TELEDYNE HASTINGS INSTRUMENTS

INSTRUCTION MANUAL

HASTINGS POWER SUPPLY MODEL 400

TELEDYNE INSTRUMENTS
Hastings Instruments
A Teledyne Technologies Company

ISO 9001
KEMA CERT 10192.01
Accredited by the Dutch Council for Accreditation (RvA)
Accredited by the Registrar Accreditation Board (RAB)

Manual Print History

The print history shown below lists the printing dates of all revisions and addenda created for this manual. The revision level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new revision is created, all addenda associated with the previous revision of the manual are incorporated into the new revision of the manual. Each new revision includes a revised copy of this print history page.

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Revision E (Document Number 113-082005) ..... August 2005

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Table of Contents

SECTION 1

General Information

The Hastings Model 400 Power Supply is a combination power supply and digital readout monitor for up to four Hastings Flow Instruments having the model number prefixes of HFM, HFC, ST, FST, CST, or CSH. (NOTE: HFM, ST, and FST Series Flowmeters can provide flow readings only and have no control capabilities). The command signal for flow controllers can be generated from a potentiometer on the front panel or may be applied through terminals on the back panel. Four valve override switches are provided on the front panel for manual control of the flow controller valves. These controls provide for easy monitoring and control of the flow instruments with minimal time required to get the flow instruments on line.

1.1 Features:

The power supply fuse is user-accessible from the rear of the instrument without disassembly of the case. Internal dipswitches allow the user to change from the command signal generated internally to an external command signal. A rear panel terminal strip provides the user with analog output from flow instruments and external command signal input. A 3-1/2 digit LCD display monitors the flow instruments. Input voltage is internally switchable between 115 and 230 VAC. Front panel valve override switches manually control valves to either full open (for purges) or fully closed to shut down. Soft starts are provided through internal jumpers for changing the method of flow control in the field. Display can be set up to read directly in the units in which the flow instrument is calibrated.

1.2 Specifications

Weight ..... Approximately 4 lbs.

Dimensions ..... 3.47"(H) X 9.47"(W) X 7.19"(D)

Meter ..... 3-1/2 digit LCD

Power ..... 112-125/224-250 VAC 50 or 60 hz

Output ..... -15 VDC @ 850 mA

+15 VDC @ 250 mA

Command Input ..... 0-5 VDC

Channels ..... 1 to 4

Scaling ..... Individual channel meter adjustment.

Signal Output ..... 0-5 VDC into 2K Ohms minimum load. All four channels can be read simultaneously.

Feet supports and a stand are standard. They can be easily removed for rack mounting (mounting screws can cause electrical shorts if re-installed without feet supports and stand).

OPTIONAL CABLES:

Type AF-(length)-AM for "D" connector

Type CE-(length)-AM for edge connector

8, 25, 50, 100 ft. lengths available as separate item.

Cables *DO NOT* have to be the same length.

1.4 Accessories:

1.4.1 Alarms

The Model AL-1J Flow Alarm is available as an attachment suitable for use with any 0-5.00 VDC input signal. Calibrated digital dial precision pots determine the low and high set points as a percent of full scale. This permits use with any range flow controller or other instrument having a 0-5.00 VDC linear output signal. Control action is within 0.2% of scale.

1.4.2 Totalizer

The Hastings TR-1J Flow Totalizer integrates the 0-5.00 VDC signal generated by the flow controller to give a total flow reading. Count rates from 0-999 counts per minute are selectable by internal setting.

1.4.3 4-20 mA Current Converter

The Hastings Model CC-420J Series Current Converter is an option available with Hastings Mass Flow Controllers. The CC-420J produces a 4-20 mA signal from the 0-5.00 VDC output of the flowmeter.

SECTION 2
Installation

This section is designed to assist you in getting a new power supply into operation as quickly and easily as possible. Please read the following very thoroughly before attempting to install the instrument.

2.1 Receiving Inspection:

Carefully unpack the Hastings Power Supply and any accessories that arrive with it. Inspect it for any obvious signs of damage due to shipment. Immediately advise the carrier if any damage is suspected.

Compare each component shipped against the packing list. Ensure that all parts are present (i.e. power supply, cables, etc.). Optional equipment or accessories will be listed separately on the packing list (see Section 1.4 - Accessories). There may also be one or more OPT- options on the packing list. These normally refer to special ranges or special gas calibrations. They may also refer to special helium leak tests or high pressure tests or special modifications such as high temperature or special O-ring materials. In most cases these are not separate parts, but rather special options or modifications built into the power supply.

2.2 Power Requirements:

The Model 400 Power Supply normally operates on either 115 or 230 VAC. It can be switched between these two supplies by the black switch next to the transformer on the PC board, front left corner (see Figure 2.1). Access the switch by removing two top screws in the rear panel and sliding the top cover aft. The 110 (115) and 220 (230) VAC positions are marked on the PCB. Units will be shipped for the voltage specified in the order.

NOTE: If this power supply is to operate on the 100 VAC nominal voltage used in Japan, a special transformer must be installed and the slide switch must be in the 110 position.

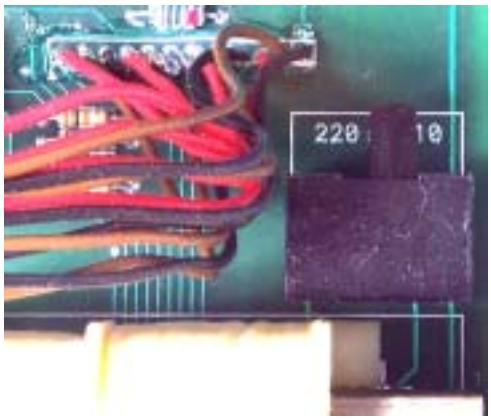


Figure 2.1

2.3 Reference Voltage:

The Model 400 Power Supply provides a command signal by applying an internally generated 5.00 VDC reference voltage to the command potentiometer on the front panel, if an external command signal is not supplied. **It does not use the 5.00 VDC reference inside the flow controller as specified in the flow controller manual.**

2.4 Output Voltage:

The output of the flow instrument is a 0-5.00 VDC signal proportional to the flow rate. The output is sent to the display and is available at terminals at the rear of the Model 400 Power Supply. It is recommended that the load resistance be no less than 2K Ohms.

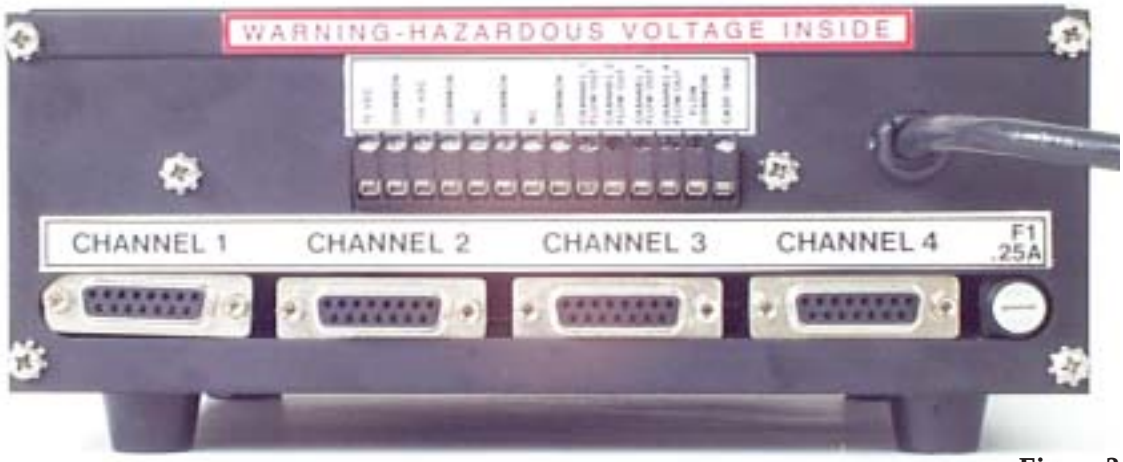


Figure 2.2

Figure 2.3

2.5 Electrical Connection:

Ensure that the power switch is turned off. Plug the AC line cord into an acceptable receptacle. Then plug the 15 pin D connector cable, purchased separately from Hastings Instruments, into the top of the flow instrument and into the back of the power supply. When looking at the back panel of the power supply the different channels are numbered from left to right (see Figure 2.2).

2.6 Operation:

2.6.1 Valve Override

Each controller connected to the Hastings Power Suppl has a valve override switch. For normal operation this will remain in the AUTO position. The CLOSE position will remove power from the valve, thus shutting off the flow regardless of the command signal. The OPEN position will send the maximum available voltage to the valve ensuring that it will be wide open, independent of the command signal. The OPEN position is useful for purging the system. When the soft start method of valve override has been installed as described in Section 3.2.1, the switch operates by overriding the command signal. Therefore when monitoring the command signal, the display will over range high when the valve is opened and over range negative (i.e. -1. - - -) when the valve is closed.

2.6.2 Display

The DISPLAY switch, located in the upper right hand corner of the front panel, controls the digital display (refer to Figure 2.3). When the DISPLAY switch is in the FLOW position, the display is monitoring the mass flow rate. If the DISPLAY switch is in the COMMAND position the display is monitoring the desired flow rate, also referred to as the command signal, for flow controllers only. If the power supply was purchased with the flow instruments, the power supply will be already set up so that the display reads directly in the units of flow to be monitored.

EXAMPLE: A 5 SLPM unit is connected to channel 1. When the CHANNEL SELECTOR switch is turned to channel 1, the display will read 5.00 at 5 SLPM flow rate. A 50 SCCM unit will have the display for its channel read 50.0 at full flow. Note that the display has 3-1/2 digits, but only two decimal points are active, therefore a 1 SLPM unit will read 1000 SCCM.

2.6.3 Channel Selection

The CHANNEL SELECTOR switch in the lower right-hand corner of the front panel is used to switch the display between the different flow instruments to be monitored. Note that the OFF position removes all power from the flow instruments and from most of the power supply. If the CHANNEL SELECTOR switch is inadvertently turned to the OFF position, the flow controller valves will close. After turning the instrument back on, there will be a short period of time before control of the gas flow will resume.

2.6.4 Internal Command

When an external command signal is not provided to the Hastings Power Supply, it is generated internally by applying a 5 volt reference to the command potentiometer on the front panel. To set the command, turn the DISPLAY switch to the COMMAND position. Turn the channel selector switch to the channel to be set. The display is now reading the desired flow rate. Turn the command potentiometer of the channel to be changed clockwise to increase flow rate and counterclockwise to decrease flow rate.

2.6.5 External Command

The Hastings Power Supply can be set up to accept an external command signal such as the output from a D/A converter. When operating in this mode, the signal from the D/A converter is connected to the external command input terminals on the back of the power supply (see Figure 2.4). There is a plus (+) and a minus (-) terminal for each channel. NOTE: All four negative terminals are tied together and to the flow common terminal inside the power supply. If this mode of operation was not specified on the original order, there will be an internal dipswitch that must be set. See Section 3.3 to set this. When operating with a 0-5 volt external command signal the command potentiometer on the front panel must be set fully clockwise. This will result in the external command signal being sent directly to the controller. The command signal can be monitored by turning the Flow/Command switch to Command. If an external command signal greater than 5 volts full scale is used, apply full scale command signal and turn the command potentiometer counterclockwise until the desired full scale command is displayed.

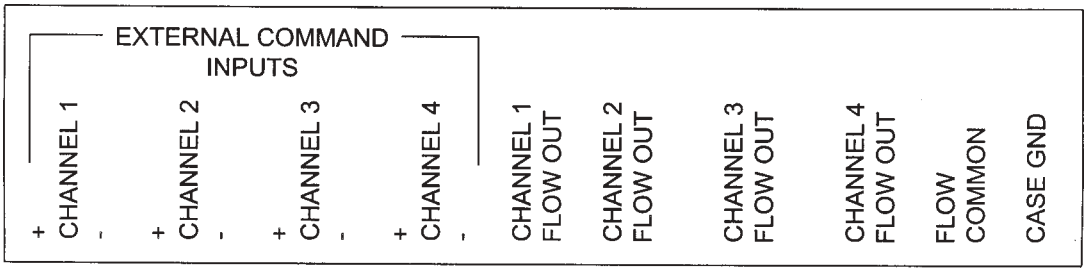


Figure 2.4

2.6.6 Slave Controllers

The Model 400 Power Supply can be configured to slave one flow controller to another controller or flowmeter. This is commonly used to generate gas mixtures when varying flowrates are desired. Either channel can be set up as the master or the slave. Normally, the master will be a flow controller and will be controlled by the command potentiometer on the front panel for its channel. Occasionally the master will be a flowmeter which is controlled by an external throttle valve. The slave will be a flow controller that has its command input tied to the master's flow output. The slave controller will follow the master's lead.

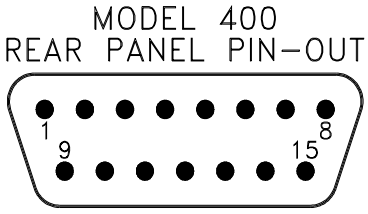
When the master increases, the slave will increase. When the master decreases, the slave will decrease. This results in a constant ratio of the two gases regardless of the flowrate through the master. The command potentiometer on the front panel for the slaved controller adjusts this ratio between 0 and 100% of full scale. Turning the ratio control clockwise increases the ratio of the slaved gas to the master. Counterclockwise decreases the ratio.

The output of the slave controller cannot exceed the command input voltage. EXAMPLE: If two 10 SLPM full-scale flow controllers are used and the primary controller is set to 50% of full scale, the slave controller cannot be adjusted using the front panel potentiometer for more than 50% of full scale. If the slave controller must have more flow than the primary controller, the slaved controller requires a higher full-scale range than the primary controller or the controller which is primary may be changed to the slave controller and vice-versa. A jumper wire must be installed on the rear terminal board from the master's Flow out terminal to the + External command input channel for the slave. The negative terminals are internally connected.

If this mode of operation was not specified on the original order, there is an internal command source selector dipswitch which must be set to the external position. See Section 3.1.3 to do this.

2.6.7 Fuse

The fuseholder is mounted on the lower right-hand corner of the back panel. To remove the fuse, unplug the unit from the power supply, insert a screwdriver into the slot, and turn counterclockwise 1/4 turn. Replace the fuse with a 250 volt 1/2 amp Slo-Blo fuse, 1/4" x 1-1/4". Insert fuse into fuseholder. Place into fuse base and turn clockwise 1/4 turn. Attempting to turn past the stop may damage the fuseholder.



5. SIGNAL COMMON
6. SIGNAL OUTPUT
7. CASE GROUND
8. CONTROL OVER-RIDE
9. -15 VDC
11. +15 VDC
12. VALVE RETURN
14. SET POINT OUT

SECTION 3

Operating Information

This section contains instructions to change the configuration of the power supply from the way it was set up at the factory.

3.1 Range Change:

Since the display uses a 3-1/2 digit LCD, the highest number that can be displayed is 1999. If the display is to read directly in the flow units being used, it must be adjusted whenever the highest digit of the maximum flow rate changes, such as, a 20 SLPM flow instrument being changed to 5 SLPM. If a 10 SLPM unit is exchanged for a 10 SCCM unit, the display will not need to be changed at all. If a 5 SLPM unit is changed to a 500 SCCM unit, then only the decimal point needs to be changed, as described in Section 3.1.4. If the supply is being used in the standard configuration, i.e. internally generating its own command signal, see Section 3.1.1 to adjust the display. If an external command is being supplied, see Section 3.1.2 to set the display. See Section 3.1.3 if a master slave configuration is being operated.

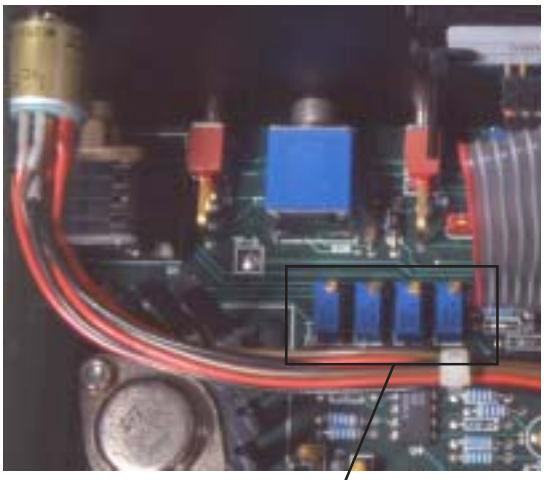


Figure 3.1

3.1.1 Display Adjustment for Internal Command

To change the display, remove the two screws on the top of the back panel. Slide the aluminum perforated top cover out. Turn the DISPLAY switch to the COMMAND position. Generate the maximum command signal. Turn the command potentiometer on the front panel fully clockwise. Turn the DISPLAY-ADJUST potentiometer for the channel to be set until the display reads the desired full scale reading. The DISPLAY-ADJUST potentiometers are located on the PC board near the front/center as shown in Figure 3.1. Channel 1 is on the right when looking from the front of the power supply. Set the decimal point for the display according to Section 3.1.3 if required. Reinstall the cover.

3.1.2 Display Adjustment for 0-5 Volt External Command

Remove the two screws on the top of the back panel. Slide the aluminum perforated cover out. Turn the FLOW/COMMAND switch to the COMMAND position. Generate the maximum command signal (normally 5.00 volts). Turn the COMMAND potentiometer on the front panel fully clockwise. Turn the DISPLAY-ADJUST potentiometer for the channel to be set until the display reads the desired full scale reading. The DISPLAY-ADJUST potentiometers are in the front/center of the PC board. Channel 1 is on the right when looking from the front of the power supply. See Figure 3.1. Set the decimal point for the display according to Section 3.1.4 if required. Reinstall the cover.

3.1.3 Display Adjustment for Master Slave

To set the master unit, follow the instructions for adjusting the display in an internal command configuration; see Section 3.1.1. To set the slave unit, remove the top two screws in the back panel and slide out the top cover. Turn the EXTERNAL COMMAND dipswitch to the INTERNAL position per Section 3.3. Turn the COMMAND potentiometer fully clockwise. Set the FLOW/COMMAND switch to COMMAND. Adjust the DISPLAY-ADJUST potentiometer for the channel being set until the display reads the desired full scale reading. The DISPLAY-ADJUST potentiometer is located in the front/center of the PC board (see Figure 3.1). Channel one is on the right side when looking from the front. Set the decimal point per Section 3.1.4 if required. Reset the EXTERNAL COMMAND dipswitch to EXTERNAL per Section 3.3 Replace the top cover.

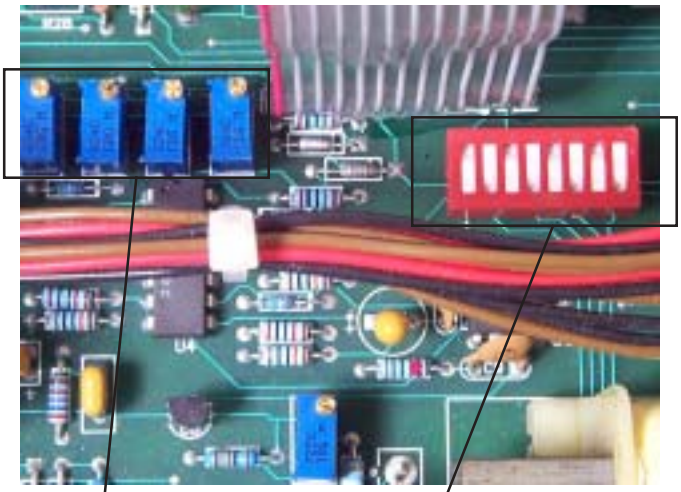


Figure 3.2

3.1.4 Decimal Point

Remove the two screws that hold the aluminum perforated upper cover in place. Slide the cover out. The dipswitches are located next to the display terminal strip (see Figure 3.2). Turn on the desired decimal point for a particular channel by pressing its respective dipswitch down towards the channel number (OPEN indicates that the switch is off). **Switches 1 and 2 are for Channel 1** (Switch 1 provides 2 places to the right of the decimal point, and Switch 2 provides 1 place to the right of the decimal point). **Switches 3 and 4 are for Channel 2** (Switch 3 provides 2 places to the right of the decimal point, and Switch 4 provides 1 place to the right of the decimal point). Switches 5, 6, 7, 8 are used for channels 3 and 4 in the same fashion (see Figure 3.2) for example and chart below). Reinstall cover if no further modifications are needed.

Channel	Switch Selection	Decimal Position
1	1	xx.xx
	2	xxx.x
2	3	xx.xx
	4	xxx.x
3	5	xx.xx
	6	xxx.x
4	7	xx.xx
	8	xxx.x

3.2 Switch Change:

The valve override switches on the front panel of the Hastings Power Supply are normally set up for an OPEN - AUTO - SHUT configuration. This method results in the voltage on pin 8 of the connector to the individual flow instrument being forced to different values. +15VDC drives the

valve open, -15VDC closes the valve, and if pin 8 is left floating, the valve will be in the flow control mode. The valve is fast-responding and has rapid recovery when returning to the AUTO mode.

This option bypasses most of the electronics in the control circuit of the flow controller, including the soft start circuit. The soft start will be active when changing the command signal if the switch is in the AUTO mode, but the controller will have overshoot or undershoot when switching to the AUTO position from the OPEN or SHUT positions. There are jumpers in the power supply that can be changed to put soft start into the switch. This is accomplished by overriding the command signal to the HFC unit. See Section 3.2.1 to set up this option. When using this option, there will be no overshoot or undershoot when switching from SHUT or OPEN to the AUTO position, but the valve will be slower acting.

3.2.1 Soft Start

For this change to be effective, there is a jumper inside the HFC cover which must also be moved. See the HFC manual for instructions. To change to the soft start method of valve override, remove the two screws on the top of the back panel and slide the aluminum perforated top cover from the unit. When looking from the front of the unit, there are a series of four jumpers on the left rear of the pc board behind the power transformer (see Figure 3.3). Each jumper will be on a series of three square pins. If the power supply was purchased with a standard setup, all four jumpers should be on the back two pins as shown in Figure 3.4. The first jumper on the right is used for channel one and jumper two is used for channel two, etc. To change to the soft start mode, remove the jumper for the channel to be changed and reinstall it on the other two pins as shown in Figure 3.5. Reinstall the top cover. With this method of valve control, there will be an approximate fifteen second delay when switching from override CLOSED or override OPEN to the AUTO position.

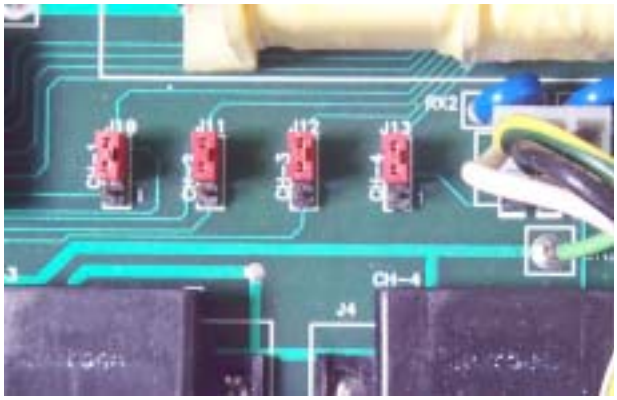


Figure 3.3

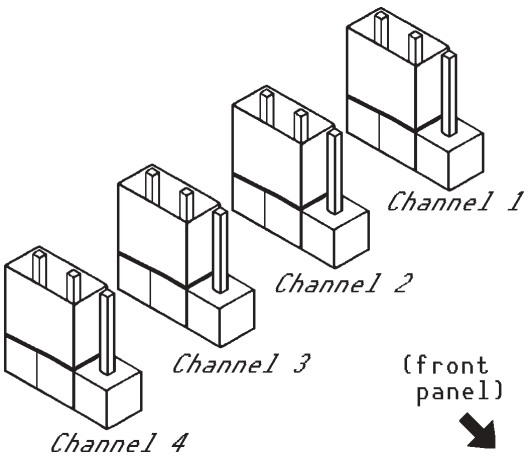


Figure 3.4

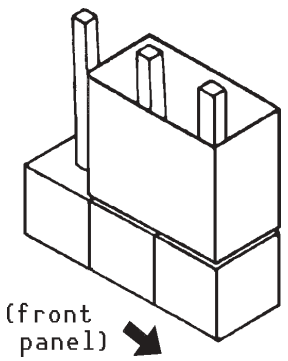


Figure 3.5

3.3 External Command Dipswitch:

The Hastings Model 400 Power Supply can be set to accept an external command signal or to generate its own command signal. The command source selector dipswitch changes between the external or the internal source. To change the command signal source, remove the two screws on the top of the back panel and slide out the top aluminum perforated cover. The COMMAND dipswitch is the four-section switch located on the PC board directly in front of the channel two "D" connector (see Figure 3.6). Channel one is labeled "1" and channel two is labeled "2", etc. If the switch is pressed down on the left side when looking from the front of the power supply, then the internal command signal is selected. See Figure 3.6. Depressing the other side selects external command operation. Set the switches to the desired position for the channel to be changed.

Reinstall the cover if no further adjustments are required.

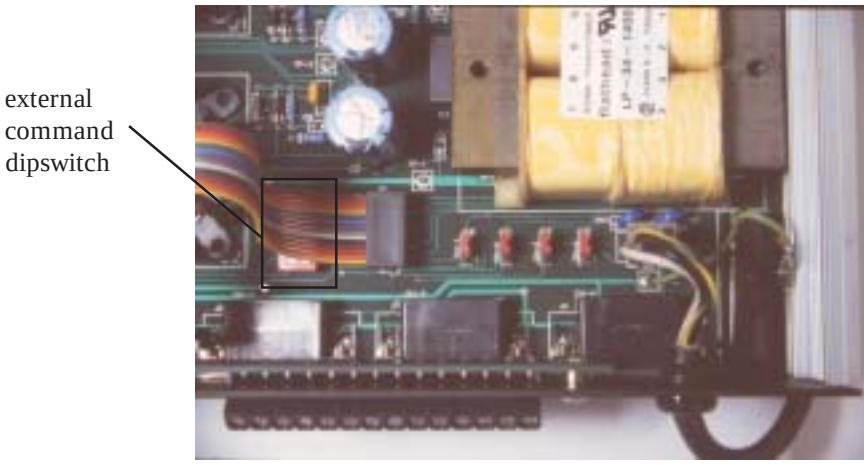


Figure 3.6

3.4 5 Volt Reference:

If the reference voltage range needs to be set, remove the two screws on the top of the back panel. Slide the aluminum perforated cover out. Connect the positive lead of a voltmeter to the test point TP-4 (see Figure 4.1 on page 15 for test point locations). Connect the negative lead of the voltmeter to the test point TP-1. Adjust the 5 volt reference potentiometer (R6) until the voltmeter reads the desired full range command voltage, normally 5.010 volts. See Figure 3.7. After adjusting this, the display potentiometer must be adjusted for all of the channels as described in Section 3.1.1.

Figure 3.7

Calibration

This section contains a troubleshooting guide to help locate and repair failed components. This troubleshooting guide is designed as a general reference only and will not cover every possible component failure. It is possible for problems with the flow instruments to appear as a failed power supply and vice versa. Therefore, if possible, try to verify the proper operation of the flow instruments on a different power supply. The components and test points mentioned in this section can be located by aquiring the component layout drawing listed in Section 6.0.

NOTE: **Some of the troubleshooting procedures will involve replacing failed components on the printed circuit board. DO NOT perform these steps if the power supply is still under warranty, since printed circuit board modifications will void the warranty.**

4.1 Test Points:

Refer to Figure 4.1. Test point 1 (TP-1) is common. All of the voltages specified in this section are referenced to this point unless stated otherwise. These voltages should be checked under load condition. Test point 2 (TP-2) is the output of the positive regulator and should read +14.25, -15.75VDC. Test point 3 (TP-3) is the output of the negative regulator and should read -14.25, -15.75VDC. Test point 4 (TP-4) is the output of the 5 volt reference and should read +5.01VDC. Test point 5 (TP-5) is the voltage applied to the front panel display. Since the display is a miniature digital voltmeter, the voltage on TP-5 should be the same as the number on the display.

Check these voltages prior to using the troubleshooting chart.

Figure 4.1

4.2 Troubleshooting Chart:

SYMPTOM: Display has no indication regardless of the position of the Channel Selector switch and all TP voltages are 0.0 VDC.

ACTION: First, ensure the unit is plugged into an operating source of AC power of the proper voltage for the unit. If so, unplug the instrumentation and remove the fuse from the back of the unit. Replace it with a 0.5 amp 250 volt fuse if it has failed.

SYMPTOM: TP-2 is approximately 1.25 V, but TP-3 is correct.

ACTION: C4 has failed. Replace it.

SYMPTOM: TP-2 is 0, but TP-3 is correct.

ACTION: The positive voltage regulator (U1) has failed. Replace it.

SYMPTOM: TP-3 has approximately -1.25 V, but TP-2 is correct.

ACTION: C5 has failed. Replace it.

SYMPTOM: TP-3 is 0, but TP-2 is correct.

ACTION: The negative voltage regulator (U2) has failed. Replace it.

SYMPTOM: TP-4 is incorrect but TP-2 and TP-3 are correct.

ACTION: Adjust the 5 volt reference potentiometer (R6) until the proper voltage at TP-4 is obtained. If it cannot be obtained, the reference regulator (U3) has failed. Replace it.

SYMPTOM: TP-3 and TP-2 are both low but non-zero.

ACTION: Check to see if the power supply 110/220V source selector switch (S2) is in the proper position for the AC supply being used.

SYMPTOM: No command voltage reaching one or more flow controllers, and all test points read correctly.

ACTION: Check to ensure that the command source selector switch and valve override jumpers are on.

SECTION 5

Warranty and Repair

5.1 Warranty Repair Policy

Hastings Instruments warrants this product for a period of one year from the date of shipment to be free from defects in material and workmanship. This warranty does not apply to defects or failures resulting from unauthorized modification, misuse or mishandling of the product. This warranty does not apply to batteries or other expendable parts, nor to damage caused by leaking batteries or any similar occurrence. This warranty does not apply to any instrument which has had a tamper seal removed or broken.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty as to fitness for a particular use. Hastings Instruments shall not be liable for any indirect or consequential damages.

Hastings Instruments, will, at its option, repair, replace or refund the selling price of the product if Hastings Instruments determines, in good faith, that it is defective in materials or workmanship during the warranty period. Defective instruments should be returned to Hastings Instruments, **shipment prepaid,** together with a written statement of the problem and a Return Material Authorization (RMA) number. Please consult the factory for your RMA number before returning any product for repair. Collect freight will not be accepted.

5.2 Non-Warranty Repair Policy

Any product returned for a non-warranty repair must be accompanied by a purchase order, RMA form and a written description of the problem with the instrument. If the repair cost is higher, you will be contacted for authorization before we proceed with any repairs. If you then choose not to have the product repaired, a minimum will be charged to cover the processing and inspection. Please consult the factory for your RMA number before returning any product repair.

TELEDYNE HASTINGS INSTRUMENTS

804 NEWCOMBE AVENUE

HAMPTON, VIRGINIA 23669 U.S.A.

ATTENTION: REPAIR DEPARTMENT

TELEPHONE	(757) 723-6531
	1-800-950-2468
FAX	(757) 723-3925
E MAIL	hastings_instruments@teledyne.com
INTERNET ADDRESS	http://www.hastings-inst.com

Repair Forms may be obtained from the “Information Request” section of the Hastings Instruments web site.

SECTION 6

Diagrams and Drawings