INSTRUCTION BOOK FOR

BIRD

SERIES 8630-600A
MODULOAD® RF CALORIMETER

LIMITED WARRANTY

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

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The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

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MODELS COVERED IN THIS INSTRUCTION BOOK

MODELS *	VOLTS	MODELS **	VOLTS
8631-601A	115	8631-631A	115
8631-602A	230	8631-632A	230
8635-601A	115	8635-631A	115
8635-602A	230	8635-632A	230
8638-601A	115	8638-631A	115
8638-602A	230	8638-632A	230

*Without Ethylene Glycol
**With Ethylene Glycol

INSTRUCTION BOOK

FOR

SERIES 8630-600A

DIGITAL RF CALORIMETER

Bird Electronic Corporation

30303 Aurora Road, Cleveland, Ohio 44139-2794

SAFETY PRECAUTIONS

The following are general safety precautions that are not necessarily related to any specific part or procedure and do not necessarily appear elsewhere in this publication.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect an RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

Warning: Warning notes call attention to a procedure, which if not correctly performed could result in personal injury.

Caution: Caution notes call attention to a procedure, which if not correctly performed could result in damage to the instrument.

The following will appear in the text of this publication and are shown here for emphasis.

****
* C A U T I O N *
*
* Do not use any sealants, leak-stopping material, or *
* automotive antifreeze in the coolant. Use only *
* distilled water and pure ethylene glycol. Do not use *
* de-ionized water. *
****

****
* C A U T I O N *
*
* The pump/motor must not be operated without sufficient *
* coolant in the system, damage to its working parts will *
* result. *
*
****

Continued

SERIES 8630-600A DIGITAL RF CALORIMETER

INTRODUCTION

PURPOSE AND FUNCTION

The Bird Series 8631/35/38-(600A) Calorimeters are instruments realized by the marriage of the popular Bird Model 6080A Calorimeter and the Series 8600 MODULOAD® RF load resistor. This idea was destined to evolve into an auspicious combination very useful to any type of transmitting station.

The Series 8631/35/38-(600A) Calorimeter is a space saving unit that is easily installed and has a serviceability similar to a MODULOAD® RF load resistor, yet displays measured RF power very precisely, without resorting to any calculations. The unit is also independent of frequency within the frequency band of the load.

The load section is designed as a unique self-cooling, low reflection and non-radiating termination for high power RF transmission. It is capable of continuous power dissipation of 10kW with a VSWR of less than 1.10 to 1 from 1kHz to 1000MHz; see Specifications. The Models 8631/35/38-(600A) are designed for use on CW, AM, FM, SSB and TV modulation envelopes, and within certain limits on radar or pulse modes.

The Series 8631/35/38-(600A) Calorimeter is another unique innovation by Bird Electronic Corporation in calorimetric measurement. The need for interpolation of the flow rates, temperature differences, and system constants by the user has been eliminated. Calibration is performed by one simple adjustment before power is applied, see Section III - Operating Instructions. The power is directly displayed in kilowatts on a digital meter. Because measurement has ±2.5% accuracy and is not frequency dependent and measures energy transferred into a water medium, the calorimeter is ideal for use as a standard for other wattmeters.

Lightweight and versatile, the control unit can be moved within a ten foot radius of the load/sensor unit. Combining this with a bright display permits easy to read power measurements.

DESCRIPTION

The Calorimeter is comprised of two units as described above: the calorimeter control unit and the load/sensor unit. These two units are connected by a ten foot sensor cable. Portion of the Model 6080A Calorimeter's measurement system has been conveniently installed into the 8630 Series load resistor. This has been done to ease operator installation and use.

The load/sensor unit consists of four basic systems:

1. The RF load assembly - contains the resistive load element with cooling water system.

2. Sensor unit - contains two temperature sensors, input and output water temperature, and another sensor to monitor water flow rate.

3. Heat exchanger - consists of a pump/motor unit, collector tank, a finned cooling coil unit and cover blower.

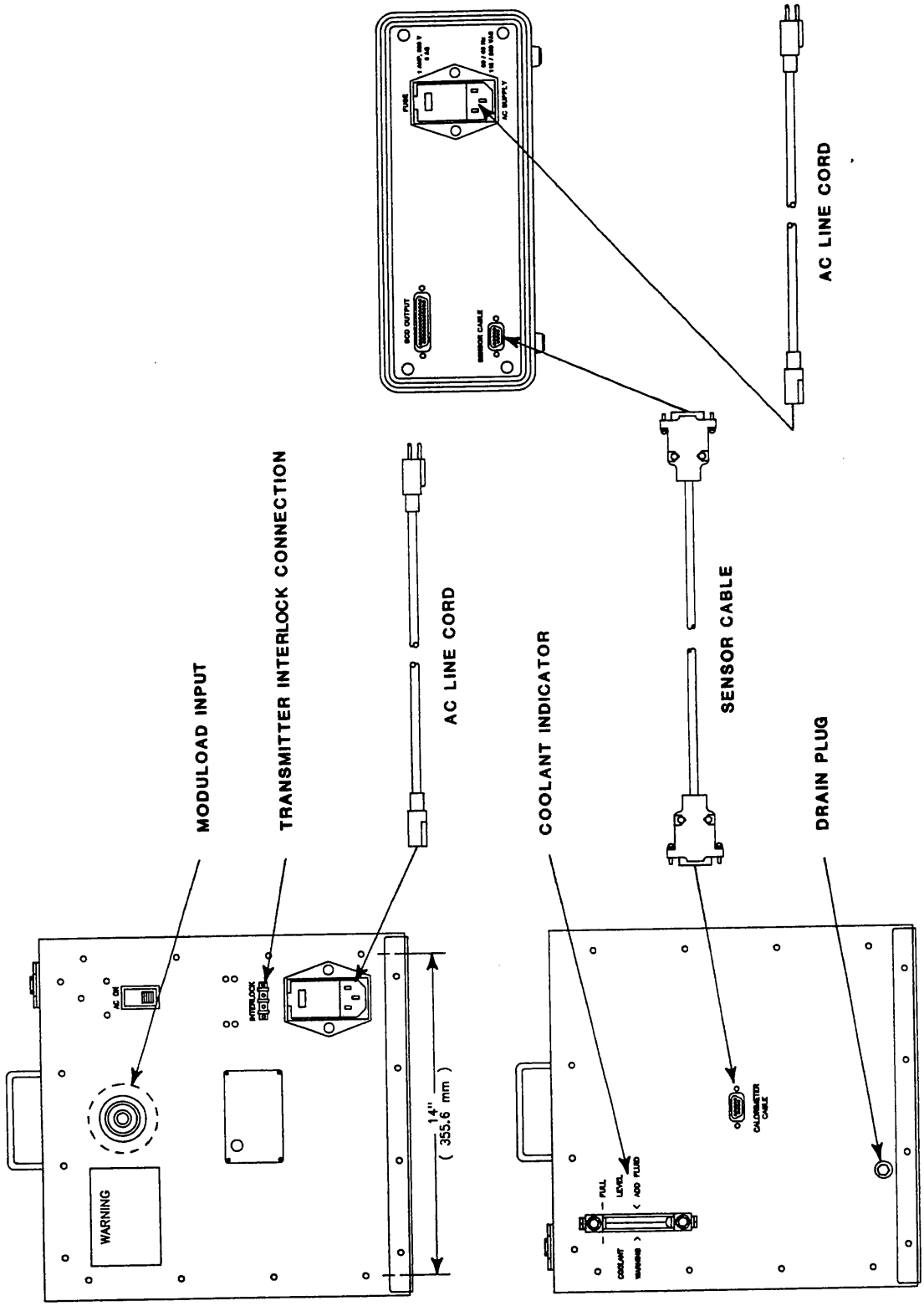
4. Interlock control system - includes the electrical interlock circuitry required to prevent damage to the transmitter or load in the case of a malfunction.

SECTION I - INSTALLATION

1-1. GENERAL

1-2. The purpose of this section is to assist the user with the initial steps that should be performed when receiving and preparing the RF Calorimeter for service. Refer to Figure 1-1 throughout this section.

FIGURE 1-1. INSTALLATION.



1-3. UNPACKING

1-4. The Model 6080A Control Unit and 8630 series Load/Sensor Unit are shipped in separate containers. Included in these containers are:

- 1 6080A Control Unit
- 1 8630 Series Load/Sensor Unit
- 2 ac line cords
- 1 Sensor cable
- 1 instruction manual

1-5. The load/sensor unit is encased in foam inside a tri-wall box. It should be lifted straight up out of the box and placed on a supportive flat surface. Personnel should take caution when removing load/sensor unit due to weight consideration. Foam can now be removed from outside surface of load/sensor unit.

1-6. The 6080A Control Unit is shipped in a separate box. The unit is protected by foam inserts and is easily removed by lifting unit straight up out of the box.

1-7. INITIAL INSPECTION

1-8. All packages are carefully wrapped and inspected by Bird prior to shipment. If the package shows any sign of damage, open and inspect the contents. If any damage is visible, notify the carrier immediately. Retain the shipping container for inspection.

1-9. MOUNTING AND LOCATION

1-10. For convenience in installation of the load/sensor unit, mounting angle brackets are attached to the front and back base edges of the enclosure. They may be removed by unscrewing the four 8-32 truss head screws holding each bracket. These brackets have two slots each on 14 inch centers to accommodate four 1/4 inch screws that may be used for mounting the unit. The control unit may be placed conveniently within the ten foot radius of the sensor cable reach.

1-11. The load/sensor unit may be operated anywhere that adequate ac line power and air supply are available, and ambient temperatures do not exceed those given, 40°C maximum (see Specifications). Note that since 10kW is equivalent to 34,000 Btu/h, a sufficient quantity of air must be provided. Allow room for unobstructed air intake over the whole surface of the perforated grilles on both sides of the equipment, and a clearance of at least three feet over the top of the unit.

1-12. AC LINE CONNECTION

1-13. Model 6080A Control Unit contains an ac line module located on the rear panel for input of ac power. This module is voltage selectable between 115 Vac or 230 Vac and contains the ac line fuse. The following steps explain voltage selectability and fuse accessibility:

Step 1: Determine the voltage level of the ac line. This may be 115/230 Vac.

Step 2: Compare this voltage level with the number that appears in the ac line select window.

Step 3: The control unit is factory-shipped for 115 Vac operation. Change to 230 Vac, if necessary, by opening cover door and removing voltage selector drum. See Figure 1-2.

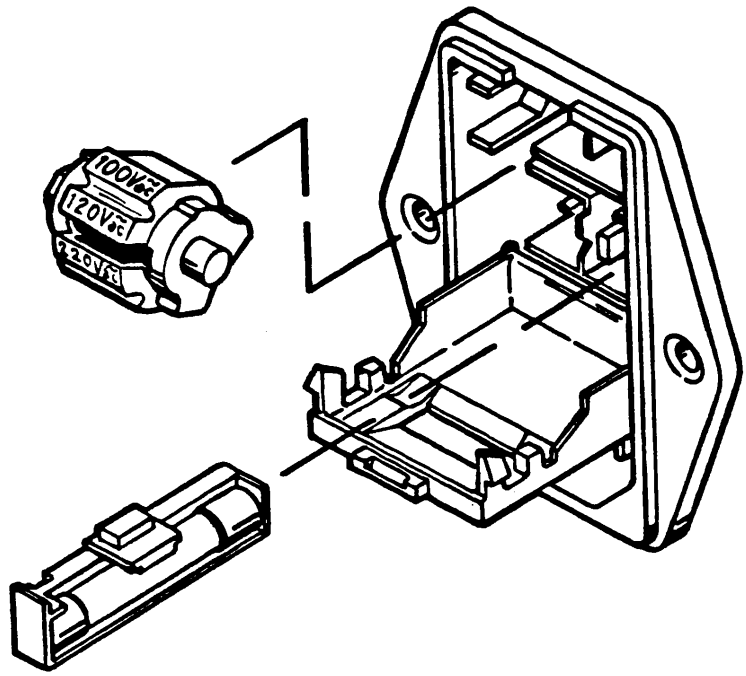
Step 4: Rotate voltage selector drum to desired voltage and reinsert.

Step 5: AC line fuse is also accessible by pulling out fuse drawer.

Step 6: Close cover door.

Step 7: Locate the ac cord. Plug one end at the control unit's ac line module the other end at the line socket. (Refer to paragraph 1-15 when connecting to European style sockets.)

FIGURE 1-2. AC LINE MODULE.



1-14. The load/sensor unit also contains an ac line module located on the front panel. This module is wired for either 115 Vac or 230 Vac and does not supply voltage selectability. The module does contain an ac line fuse which is accessible as described in the preceding steps. Locate the ac cord. Plug one end at the load/sensor unit's ac line module the other end at the ac outlet. (Refer to paragraph 1-15 when connecting to European style sockets.)

For safety, the third wire in the ac line cord (the green wire) is the ground wire and must be connected to an earth ground. If a three wire system is not used, this wire must be properly attached to an earth ground.

1-15. EUROPEAN STYLE CONNECTORS

1-16. In order to make the ac line cord compatible with European style sockets, users must replace the connector at the end of the power cord. Then set the operating voltage selection drum for 230 Vac.

1-17. 6080A CONTROL UNIT INSTALLATION

1-18. Locate control unit on a clean flat surface within the radius of the sensor cable. For longer distance remote monitoring, various length sensor cables are available. See Section VII Replacement Parts.

With ac line already connected the control unit requires only one other connection, the sensor cable. Connect the sensor cable to the calorimeter as follows:

Step 1: A 9-pin D-shell sensor cable connector is located on the rear panel of the control unit. Correctly align the sensor cable with the sensor cable connector and mate the two parts. (The design does not permit incorrect connection.)

Step 2: Secure the provided screws, but do not overtighten them.

1-19. LOAD/SENSOR UNIT INSTALLATION

1-20. Connect unterminated end of sensor cable to load/sensor unit cable connector located on rear panel. Follow the preceding steps for connection.

Connect the transmitter's interlock cable (not provided) to the two binding posts located on the front panel.

1-21. COOLANT

```
************************************************************
*                                                          *
*                      C A U T I O N                       *
*                                                          *
* Do not use any sealants, leak-stopping material, or      *
* automotive antifreeze in the coolant. Use only           *
* distilled water and pure ethylene glycol. Do not use     *
* de-ionized water.                                        *
************************************************************
```

1-22. The unit operates with ten pints (4.73 liters) of coolant. The coolant may be distilled water for an ambient temperature of +5°C to +40°C (+41°F to +104°F), or 2/3 distilled water and 1/3 ethylene glycol for temperatures from 0°C to +35°C (+32°F to +95°F). Temperature range must be stated when order is placed. Use only distilled water and industrially pure ethylene glycol. Note - Do not, under any circumstances, use de-ionized water in the system. It will have a detrimental action on the internal parts. Do not use any antifreeze preparations. Note - When ethylene glycol is used, special calibration of the calorimeter is necessary. Any change in the concentration of the factory supplied coolant will require recalibration.

```
************************************************************
*                                                          *
*                      C A U T I O N                       *
*                                                          *
* The pump/motor must not be operated without sufficient   *
* coolant in the system. Damage to its working parts will  *
* result.                                                  *
************************************************************
```

1-23. Check the coolant level daily when the unit is in prolonged use, or when starting after a period of inaction. The coolant gauge is in the upper left side of the rear face panel of the load/sensor unit. Whether the pump is on or off, when properly filled, the coolant indicator in the glass tube should show the liquid level at the upper gauge level. The level may also be checked by removing the filler plug at the top. It should be filled to a level about 2-7/8" (73mm) below the top face of the filler tube opening. Add coolant if necessary to bring to the required level.

1-24. DRAINAGE AND FILLING

NOTE: All units are flushed with ethylene glycol before leaving the factory to prevent damage in shipment by freezing. All units to be used with distilled water only (those with the suffix number of 601 and 602) must be flushed twice with distilled water before final filling to assure accuracy.

1-25. Drainage of the system is accomplished by removal of the drain plug at the bottom of the rear panel. Do not use any other drain plug than that provided by Bird. Use of a substitute plug could cause equipment overheating by crossflow in drain tubes. To refill the system, pour coolant in until the tank is approximately at the requisite level, stated previously, and then run the motor a few seconds to pull fluid into the system. A convenient method is to watch through the reservoir filler and stop the pump when the water level approaches the bottom. Do not run too long on original pourings, as partially dry operation of pump might ensue, with possible damage to the pump mechanism. Repeat filling in this manner until fluid level remains steady at the proper level, then run the load/sensor unit about five minutes and recheck fluid level before applying RF power (see 1-21, Coolant).

1-26. BLOWER FAN

1-27. The fan is wired direct to the ac line input and will always operate along with the pump when the ac switch is on. In addition to the basic function of producing requisite air flow through the radiators, this ventilation materially assists in cooling the pump/motor unit.

SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. The Series 8730/31/38 TERMALINE® Coaxial Load Resistor installed in this unit is unique in having its water supply primarily directed over the outer, wet-film type resistive coating of the substrate. This technique is valuable in eliminating the need for an intermediate heat transfer fluid system. This method reduces the physical size of the load to a virtual minimum and makes it ideal for use in this calorimetric application. The construction and materials herein permit field repair of the unit (see Section IV - Maintenance).

2-3. HEAT TRANSFER

2-4. The 50 ohm resistor consists of a substrate made of a special compound and has a permanently deposited resistive film on its outer surface. The heat generated by absorption of RF power is transferred from the film to the water which flows over it through a restricted chamber surrounding the resistor body. This water, first carried to the front of the load resistor, passes over the entire length of the resistor and discharges through the sealed water chamber at the rear. The composite dielectric characteristics and the distinctive design of these enclosures provide a very accurate 50 ohm termination over the specified frequency range of this load, 1000Hz to 1000MHz.

2-5. THEORY OF CALORIMETRY

2-6. The term calorimetry refers to the measurement of quantities of heat. Heat is energy in transition resulting from a temperature differential. This energy in transition may be expressed in ft-lb/h, Btu/m, or cal/sec.

2-7. The "First Law" of thermodynamics states that energy can neither be created nor destroyed, but only converted from one form to another. This is the basic concept behind the calorimetric method of measurement. A basic definition should be noted: if a quantity of heat is transferred into one gram of water until the temperature of the water is increased one degree centigrade, it would be called one gram-calorie, more commonly referred to as one calorie. In the English system, if one pound of water will increase its temperature one Fahrenheit degree, one Btu of heat has been transferred into it.

Equation 1.
$$1 \text{ Btu} = 1 \text{ lb.} \times 1^\circ\text{F}$$
$$1 \text{ Calorie} = 1 \text{ gram} \times 1^\circ\text{C}$$

The relationship of grams to pounds and °C to °F is such that it makes one Btu equal to 251.996 calories.

2-8. Another factor in calorimetric measurement should also be taken into consideration: the specific heat of a substance. It has been proven that different substances having a weight of one pound will require different amounts of energy to increase their temperature one degree Fahrenheit. To compensate for this behavior of different materials, including water, a correction factor was assigned called specific heat. The units for specific

heat are Btu/lb°F. By applying this correction factor to Equation 1, the calorimetric formula for heat thus becomes:

Equation 2. $1\ \text{Btu} = 1\ \text{lb.} \times 1°\text{F} \times 1\ \text{Btu/lb°F}$
$\text{heat} = \text{mass} \times \Delta T \times Cp$

Since 1 Btu of heat is equal to 778.16 ft-lb of work, and the time rate of doing work is power, ft-lb/h or Btu/h could be a description of electrical watts or mechanical ft-lb power. Thus, when the time element is introduced into Equation 2, it simply becomes:

Equation 3. $\text{Btu/h} = \text{mass (lb/h)} \times \Delta T(°\text{F}) \times Cp\ (\text{Btu/lb°F})$

This is the equation of calorimetry. Knowledge of delta T, rate of mass flow, and specific heat would produce Btu/h, equal to power.

2-9. DIGITAL RF CALORIMETER

2-10. Calorimetry as applied to this series calorimeter is essentially the same as described in the preceding paragraphs. The water cooled loads, installed in the Series 8631/35/38-(600A), transfer almost 100% of RF heating power into a cooling liquid. This provides a means with which an elementary calorimetric formula can be utilized.

Equation 4. $\text{RF Power} = \text{flow} \times \Delta T \times \text{constant} \times Cp$

The electronic calorimeter synthesizes the flow rate, temperature differential and conversion factor, displaying the final result in kilowatts on a digital readout.

2-11. To determine the temperature it is necessary to linearly track temperatures between 0°C and 50°C. This is accomplished through electronic thermometers that produce a voltage output as a direct function of temperature in °C. The temperature difference is found by placing an electronic thermometer at the load water input and also at the load drain. Their voltage outputs are fed into a differential amplifier and the resulting output will be the temperature difference.

2-12. Flow rate is measured by a magnetic sensor which is located at the water input of the load. This metering device utilizes a turbine bladed rotor to generate a pulse output. These pulses are then fed into a frequency to voltage converter that produces a gallon per minute voltage output. By adjusting the output gain to the systems constant we implement our conversion factor. To synthesize these system variables, an analog multiplier is used. The X input of the multiplier is used for flow rate and the Y input is for temperature difference. By applying the output of the multiplier to a digital panel meter, the voltage measured will be the power consumption in kilowatts.

2-13. FLOW INTERLOCK CONTROL CIRCUIT

2-14. The interlock control circuit provides instantaneous fail-safe protection of the transmitter and load in the event of even momentary interruption of the cooling water supply. This protection is necessary

because dissipation of the heat generated by the RF power is critically dependent upon a required minimum water flow at all times regardless of system water temperature.

2-15. The water flow switch, installed directly on load output, has its electrical contacts closed during normal operation. This switch is factory calibrated to open whenever water flow drops below the prescribed minimum. Then the water flow switch contacts open and the time delay switch is deactivated, which at once opens the interlock switch, causing immediate shutdown of the transmitter.

Note: The impeller of the centrifugal water pump is carefully selected for the necessary current flow. The proper operation of this equipment depends on these conditions being maintained. Do not alter the flow switch setting or disturb the pump.

2-16. The time delay switch also keeps the interlock switch "open" for approximately two seconds, nominal, after the minimum flow has been re-established. This safeguard feature assures adequate operation of the cooling system before RF power can be applied to the load/sensor unit, preventing damage or burnout of the resistor element. See warning label on connector panel of the load/sensor unit. As an additional safeguard, a thermoswitch, normally closed at +85°C (+185°F) or lower, is wired in series with the flow switch for protection from overheating due to overloading of the Load/Sensor unit.

SECTION III - OPERATING INSTRUCTIONS

3-1. GENERAL

```
**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Do not apply more than the rated RF power to the load. *
* Do not block air flow - air enters housing through     *
* circular fan opening and exhausts at the grille        *
* opposite.                                              *
**********************************************************
```

3-2. The Series 8631/35/38-(600A) Load/Sensor Unit have no operating controls; therefore, require only routine operator attention. Install per instructions in Section I - Installation. Follow the procedure carefully to assure proper operation of equipment.

3-3. CONNECTING RF POWER TO LOAD

3-4. After installation, the coaxial RF transmission line may be attached. For the respective Models 8631/35-601A and 8638-601A the connections are as follows:

a. Model 8631-601A, 3-1/8 inch EIA, 50 ohms with swivel flange.

1. Use 3-1/8 inch EIA coupling kit, P/N 4600-020, which includes: six each 3/8-16 x 1-1/2 bolt and nut sets, O-Ring, and insulated center bullet.

2. Insert the center bullet, push into the bottom of the insulator in the recess of facing and install O-Ring in groove.

3. Connect coaxial input in straight line, push carefully on center contact to close. The swivel flange on the load/sensor unit makes connection independent of a fixed flange on the coaxial input.

4. Insert bolt sets, tighten evenly all around.

b. Model 8635, 1-5/8 inch EIA flanged, 50 ohms, swivel flanged.

1. Use 1-5/8 inch EIA coupling kit, P/N 4712-020, which includes: four each 5/16-18 x 1-1/2 bolt sets, O-Ring and anchor bullet (Mectron No. 320-14, Prodelin No. 302-825, etc.).

2. Assembly procedure similar to Paragraph 3-4a, above.

c. Model 8638, 3-1/8 inch unflanged, 50 ohm impedance.

1. Use coupling kit, P/N 5-726 or RCA MI-277791K-4A.

2. Insert center bullet and bottom it on the midpoint nibs.

3. Position the outer sleeve with clamps over input connector.

4. Introduce transmission line and seat snugly against the coupling stops.

5. Position clamp bands evenly about 1-3/4 inches apart and tighten.

```
************************************************************
*                        C A U T I O N                     *
*                                                          *
* Do not operate load/sensor unit without connecting       *
* interlock. This is very important. Even momentary        *
* application of power to the load while the cooling       *
* circulation is off or possibly functioning improperly    *
* will cause immediate destruction of the resistor         *
* element.                                                 *
************************************************************
```

3-5. NORMAL OPERATION AS A LOAD RESISTOR

a. Turn interlock supply on.

b. Turn on 115V or 230V ac power. Note - fan operation.

c. Apply RF power to load.

3-6. SHUTDOWN

a. Turn RF power to load off.

b. Wait five minutes, allowing pump and fans to run.

c. Turn ac power off. Stopping the load/sensor unit automatically opens the interlock connection.

3-7. COOLING CHARACTERISTICS

3-8. The electrical performance of the Series 8631/35/38-(600A) RF Calorimeter is affected by impurities or other chemical additives in the cooling liquid. Therefore, the cooling liquid should be distilled water, with industrially pure ethylene glycol when used, and be kept clean at all times.

3-9. Thermal performance is affected by impurities, particularly those which accumulate in the form of scale on the surface of the ceramic tube and other water passages. This results in an increase of thermal resistance of the load and may cause the load to overheat and fail.

3-10. CONTROL UNIT (MODEL 6080A)

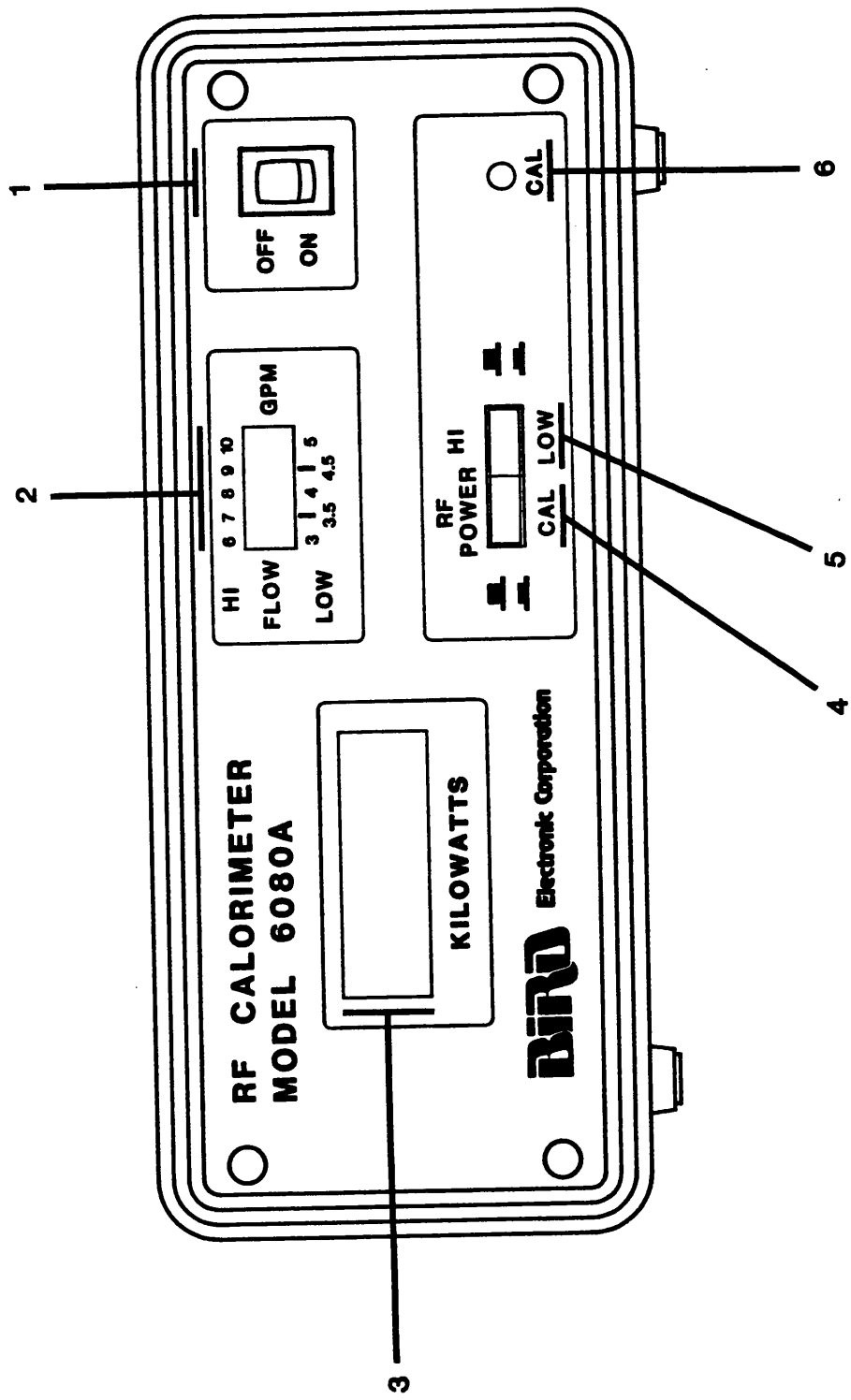
3-11. This section describes the operation of the Model 6080A Control Unit. Operator is given a description of front and rear panel features and is guided through a step by step format of how to take measurements.

Calorimeter is installed per installation procedures (see Section I - Installation).

3-12. FRONT PANEL LAYOUT

3-13. The following is a description of front panel features, see Figure 3-1.

FIGURE 3-1. FRONT PANEL LAYOUT.



1. ON / OFF SWITCH
2. FLOW INDICATOR
3. DISPLAY
4. RF POWER / CAL SWITCH
5. HI / LOW SWITCH
6. CAL ADJUST

a. ON/OFF Switch - Controls ac line power

b. FLOW INDICATOR - Gives visual indication of coolant flow in gallons per minute (GPM). The flow indicator has two ranges, a low power range which indicates a flow of 3 to 5.25 GPM and a high power range which indicates a flow of 6 to 10.5 GPM. These ranges are selectable through the use of the HI/LOW pushbutton. The 8630 series having a maximum power level of 10 Kilowatts uses only the low power range.

c. DISPLAY - Gives a visual indication of the present value being measured. This value represents kilowatts of RF power being seen by the load/sensor unit.

d. RF POWER/CAL SWITCH - When not depressed RF power mode is selected. This mode is implemented during normal operating conditions and is used in conjunction with the HI/LOW range button.

When the button is depressed then CAL mode is selected. Unit is now ready to perform initial system calibration.

e. HI/LOW SWITCH - With unit in RF power mode this button will select between High or Low power and flow ranges. In LOW mode the usable power range is 1 to 10kW and flow range is 3 to 5.25GPM. In HI power mode the upper power limit is determined by the load/sensor unit (Series 8630-600A uses only LOW power mode). The HI range of the flow sensor is 6 to 10.5 GPM.

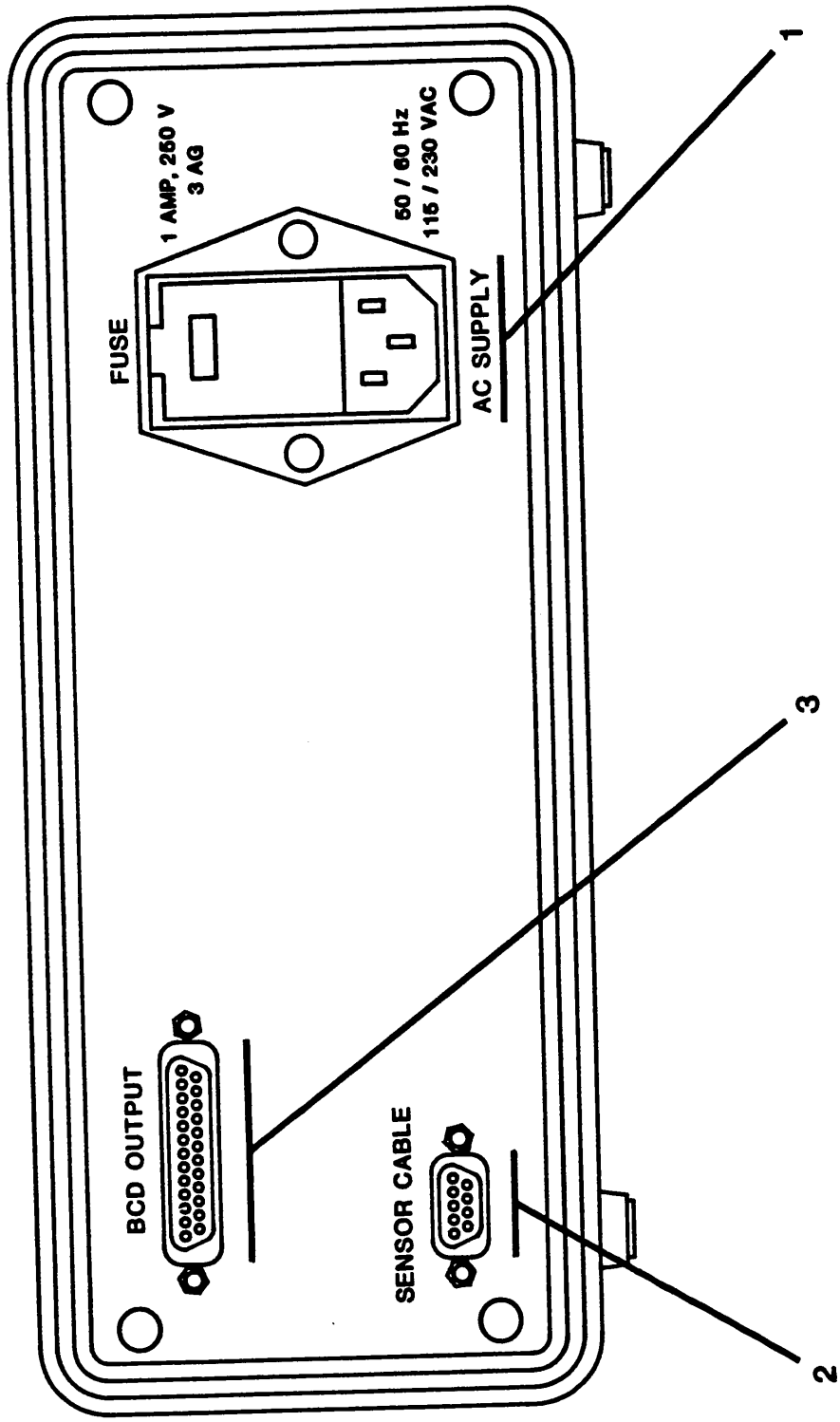
With unit in CAL mode the HI/LOW button allows operator to perform initial calibration for both ranges.

f. CAL ADJUST - This is the adjustment potentiometer for nulling power ranges when unit is in CAL mode.

3-14. REAR PANEL LAYOUT

3-15. The following is a description of rear panel features, see Figure 3-2.

FIGURE 3-2. REAR PANEL LAYOUT.



1. AC LINE SENSOR
2. SENSOR CABLE CONNECTOR
3. BCD OUTPUT CONNECTOR

a. AC LINE MODULE - The ac line module provides a three function capability:

1. Contains the ac line socket for input of ac power.
2. Provides line voltage selection 115/230 volts.
3. Contains internally, an ac line fuse.

Location of fuse and instructions on line voltage selection are detailed in Section 1-12.

b. SENSOR CABLE - This 9-pin D-shell connector supplies the mating contacts for the sensor cable. Input/Output data passes to and from control unit via this connector. Pin assignments for this connector are given below:

Pin No.	Function
1	Flow Frequency
2	Sensor Supply Voltage (+15V)
3	Input Voltage Reference (+5V)
4	Input Voltage Ratio
5	Input Temperature Voltage
6	Signal Ground
7	Output Voltage Reference (+5V)
8	Output Voltage Ratio
9	Output Temperature Voltage

c. BCD OUTPUT - This 25-pin D-shell connector supplies a BCD output for remote use. Various application for this output are described in Section IX. Pin assignments for this connector are given below:

Pin No.	Function	Pin No.	Function
1	BCD 100	14	BCD Ground
2	BCD 200	15	Hold
3	BCD 400	16	NC
4	BCD 800	17	BCD 1000
5	NC	18	+5V
6	BCD 10	19	OE3 (Tens)
7	BCD 20	20	OE2 (Hundreds)
8	BCD 40	21	OE4 (Units + Overrange)
9	BCD 80	22	OE1 (Thousand + Polarity)
10	BCD 1	23	Overrange
11	BCD 2	24	Polarity
12	BCD 4	25	Data Valid
13	BCD 8		

3-16. START UP

3-17. Before applying ac line power to load/sensor unit or control unit make certain that ac line module is matched to the available line voltage and all safety precautions are taken.

3-18. Perform the following steps to achieve a proper start up condition:

```
**********************************************************
*                                                        *
*                      C A U T I O N                     *
*                                                        *
*                                                        *
* Check coolant level before turning on ac power.  If    *
* insufficient coolant is present damage could result to *
* pump/motor.  See Paragraph 1-23.                       *
*                                                        *
**********************************************************
```

a. Turn on ac power switch on load/sensor unit. This will start the coolant pump directly, regardless of the condition of the control system. The line power supply to the load/sensor unit will usually be remotely controlled, and generally may be switched in conjunction with RF power loading of the system.

Operation of the pump/motor, initiating coolant flow, will close the flow switch contacts. The high temperature thermoswitch in series with it is normally closed and this will start operation of the time delay. In approximately two seconds it will close contacts and the transmitter interlock will then permit the application of RF power. Do not apply RF power at this time.

b. Allow coolant flow and load/sensor unit to stabilize for a minimum of five minutes.

c. Turn on ac power to control unit.

d. Set RF POWER/CAL switch to CAL mode.

e. Perform an initial calibration on the LOW power range by selecting the LOW range and adjusting the CAL adjustment for a display indication of zero. NEVER CALIBRATE UNIT WITH RF POWER APPLIED.

f. Return RF POWER/CAL switch to RF power mode.

g. If display still doesn't indicate zero a fine adjustment can be made to the CAL adjustment while in RF power mode.

NOTE: If null setting could not be achieved then see Maintenance Section.

h. Flow indicator should show a stable flow of approximately 3.5 GPM. If flow is below 3.25 or above 3.75, see Maintenance Section.

3-19. Series 8630-600A RF Calorimeter is now ready for normal operation.

3-20. NORMAL OPERATION

```
**********************************************************
*                       C A U T I O N                    *
*                                                        *
* Do not apply RF power greater than maximum power level *
* of load.                                               *
**********************************************************
```

3-21. With the Model 6080A Control Unit set in RF power mode, low power range, RF power measurements can now be made.

Apply RF power. The display will indicate RF power being measured in kilowatts. With large changes of transmitter power allow three minutes stabilization time to achieve stated accuracy.

3-22. SHUTDOWN

3-23. The following steps apply to 8630-600A system shutdown:

a. Turn off transmitter power.

b. Turn off Model 6080A controller

c. Wait five minutes before turning off ac line power to load/sensor unit.

SECTION IV. - MAINTENANCE

4-1. GENERAL

4-2. Only a moderate amount of preventive maintenance is required for the 8631/35/38-(600A) Series RF Calorimeter. Use reasonable care in handling; do not drop the control unit or load assembly.

4-3. The coaxial load resistor installed in the load/sensor unit is rugged and simple, requiring only nominal and routine attention. The load is designed to operate for long periods of time if care is taken not to exceed its power handling capabilities.

4-4. PREVENTIVE MAINTENANCE

Following the routine below will ensure years of failure-free operation.

a. CLEANING

1. A main factor in effective preventive maintenance is cleanliness. For optimum performance and service life the calorimeter must be kept in a clean and dust free condition.

2. The outside surface of the load/sensor unit should be wiped free of dust and dirt at regular intervals. Particular attention should be given to the air intakes (see Paragraph 4-4, c.2). Occasionally, check condition of RF coaxial connection. If required, disconnect the instrument from the transmission line and clean the RF connector parts, both metallic and insulator surfaces. The sensor cable connector must be kept clean. Carefully wipe the metallic contacts and connector body. A cotton swab stick is useful for this. The operating panel should be wiped clean with a soft cloth. Wipe the meter face only when necessary.

b. INSPECTION

Periodic inspection should be performed at three to six-month intervals dependent on amount of continuous use.

1. WATER FLOW SWITCH - The water flow switch should be inspected periodically for accumulated scale and cleaned, if necessary, to permit free movement of the sliding valve. This should be done only by removing the wired sensor plug with a 1-1/2 end wrench. The component is irreparable and must be replaced if its performance is defective. Operation can be checked by monitoring the interlock circuits while starting or stopping pump/motor with RF power off. See 5-12, Water Flow Switch Removal for replacement procedures.

2. CONNECTORS - Inspect all interconnections to load/sensor unit and control unit for bent, broken, and missing pins.

c. ROUTINE SERVICE CHECKS

1. When the equipment is in use, watch the coolant level at regular intervals. Check once or twice a week normally, more often if used continuously or under high ambient temperatures. The coolant level should remain at upper gauge mark on the back panel, whether the load/sensor unit is running or not. For test measurement and addition of liquid if required (see 1-22, Coolant and 1-24, Drainage and Filling). Use only distilled water and industrially pure ethylene glycol - no automotive antifreeze.

2. The radiator surfaces, particularly on the inside, should be checked through the grille periodically for possible collection of dust and lint. If necessary release screws, 18 each, from edges of top panel and remove these panels. Clean off any collected dust and lint with a radiator brush or any stiff bristle brush. Also, check under ribs of the exhaust grille at the side, for dust collection. If there is a buildup, remove and clean under the grille. Heavy lint coatings on any surface of the radiator unit can impair efficiency of the load/sensor unit - keep these clean.

3. The coolant strainer, located inside the load/sensor unit, is used to trap any small particles that may hinder the operation of the flow meter or load. This strainer is subject to occasional cleaning or element replacement. If the unit is heavily used the strainer should be checked and cleaned about once a month. This interval may be extended if experience shows that only a small amount of residue is found in the sediment bowl. Always check the strainer within 30 days after a coolant change.

Blockage of the filter screen of over 75% could reduce the flow in the system to an unacceptable level and cause the interlock relay to activate. For cleaning or replacement of strainer see Paragraph 5-16.

4-5. PERFORMANCE TEST

4-6. RF LOAD RESISTOR

4-7. Accurate measurement of the dc resistance between the inner and outer conductors of the RF input connector will provide a good check of the condition of the load resistor. For this measurement a resistance bridge or ohmmeter with an accuracy of 1% or better at 50 ohms is recommended. Use low resistance leads, preferably a short piece of 50 ohm cable with test clips attached. The measured resistance should not deviate more than ±2 ohms from the nominal value.

Note - It is recommended that this resistance check be performed each time the load is to be used.

4-8. If measured resistance is greater than ±2 ohms from nominal value, see Paragraph 5-7.

SECTION V - TROUBLESHOOTING AND REPAIR

5-1. GENERAL

5-2. Due to its electronic complexity, repair of 8631/35/38-(600A) Series RF Calorimeter systems is recommended only for certain malfunctions. Table 5-1 contains a list of problems that are commonly experienced with their probable cause and remedy.

Table 5-1. Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	REMEDY
	LOAD/SENSOR UNIT	
Fan and pump not operational	Power cord not connected, ON/OFF switch is off	Check power cord connection, turn switch on.
AC applied but fan and pump not operational	Defective fuse Defective ON/OFF switch Disconnected wire	Check fuse. Check switch. Connect loose wire using schematic as a reference figure. See Appendix A.
AC applied but fan not operational	Defective starting capacitor	Check capacitance. The The capacitance should be 3uF.
	Defective fan	Replace fan.
AC applied but pump not operational	Pump overheated	Pump is thermally protected. Check ambient temperature specifications.
	Defective pump	Replace pump.
	CONTROL UNIT	
Panel meter does not illuminate	Power cord not connected, ON/OFF switch is off	Check power cord connection. Turn switch on.
AC applied but panel meter not illuminated	Defective fuse Defective ON/OFF switch Loose or disconnected wires	Check fuse. Check switch. Check connections at header J3 and J5.

TROUBLESHOOTING [CONT.]

PROBLEM	POSSIBLE CAUSE	REMEDY
	Improper supply voltage	Check the voltage at screw terminal No. 8 on the lower card of the panel meter. Check connections at screw terminals and check voltage. Should be approximately 5V. If voltage is not present replace PC board.
	Defective meter	Replace meter.

RF CALORIMETER SYSTEM

Refer to Figure 5-4 for location of header J1. J1 will be used as a test header throughout the remainder of the troubleshooting procedures. Figure 5-6 gives the pin functions for header J1.

PROBLEM	POSSIBLE CAUSE	REMEDY
Flow indicator inoperative	Poor cable connection	Check cable connection at load/sensor unit and control unit.
	Loose or disconnected wires	Check connection of J1 on flow indicator PC board.
	Faulty flowmeter	Check frequency at pin 8 of header J1. If frequency is not approximately 350Hz and the reading is erratic, then proceed to replace flowmeter.
	Flow circuit defective	Check the voltage at pin 10 and frequency at pin 8 of header J1. The voltage should be approximately 1V and the frequency approximately 350Hz. If these readings are not present proceed to replace PC board.
	Faulty indicator	If all of the above corrections have already been tried, proceed to replace flow indicator PC board.

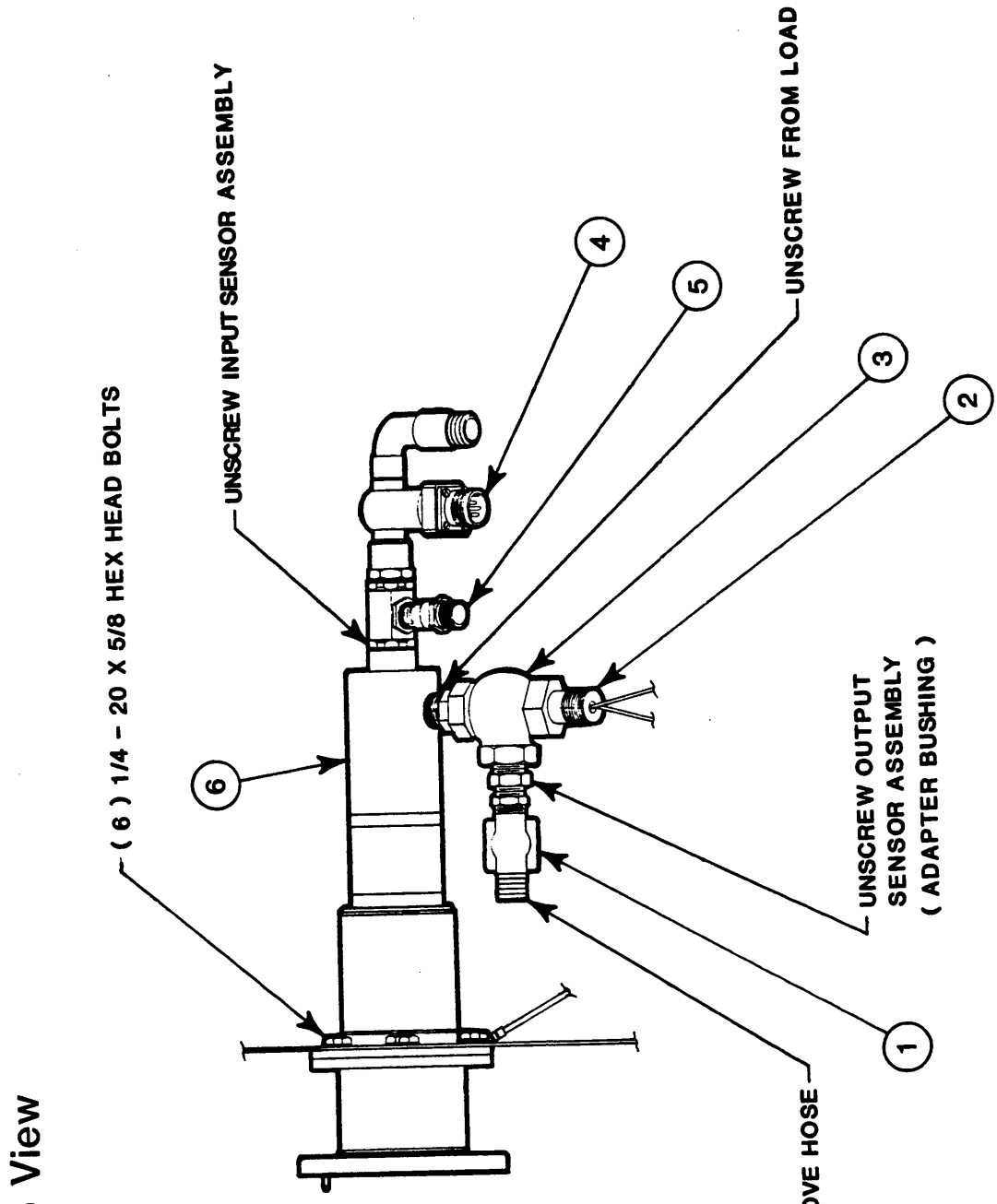
c. Unscrew the cable assemblies from the input temperature sensor and flow meter.

d. On the inside of the front panel remove the six 1/4-20 x 5/8 hex head bolts securing the load to the front panel. Note - When the six bolts securing the load to the front panel are removed the outer conductor assembly will be disconnected. Hold this assembly to keep it from being damaged by falling off. Position the load resistor half way through the front panel and temporarily reattach the outer conductor to the load body. Use two or three of the 1/4-20 bolts finger tight for this purpose. Having the load resistor half way through the front panel will allow enough clearance to remove the flowmeter and input sensor assembly from the load water chamber by firmly holding the water chamber and turning the flowmeter counterclockwise with a 1-1/8 end-wrench. The load can now be removed from the front panel.

e. If the load resistor is to be returned to the factory for repair, store components with the load/sensor unit until further use. Consult the factory. If the unit is to be field repaired, proceed with resistor replacement instructions as described in Section VIII - Internal Repair Of The Load Resistor.

f. Replace the load resistor by careful reversal of the preceding procedure. Be sure to replace coolant (see 1-24, Drainage and Filling). Check for leaks, especially at restored connections.

FIGURE 5-1. RF LOAD RESISTOR REMOVAL.



1. OUTPUT SENSOR ASSEMBLY (TEMPERATURE SENSOR)
2. FLOW SWITCH SENSOR ASSEMBLY
3. FLOW SWITCH BODY
4. INPUT SENSOR ASSEMBLY (TEMPERATURE SENSOR)
5. FLOW METER
6. LOAD

5-10. PUMP/MOTOR REMOVAL

5-11. For removal of the pump/motor observe that it should not be necessary to remove the load resistor as previously discussed; however, the fan panel and perhaps rear panel should be taken off. Then proceed as follows:

a. Drain the unit of coolant by unscrewing plug at lower rear.

b. Release the side fan panel by simply removing the 18 truss head screws on its periphery. To detach panel completely just unplug wire connections. Note: Observe proper wire connections for reassembly.

c. If it is necessary to remove the back panel, the coolant gauge must be removed and the sensor box detached from its mounting. Remove the coolant gauge by unscrewing the two special 3/4 hex bolts securing it. Be careful not to lose the two spacer collars and O-Ring seals located between the gauge and coolant tank. The sensor box assembly is detached by removing three 4-40 x 1/2 truss head screws located on the back panel above and to the sides of the 9 pin connector. Support the sensor box by hand when removing the screws. When free, position the sensor box inside the load/sensor unit so that it will not interfere with pump/motor removal. Remove the (16) 8-32 screws in the back panel and it will come right off.

d. Detach 3-wire cable from the 3-lug terminal block on the inside of the front panel. For reference, the color codes of the motor supply wires generally match the input wires with the green ground wire going on the blue ground wire from the socket. Note these wire connections carefully before detaching.

e. Loosen the hose clamp nearest the pump on the input hose and carefully loosen it from the 90° input elbow at the center of the volute. In the same manner loosen the output hose from the strainer output assembly (refer to Figure 5-2).

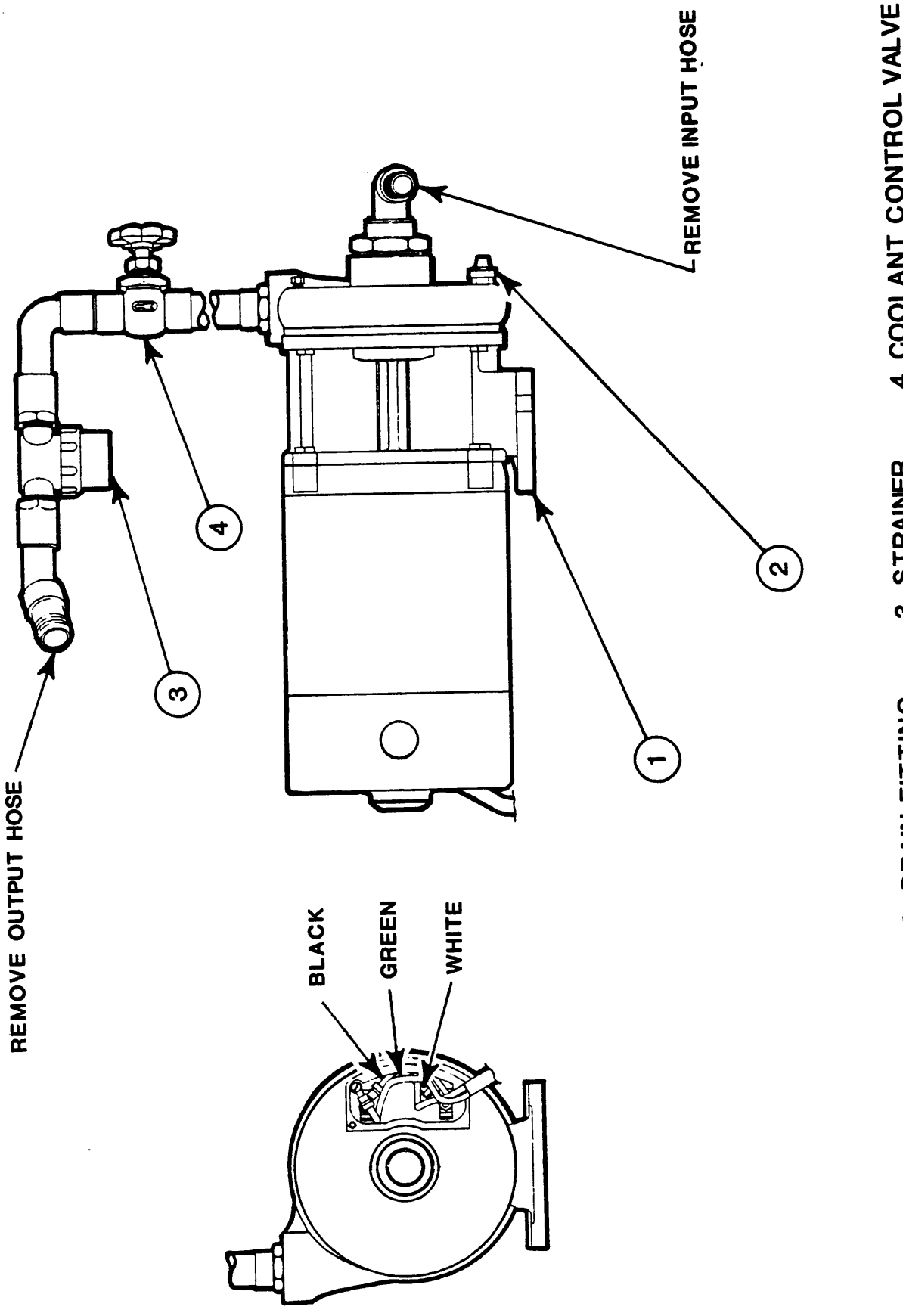
f. Reach under the input elbow and loosen the hose clamp on drain fitting at the base of the volute. Disconnect hose from fitting.

g. Using a 9/16 hex socket extension wrench or a small, flat end-wrench, remove the two 3/8-16 nuts from base studs holding the motor base. Lift the motor slightly to clear the studs then carefully inch the pump assembly forward while detaching the hoses. The pump will have to be turned to a position where the strainer assembly will fit under load housing. The freed assembly may be lifted from the equipment out the open side. Remove wires, if required, noting connections.

h. Before removing the fittings, note their positions carefully. Just twist off, counterclockwise, input and output assemblies, respectively. Watch the slight downward tilt of the 90° input elbow. Carefully store the detached parts with the load/sensor unit and return the pump/motor to the factory for replacement. Note - Be sure to also remove small drain hose fitting.

i. Reverse all preceding procedures to reinstall. When restoring threaded fittings, coat external threads thoroughly with a good pipe sealing compound. Twist on until the threaded joints are tight and the parts are back in the same alignment (see Paragraph 5-9f). Use care to rewire to same terminal block connections.

FIGURE 5-2. PUMP/MOTOR REMOVAL.



5-12. WATER FLOW SWITCH REMOVAL

5-13. To remove the water flow (safety control) switch, proceed with load resistor removal instructions per Paragraph 5-7. Disconnection of the output temperature sensor and cable assembly will be required. The sensor subassembly may be removed along with the hex adapter bushing on the flow switch output. It is not necessary to loosen the flow switch sensor unit when removing the entire flow switch, refer to Figure 5-1.

a. Undo the cable clamps and release the flow switch wire harness from the frame. Detach the black wire from the thermoswitch post. The orange or yellow wire is disconnected from the terminal block mounted on the inside of the front panel.

b. Now, using special care, hold the adapter fitting on the load output with a 1-1/16 end-wrench and carefully twist off the flow switch. Be sure not to stress any other parts of the configuration.

```
**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Do not remove any fittings from the water chamber.     *
* The threads could be damaged, and it may be difficult  *
* to restore them to their original positions while      *
* keeping a watertight seal.                             *
**********************************************************
```

c. Remove the entire flow switch by turning it in a counterclockwise direction. Be sure the load output adapter has not been removed with the flow switch. If it has, remove it before returning the flow switch to the company for repair or replacement and consult with the factory.

d. Replace the flow switch by simply reversing the preceding procedure. It is important when replacing all water fittings to carefully coat threads with a good pipe joint sealing compound. When reinstalling the switch assembly twist on the components until switch body is in original angular alignment.

e. Restore plumbing and wire connections the same as removed. Refill equipment with coolant to proper level. Check the refitted joints thoroughly and test the switch operation by a preoperational run without RF power; run coolant pump a few minutes without top panel, and inspect for leaks.

5-14. TIME DELAY RELAY

5-15. The time delay is an integral component, factory set for the operation of this equipment; i.e., an approximately two second delay, isolated circuit relay (see Paragraphs 2-15 and 2-16). The relay is situated on the upper left inside of front panel mounted in an octal socket. The relay cartridge cannot be disassembled or repaired in the field. A faulty unit should simply be replaced, as follows:

a. Loosen the 8-32 pan head screw at the top of the relay clamp and push slightly to release the retaining prongs of clamp. Pull delay relay cartridge straight out of the socket.

b. To replace the relay, reverse the preceding procedure. The socket is an ordinary octal type. When inserting the relay, rotate the cartridge for alignment of center post nub in the socket.

c. Prongs of clamp match side slots in the socket holder. Fit clamp in the slots and tighten the head screw snugly.

5-16. COOLANT STRAINER CLEANING OR REPLACEMENT

5-17. To check or replace the screen of the coolant strainer follow the steps below:

a. Remove the 18 8-32 x 5/16 inch truss head screws from the periphery of the fan panel.

b. Carefully remove the fan panel. Tilt it slowly forward until there is enough room to reach behind the panel and disconnect the fan wire from the terminal strip mounted on the inside of the front panel.

Note: Observe proper wire connections for reassembly.

c. Set the panel aside and notice the strainer in the coolant line just above and to the side of the pump motor, refer to Figure 5-2.

d. If the strainer sediment bowl and screen do not appear to have any amount of residue, proceed with step h, and reassemble the unit. If, however, the sediment bowl and filter screen are contaminated, proceed with step e.

e. Partially drain the unit until the coolant level is below the level of the strainer. Cover the pump motor with a cloth to catch any spillage when the sediment bowl is removed.

f. The thread on the sediment bowl is a right hand thread. Grasp the sediment bowl in your hand and remove it by unscrewing it in a clockwise direction, as viewed from the top. When unscrewing the sediment bowl be careful not to cut your hand on the sharp fins of the heat exchanger. These fins, although very sharp, are made of thin gage aluminum and are easily bent and dented. Care must be taken not to dent these fins as it will reduce the efficiency of the heat exchanger.

g. When removing the sediment bowl, the filter screen may remain in the strainer body; remove it for cleaning as well. Rinse the sediment bowl and filter screen under clean running water. If the stainless steel screen should become disfigured or blocked beyond cleaning, it should be replaced.

h. Reassemble the strainer and load by reversing the above procedures. Position the filter screen in the strainer bowl and be sure the green gasket is properly positioned in place before reassembly.

i. Refill load/sensor unit to proper coolant level (refer to Section 1-24, Drainage and Filling).

Note: The coolant control valve is used for factory calibration procedures for coolant flow. It must not be tampered with or adjusted for any reason other than precise factory calibration.

5-18. FLOWMETER REMOVAL

5-19. To remove the flowmeter, take off the top panel by removing 18 screws around its perimeter. Lift off the top panel assembly by the handles. Refer to Figure 5-1 for the following procedures:

a. Unscrew drain plug at center of rear panel of unit and allow coolant to drain. NOTE: Be careful not to mislay this plug. Do not replace it with any substitute plug. Using an ordinary screwdriver, unscrew the hose clamp on both the input and output sensor assemblies and remove the hoses. Also disconnect the cable assembly from the input temperature sensor.

b. On the inside of the front panel remove the six 1/4-20 x 5/8 hex head bolts securing the load to the front panel. Note: When the six bolts securing the load to the front panel are removed the outer conductor assembly will be disconnected. Hold this assembly to keep it from being damaged by falling off. Position the load resistor half-way through the front panel and temporarily reattach the outer conductor to the load body. Use two or three of the 1/4-20 bolts finger tight for this purpose. Having the load resistor half-way through the front panel will allow enough clearance to remove the flowmeter and input sensor assembly from the water chamber. This is done by firmly holding the load water chamber and turning the flowmeter counterclockwise with a 1-1/8 end-wrench. Notice the angular position of the flowmeter and temperature sensor to the load before removal as it must be returned to this position when reinstalled.

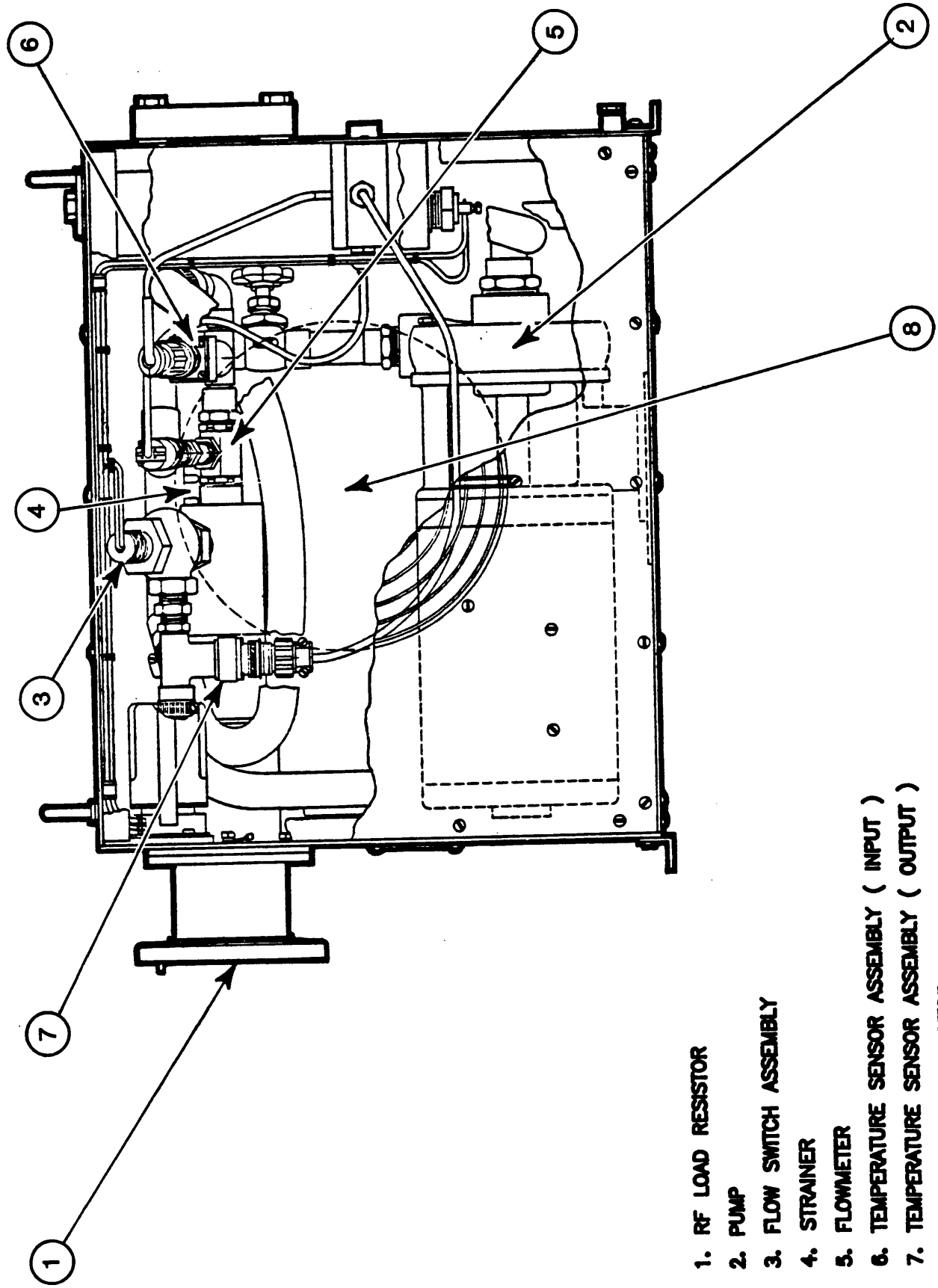
c. Flowmeter can now be removed from the input temperature assembly. Remove the tru-seal fittings from the flowmeter and thread them on the new flowmeter until they bottom out. Use Teflon or an equivalent type of plumber's tape on the threads of the flowmeter to insure a proper seal when reinstalling. Note: When applying plumber's tape to threads, take care to start applying tape at a minimum of 1 thread from the end, so no tape can get trapped inside the plumbing and clog flowmeter.

d. Thread input end of flowmeter into input temperature assembly until snug then tighten. Flowmeter must be in same angular position as the temperature sensor as shown in Figure 5-1. Note position of arrow on flowmeter when assembling. Arrow should be pointed away

from input temperature assembly. Thread output end of flowmeter into water chamber of load resistor until snug then tighten. Flowmeter must be in the same angular position with the load as shown in Figure 5-1. Tighten tru-seal fittings. The tru-seal fittings are used to allow proper positioning of the flowmeter without the risk of leaks.

e. Replace the load resistor by careful reversal of the preceding procedure. Be sure to replace coolant (see Drainage and Filling). Check for leaks, especially at restored connections.

FIGURE 5-3. LOAD/SENSOR UNIT INTERNAL STRUCTURE.



5-20. CONTROL UNIT REPAIR/REPLACEMENT

5-21. This section shows PC board component layout and test points to aid operator. Follow troubleshooting chart while referring to this section.

5-22. Remove the four screws that secure the cover to the control unit. This will expose the control unit's internal circuitry.

```
**************************************************************
*                        W A R N I N G                       *
*                                                            *
* The potential of electrical shock exists.  Operator        *
* must use caution when performing internal testing or       *
* making adjustments to avoid bodily contact with            *
* potentials.                                                *
**************************************************************
```

FIGURE 5-4. MAIN PC BOARD COMPONENT LAYOUT

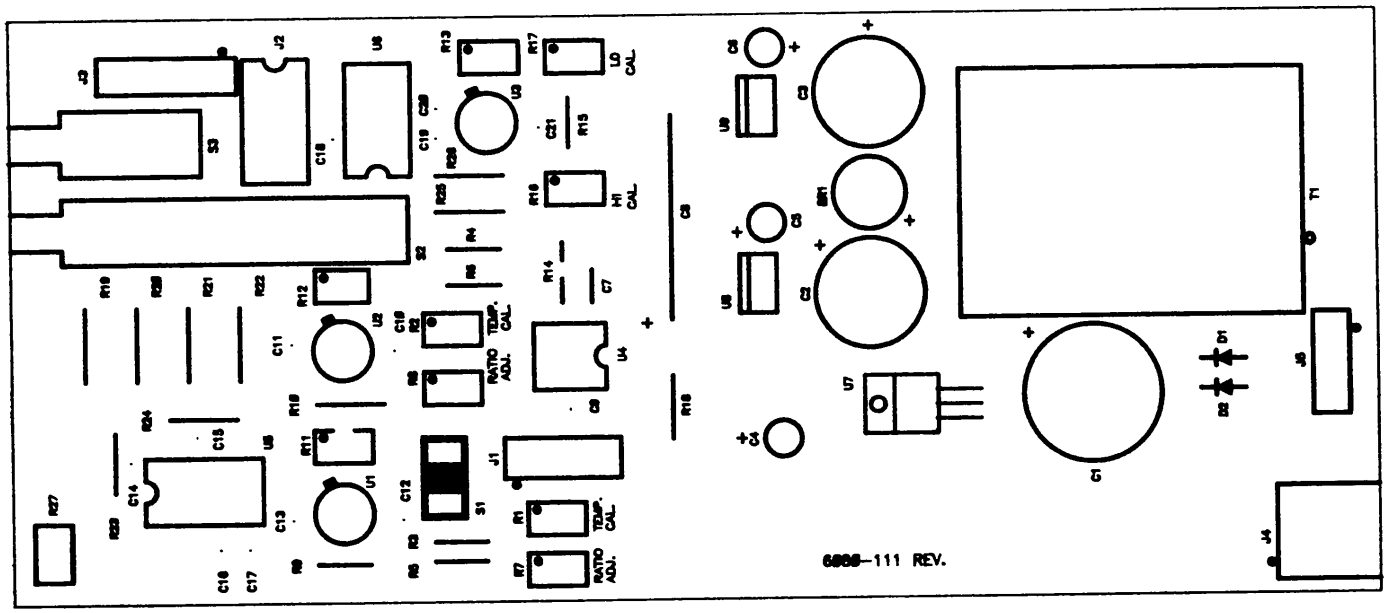


FIGURE 5-5. FLOW INDICATOR PC BOARD COMPONENT LAYOUT.

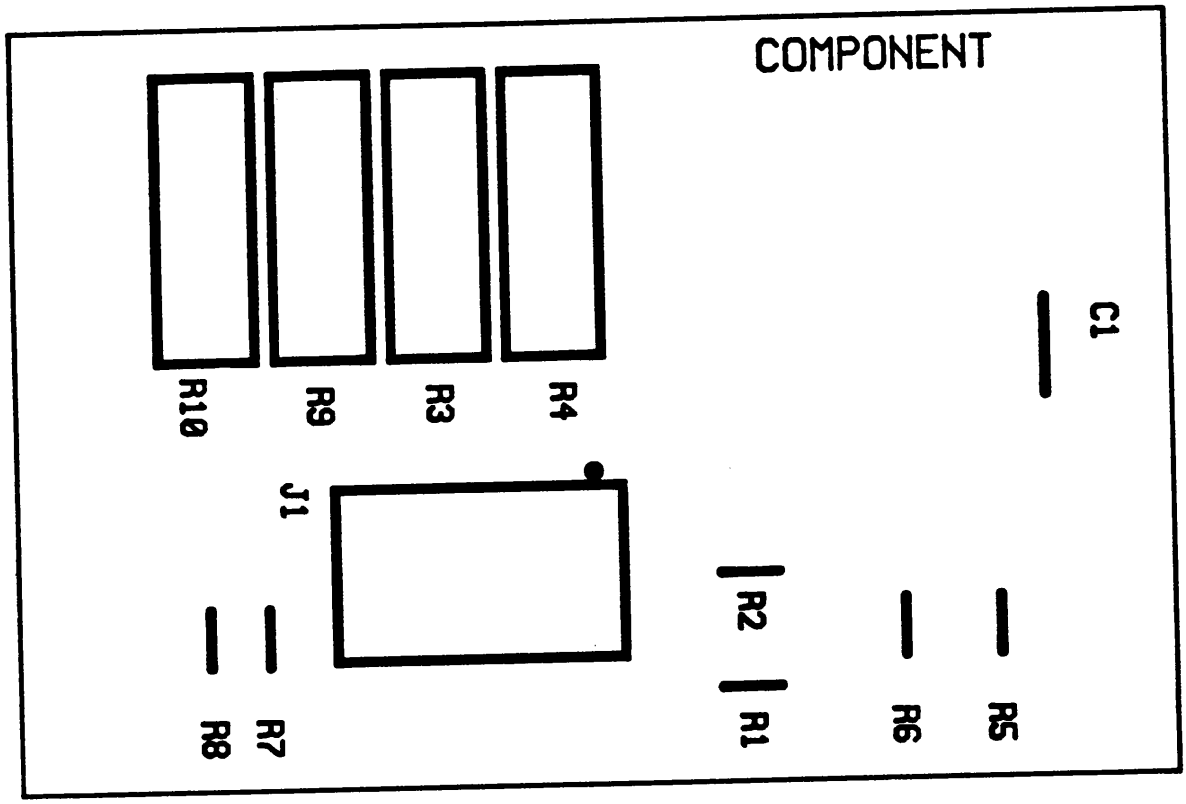
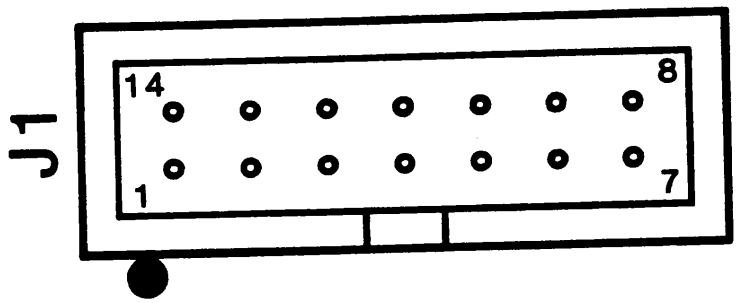


FIGURE 5-6. TEST HEADER PIN FUNCTIONS.



PIN 1	Input voltage reference +5V
PIN 2	Input voltage ratio
PIN 3	Input temperature voltage
PIN 4	Input temperature
PIN 5	Supply voltage +5V
PIN 6	Supply voltage +15V
PIN 7	Ground
PIN 8	Flow frequency
PIN 9	Supply voltage −15V
PIN 10	Flow voltage
PIN 11	Output temperature
PIN 12	Output temperature voltage
PIN 13	Output voltage ratio
PIN 14	Output voltage reference +5V

5-23. SYSTEM COMPONENT REPAIR/REPLACEMENT

5-24. After troubleshooting the complete calorimeter it may be necessary to repair or replace one of the following components:

a. Sensor cable
b. Perform a temperature sensor realignment
c. Replace temperature sensor

5-25. SENSOR CABLE

5-26. Remove sensor cable connectors from mating connectors on both the control unit and load/sensor unit. This is done by unscrewing the connector mounting screws and pulling straight back on connector.

5-27. Pin to pin continuity from connector to connector can now be checked using a standard VOM. Refer to Table 5-2 for pin to pin connection. Any shorts or opens contrary to Table 5-2 require replacement of the sensor cable.

Table 5-2. Sensor Cable Pin Connections.

Connector 1 Pin	Connector 2 Pin
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

Outside connector shells are at system ground and should be electrically connected together.

5-28. TEMPERATURE SENSOR REALIGNMENT

5-29. Each temperature sensor will have a voltage output of 10mV/°C. If sensors are out of calibration (after temperature stabilizes the sensors should read within 1mV of each other) the following procedure for realignment must be performed:

a. Circulate water through the system until sensors stabilize. Measure temperature of circulating water and voltage output (pins 4 and 11 of header J1, Figure 5-6) of both sensors. Each sensor's output should read within 1mV, at header. This output voltage is determined by the water temperature in °C.

Example: Water temperature is 5.5°C. Output voltage of both sensors then will be adjusted to 10mV x 5.5 = 55mV.

b. To adjust the output voltage, adjust 25K ohm potentiometer (R1 or R2) until proper settings are reached.

5-30. TEMPERATURE SENSOR REPLACEMENT

5-31. To replace a temperature sensor take off the top panel by removing 18 screws around its perimeter. Lift off top panel assembly by the handles. To remove sensor follow the procedure below:

a. Remove sensor cable assembly by unscrewing the circular connector.

b. Temperature sensor can now be removed by gripping sensor housing and turning by hand counterclockwise. Take care not to lose O-Ring on bottom of housing.

c. To install new temperature sensor assembly reverse the above steps. Take care to make sure O-Ring is properly seated in housing when screwing in temperature sensor assembly. Hand tighten this assembly.

d. Complete calibration is now required (see Section VI).

5-32. CUSTOMER SERVICE

5-33. Bird Electronic Corporation maintains a complete repair and calibration department at our corporate headquarters. This department is set up to provide the best possible service of Bird equipment.

5-34. All instruments returned for service must be shipped prepaid and to the attention of the Customer Service Group.

Bird Electronic Corporation
30303 Aurora Road
Cleveland (Solon), OH 44139
Phone: 216-248-1200
Cable: BIRDELEC
Telex: 706898 Bird Elec UD

5-35. REPACKAGING

5-36. Should you need to return the calorimeter, or associated parts, use the original shipping package if possible. If the original package is not available, use a heavy duty corrugated box with shock-absorbing material around all sides of the unit to provide firm cushion and to prevent movement in container. Container should be properly sealed.

SECTION VI - CALIBRATION AND TEST PROCEDURES

6-1. GENERAL

6-2. This section contains information on both high and low power calibration.

6-3. REQUIRED TEST EQUIPMENT

ITEM	QTY	TYPE UNIT	RECOMMENDATIONS
1	1	DC Millivoltmeter	Digitec 268 or Equivalent
2	1	DC Power Supply	Sorensen QRD30-1 or Equivalent
3	1	AC Ammeter	Y.E.W., Model 2013-09
4	1	AC Voltmeter	Y.E.W., Model 2013-17
5	1	Potential Transformer	Y.E.W., Model 2261
6	1	Thermometer (Mercury)	0° to 30° Centigrade (0.1° Accuracy)
7	1	AC Signal Source	20kW Output Minimum at 50 or 60Hz

6-4. CALIBRATION PROCEDURE

6-5. Calibration Procedure - Calorimeter.

a. Connect load/sensor unit and control unit operating power cords to the appropriate voltage supply of 115V/60Hz or 230V/50Hz.

b. Check control unit's ac line module for correct selection of line voltage.

c. Turn on control unit by pressing ON/OFF button on front panel.

d. Turn on load/sensor unit by placing ON/OFF rocker switch in the ON position.

6-6. TEST EQUIPMENT PREPARATION

a. Turn dc millivolt meter on.

b. Turn dc power supply on.

c. Remove filler plug from the load/sensor unit and insert the thermometer into the coolant in the tank.

d. Connect the calorimeter sensor cable, P/N 6080-320-1, to connector at the back panel of the load/sensor unit and back panel of control unit.

e. Connect the ac signal source output cable to the load/sensor unit input connector but leave the ac power source turned off.

f. Connect Y.E.W. meters, if not already connected, as illustrated in Figure 6-1.

g. Leave the above equipment on for 15 minutes, to stabilize, before continuing.

6-7. TEMPERATURE CALIBRATION

a. Assure that the coolant temperature has stabilized by reading the temperature indicated on the thermometer in the coolant; then recheck the thermometer after a few minutes. If the coolant temperature is the same both times and the system is stabilized you may continue.

b. Remove four screws from upper cover to expose control unit internal circuitry.

```
************************************************************
*                        W A R N I N G                     *
*                                                          *
* The potential of electrical shock exists. Operator       *
* must use caution when performing internal testing or     *
* making adjustments to avoid bodily contact with          *
* potentials.                                              *
************************************************************
```

c. Short the inputs to the temperature OP Amps by:

1. Disconnecting the sensor cable from the rear panel connector of the load/sensor unit.

2. Short pins 3 and 12 of PC board connector J1 to PC board ground. See Figure 6-2 for pin notations.

d. Connect the negative lead of the dc millivoltmeter to PC board ground and the positive lead of the dc millivoltmeter to the output temperature, pin No. 11 of header J1.

e. Set the dc millivoltmeter to the 200mV range, or lower, and observe the indication on the voltmeter. Then adjust the voltage at (output temp.) by turning the offset null adjust potentiometer R12, to read zero ±20 microvolts. For location of adjustment potentiometer see Figure 6-2.

f. Move the positive lead of the dc millivoltmeter to the input temperature, pin No. 4 of header J1 and repeat step e above by adjusting the offset null potentiometer R11. This adjusts the OP Amps to produce an output voltage of zero volts when the input voltage is zero volts. Disconnect the shorting jumpers from pins 3

and 12 and reconnect the sensor cable to the rear panel of the load/sensor unit.

g. With the negative lead of the dc millivoltmeter still connected to PC board ground measure and record the voltage at pin 12 (V_{TEMP} out) and pin 3 (V_{TEMP} in) of header J1 (see Figure 6-2). Then read and record the coolant temperature in the load/sensor unit tank. Check these values three times to insure repeatability. Substitute these values into Equation 5 to solve for "r".

Equation 5. $$r = \frac{V_{TEMP}}{10\ (Ta + 273)}$$

Where: r = Temperature calibration ratio.
Ta = Ambient temperature of coolant in °C. (Thermometer Reading)
V_{TEMP} = Voltage measured at (V_{TEMP} in) and (V_{TEMP} out) in millivolts.

Calculate for "r" using both the measured (V_{TEMP} in) and (V_{TEMP} out) values.

Example 1:

When: Ta = 25°C
V_{TEMP} in = 600mV
V_{TEMP} out = 610mV

$$r_1 = \frac{V_{TEMP\ in}}{10\ (Ta + 273)} = \frac{600}{10\ (25 + 273)} = \frac{600}{10 \times 298} = \frac{600}{2980} = 0.2013$$

$$r_2 = \frac{V_{TEMP\ out}}{10\ (Ta + 273)} = \frac{610}{10\ (25 + 273)} = \frac{610}{10 \times 298} = \frac{610}{2980} = 0.2046$$

h. V_B may now be determined by Equation 6.

Equation 6. $V_B = r \times 100mV$

Calculate for V_B using r_1 and r_2 for both input and output temperature OP-Amps respectively.

Example 2: $r_1 = 0.2013$
$r_2 = 0.2046$
$V_{B1} = r_1 \times 100mV = 0.2013 \times 100mV = 20.13mV$
$V_{B2} = r_2 \times 100mV = 0.2046 \times 100mV = 20.46mV$

i. Set the ON/OFF switch of the control unit to OFF. Set switch S1 on the PC board to position shown in Figure 6-3. Connect the dc power supply and the dc millivoltmeter as described below.
DC Power Supply: Positive lead to (output temp.) pin No. 11 of header J1.
Negative lead to ground.

DC Voltmeter: Positive lead to (output temp.) pin No. 11 of header J1.
Negative lead to ground.

j. Adjust the dc power supply output to read 100mV ±10 microvolts on the dc millivoltmeter using the 200mV range. Keeping the voltage at this level in the following adjustments is very critical.

k. When 100mV is stable remove the positive lead of the dc millivoltmeter and connect to pin No. 13 of header J1. Now adjust R8 ratio adjust potentiometer, to read the V_{B2} value calculated for output temperature OP Amp. When this is done reconnect the positive lead of dc millivoltmeter back to pin No. 11 of header J1 (output temp.) to check if the 100mV is still being applied. If not, adjust to 100mV and adjust your V_{B2} value again. This may take a few times to reconcile.

l. Keep the ON/OFF switch of the control unit in the OFF position. Set switch S1 on the PC board to position shown in Figure 6-4. Connect the dc power supply and dc millivoltmeter as shown below.

DC Power Supply: Positive lead to (input temp.) pin No. 4 of header J1.
Negative lead to ground.

DC Millivoltmeter: Positive lead to (input temp.) pin No. 4 of header J1.
Negative lead to ground.

Again adjust the dc power supply output to read 100mV ±10uV on the dc millivoltmeter using the 200mV range. Keeping the voltage at this level in the following adjustments is very critical.

m. When 100mV is stable remove positive lead of the dc millivoltmeter and connect to pin No. 2 of header J1. Now adjust R7, (ratio adj.) potentiometer, to read the V_{B1} value. When this is done, reconnect positive lead of dc millivoltmeter back to the (input temp.) pin No. 4 of header J1 to check if the 100mV is still being applied. If not, adjust to 100mV and adjust the V_{B1} value again. This may also take a few times to reconcile.

n. Remove dc power supply leads and return switch S1 to its center position and turn the control unit on.

o. Set the dc millivoltmeter selector switch to the 2V range and connect the positive clip lead to (input temp.) pin No. 4 of header J1 and negative lead to ground (see Figure 6-5). Adjust R1 (temp. cal.) potentiometer, to read the same temperature as the thermometer in the coolant (Using 10mV = 1°C.)

p. Keep the dc millivoltmeter on 2V range, move the positive clip lead to the (output temp.) pin No. 11 of header J1 and leave the negative lead attached to ground. Adjust R2, (temp. cal.)

potentiometer, to also read the same temperature as the thermometer in the coolant.

q. Place the ON/OFF switch of the load/sensor unit in the OFF position and wait a few minutes to allow the control unit to stabilize. Short pin 10 of PC board connector J1 to PC board ground. Set dc millivoltmeter on 200mV range and connect the positive clip lead to the side of R26 that is common to pin 6 of op. amp. U3 as shown in Figure 6-6. Adjust potentiometer R13 to read zero on the dc millivoltmeter. When this is done, remove all clip leads.

r. Place the ON/OFF switch of the load/sensor unit in the ON position and check unit calibration by pushing in (CAL) button on the front of the control unit. Adjust the potentiometer on the front of the control unit for the display to read zero. Then switch the (CAL) button to the out position and, if necessary, readjust the front panel potentiometer for a calorimeter reading of zero.

```
**********************************************************
*                      W A R N I N G                     *
*                                                        *
* The following sections of this procedure involve the   *
* application of high power to the load/sensor unit. The *
* following precautions must be observed to insure       *
* operator safety as severe burn or possibly death may   *
* result.                                                *
*                                                        *
* 1. Make sure that the coaxial power cable connector    *
* is securely fastened to the load/sensor unit and that  *
* the load/sensor unit is running before turning on the  *
* ac power source.                                       *
*                                                        *
* 2. Ensure that all Y.E.W. meter connections are tight  *
* before turning on ac power source.                     *
*                                                        *
* 3. High voltage is present at the terminals of the     *
* Y.E.W. meters when the ac power source is on. Keep     *
* clear of these terminals.                              *
*                                                        *
* 4. Completely shut down the ac power source before     *
* changing the Y.E.W. meter connections, unplugging the  *
* load/sensor unit or removing the power cable from the  *
* load/sensor unit input connector.                      *
**********************************************************
```

6-8. LOW RANGE POWER CALIBRATION -

a. Connect Y.E.W. meters as shown in Figure 6-1. Make sure that all connections are tight.

b. Push in button marked (LOW) on the control unit. Adjust front panel potentiometer for a zero display on the DPM. Then turn on ac signal source and adjust the power Variac to produce a reading of 10 amps on the Y.E.W. ammeter. In this position the power source output will be approximately 5kW.

c. Determine the actual power applied to the load/sensor unit coaxial input by reading the Y.E.W. meters and using Equation 7.

Equation 7. Power = V x I x K

Where: V = Voltage read at Y.E.W. voltmeter
I = Current read at Y.E.W. ammeter
K = Potential transformer ratio (20.067 for 2200V to 110V position)

Example 3: V = 25.6V I = 10 AMPS
P = V x I x K = 25.6 x 10 x 20.067
P = 5.14kW

d. Adjust R17, (LO CAL) potentiometer on the control unit main PC board, slowly until the display of the DPM indicates the actual power being applied. After each adjustment allow the display to stabilize. Repeat steps 6-8c. and d. several times, due to power fluctuations, to assure accuracy of the unit to be within ±2.5% of actual power. The error percentage can be determined by Equation 8.

Equation 8: $$\% \text{ error} = \frac{\text{Actual Power} - \text{Indicated Power}}{\text{Actual Power}} \times 100$$

Where: Actual Power = Y.E.W. meter reading
Indicated Power = Calorimeter reading

e. Turn off ac power source and allow load/sensor unit to run for several minutes to cool until calorimeter display is stabilized at zero.

6-9. LOW RANGE FLOW INDICATOR CALIBRATION

6-10. This section explains calibration of flow indicator LOW range. Refer to Figure 6-7 while following the steps below.

a. Place the control unit in low range by depressing the range selector button. Also place the flow control switch on the load/sensor unit to LOW range. (10kW Calorimetric unit is low range only.)

b. Connect the positive lead of dc millivoltmeter to the common leg of resistors R1 and R2 and the negative lead to pin 2 of J1 on flow indicator PC board. Adjust the voltage between the common leg of R1 and R2 and pin 2 of J1 on flow indicator PC board to 687mV ± 1mV by adjusting R3.

c. Disconnect millivoltmeter and connect positive lead of frequency counter to pin 8 of header J1 on the main PC board and negative lead to PC board ground (see Figure 6-2). The frequency output should be 350Hz ± 5Hz. If it is, proceed to adjust R10 (flow indicator PC board) until the third LED is lighted, which represents 3.5 GPM. If the frequency output is not 350Hz ± 5Hz, the flow control valve will have to be adjusted appropriately. See Figure 5-3 for location of flow control valve.

6-11. TEST PROCEDURES

a. Testing LOW Power Range Accuracy -

1. Set HI/LOW switch to LOW position and adjust CAL potentiometer until the display indicates zero.

2. Turn ac signal source on and apply approximately 10kW, 14 amps on Y.E.W. ammeter, and check to see that the calorimeter accuracy is within the ±2.5% specification as described above.

3. Turn off ac signal source and allow load/sensor unit to cool until calorimeter's DPM display is stabilized at zero.

4. Connect potential transformer and Y.E.W. meters as shown in Figure 6-8.

5. Turn on ac signal source and adjust power to read 4.5 amps on Y.E.W. ammeter to check accuracy at approximately 1kW. Use Equation 7 and new example as follows:

Where: V = 56.9V = reading on voltmeter
I = 4.5 amps = reading on ammeter
K = 4 = ratio constant

Example 4: 56.9V x 4.5 amps x 4 = 1.02kW

The display reading should be within ±2.5% of actual power being applied. If not, recalibrate low range.

6. Turn off ac signal source and let load/sensor unit run for several minutes to allow unit to cool.

7. After cooling is complete, turn off power to load/sensor unit and control unit.

8. This completes all calibration and unit is now ready for use.

FIGURE 6-1. Y.E.W. METER CONNECTIONS - HI POWER CALIBRATION.

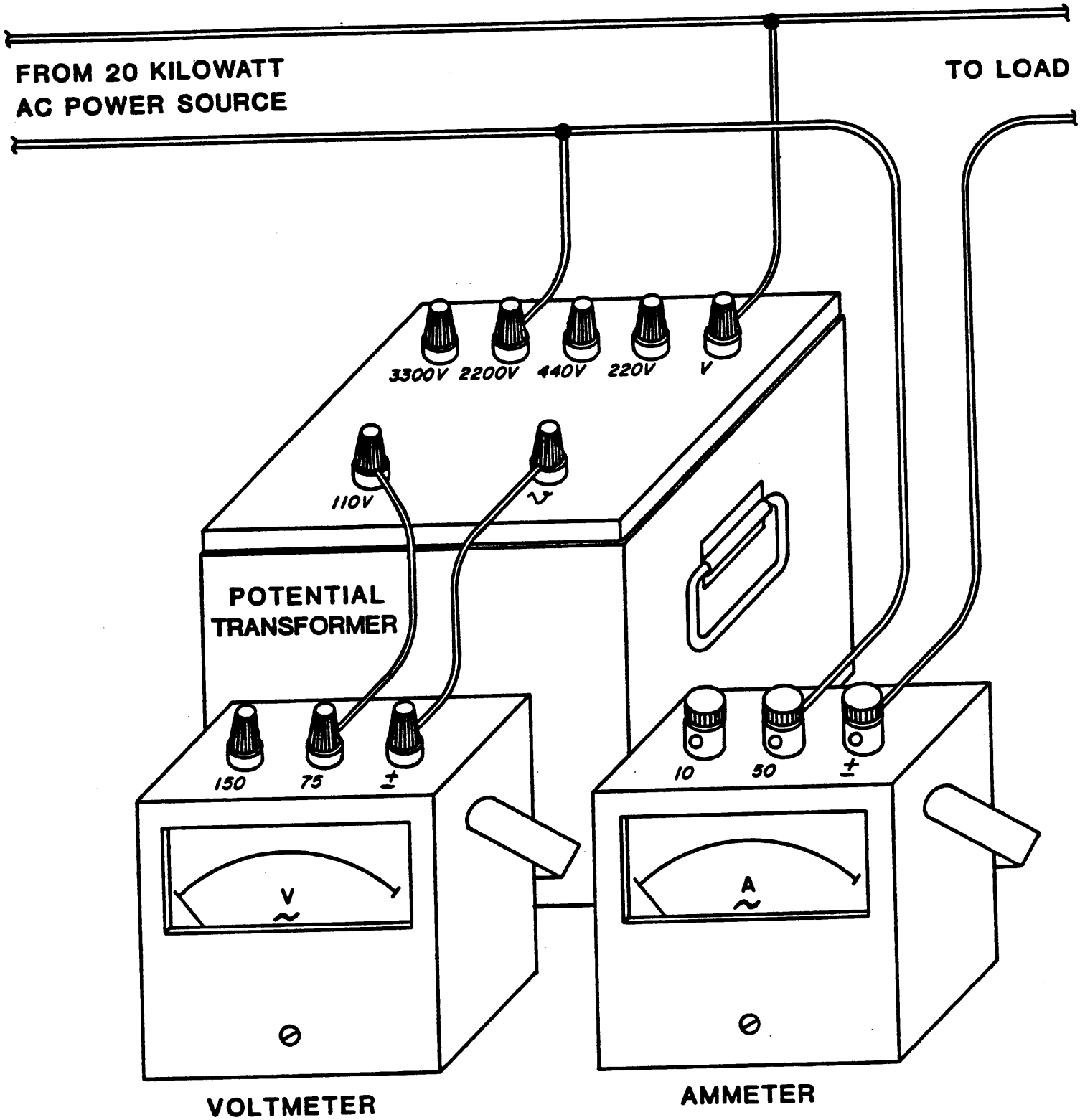


FIGURE 6-2. NULL TEMPERATURE SENSORS.

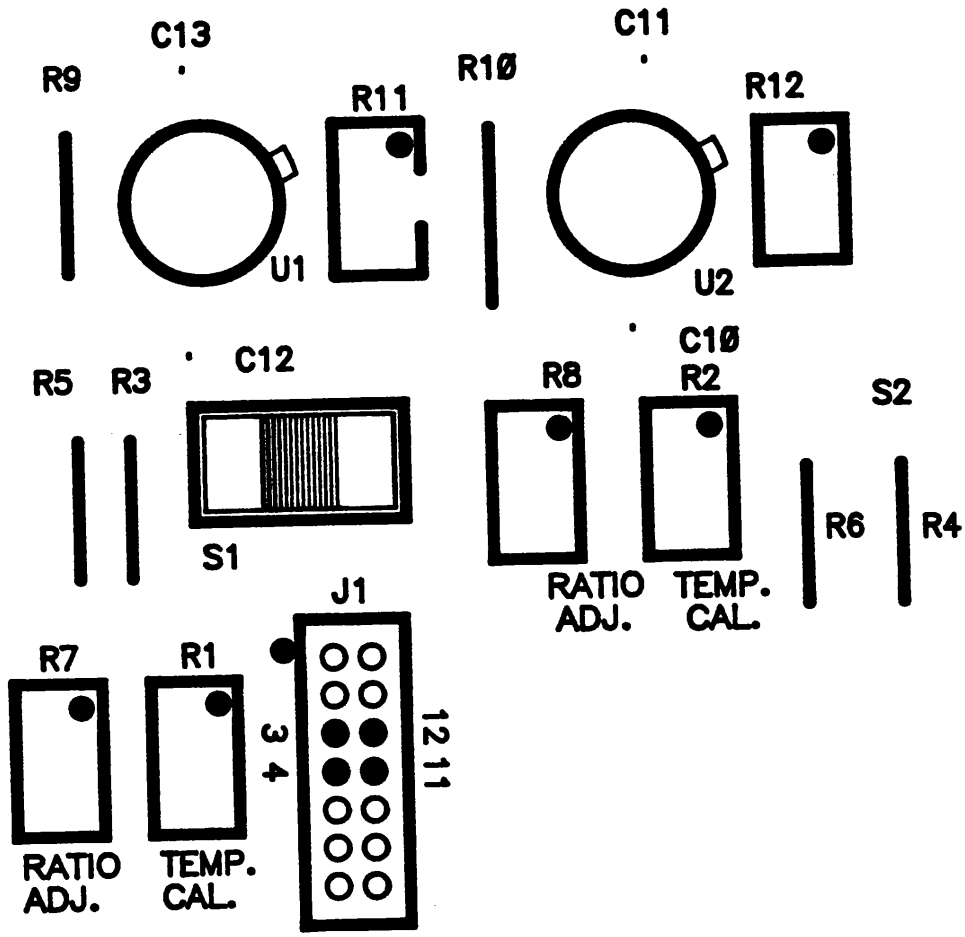


FIGURE 6-3. CALIBRATE OUTPUT TEMPERATURE SENSOR RATIO.

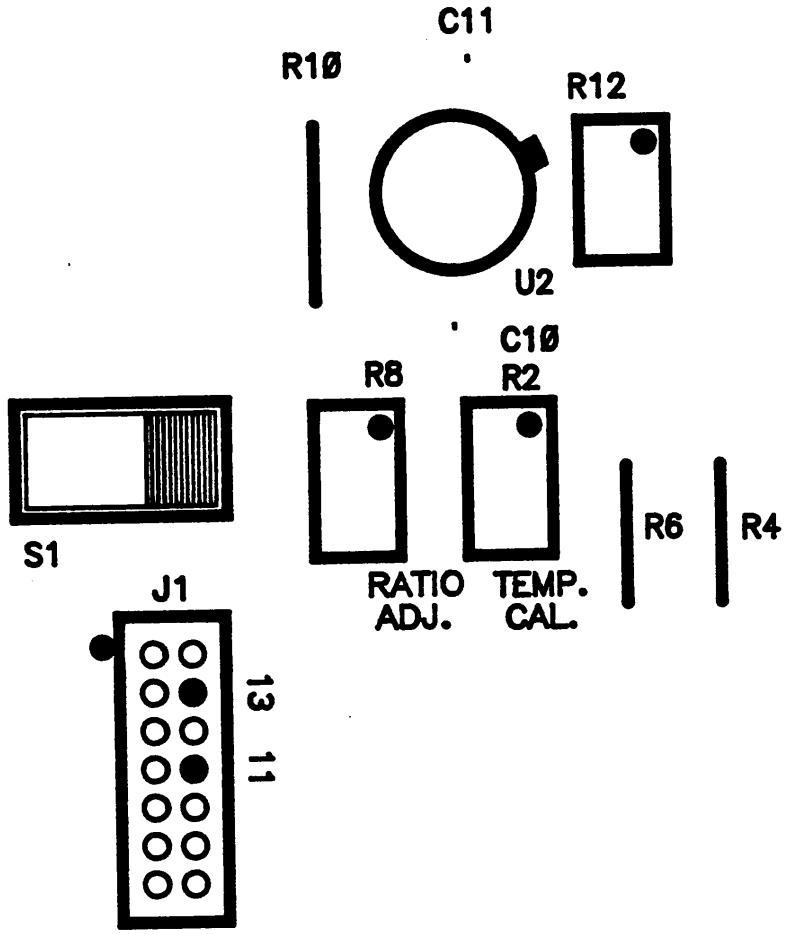


FIGURE 6-4. CALIBRATE INPUT TEMPERATURE SENSOR RATIO.

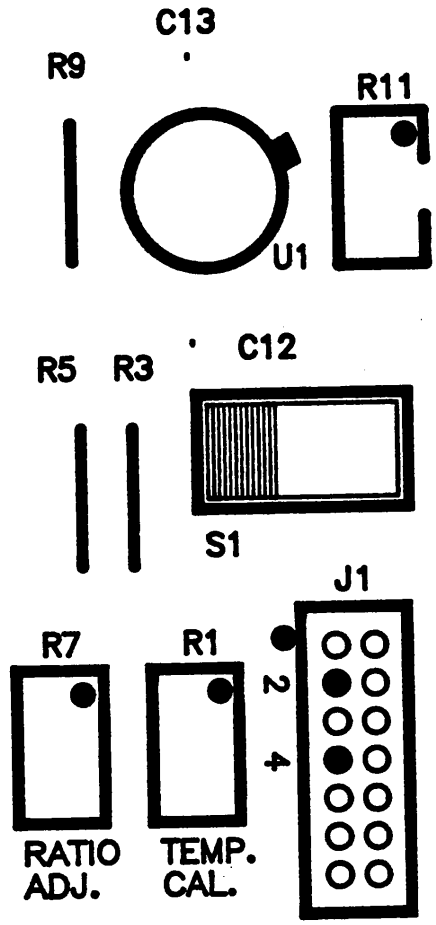


FIGURE 6-5. CALIBRATE TEMPERATURE SENSORS.

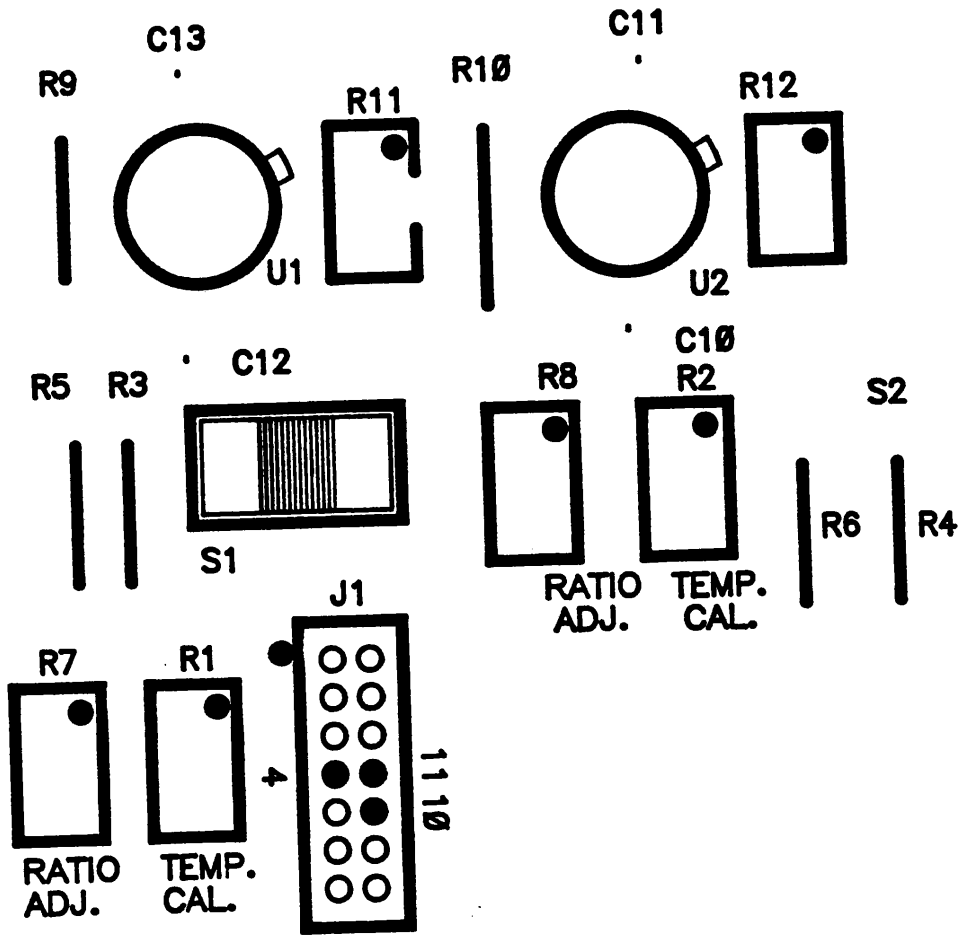


FIGURE 6-6. UNIT CALIBRATION.

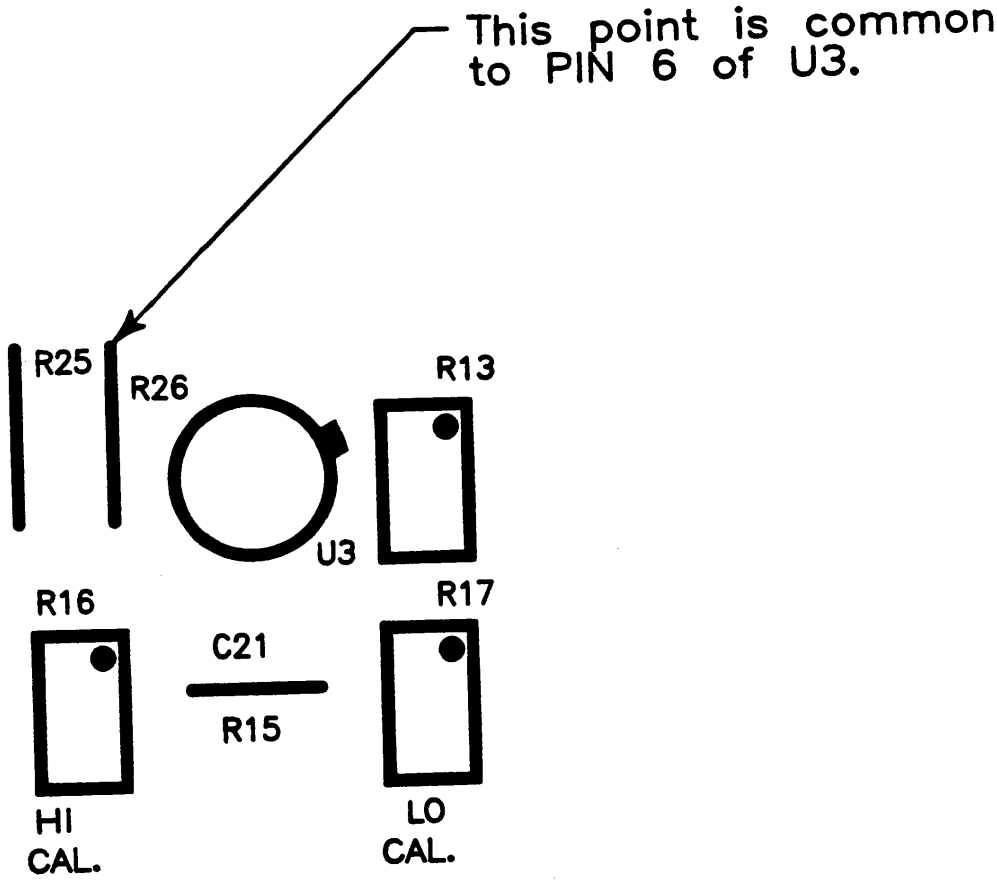


FIGURE 6-7. FLOW INDICATOR CALIBRATION.

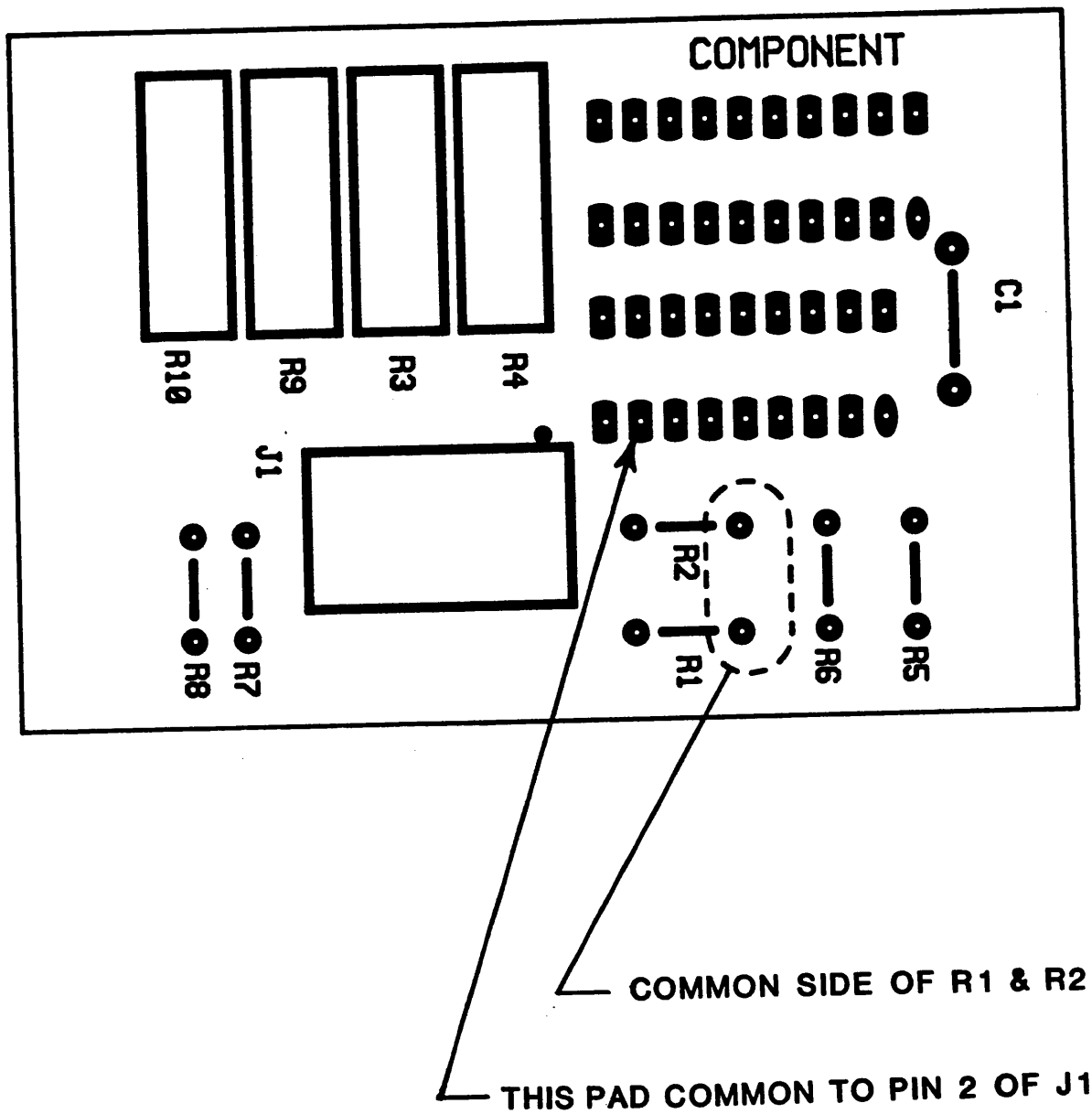
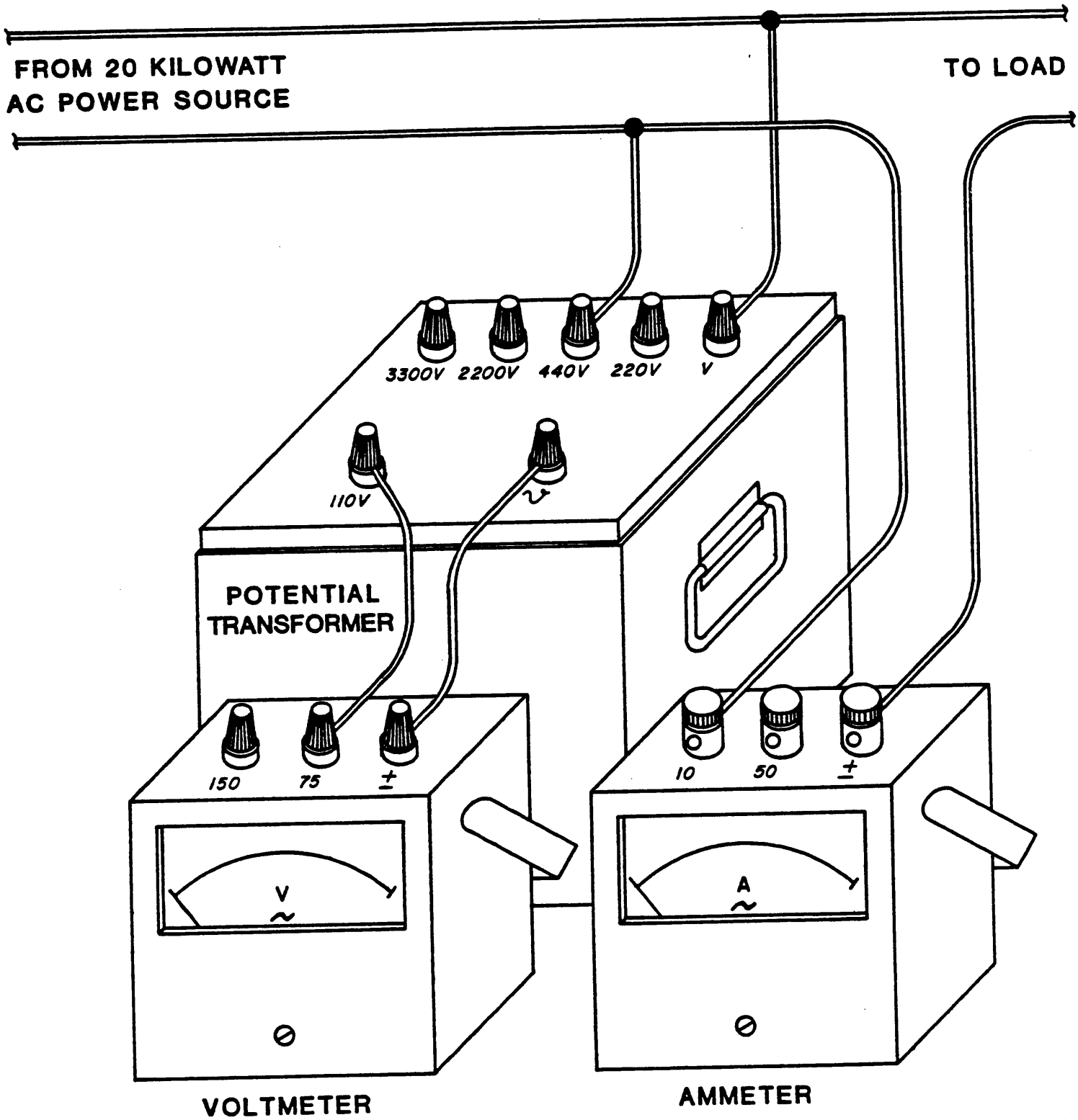


FIGURE 6-8. Y.E.W. METER CONNECTIONS - LOW POWER CALIBRATION.



SECTION VII - REPLACEMENT PARTS

7-1. GENERAL

7-2. The purpose of this section is to provide the user with a consumables type spare parts listing. Quantities used within the calorimeter are indicated.

7-3. Refer to Figure 7-1 for location of spare parts. Item numbers correspond to call outs in Figure.

LOAD/SENSOR UNIT PARTS:

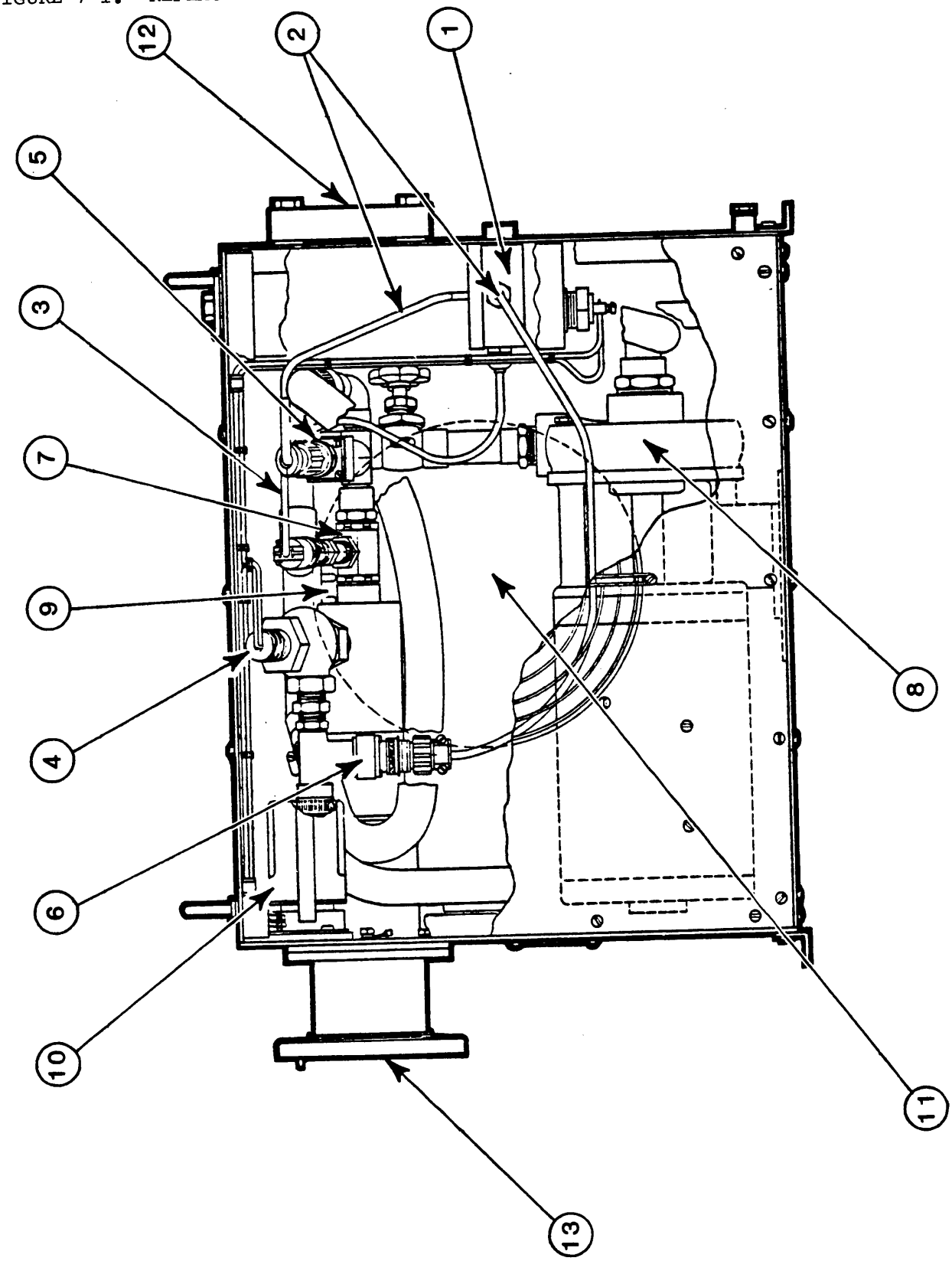
ITEM	QTY.	DESCRIPTION	PART NUMBER
1	1	Sensor Box Assembly (includes Items 2 & 3)	8640-633-2
2	2	Temperature Sensor Cables	6080-096-1
3	1	Flow Sensor Cable	6080-025-2
4	1	Flow Switch Assembly	8630-035
5	1	Temperature Sensor Assembly (Input)	6080-095-1
6	1	Temperature Sensor Assembly (Output)	6080-095-2
7	1	Flowmeter	5-1145-1
8	1	Pump 115V	5-1053-1
		230V	5-1053-2
9	1	Strainer	5-1676
10	1	Time Delay Relay - 115V	5-1627
		- 230V	5-1625
11*	1	Fan - 115V	8630-644-1
		- 230V	8630-644-2
12	1	Coolant Gauge -	5-1200
		Replacement kit includes:	
		Body, self-sealing screws and O-Ring seals	
13	1	RF Load Resistor	
		Model 8631-( )	8731-101
		Model 8635-( )	8730-101
		Model 8638-( )	8738-101
14**	1	AC line cord	4421-055
15**	1	Fuse - 115V	5-1828-34
		- 230V	5-1828-30

* Located on fan panel, which was removed in Figure 7-1 to expose load/sensor unit internal components.

** Refer to Figure 1-1 for location of these parts.

7-4. Refer to Figure 7-2 for location of spare parts. Item numbers correspond to call outs in Figure.

FIGURE 7-1. REPLACEMENT PARTS ILLUSTRATION - LOAD/SENSOR UNIT SECTION.



REPLACEMENT PARTS LIST [CONT.]

CONTROL UNIT PARTS:

ITEM	QTY.	DESCRIPTION	PART NUMBER
1	1	Main PC Board	6080-306
2	1	Flow Indicator PC Board	6080-318
3	1	3-1/2 Digit Panel Meter with optional BCD output	5-1910
4	1	Cable Assembly, BCD Option	6080-315
5	1	Switch, power assembly	6080-305
6*	1	AC Line Cord	4421-055
7*	1	Fuse	5-721-6

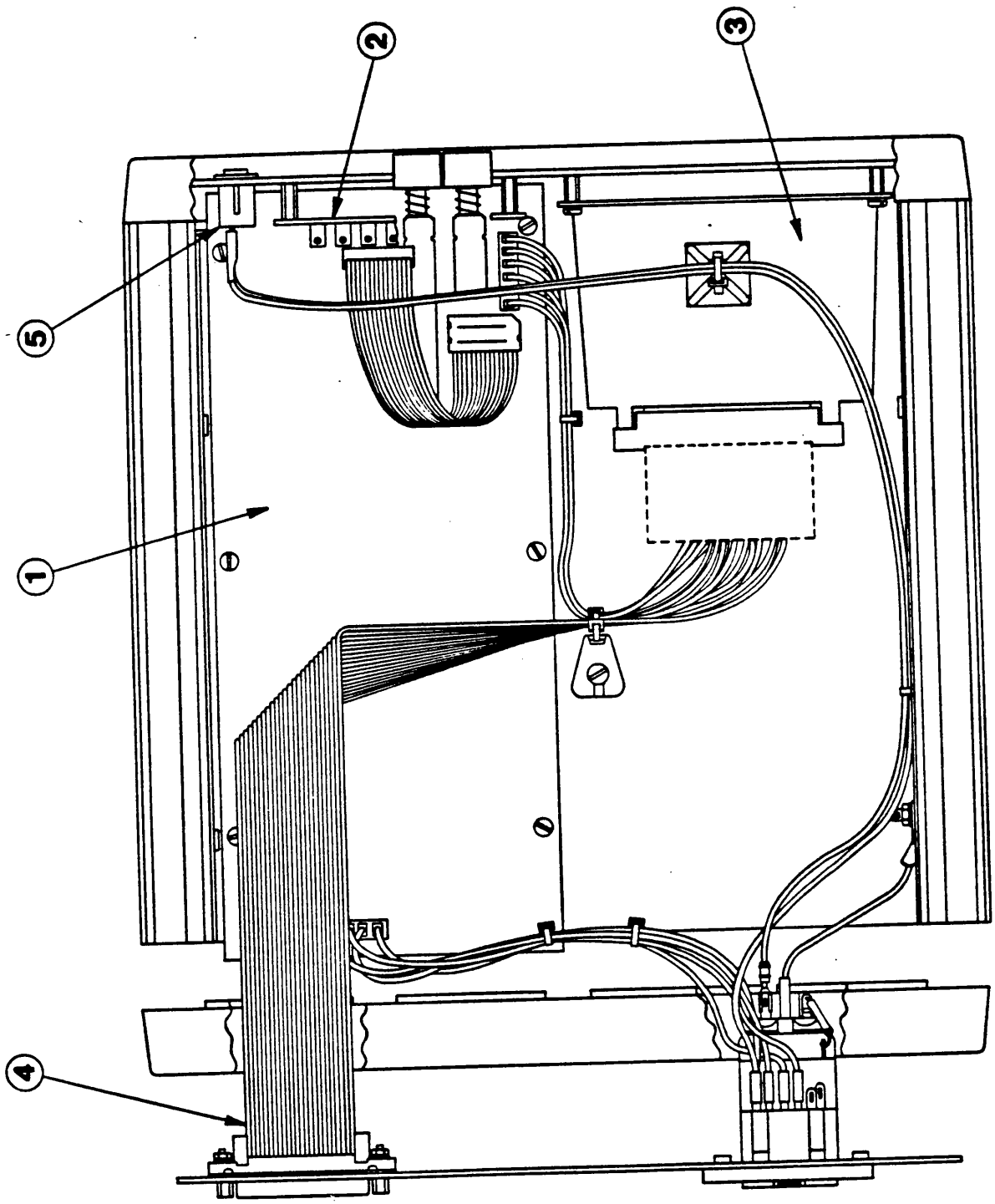
* Refer to Figures 1-1 and 1-2 for location of these parts.

ADDITIONAL PARTS:

ITEM	QTY.	DESCRIPTION	PART NUMBER
1	1	Sensor Cable	6080-320-1

NOTE: Sensor cables can be purchased in various lengths. For more information contact Bird Electronic Corporation.

FIGURE 7-2 REPLACEMENT PARTS ILLUSTRATION - CONTROL UNIT SECTION.



SECTION VIII - INTERNAL REPAIR OF THE LOAD RESISTOR

8-1. REPLACEMENT PROCEDURE FOR RESISTIVE ELEMENT

8-2. The water cooled load used in this load/sensor unit is designed to be quickly and easily repaired in the field. If in performing the dc resistance check described in Paragraph 4-6 of this manual a significant change in resistance is noted, or if for any reason the resistive element should fail, inexpensive replacement resistors are available. Installation is accomplished as described in this section.

8-3. The entire load resistor unit need not be removed from the load/sensor unit as a piece. It is simpler to disassemble it in place by the following procedure:

8-4. Load Resistor Dismounting - Parts designated by parentheses ( ) around the numbers in the ensuing text transfer to the parts that are shown in Figures 8-1, 8-2 and 8-3 attached herewith. For other parts, not part of the 8730 Series Load, refer to Section IV - Maintenance.

a. Drain coolant from the equipment by unscrewing the drain plug from the lower face of the back of equipment (see Paragraph 1-25 of this instruction book). Do not mislay the drain plug. Use only the supplied drain plug for plugging, and do not reuse coolant (see Paragraph 1-21).

b. Remove the top panel of load/sensor unit. Unscrew the eighteen 8-32 x 1/4 truss head screws and remove coolant filler plug. Lift lid off by handles.

c. The 8-32 x 1/8 socket set screw will appear on top of the water chamber assembly (3) near the housing (10) seam. Using a 5/64 Allen wrench, remove the socket set screw and carefully retain it for reuse.

d. With a 7/16 end-wrench, unscrew the six 1/4-20 x 5/8 flange mounting screws from inside the front panel. Fully remove them to release exterior flanges. Notice ground lug from terminal block.

e. Using a leather strap type pipe wrench, or by twisting the housing flange on the outside of the front panel, turn the housing counterclockwise while firmly holding the water chamber and flow switch at the back. A little extra torque will break the initial screw compression, the housing should screw off easily on its fine pitch threads. Unscrew the housing until threads are disengaged and pull it out of the front panel.

f. After removal of the load housing assembly (10), to prevent displacement of the center conductor assembly, it may be best to temporarily reattach the outer conductor assembly of the ECONOLOAD® Load Resistor, Item (19), (26) or (28). Do this with two of the 1/4-20 mounting screws placed through diametrically opposite flange holes, fastened thumb-tight.

g. The load resistor is now ready for repair.

8-5. Resistor Removal -

a. This water chamber complex of the load resistor chamber assembly (3), and flow switch with the attaching adapters may be dismounted, but this is not necessarily required or recommended. Do this only by carefully unscrewing the wired sensor plug of the flow switch, with a 1-1/2 end-wrench. Do not disconnect wiring. Follow instructions of Section V, Paragraph 5-7 of this instruction book for entire load removal.

```
**********************************************************
*                      C A U T I O N                     *
*                                                        *
* The adapter fittings are not normally removed from the *
* water chamber. They are very likely to leak upon       *
* refitting to original position.                        *
**********************************************************
```

The O-Ring inlet seal (4) in the water chamber (3) may be removed and replaced if necessary (see Figure 8-1).

b. Notice that the process of resistor replacement for the ECONOLOAD® Load Resistor is to be done with the unit held vertically, connector end down. Handle gently and keep parts clean.

c. Remove the retainer sleeve (6) and O-Ring sleeve backup (7). The inner flow tube (8) maybe removed. Next grasp resistor ground cap (9) and remove it by pulling with a slight rocking motion.

d. The end of the resistor (1) will now be exposed. Carefully withdraw the resistor with a slight rocking motion if needed, from the load housing. Notice carefully at this point that the spacer ring (30) remains nested inside the resistor fitting (16) or (22). It should be there at reassembly. If displaced it may have to be repositioned (refer to Figures 8-2 and 8-3 respectively for illustration). Be sure to bottom spacer ring.

8-6. Inspection - At this point, inspect the resistor and visible internal parts for damage. In the majority of cases even in the event of a resistor failure, the resistor substrate will remain intact. If so, continue the procedure in this section, starting with Paragraph 8-7a. Use the special procedure for the replacement of fractured resistors or damaged internal parts, as the condition of the resistor or internal parts require.

8-7. Resistor Replacement - Take particular care of outside surface of resistor(s). Treating the surface gently, wipe with soft cloth. Do not fire, sand, or use abrasive action.

a. Insert the new resistor (1) into the load housing until it reaches the resistor fitting, then gently rotate and rock the resistor until it starts to enter its way into the resistor fitting. Push the resistor into the fitting until it bottoms on the spacer

ring. Be sure spacer ring (30) is in proper place. If the resistor seems to be loose, refer to the procedure for the replacement of fractured resistors or damaged internal parts below for instructions on how to tighten the resistor fitting.

b. If damaged, replace the inner flow tube. If undamaged, place the original flow tube (8) inside the resistor (1) and lower it until it reaches the resistor fitting. Gently work and twist the inner flow tube until it seats in the bottom of the resistor fitting.

c. Place the resistor ground cap (9) on the exposed end of the resistor (see Figure 8-1) and press it into place. Slide the sleeve back-up, O-Ring (7) down the inner flow tube until it rests on the end of the resistor. Then slide the retainer sleeve (6) down the inner flow tube until it rests on the O-Ring (7), insuring that the end of the retainer sleeve with the larger inside diameter goes on first.

d. Check O-Ring, inlet seal (4) to see that it is properly seated in its groove in the inside of water chamber subassembly (3). At this point, ordinarily, the water chamber will not have been dismounted. Be sure the screws are removed from the flange connecting the outer conductor assembly (see Paragraph 8-4f). Reintroduce the resistor housing (10) through the front panel opening and into the water chamber, turning gently clockwise to thread it on, eventually bottoming in its original position. Now reverse the procedures of Paragraph 8-4 to restore original condition. Do not replace top panel until the procedures in Paragraph 8-7e. have been completed.

e. Check the dc resistance between the outer and inner conductors; it should be approximately 50 ohms. If OK, fill equipment with coolant, performing the flush out procedures according to 5-5, Special Instructions and check for leaks.

f. Note - After the completion of this or any of the resistor repair procedures, we urge a 10kW test on ac line power with the load/sensor unit in operation for at least one-half hour and a recheck of dc resistance before RF load use.

8-8. REPLACEMENT OF FRACTURED RESISTOR OR DAMAGED INTERNAL PARTS

8-9. Resistor Removal -

a. The load should already be disassembled to the point of step 8-5d. Now turn the load on end, with the RF input connector up to allow pieces of parts, if present, to fall out of the load housing.

b. Loosen and remove the 1/4-20 x 5/8 hex head screws (31) from the flanged end of the load housing assembly, as shown in Figure 8-1. The outer conductor assembly (19), (26), or (28) may now be easily removed.

c. Next remove the input center conductor assembly (see Figure 8-1), by pulling it out of the load housing assembly (10).

8-10. Input Center Conductor Assembly -

a. Model 8730-101, 1-5/8" EIA flanged input connector only, Figure 8-2.

1. Remove the 1/4-20 x 3/4 pan head machine screw (20) and 1/4 split lockwasher (21) by unscrewing item (20) while holding the center conductor (18) stationary. The center conductor (18), the center conductor adapter (17) and the insulator (15) may now be easily removed from the rest of the assembly.

2. Remove the resistor fitting (16) by pushing the exposed end of the fitting into the outer flow tube (13). The resistor fitting and any broken pieces of resistor will then fall from the opposite end of the outer flow tube (see Figure 8-2).

3. Inspect all O-Ring seals, metal and internal parts for damage. The metal parts may be discolored or oxidized and may be cleaned by rubbing with fine steel wool. The Teflon parts are cleaned with soap and water; however, if any of the internal parts are damaged they must be replaced to insure proper electrical and/or thermal performance of the load. Insert the replacement resistor (1) into the resistor fitting (16). If the fitting is loose press the slotted finger contacts of the fitting together slightly and try the resistor again. Continue this procedure until a snug fit is obtained.

4. Reassemble input center conductor assembly. First replace O-Ring, outer flow tube seal (14), if necessary, then insert resistor fitting (16) in position in the outer flow tube (13) as shown in Figure 8-2. Replace insulator (15), center conductor adapter (17), and center conductor (18). Tighten in place with 1/4-20 x 3/4 pan head machine screw (20) and 1/4 split lockwasher.

b. Model 8731-101 3-1/8" EIA flanged and Model 8738-101 3-1/8" unflanged input connector, Figure 8-3.

1. Loosen and remove the 3/8-16 hex nut (24) and the 3/8 split lockwasher (25) with a 9/16 socket or nut driver while holding the center conductor stationary. The center conductor (23) for Model 8731 or (27) for Model 8738 and the insulator (15) may now be easily removed.

2. Remove the resistor fitting (22) by pushing the exposed threaded end of the fitting into the outer flow tube (13). The resistor fitting (22) and any broken pieces of resistor will now fall from the opposite end of the outer flow tube (see Figure 8-3).

3. Inspect all internal parts and O-Ring seals for damage. The metal parts may be discolored or oxidized and may be cleaned by polishing with fine steel wool. The Teflon parts are cleaned with soap and water. However, if any of the internal parts are damaged they must be replaced to insure the proper electrical and/or thermal performance of the load.

4. Insert the replacement resistor (1) into the resistor fitting (22). If the fitting is loose press the slotted finger contacts together slightly and try the resistor again. Continue this procedure until a snug fit is obtained.

5. Reassemble the input center conductor assembly by first replacing the O-Ring and outer flow tube seal (14), if necessary. Then insert the resistor fitting (22) in position in the outer flow tube (13) as shown in Figure 8-3. Replace insulator (15) and center conductor, (23) for Model 8731 and (27) for Model 8738, and tighten in place with 3/8-16 hex nut (24) and 3/8" split lockwasher (25).

8-11. Final Assembly -

a. Replace the input center conductor assembly by lowering it into the flanged end of the load housing assembly (see Figure 8-1), and pressing it in place.

b. Remount the outer conductor assembly (19) for Model 8730, (26) for Model 8731 or (28) for Model 8738, by placing the flange with the threaded holes against the flange of the housing assembly (10) and tighten the six 1/4-20 x 2/8 hex head cap screws (31) securely (see Figure 8-1).

c. Continue with instructions given in Paragraph 8-7a. through e.

FIGURE 8-1. SERIES 8730 RF LOAD, EXPLODED VIEW (MODEL 8731 SHOWN).

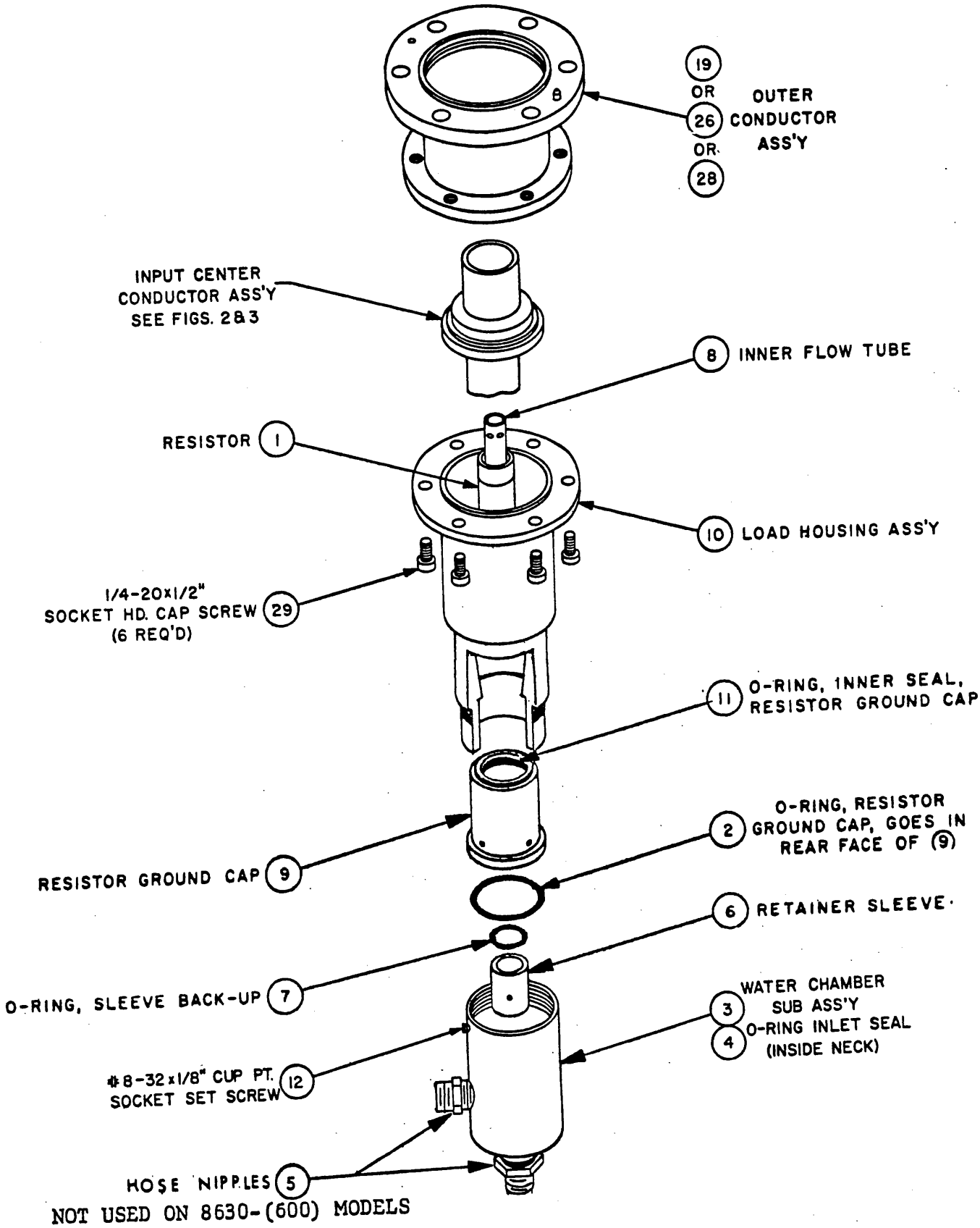


FIGURE 8-2. INPUT CENTER CONDUCTOR ASSEMBLY, MODEL 8730.

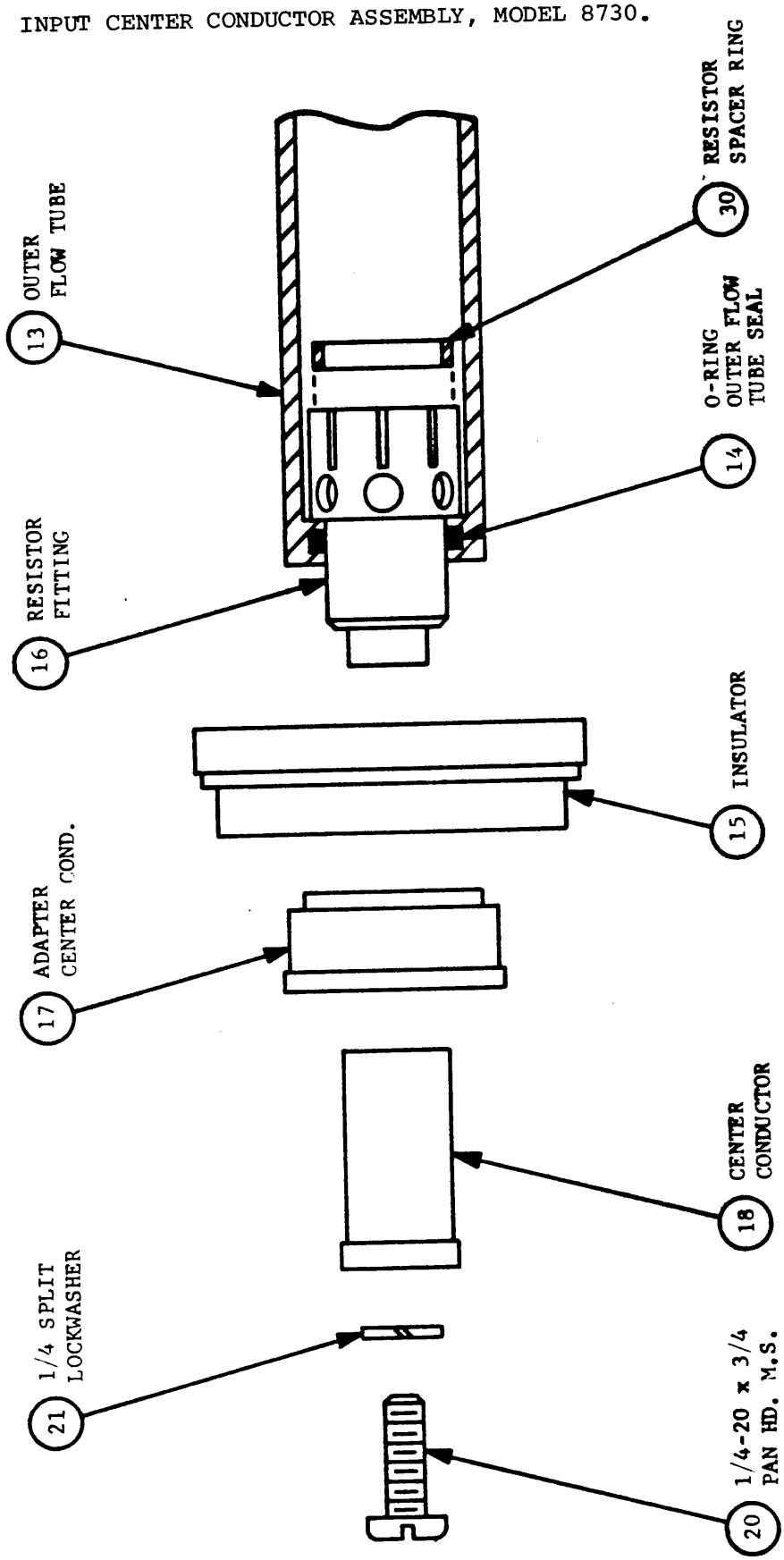
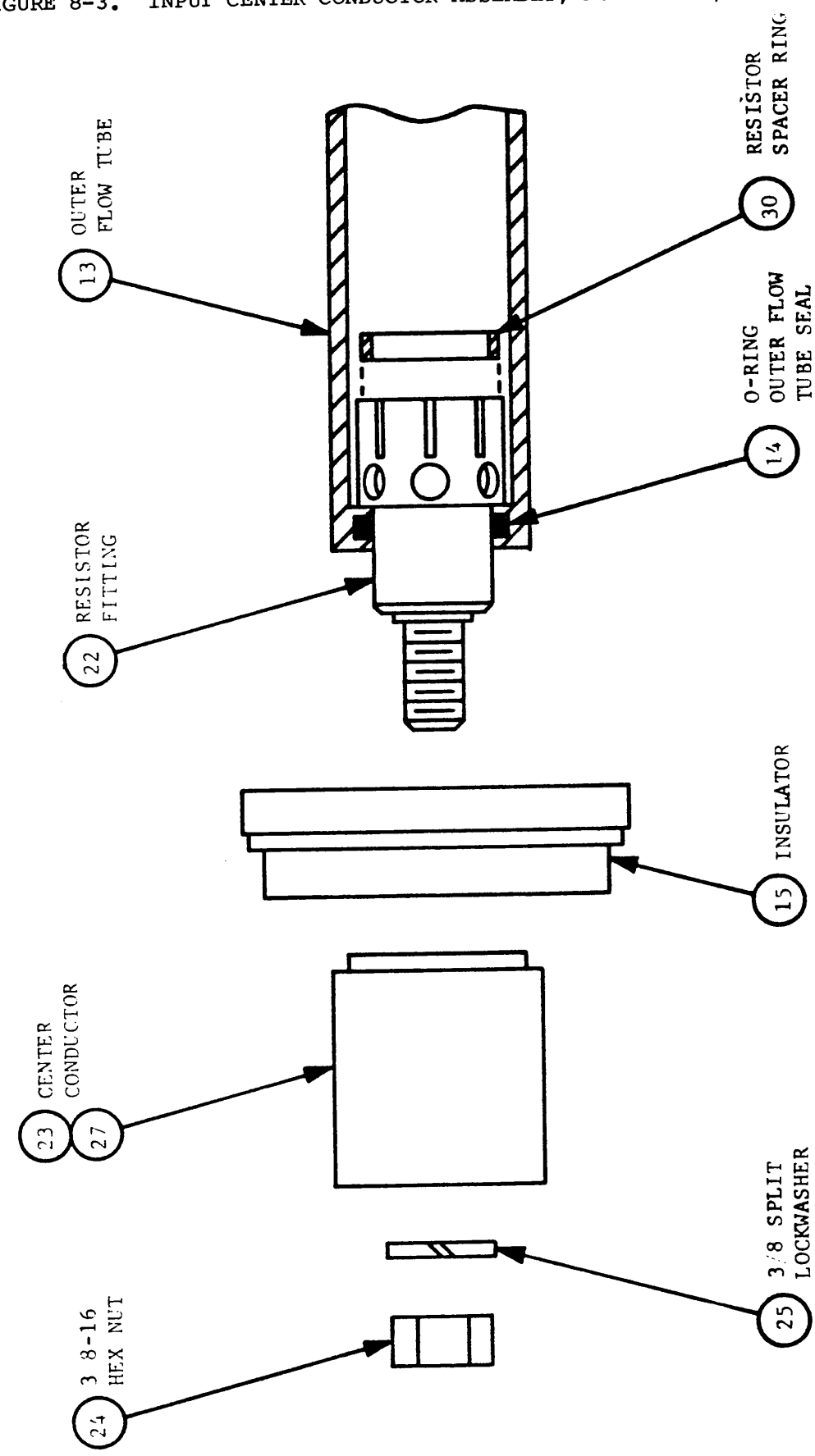


FIGURE 8-3. INPUT CENTER CONDUCTOR ASSEMBLY, MODEL 8731/8738.



8-12 REPLACEMENT PARTS LIST

8-13. MODELS 8731-101, 8738-101 AND 8730-101 LOAD RESISTORS FOR LOAD/SENSOR UNIT -

8-14. Item numbers are equivalent to circled numbers on figures.

ITEM	QTY.	DESCRIPTION	PART NUMBER
1	1	Resistor	8731-021
2	1	Resistor Ground Cap Rear Seal O-Ring	5-176
3	1	Water Chamber Subassembly	8731-025
4	1	Inlet Seal O-Ring	5-430
5	0	(Hose Nipples Omitted)	
6	1	Retainer Sleeve	8731-023
7	1	Sleeve Backup O-Ring	5-1142
8	1	Inner Flow Tube	8731-022
9	1	Resistor Ground Cap	8731-007
10	1	Assembly Housing	8731-002
11	1	Resistor Ground Cap Internal Seal O-Ring	5-187
12	1	8-32 x 1/8 Cup Point Socket Set Screw	Standard
13	1	Outer Flow Tube	8731-016
14	1	Outer Flow Tube Seal O-Ring	5-099
15	1	Insulator	8731-018

Front Connector Parts Assigned Per Model Type Below:

LOAD/SENSOR UNIT (Model 8635) 8730-101 - 1-5/8" EIA Flanged Connector - 50 ohms

	(1)	Center Conductor Assembly	
16	1	Resistor Fitting	8730-008
17	1	Center Conductor Adapter	8730-009
18	1	Center Conductor	8730-010
19	1	Outer Conductor Assembly	8730-002
20	1	1/4-20 x 3/4 Pan Head Machine Screw	Standard
21	1	1/4 Split Lockwasher	Standard

LOAD/SENSOR UNIT (Model 8631) 8731-101 - 3-1/8" EIA Flanged Connector - 50 ohms

	(1)	Center Conductor Assembly	
22	1	Resistor Fitting	8731-017
23	1	Center Conductor	8731-015
24	1	3/8-16 Hex Nut	Standard
25	1	3/8 Split Lockwasher	Standard
26	1	Outer Conductor Assembly	8731-004

LOAD/SENSOR UNIT (Model 8638) 8738-101 - 3-1/8" Unflanged Connector - 50 ohm

	(1)	Center Conductor Assembly	
22	1	Resistor Fitting	8731-017
24	1	3/8-16 Hex Nut	Standard
25	1	3/8 Split Lockwasher	Standard
27	1	Center Conductor	8738-005

REPLACEMENT PARTS LIST [CONT.]

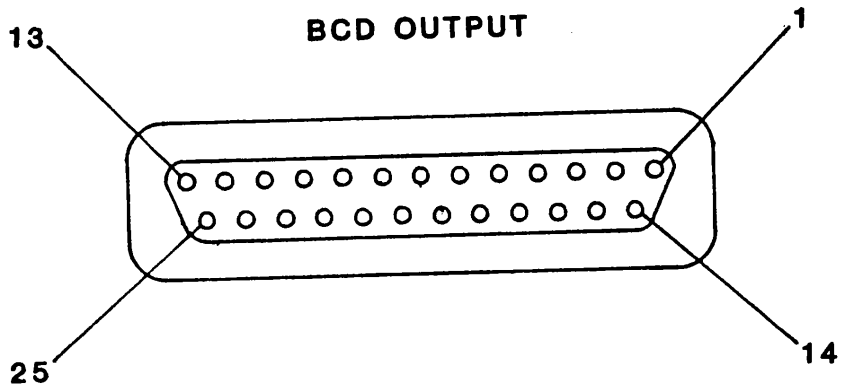
ITEM	QTY.	DESCRIPTION	PART NUMBER
28	1	Outer Conductor Assembly	8738-002
For All Models			
29	6	1/4-20 x 5/8 Hex Head Cap Screw	Standard
30	1	Resistor Fitting	8731-008

SECTION IX - BINARY-CODED-DECIMAL (BCD) OUTPUT CONNECTOR

9-1. GENERAL

9-2. A 25-pin D-shell connector for the Binary-Coded-Decimal outputs is provided on the upper left hand portion of back panel of the digital control unit. A drawing of the pin locations for same, with description of the pin assignments is provided in Figure 9-1.

FIGURE 9-1. BCD CONNECTOR PIN FUNCTIONS.



Pin No.	Function	Pin No.	Function
1	BCD 100	14	BCD Ground
2	BCD 200	15	Hold
3	BCD 400	16	NC
4	BCD 800	17	BCD 1000
5	NC	18	+5V
6	BCD 10	19	OE3 (Tens)
7	BCD 20	20	OE2 (Hundreds)
8	BCD 40	21	OE4 (Units + Overrange)
9	BCD 80	22	OE1 (Thousand + Polarity)
10	BCD 1	23	Overrange
11	BCD 2	24	Polarity
12	BCD 4	25	Data Valid
13	BCD 8		

9-3. SUPPLY WIRING (See Figure 9-1)

a. Pin 18 must be powered by an external power supply, which must supply a regulated power of +5Vdc @ 6mA.

Pin 14 is connected to the external power supply ground.

IMPORTANT NOTE:

BCD output and logic signals are referenced to the external power supply.

9-4. LOGIC INPUT WIRING (See Figure 9-1)

a. All Output Enable (OE) lines are internally pulled to ground through a 100k ohm resistor.

For a multiplexed BCD output, each digit can be disabled by putting a Logic "1" (+5Vdc) on its OE line, and enabled by disconnecting it or pulling the OE line down to Logic "0" (0Vdc).

b. Putting a Logic "1" (+5Vdc) on Data Hold (Pin 15) locks the present data into the output storage latches until the Data Hold is returned to Logic "0" (0Vdc). With removal of Logic "1", Data Hold will automatically return to Logic "0".

9-5. DATA OUTPUT WIRING

There are three commonly used output formats compatible with the Model 6080A. Once you have determined which format is required, follow the wiring instructions for that format only.

a. Full Parallel BCD Output Lines (See Figure 9-1):

1. For a fully parallel BCD output, no connections to the four output enable lines are necessary.

2. The Data Valid Signal (Pin 25) is Logic "1" when data is valid. See note at the end of Section 9-5.

b. Multiplexed BCD Output (Bit Parallel, Digit Serial) See Figure 9-1:

1. BCD Output

2^0 - Pin 10
2^1 - Pin 11
2^2 - Pin 12
2^3 - Pin 13

2. Jumpers Required

Pin To Pin	Pin To Pin
12 - 3	10 - 1
3 - 8	1 - 6
8 - 24	6 - 17
13 - 4	11 - 2
4 - 9	2 - 7

3. Each digit will appear at these pins when its OE line is enabled, and all other lines are disabled.

NOTE: Thousand bit will appear at 2^0 (Pin 10). Polarity bit will appear at 2^2 (Pin 12).

c. 8 Bit Multiplexed (Sometimes used with 8 bit computers) See Figure 9-1:

1. BCD OUTPUT

PIN	OE3 and OE4* LOGIC "0"	OE1 and OE4* LOGIC "0"
10	Units 2^0	Hundreds 2^0
11	2^1	2^1
12	2^2	2^2
13	2^3	2^3
6	Tens 2^0	Thousand
7	2^1	--
8	2^2	Polarity
9	2^3	--
23	Overrange	--

2. Jumpers Required

PIN TO PIN
10 - 1
11 - 2
12 - 3
13 - 4
6 - 17
8 - 24

* All other OE lines must be Logic "1".

3. The Data Valid Signal (Pin 25) is Logic "1" when data is valid.

NOTE: For low input signals (less than 10 counts). Data Valid Signal may not go to Logic "0" when data is updated, because its length is proportional to input signal and may become difficult to detect.

APPENDIX A - LOAD/SENSOR UNIT SCHEMATICS

A-1. GENERAL

A-2. This section contains the schematics for load/sensor unit wired for 115V and 230V.

FIGURE A-1. 10KW LOAD/SENSOR UNIT SCHEMATIC, 115V, 60HZ SUPPLY.

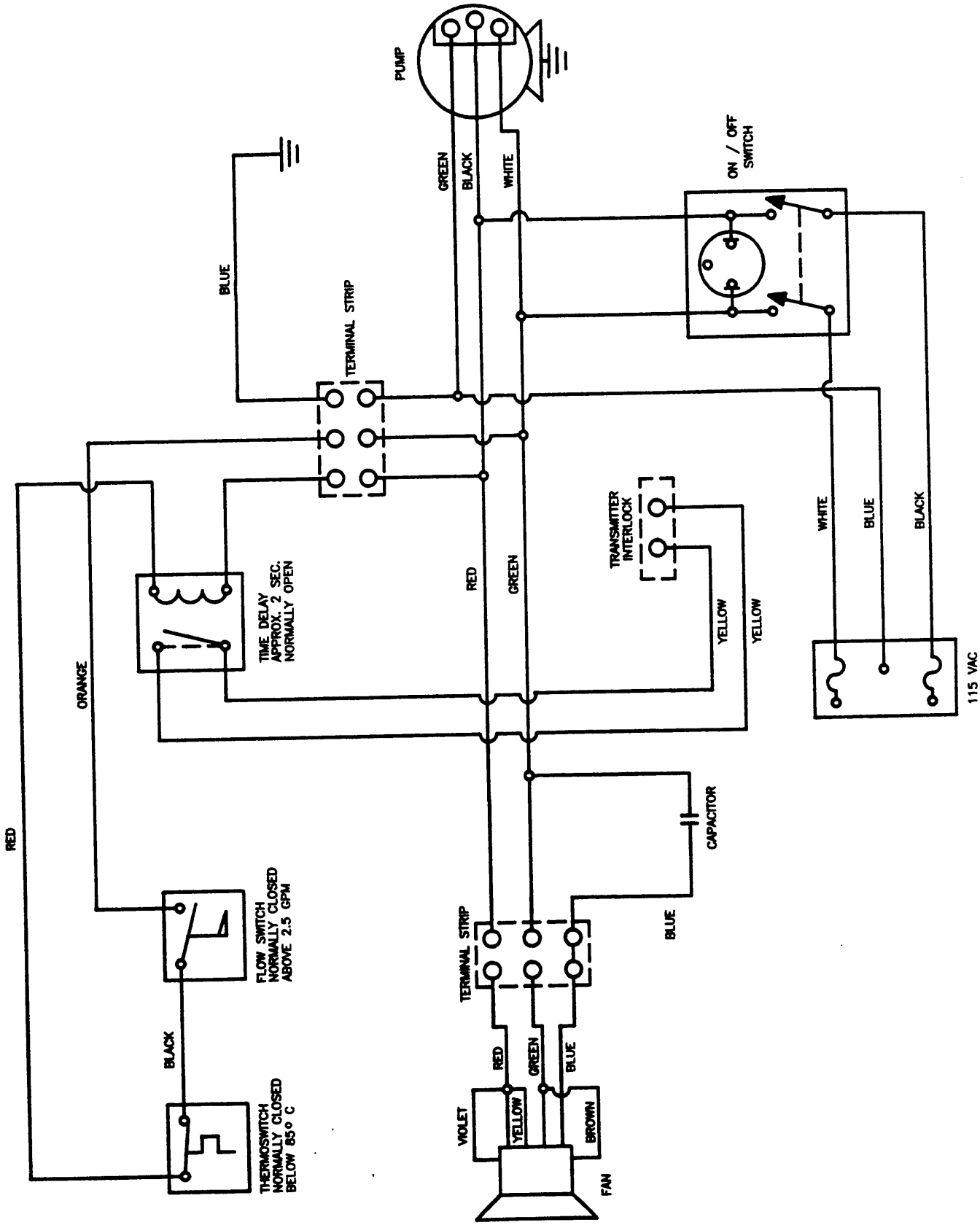


FIGURE A-2. 10KW LOAD/SENSOR UNIT SCHEMATIC, 230V, 50HZ SUPPLY.