator. In the case of a valve on a standoff, this is accomplished by loosening the socket head screw (8-32 x 5/8") in the black anodized CR3 clamp ring on the actuator, using a 9/64 hex driver. **(Figure 6)** In valves utilizing a closemount assembly, the removal is accomplished by using a 7/64 hex driver to loosen the socket head screw (6-32 x 5/8") in the stainless CR11 clamp ring on the actuator. **(Figure 5)**

Any time the screw in the CR3 or CR11 clamp ring has been loosened, the alignment of the valve after replacement on the actuator should be checked. The chances of proper alignment after reassembly are greatly enhanced by following the suggestion in the highlighted note found in the box above.



CAUTION: In some applications it is desirable to delete the black right-angle mounting bracket supplied as part of the actuator, as when it is replaced by an oven wall or instrument panel. For the valve mounting and driving hardware to function properly, the thickness of the substitute must approximate the thickness of the bracket. Consult the factory if problems are experienced.

2. Shock from heavy or continuous use

Occasionally, when valves are used in applications requiring a high-duty cycle, wear or shock can cause the screw and clamp ring to loosen. Instrument vibration may have the same effect. This allows the standoff to move, causing inaccurate rotor rotation. The most obvious symptom is observable movement of the standoff, valve, or actuator, which normally do not move when the valve is actuated.

Chromatographic Symptoms of Misalignment

1. Loss of flow or blocked flow

When the valve body, rotor, and actuator are not in proper alignment, the ports do not completely intersect the flow passages on the rotor. In the worst case there is no flow in any position, but slight misalignment may eliminate flow from ports on one side of the valve only. With a rotometer or a line placed into liquid, gas flow may be observed between positions as the actuator cycles the valve. In liquid applications, blocked flow may cause pump shutdown or failure of other components due to pressure buildup.

2. Mixing of samples

In some configurations with large ports and their corresponding large flow passages which are very close together, poor alignment can cause mixing of samples even when a flow restriction has not been observed. This may be manifested as “ghost” peaks or poor reproducibility.

Alignment Procedure

NOTE: The alignment procedures for air actuated and electrically actuated valves are not the same. For an air actuated valve, see Technical Note 707, Operation Notes and Alignment Instructions, Air Actuated Multiposition Valves.

Description

The valve will have either one (SD and SC types) or two (SF and ST types) rows of ports evenly spaced around the circumference of the body. See **Figure 10**. In addition there will be one (SD and SF types) or two (SC and ST types) “common” ports offset to either side of these rows. By convention, Position 1 falls counterclockwise from these common port(s) when the valve is viewed from the end away from the actuator. The rotor will have either one or two flow passages appearing as engraved rings around the seal, which intersect the common port(s). Flow passages perpendicular to the ring(s) connect the ring(s) to the selected port(s).

STUW

The only configuration which does not fall within this description is the STUW. Unlike the standard ST, these have one row of ports around the circumference, with two common ports offset in the same direction. The common ports are 180° apart, so only one shows in **Figure 10**. Special instructions and descriptions regarding STUW's will be highlighted in this manner at several points in the procedures which follow.

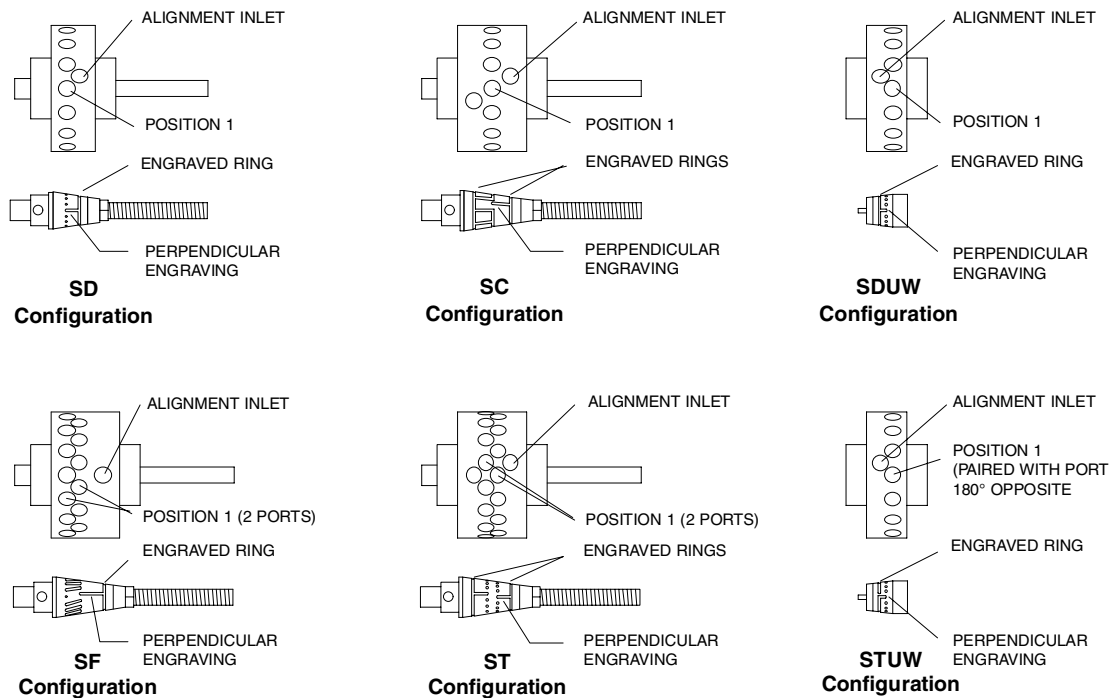


Figure 10: Typical multiposition valve bodies and seals

Basically, this procedure is a method of centering the perpendicular engraving on the selected port by determining the point at which flow begins (when the engraving just starts to intersect the port) and the point at which flow ends (when the engraving ceases to intersect the port), and centering the rotor between those two points.

1. Plug the actuator in. If the position indicator doesn't read "1", flip the switch to the HOME position.
2. Place the valve or valve and standoff combination on the actuator. By convention, the factory alignment places the common port(s) at 12 o'clock. Re-orienting the standoff or the slotted coupling (in close-mount applications) on the square drive of the actuator allows three other possibilities.

For a valve on a standoff, make sure the standoff butts all the way against the actuator so that the drive mechanism is completely engaged. Tighten the clamp ring screw enough to keep the standoff from falling out when it is released, but make sure it is loose enough to allow the assembly to be turned during the alignment procedure.

For a closemount valve, make sure that the ends of the pin in the rotor are engaged by the slots of the coupling. Tighten the clamp ring screw enough to keep the valve from falling out when it is released, but make sure it is loose enough for the valve to be turned during the alignment procedure.

- Establish a flow of clean gas (50 psi is adequate) into the port offset away from the actuator. This port, called the alignment inlet in **Figure 10**, will be the designated inlet throughout this procedure.

STUW

Establish gas flow into the common port at 6 o'clock (alignment inlet in **Figure 10**).

- With the valve facing you and the actuator behind the valve, the port to the left of or counterclockwise from the alignment inlet corresponds to Position 1. (See **Figure 10**. This is the opposite of valves on air actuators.)

STUW

With the common port at 6 o'clock as the alignment inlet, the port to the left of or counterclockwise from the common port at 12 o'clock corresponds to Position 1.

If the gas is flowing from the port in Position 1, go to Step 5. If you hear no flow, grip the valve and rotate it either way as necessary (the actuator keeps the rotor fixed) until gas flows from this port.

NOTE: When listening for flow, it is helpful if the fittings are removed from the port under consideration but left in the adjacent ports. If all the fittings have been removed, install a loop connecting the two adjacent ports to better isolate the sound of the flow.

- Grip the valve and rotate it counterclockwise a few degrees past the point where flow stops.

This sets up a "staging area" for the approach to Position 1.

- Grip the valve and slowly rotate it clockwise until the first traces of flow are heard from the port of Position 1. (The port to the left of the alignment inlet.)

- While holding the valve steady, use a soft pencil or ink marker to make a mark on the standoff corresponding to the slot in the actuator clamp ring. This slot makes a clear fixed reference point for observing relative rotational positions. In the case of a closemount valve, make this mark on the valve body. (**Figure 11**)

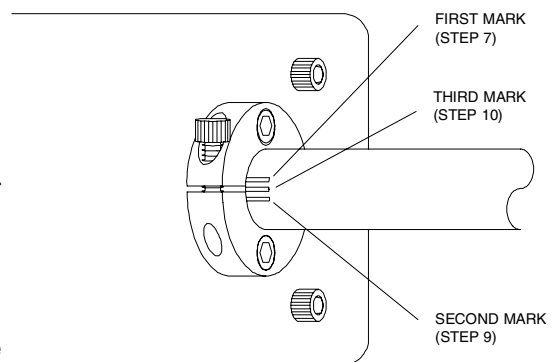


Figure 11: Marking valve or standoff during alignment procedure

- Continue the slow manual clockwise rotation of the valve body through the point of peak flow and beyond until the flow stops or is barely perceptible, as in Step 6.
- Make another mark as in Step 7. (**Figure 11**)
- Make a third pencil mark halfway between the first two and rotate the valve counterclockwise until this midway mark is reached. (**Figure 11**)

11. While holding the valve steady, firmly tighten the screw in the clamp ring. The rotor should be properly positioned at the point of maximum flow when the actuator is stepped to the next position.

Congratulations, the procedure is complete. It is a good idea to cycle the valve through all its positions to be certain everything is functioning properly. In some cases it is possible to do an additional check by simply looking down the fitting detail and into the port as the valve is stepped from position to position. If it is a valve which has a relatively short distance from the bottom of the detail to the internal taper, the engraved “dimples” on the seal are visible as they come into alignment with the port.

Consult the factory if additional help is needed.

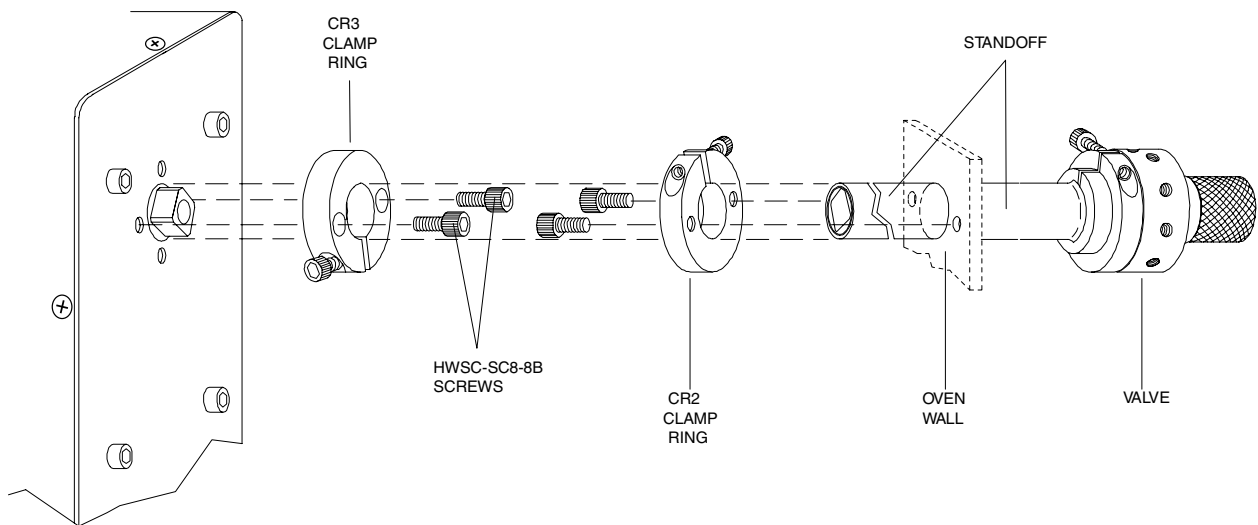


Figure 12: Standoff assembly connecting actuator and valve

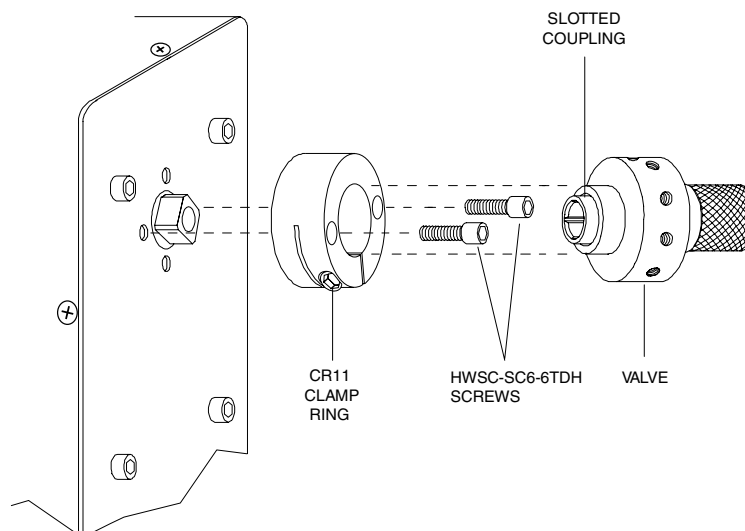
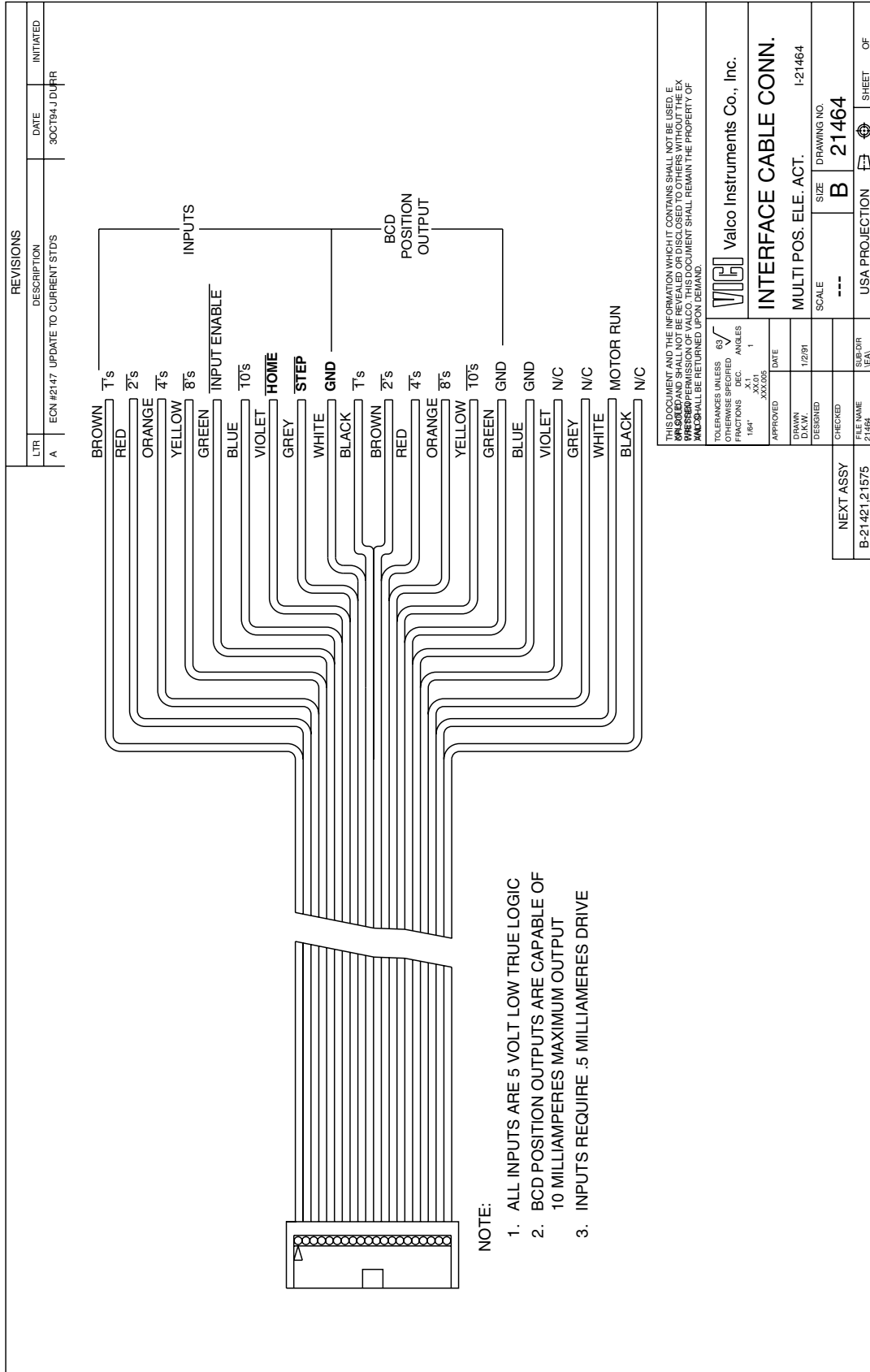


Figure 13: Closemount assembly connecting actuator and valve

Technical Drawings

Interface Cable Assembly	Drawing 21464	Page 18
Logic Board Schematic.....	Drawing 22721	Page 19
Logic Board Assembly	Drawing 22720	Page 20
Controller Assembly.....	Drawing 21412	Page 21
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Encoder Board Assembly	Drawing 22726	Page 23
Driver Board Schematic.....	Drawing 22724	Page 24
Driver Board Assembly	Drawing 22723	Page 25
Transformer Board Assembly	Drawing 22729	Page 26
Transformer Board Schematic	Drawing 22730	Page 27
Multiposition Electric Actuator Assembly.....	Drawing 22835	Page 28
Multiposition Electric Actuator Motor Assembly	Drawing 22834	Page 29



NOTE:

1. ALL INPUTS ARE 5 VOLT LOW TRUE LOGIC
2. BCD POSITION OUTPUTS ARE CAPABLE OF 10 MILLIAMPERES MAXIMUM OUTPUT
3. INPUTS REQUIRE .5 MILLIAMERES DRIVE

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Valco Instruments Co., Inc.

INTERFACE CABLE CONN.

MULTI POS. ELE. ACT. I-21464

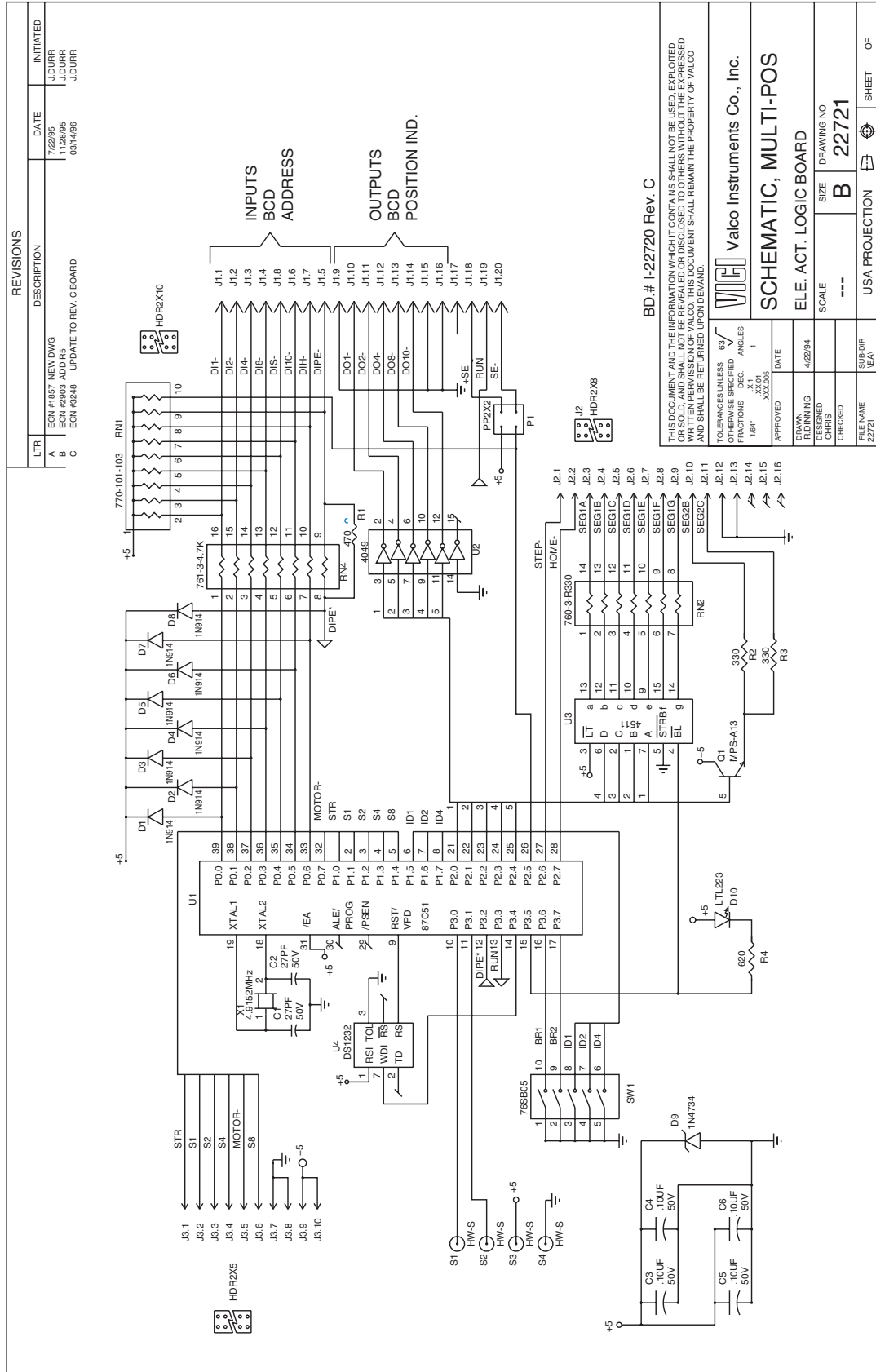
SCALE --- SIZE B 21464

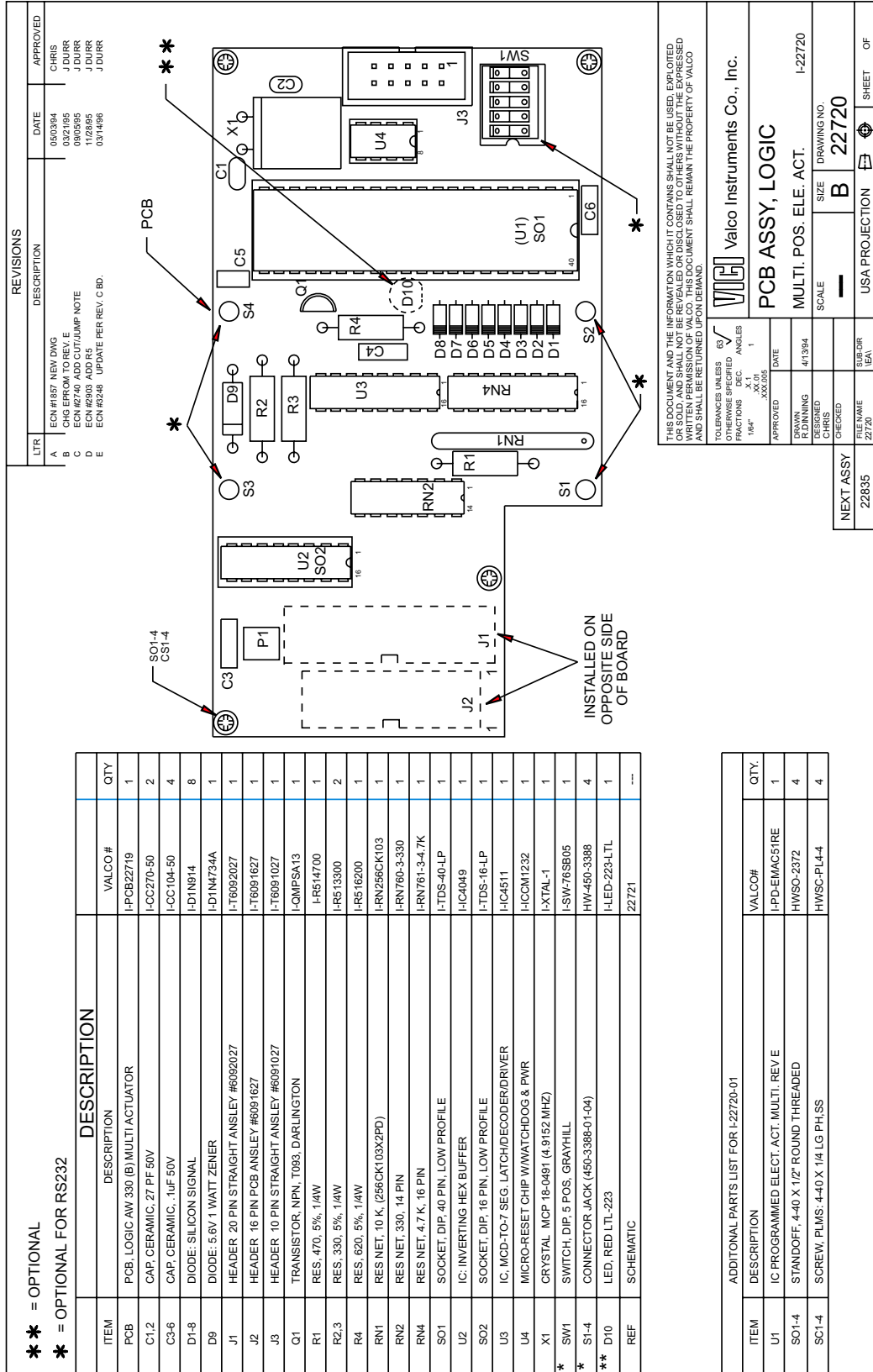
DRAWN 1/2/91 DESIGNED 1/2/91

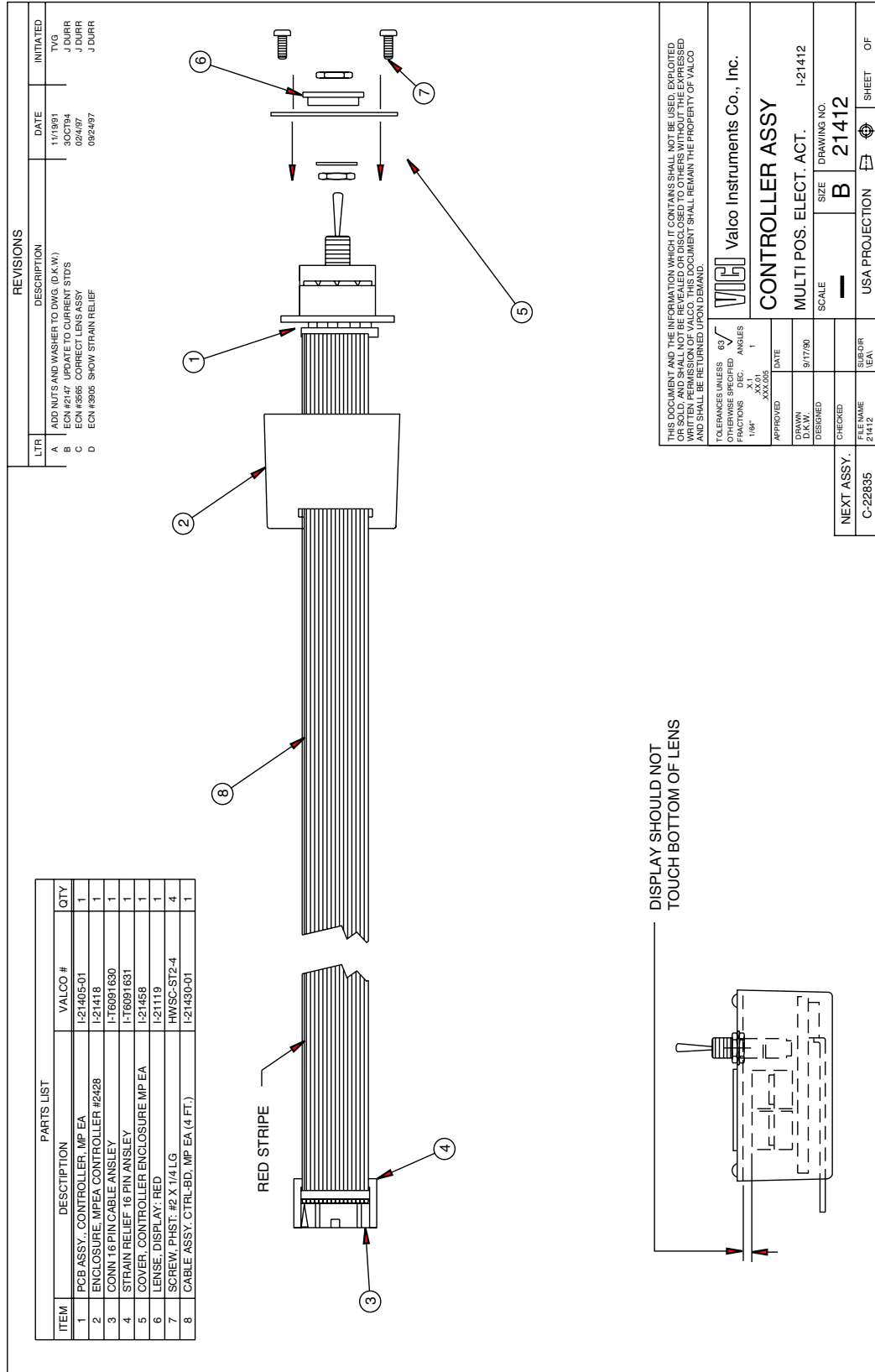
TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS 164 DEC. ANGLES 164 APPROVED XXX,005 DATE XX,01 XX,01 1

NEXT ASSY B-21421, 2, 1575 CHECKED SUB/DIR 21464

USA PROJECTION SHEET OF

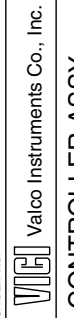






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TOLERANCES UNLESS OTHERWISE SPECIFIED	FRACCTIONS	DEC.	ANGLES
1/16"	.X.1		1
APPROVED	DATE	DESIGNED	DRAWING NO.
D.K.W.	9/17/90		I-21412
DESIGNED	SCALE	CHECKED	SIZE
	—		B
NEXT ASSY.	USA PROJECTION	FILE NAME	DRAWING NO.
C-22835		21412	21412
		SUB-DIR	SHEET
		1EA	OF



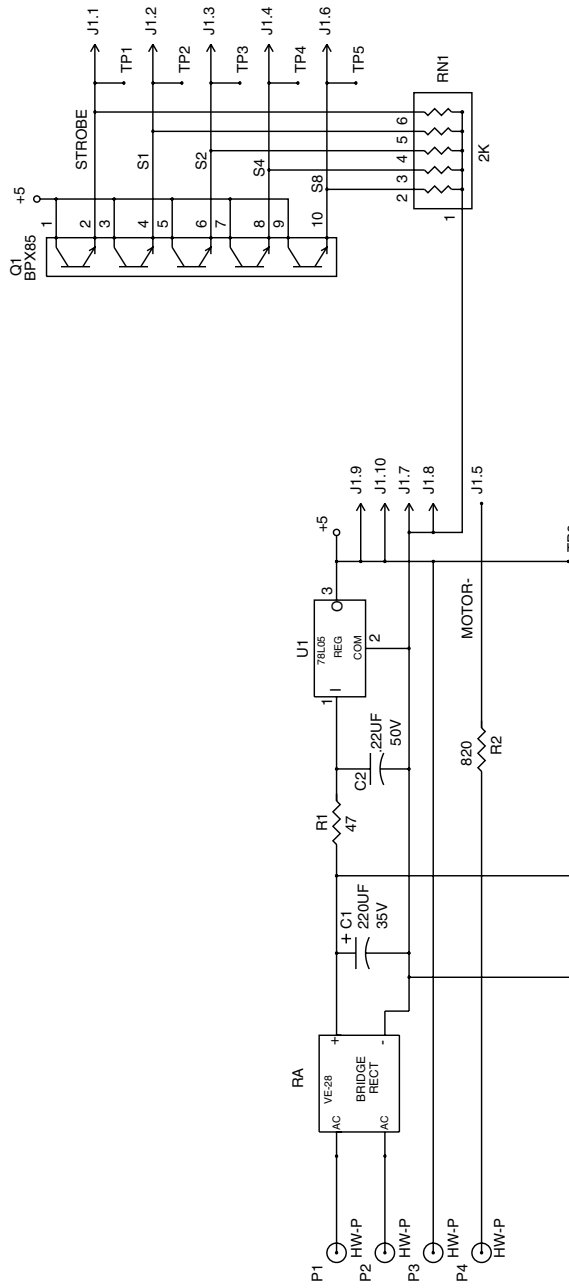
CONTROLLER ASSY

MULTI POS. ELECT. ACT. I-21412

SCALE: — SIZE: B 21412

USA PROJECTION

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ECN #1857 NEW DWG	7/22/94	J DURR
B	ECN #4332 CHG RNI TO 2K (4.7)	8/19/98	J DURR

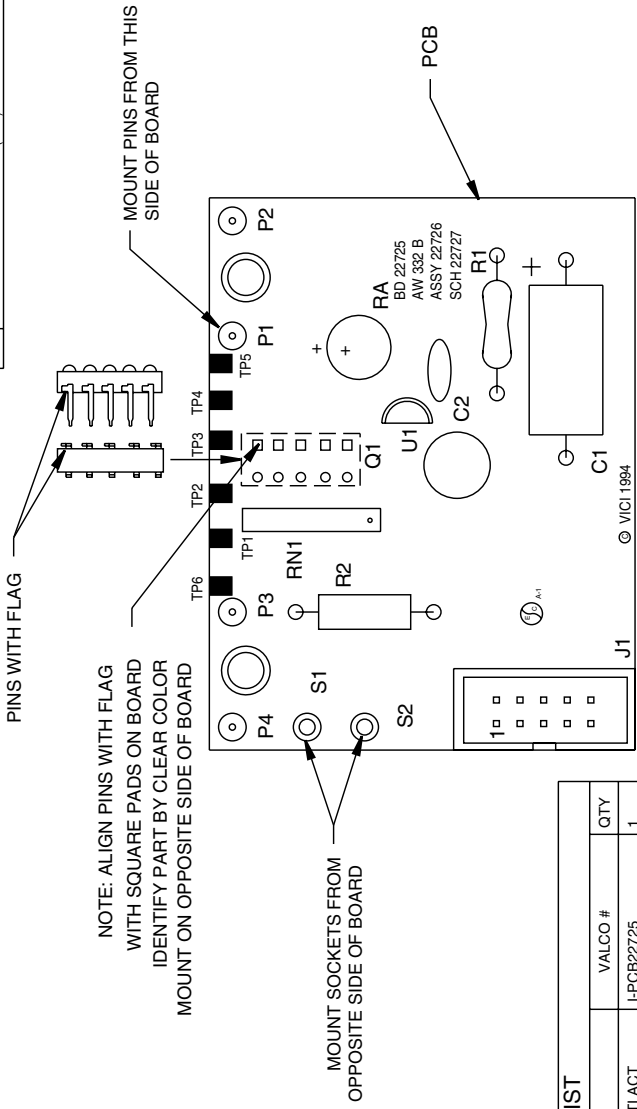


BD# I-22726

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TOLERANCES UNLESS OTHERWISE SPECIFIED	63	APPROVED	DATE
FRACTIONS DEC.	X.11	CHRIS	4/13/94
ANGLES	X.11	CHRIS	
	XX.005		
SCHEMATIC, MULTI-POS			
ELE. ACT. LED ENCODER			
SCALE	---	SIZE	DRAWING NO.
		B	22727
FILE NAME	SUB-DR	SHEET	OF
22727	22727		

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
B	ECN #1857. UPDATE TO REV B	5/4/94	CHRIS
C	ECN #4332. CHG RNI TO 2K (4.7K)	8/19/98	J DURR



ITEM	DESCRIPTION	VALCO #	QTY
PCB	PCB, BOARD ENCODER AW 332 (B) MULTI ACT	I-PCB22725	1
C1	CAP. ELECT. 220uF 35V. AXIAL LEAD	I-CE227-35AL	1
C2	CAP. MONO CERAMIC, .22 uF 50V, .2"LEADS	I-CC224-50	1
J1	HEADER 10 PIN STRAIGHT ANSLEY #6091027	I-T6091027	1
Q1	PHOTOTRANSISTOR ARRAY, 5X	I-QBPX85	1
R1	RES. 47, 5%, 1/2W	I-R5247R0	1
R2	RES. 680, 5%, 1/4W	I-R516800	1
RA	RECTIFIER BRIDGE	I-D-VE28	1
RN1	RES NET: 2K 6 PIN, SIP, COMMON	I-RN750-61-202	1
S1,2	CONNECTOR JACK (450-3388-01-04)	HW-450-3388	2
P1-4	PIN, .0400D X .520L (CONCORD)	HW-10-990-2-04	4
U1	5V REGULATOR-LOW POWER -100MA	I-IC78L05	1
REF	SCHEMATIC	22727	---

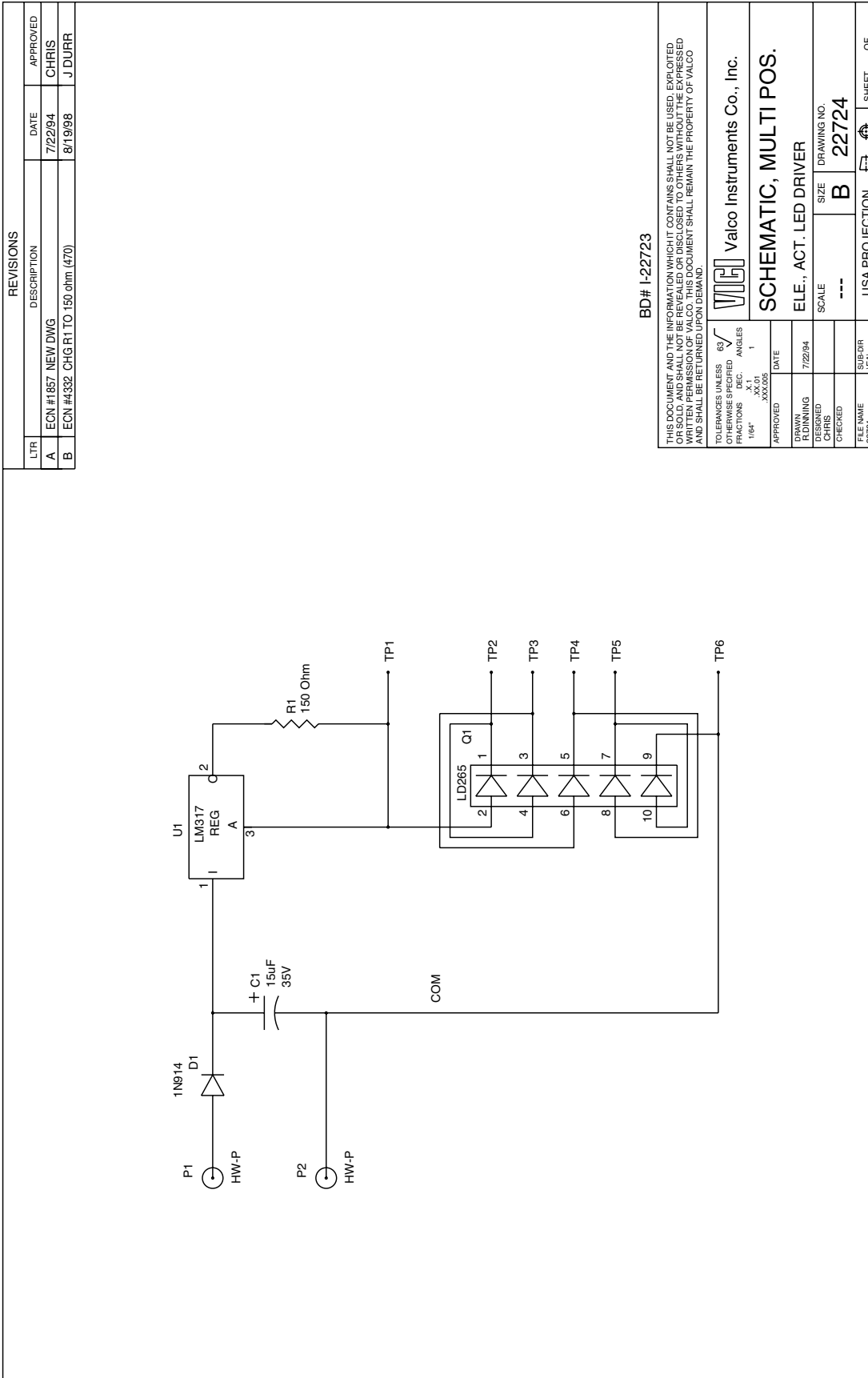
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TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS DEC. ANGLES 1/64" XX.01 XXX.005

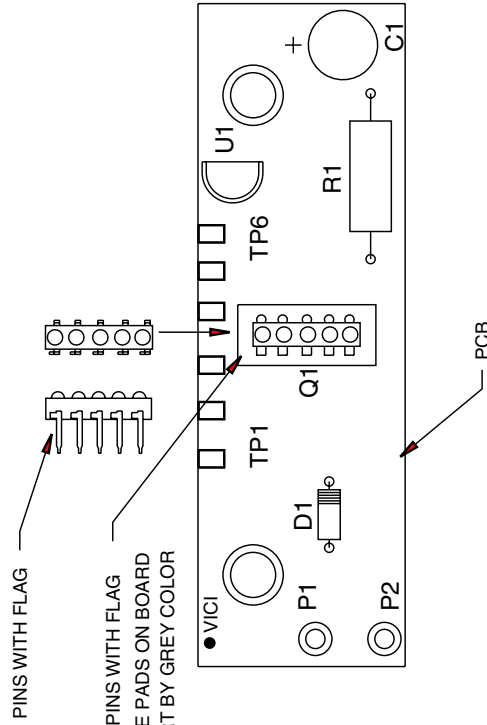
APPROVED: CHRIS DATE: 4/13/94
DESIGNED: CHRIS
CHECKED: FILE NAME: 22726

Valco Instruments Co., Inc.
PCB ASSY, ENCODER
MULTI POS. ELE. ACT. I-22726
SCALE: --- SIZE: B DRAWING NO. I-22726
USA PROJECTION SHEET OF

NEXT ASSY	22834
FILE NAME	22726
SUB-OR	LEA



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ECN #1857 NEW DWG	5/3/94	CHRIS
B	ECN #4040 CHG R1 TO 90.9 (470)	1/16/98	J DURR
C	ECN #4332 CHG R1 150ohm (90.9)	8/19/98	J DURR



PARTS LIST			
ITEM	DESCRIPTION	VALCO #	QTY
PCB	PCB, LED DRIVE AW 331(B) MULTI ACT ASSY	I-PCB22722	1
C1	CAP, TANTAL, 10MF 25V	I-CT106-25	1
D1	DIODE, SILICON SIGNAL	I-D1N914	1
Q1	DIODE ARRAY LIGHT-EMITTING	I-QLD265	1
R1	RES: 150 OHM 1%, 1/4W	I-R111500	1
P1,2	PIN, .0400D X .520L (CONCORD)	HW-10-990-2-04	1
U1	VOLTAGE REGULATOR, LOW POWER ADJ. TO-92	I-CLM317LZ	1
REF	SCHEMATIC	22724	--

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TOLERANCES UNLESS OTHERWISE SPECIFIED: FRACTIONS DECIMALS ANGLES 1/64" .XX.01 .XXX008

APPROVED: CHRIS DATE: 4/13/94

DESIGNED: CHRIS

CHECKED: CHRIS

FILE NAME: 22723

SUB-DIR: LEA

USA PROJECTION

Valco Instruments Co., Inc.

PCB ASSY, LED DRIVER

MULTI POS ELE ACT I-22723

SCALE: --- SIZE: B DRAWING NO. 22723

22834 NEXT ASSY

22723 FILE NAME

22723 SHEET OF

DASH SCHEDULE		REVISIONS	
VALCO #	VOLTAGE OPT.	DESCRIPTION	DATE
I-22729-01	110V	ECN #1857 NEW DWG	5/3/94
I-22729-02	220V	ECN #6852 ADD POLARITY MARK ON TRANSFORMER	10/23/95
		APPROVED	CHRIS J DURRUMELLE

VALCO #	BD. OPTIONS	C2 VALCO #
I-22729-01	STANDARD	I-CM106-250
I-22729-02	SEE NOTES	I-CM335-400

* I-22729-02

* FOR 220V OPTION

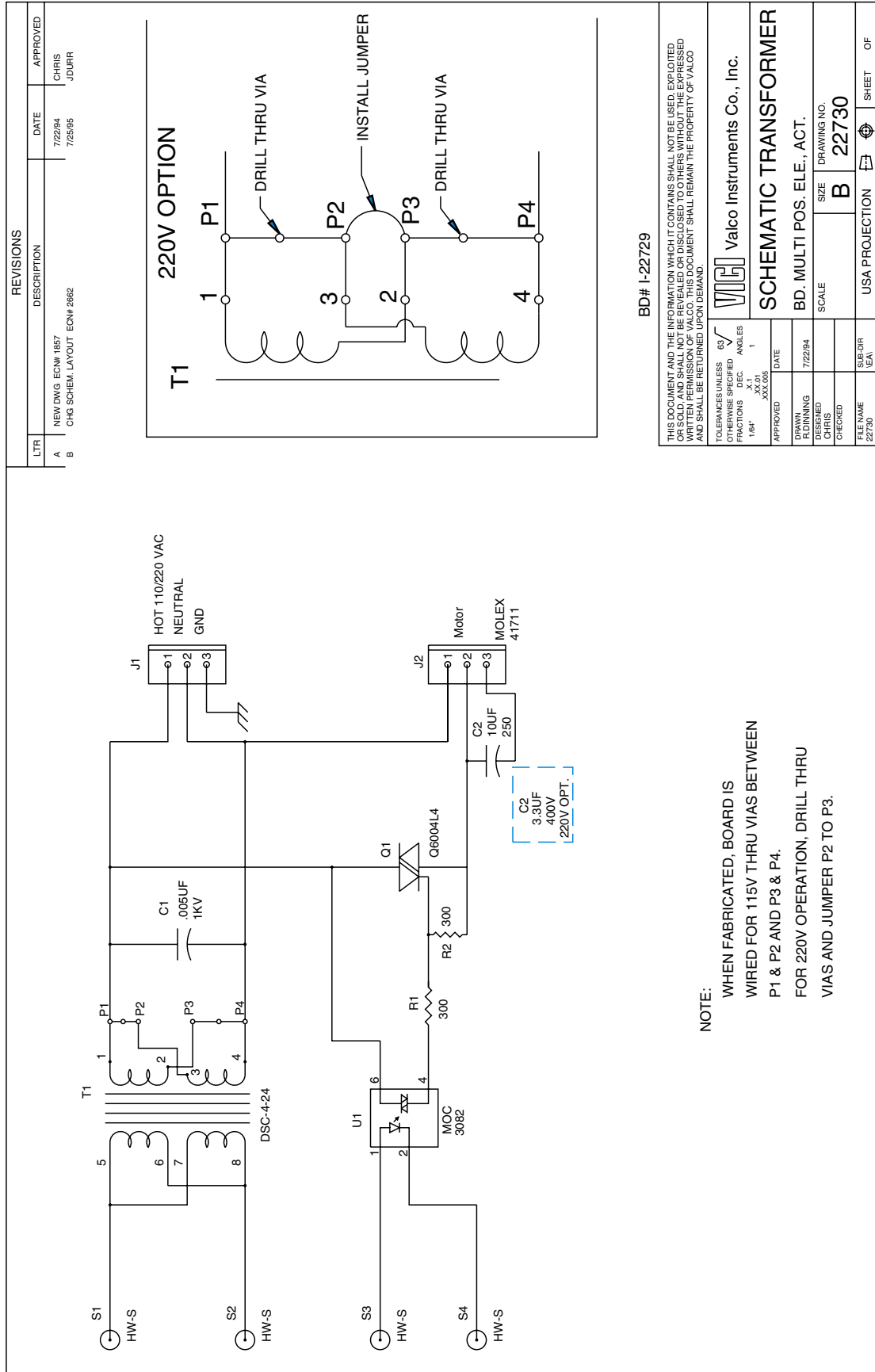
* NOTE:
FOR 220V OPTION FROM BOTTOM OF BOARD DRILL THRU VIAS (2) JUMPER AS SHOWN

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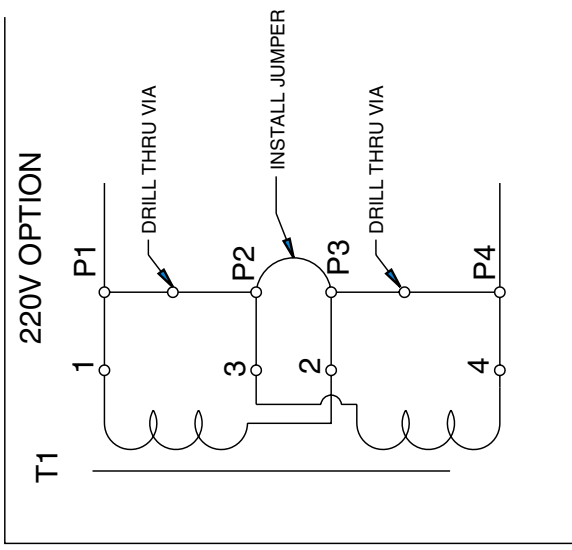
TOLERANCES UNLESS OTHERWISE SPECIFIED	63	ANGLES	
FRACTIONS	1/16"	DEC.	1
	.XX-01		
	.XXX-05		
APPROVED	DATE		
DRAWN	4/19/94		
DESIGNED			
CHECKED			
FILE NAME	22729	SUBDIR	
22834		USA PROJECTION	SHEET OF

Valco Instruments Co., Inc.	
PCB ASSY, TRANSFORMER	
MULTI. POS. ELE. ACT.	I-22729
SCALE	B 22729
DRAWING NO.	

ITEM	DESCRIPTION	VALCO #	QTY
PCB	PCB, TRANSFORMER AW 333 (A) MULTI ACT	I-PCB22728	1
C1	CAP, CERAMIC, .005uF 1KV	I-CC502-1K	1
C2	CAP, MYLAR, 10uF 250V (110V VERSION)	SEE DASH SCH	1
J1,2	CONN 3 PIN W/RAMP MOLEX	I-T265 10032	2
Q1	TRIAC 4AMP-600V	I-O6004L4	1
R1,2	RES. 300. 5%, 1/4W	I-R513000	2
S1-4	CONNECTOR JACK (450-3388-01-04)	HW-450-3388	4
T1	TRANSFORMER 115/230V DSC4-24	I-X-DSC4-24	1
U1	IC, OPTO-TRIAC ZERO CROSSING	I-IC3082	1
SO1	SOCKET, DIP, 6 PIN, LOW PROFILE	I-TDS-6LP	1
JMP	BUSS WIRE UNINSULATED .025 DIA	I-W-BUSS-1	.5"
REF	SCHEMATIC	22730	--



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	NEW DWG ECF# 1857	7/22/94	CHRIS
B	CHG SCHEM. LAYOUT ECF# 2662	7/25/95	JDURR



BD# I-22729

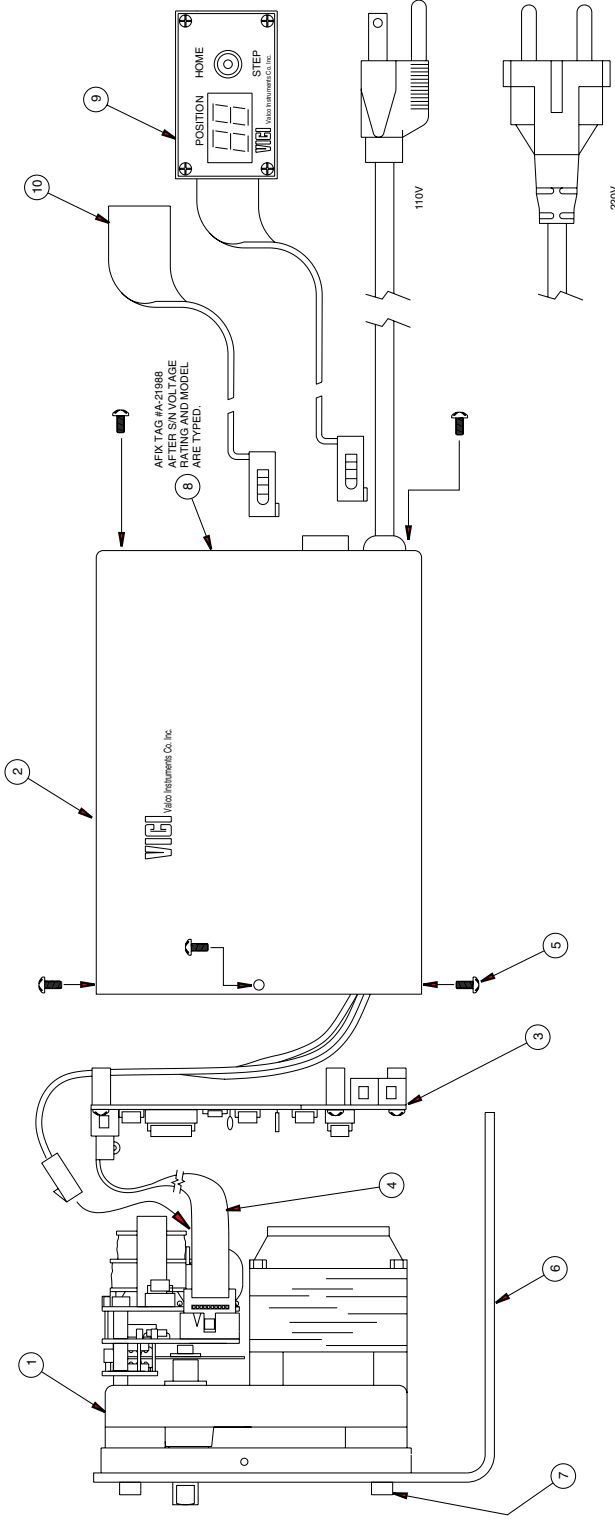
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TOLERANCES UNLESS OTHERWISE SPECIFIED	63° ANGLES
FRACTIONS	DEC
1/64"	.XX.01
	.XXX.006
APPROVED	DATE
	7/22/94
DRAWN	DESIGNED
CHRIS	CHRIS
CHECKED	SCALE
FILE NAME	SIZE
22730	B
SUB/DIR	DRAWING NO.
NEA	22730
USA PROJECTION	SHEET
	OF

NOTE:
 WHEN FABRICATED, BOARD IS
 WIRED FOR 115V THRU VIAS BETWEEN
 P1 & P2 AND P3 & P4.
 FOR 220V OPERATION, DRILL THRU
 VIAS AND JUMPER P2 TO P3.

Valco Instruments Co., Inc.
SCHEMATIC TRANSFORMER
 BD. MULTI POS. ELE., ACT.

VALCO #	ITEM 1	ITEM 2	VALCO #	POS.	ITEM 1	ITEM 2
I-22835-04-110	4	I-22834-04-110	I-22835-12-110	12	I-22834-12-110	I-21803
I-22835-04-220	4	I-22834-04-220	I-22835-12-220	12	I-22834-12-220	I-21803-220
I-22835-06-110	6	I-22834-06-110	I-22835-16-110	16	I-22834-16-110	I-21803
I-22835-06-220	6	I-22834-06-220	I-22835-16-220	16	I-22834-16-220	I-21803-220
I-22835-08-110	8	I-22834-08-110	I-22835-4CS-110	4 CS	I-22834-4CS-110	I-21803
I-22835-08-220	8	I-22834-08-220	I-22835-4CS-220	4 CS	I-22834-4CS-220	I-21803-220
I-22835-10-110	10	I-22834-10-110	I-22835-6CS-110	6 CS	I-22834-6CS-110	I-21803
I-22835-10-220	10	I-22834-10-220	I-22835-6CS-220	6 CS	I-22834-6CS-220	I-21803-220

LT#	DESCRIPTION	DATE	INITIATED BY
A	NEW WGS EOM 2015	7/20/94	J.DURR
B	ADD 220V ENC ASSY. EOM 2027	03/08/95	J.DURR
C	ADD CHANGES FOR GSS ITEMS EOM 4/1/00	11/03/98	J.DURR



ITEM	DESCRIPTION	VALCO #	QTY
* 1	MOTOR ASSY (C-22834)	SEE DASH SCH.	1
* 2	ENCLOSURE ASSY, MULTI POS ELE ACT	SEE DASH SCH.	1
* 3	BD, ASSY, LOGIC MULTI POS ELE ACT	I-22720-01	1
* 4	CABLE ASSY, ENCODER TO LOGIC	I-21487	1
* 5	SCREW P.L.M.S: 4-40 X 1/4 LG	HWSC-PL4-4	8
* 6	BRACKET FOR MP EA	I-21486	1
* 7	SCREW SHCS: 8-32 X 3/8 LG	HWSC-SC6-6B	4
* 8	TAG, SERIAL FOR ALL ELECT. DEVICES	I-21988	1
* 9	CONTROLLER ASSY, MP EA	I-21412	1
* 10	INTERFACE CABLE ASSY MP EA (ONLY 1 END)	I-21421-01	1

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VALCO INSTRUMENT CO. INC.
 1547 W. 100th St.
 Valco, MN 55981-1000
 U.S.A.

ACTUATOR ASSY,
 MULTI POS ELE

SCALE: 1:1

DATE: 7/20/94

DESIGNER: J.DURR

CHECKER: J.DURR

DATE: 11/03/98

VALCO INSTRUMENT CO. INC.

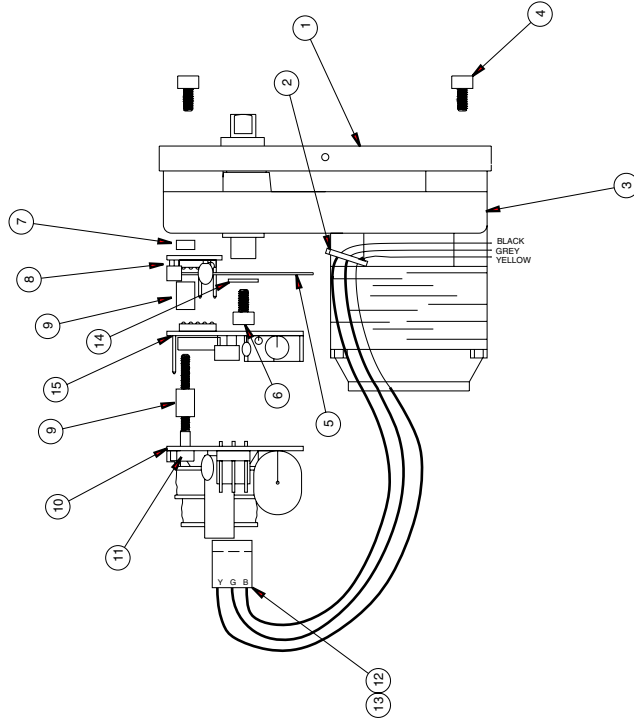
USA PROJECTION

SHEET 01 OF 01

* I-22835 WITH GSS SUFFIX USE THE APPROPRIATE MOTOR AND ENCLOSURE ASSYS AND THESE PARTS ONLY AFFIX SERIAL TAG TO FRONT CASTING

REVISIONS		
LT#	DESCRIPTION	DATE
A	EOM #2015 NEW DWG	7/28/04
		INITIATED J.DURR

PARTS LIST			
ITEM	DESCRIPTION	VALCO PART#	QTY.
1	CASTING MODIFIED C-21482	I-21482	1 EA
2	TYWRAP TYTON 1/4 X 4"	HWTYWRAP-2	1 EA
3	MOTOR	SEE DASH	1 EA
4	SCREW, SHCS: 8-32 X 1/2 LG	HWSC-SC8-8B	4 EA
5	ENCODER DISK	SEE DASH	1 EA
6	SCREW, SHCS: 8-32 X 1/4 LG	HWSC-SC8-4B	1 EA
7	SPACER, .25 OD X 1.17 ID X 1.25 LG, ALUM.	HWSP-8520	2 EA
8	PCB ASSY, LED DRIVER MULTI POS ELE ACT	I-22723	1 EA
9	SPACER #8 X 3/8"	HWSP-4522	4 EA
10	PCB ASSY, TRANSFORMER MULTI POS ELE ACT	SEE DASH SCH.	1 EA
11	SCREW, SHCS: 8-32 X 1-1/4 LG	HWSC-SC8-20B	2 EA
12	MOLEX CONN. 09-50-3031	I-T08503031	1 EA
13	MOLEX TERM. 08-50-0106 (NOT SHOWN)	IT08500106	3 EA
14	WASHER, FLAT #8 .175" .375" .030	HWW-F#8	1 EA
15	PCB ASSY, ENCODER MULTI POS ELE ACT	I-22726	1 EA



DASH SCHEDULE				
VALCO #	DISK (ITEM 5)	MOTOR (ITEM 3)	BOARD (ITEM 10)	
I-22834-04-110	I-21536	I-21481-110	I-22729-01	
I-22834-04-220	I-21536	I-21481-220	I-22729-02	
I-22834-06-110	I-21537	I-21481-110	I-22729-01	
I-22834-06-220	I-21537	I-21481-220	I-22729-02	
I-22834-08-110	I-21538	I-21481-110	I-22729-01	
I-22834-08-220	I-21538	I-21481-220	I-22729-02	
I-22834-10-110	I-21539	I-21481-110	I-22729-01	
I-22834-10-220	I-21539	I-21481-220	I-22729-02	
I-22834-12-110	I-21540	I-21481-110	I-22729-01	
I-22834-12-220	I-21540	I-21481-220	I-22729-02	
I-22834-16-110	I-21541	I-21481-110	I-22729-01	
I-22834-16-220	I-21541	I-21481-220	I-22729-02	
I-22834-4CS-110	I-21542	I-21481-110	I-22729-01	
I-22834-4CS-220	I-21542	I-21481-220	I-22729-02	
I-22834-4CS-110	I-21543	I-21481-110	I-22729-01	
I-22834-4CS-220	I-21543	I-21481-220	I-22729-02	

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Valco Instruments Co., Inc.

MOTOR ASSY MULTI POS.

ELEC. ACTUATOR

SCALE: **C**

SIZE: **22834**

DRAWING NO.: **22834**

DATE: **7/28/03**

DESIGNED BY: **---**

CHECKED BY: **---**

FILE NAME: **22834**

USA PROJECTION

SHEET **01** OF **01**

NEXT ASSY
22835

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, RESULTING 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, call or write Customer Repairs, Valco Instruments Company, Inc, P.O. Box 55603, Houston, Texas 77255. ph(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.