

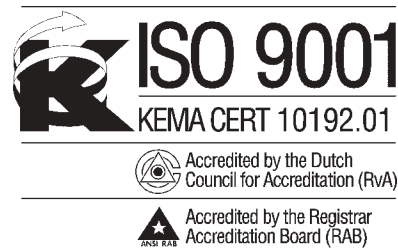
TELEDYNE HASTINGS INSTRUMENTS

INSTRUCTION MANUAL

MODEL 40 POWER SUPPLY



TELEDYNE INSTRUMENTS
Hastings Instruments
A Teledyne Technologies Company



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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If equipment is not used in the manner specified by this manual,
protection provided by the equipment may be impaired

Visit www.teledyne-hi.com for WEEE disposal guidance.

Hastings Instruments reserves the right to change or modify the design of its equipment without any obligation to provide notification of change or intent to change.

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General Information

The Hastings Model 40 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, ST, or FST and up to 2 of the HFM-D series. The gas conversion factor can be set individually for each channel by front panel mounted potentiometers. This allows meters calibrated for air to be used for other gases without recalibration. These controls provide for easy monitoring of the flow instruments with minimal time required to get the flow instruments on line.

1.1 Features:

Front panel dial-in gas conversion factors for each channel.

The power supply fuse is user-accessible from the rear of the instrument without disassembly of the case.

A rear panel terminal strip provides the user with analog output from flow instruments.

A 3-1/2 digit LCD display monitors the flow instruments.

Input voltage is internally switchable between 115 and 230 VAC.

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) — see page 20.
- Meter: 3-1/2 digit LCD
- Power: 90-125/180-250 VAC 50 or 60 HZ
- Output: 15 VDC @ ± 300 mA
- Use: 1 to 4 channels
- Scaling: Individual channel meter adjustment.
- Signal Output: 0-5 VDC into 2K Ohms minimum load. All four channels can be read simultaneously.
- Feet and a stand are standard. They are easily removeable for rack mounting. (mtg screws can cause electrical shorts if reinstalled without feet 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.

Installation and Operation

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 flowmeter power supply.

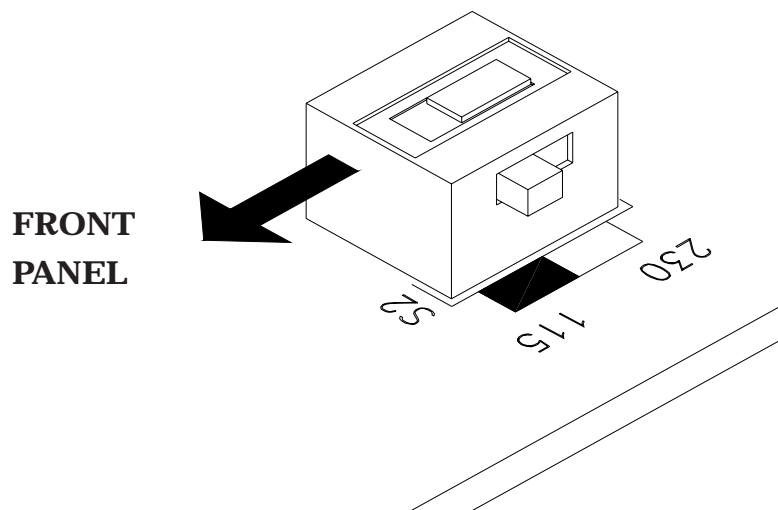


FIG 2.1

2.2 Power Requirements:

The Model 40 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. 115 and 230 positions are marked on the PCB. Units will be shipped for the voltage specified in the order.

2.3 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 40 Power Supply. It is recommended that the load resistance be no less than 2K Ohms.

2.4 Electrical Connection:

Ensure that the power switch is turned off. Plug the AC line cord into an appropriately rated 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).

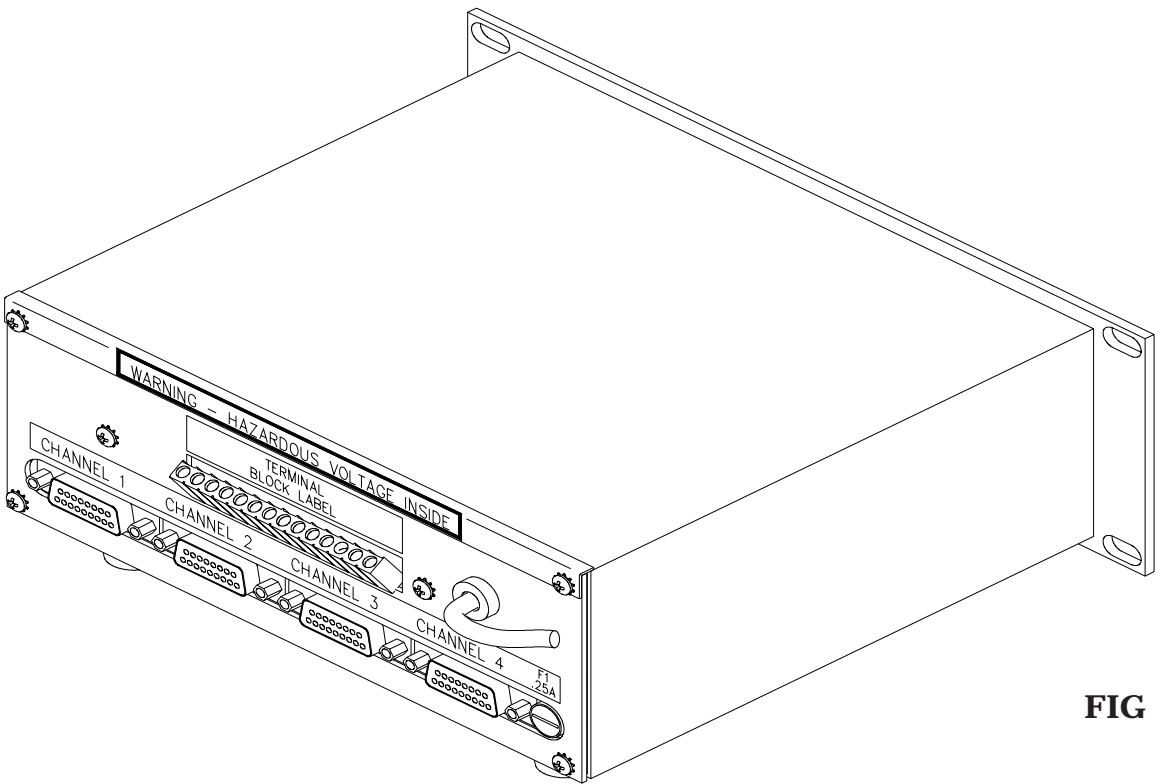


FIG 2.2

Figure 2.3 shows a close-up of the terminal block label.

15 VDC	COMMON	-15 VDC	COMMON	NC	COMMON	NC	COMMON	CHANNEL 1 FLOW OUT	CHANNEL 2 FLOW OUT	CHANNEL 3 FLOW OUT	CHANNEL 4 FLOW OUT	FLOW COMMON	CASE GND
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FIG 2.3

2.5 Operation:

2.5.1 Display

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.

2.5.2 Channel Selection

The CHANNEL SELECTOR switch in the lower right-hand corner of the front panel (see Fig. 2.4) 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 flowmeters will shut down. After turning the instrument back on, there will be a short period of time before the flowmeters will correctly indicate the gas flow.

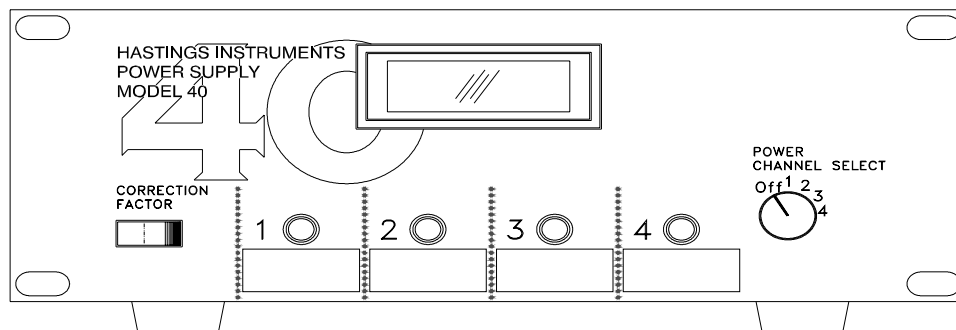


FIG 2.4

2.5.3 Correction Factor Switch

On the left hand side of the front panel is a switch labeled CORRECTION FACTOR. Depressing the right side of this switch will display the gas conversion factor for the channel correctly selected by the channel selector switch. Normally this will read 1.000. This gas conversion factor is a multiplier that is factored into the flow signal before it is sent to the front panel display. This factor will be changed to some value other than 1.000, only if the flowmeter has some gas flowing through it other than the gas for which the flowmeter is calibrated.

2.5.4 Correction Factor Potentiometers

Refer to Fig. 2.4. To set a correction factor, turn the CHANNEL SELECTOR switch to the desired channel. Depress and hold the CORRECTION FACTOR switch. The display is now reading the correction factor currently set for the channel. This factor can be adjusted by turning the CORRECTION FACTOR POTENTIOMETER for the corresponding channel with a small screw driver while holding the correction factor switch in the depressed position. Turning clockwise will increase the factor, and counterclockwise will decrease the factor. Release the CORRECTION FACTOR switch. The display is now showing the correct flow of the new gas.

2.5.5 Fuse

The fuseholder is mounted on the lower right-hand corner of the back panel. To remove the fuse, insert a screwdriver into the slot and turn counterclockwise 1/4 turn. Replace the fuse with a 250 volt 1/4 amp Slo-Blo<190> 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.

2.5.6 Rear Terminal Board

There is a 14-position terminal board on the rear panel . See Fig. 2.4. The pins are numbered from left to right. Pin 1 is the 15 VDC regulated output of the power supply. Pin 3 is the -15 VDC regulated output of the power supply. These terminals can supply up to 150 mA each for use in external display boards, etc. Pins 2, 4, 6, 8 and 13 are common for both the positive and negative supplies. All five of these terminals are tied together internally. Pins 7 - 10 are the 0 - 5 VDC flow output signals from the flowmeters on channels 1 - 4 respectively. All four of the terminals can be monitored simultaneously. These signals are referenced to pin 13 (flow common) and to the power supply common terminals.

SECTION 3

Calibration and Adjustments

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:

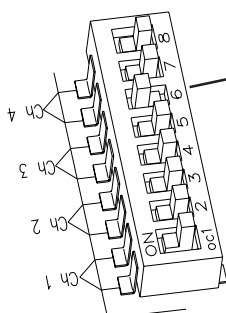
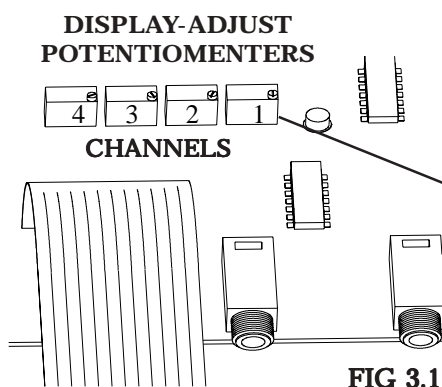
Since the display uses a 3-1/2 digit LCD, the highest number that can be displayed is 1999. If the display is to read directly in the flow units being used, it must be adjusted whenever the highest digit of the maximum flow rate changes, such as, a 20 SLPM flow instrument being changed to 5 SLPM. If 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, per Section 3.1.2.

3.1.1 Display Adjustment

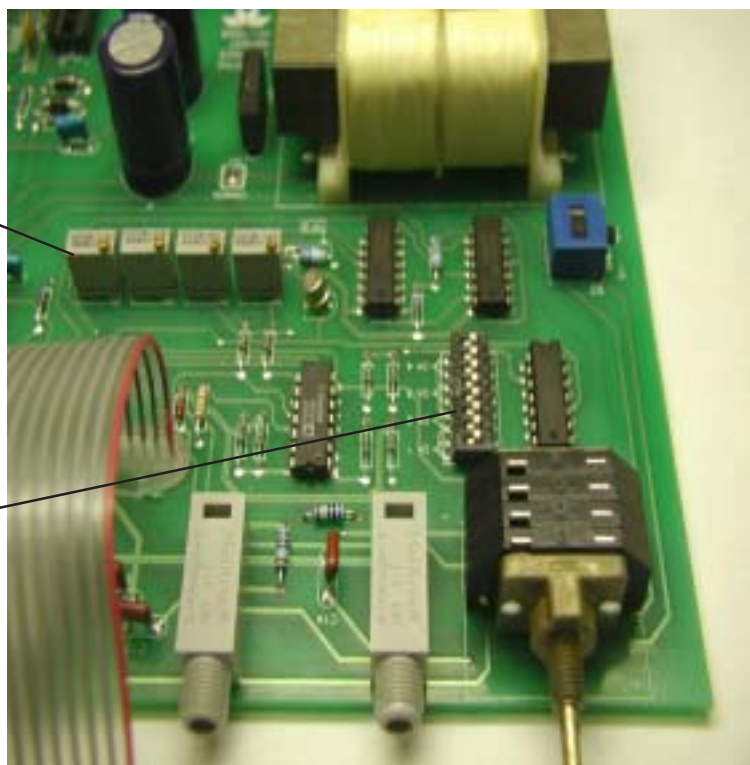
To change the display, remove the two screws on the top of the back panel. Slide the aluminum perforated top cover out. Turn the CHANNEL SELECTOR switch to the desired channel. Verify that the conversion factor has been set to the correct value, by depressing the CORRECTION FACTOR switch. The correction factor should be 1.000 if the factor has not been changed by the customer since the factory setup. If the value has been changed by the customer, determine the correct value for the gas flowing through the flowmeter per Section 3.2. Compare the observed value to the calculated value. Generate the maximum flow signal (5.000 volts) from the flowmeter,



Not operator serviceable, observe precautions when handling, do not pull cover further back more than necessary, some components toward the rear of the PC Board may be **High Voltage**, leave servicing to qualified personnel.



Switches are shown set for one place to the right of the decimal point for Channel 3.

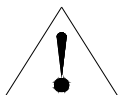


FRONT of PANEL

or supply a 5-volt dummy signal to the FLOW-OUT terminals on the back panel. 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 Fig3.1. Channel 1 is on the right when looking from the front of the Power Supply.

3.1.2 Decimal Point

Remove the two screws that hold the aluminum perforated upper cover in place. Slide the cover out. The dipswitches are located behind the CHANNEL SELECTOR switch (see Fig 3.2). Turn on the desired 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 and table "A" on page 7 for examples). Reinstall cover if no further modifications are needed.



Some components on the PC Board are at **High Voltage**, only qualified personnel should perform this test.

3.2 Correction Factor:

Normally mass flowmeters are calibrated using a standardized volumetric unit as a unit of mass, for example a standard liter is a liter of the gas at 760 Torr and 0°C. Thermal mass flowmeters measure gas flow by monitoring this heat capacity is constant, but it varies from gas to gas. If a different gas is measured than the gas for which the flowmeter is calibrated, the flowmeter will have a different mass flow through it in volumetric units for the same voltage output. This difference in volumetric mass flow for the different gases is due to every gas having a different heat capacity. Under normal situations the gases will respond as ideal gases and this difference in flow can be

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

TABLE "A"

calculated by comparing ratios of their respective heat capacities. These ratios have been calculated and are tabulated on a chart on page 16 of this manual as THR conversion factors. These factors are used as written only when an instrument calibrated for **AIR** is being used to measure the flow of a different gas. These correction factors are theoretical and they are believed to be correct by the manufacturer, but due to the wide variety of gases and the toxic or caustic properties of many of them, the accuracy of most of the correction factors has not been verified.

3.2.1 Calculation of Correction Factors For Standard Volumetric Units

Often customers would like to measure a variety of gases with the same flowmeter without having to go through the trouble some process of recalibrating the flowmeter each time a new gas is measured. The alternative has always been that each flow reading could be calculated by multiplying the display by the conversion factor, but this has always been time consuming and the actual flow of a process cannot be continuously monitored without having a calculator present. By incorporating the multiplication network into the Model 40 Power Supply, the calculations can now be made by the power supply itself continuously. All that is required is for the customer to calculate the conversion factor once as per instructions below, and then dial it in for each channel using the CONVERSION FACTOR potentiometer on the front panel.

This factor can displayed for each channel of the power supply by turning the CHANNEL SELECTOR switch to the desired channel and pressing the CORRECTION FACTOR SWITCH. The flowmeter output is being multiplied by the number that is displayed before the flow signal is sent to the display. When the flowmeter is measuring the same gas for which it is calibrated, the correction factor is 1.000 and the flow signal will be sent to the display unchanged by the multiplication network.

EXAMPLE: A 100 SLPM flowmeter is calibrated for air. The power supply is set up to display 100.0 when the flowmeter has the full scale output of 5.000 VDC. With helium flowing through the same flowmeter, the display would still read 100.0 at 5.00 VDC, however, the flow would be approximately 143 SLPM. If the calibration factor for a selected channel is set to 1.430, then the display will correctly indicate the flowrate of helium, which would be 143.0 SLPM at full scale.

If a flowmeter is calibrated for a gas other than air by the manufacturer, then the correction factor will be set to 1.000 when that gas is being measured. If a different gas is being used in the same flowmeter, then the correction factor can be calculated by taking the factor for the new gas and dividing by the factor of the gas for which the flowmeter is calibrated.

EXAMPLE: If a flowmeter is calibrated for helium at 100.0 SLPM, the correction factor will read 1.000 when the CORRECTION FACTOR switch is depressed. The display will read 100.0 when the flowmeter has an output of 5.000 volts. This indicates the full scale flowrate of 100.0 SLPM. If carbon dioxide is now measured by the flowmeter, the correction factor should be set to .510, which is the THR correction factor for carbon dioxide (.73) divided by the factor for helium (1.43). The display will now read full scale (51.0 volts) when the flowmeter has 51.0 SLPM of carbon dioxide flowing through it, and the flowmeter will have an output of 5.000 volts.

3.2.2 Calculation of Correction Factors For Mass Units

Occasionally, a customer will request a flowmeter calibrated in units of mass such as grams/min. or lbs/hour. In this case, another factor must be calculated in to compensate for the different densities of the gases. Calculate the factor as detailed above, then multiply this factor by the ratio of the specific gravity of the new gas to the specific gravity of the gas for which the flowmeter was calibrated. Since air has a specific gravity of 1.000, this will be just the specific gravity of the new gas when the flowmeter has been calibrated for air. Specific gravities for various gases can be found on the chart on page 16 .

The factor would be calculated as follows:

$$CF_m = (CF_2/CF_1) \times (s_2/s_1)$$

CF_m = conversion in mass units

CF₁ = conversion factor of gas for which the flowmeter is calibrated

CF₂ = conversion factor of the gas being measured

s₁ = specific gravity of gas for which the flowmeter is calibrated

s₂ = specific gravity of gas being measured

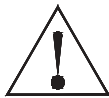
EXAMPLE: A flowmeter is calibrated for 100 grams per minute of nitrous oxide and it now has neon flowing through it. Divide the correction factor of neon (1.38) by the correction factor of nitrous oxide (.75), and multiply by the ratio of the specific gravity of neon (.70) to the specific gravity of nitrous oxide (1.54): $(1.38/.75) \times (.70/1.54) = 0.836$. This is the number that must be set per Section 2.5.4 for the display to automatically read out in grams per minute of neon.

SECTION 4

Troubleshooting

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 referring to the component layout drawing 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.



Some components on the PC Board are at **High Voltage**, only qualified personnel should perform this test.

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 between +14.25 and +15.75 VDC. Test point 3 (TP-3) is the output of the negative regulator and should read between -14.25 and -15.75 VDC. 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.



FIG 4.1

Check these voltages prior to using the troubleshooting chart.

TP-6 is one lead of R27 and should be 2.00 VDC. The flow signals sent by flowmeters on channels 1 - 4 can be accessed by test points on one lead of C7 thru 10 respectively in the left rear of the main PC board. These do not have test point numbers, but their positions are screen printed on the PC board.

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:	Ensure the unit is plugged into an operating source of AC power of the proper voltage for the unit. 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 0, but TP-3 is correct.
ACTION:	The positive voltage regulator (U1) 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:	All Correction factors are approximately 0 or out of range.
ACTION:	Check TP-6 (one end of R27). If this is not 2.00 VDC replace U3 (AD580 voltage reference).
SYMPTOM:	Correction factors not displayed when CORRECTION FACTOR switch depressed or the factors are displayed regardless of the position of the CORRECTION FACTOR switch.
ACTION:	The analog switch (U6) has failed; replace it.
SYMPTOM:	The decimal point is stuck in either the flow position or in the position used by the correction factor.
ACTION:	The decimal point analog switch (U8) has failed; replace it.
SYMPTOM:	TP-3 and TP-2 are both low but non-zero.
ACTION:	Check to see if the power supply source selector switch (S2) is in the proper position for the AC supply being used.

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.

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