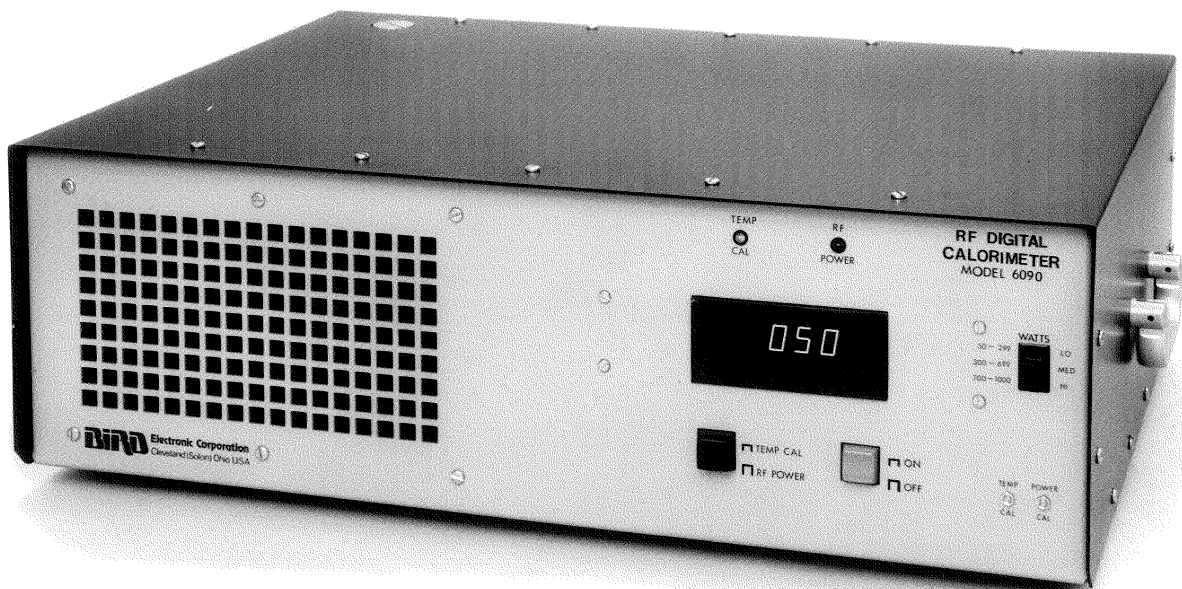


I N S T R U C T I O N   B O O K  
F O R  
M O D E L   6 0 9 0  
R F   D I G I T A L   C A L O R I M E T E R



**BIRD**  
Electronic Corporation

30303 Aurora Road, Cleveland, Ohio 44139-2794  
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## 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 a 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.

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

```
*****
*                                     C A U T I O N                                     *
*                                     *                                               *
* Before any RF operation of the calorimeter is attempt- *
* ed, transmitter interlock and ac line attachment to the *
* equipment must be made. Using a shielded line, attach *
* the transmitter interlock connections first to the two *
* binding posts on the panel. Even momentary operation *
* with RF power and without coolant flow will cause re- *
* sistor burnout. *
*****
```

```
*****
*                                     C A U T I O N                                     *
*                                     *                                               *
* The 115V or 230V ac line may be connected, but ac power *
* must not be applied unless coolant is in the system and *
* filled to the correct level. Damage to the pump will *
* result otherwise. *
*****
```

```
*****
*                                     C A U T I O N                                     *
*                                     *                                               *
* Do not use any sealants, leak stopping material, or *
* automotive antifreeze in the coolant. Use only potable *
* water. Damage may result to the cooling system or load *
* resistor. *
*****
```

Continued

## SAFETY PRECAUTIONS

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not apply more than the units rated RF power as dam- *
* age to the load resistor will result. Do not block air *
* flow. Air enters through the back panel and exhaust *
* through the front. Restricted air flow could cause *
* load resistor failure. Use only potable water for *
* coolant and fill to the proper level. High mineral *
* content water could form scales in cooling system caus- *
* ing blockage and system failure or impaired accuracy. *
*****
```

```
*****
*                               W A R N I N G                               *
*                               *                                           *
* When using dry cleaning solvents, provide adequate ven- *
* tilation and observe normal safety precautions. Many *
* dry cleaning agents emit toxic fumes that may be harm- *
* ful to your health if inhaled. *
*****
```

```
*****
*                               W A R N I N G                               *
*                               *                                           *
* Unplug the device before removing the cover to perform *
* any repair or replacement work to avert the possibility *
* of accidental shock. The potential for electrical *
* shock exists. *
*****
```

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## MODEL 6090 DIGITAL RF CALORIMETER

### INTRODUCTION

#### PURPOSE AND FUNCTION

The Bird Models 6090-115/230\* Digital RF Calorimeters are laboratory instruments designed to eliminate interpretation of temperature differences, flow rates and system constants. The measured power is precisely displayed directly in watts, within its power rating of 1kW, on a digital meter without resort to calculations. \*The 115 suffix is for units which operate on a 115V supply; and the 230 suffix is for units that operate on 230V. Throughout this manual read for applicable voltages.

The RF source is connected directly to the calorimeter through a 50 ohm coaxial cable. Calibration is performed by two simple adjustments, before RF power is applied, and power measurements are ready to be taken. (See Section III - Operating Instructions).

The calorimeter is an excellent RF line termination for frequencies up to 3500MHz. It displays power measurement with an accuracy of better than 3% of reading  $\pm$  one digit, and is not frequency dependent, see Page vii. It measures RF energy transferred as heat into a water medium. The calorimeter is an excellent standard for other wattmeters.

The Model 6090 is comprised of two main sections; one consists of the calorimeter sensors and display, the other consists of an RF load with its circulating cooling water and heat exchanger system.

Two temperature sensors are used for sensing the input and output water temperature to produce a temperature difference or Delta T, and one sensor monitors coolant flow rate. All the information produced by the sensors is fed to an electronic circuitry which processes the information to produce a digitally displayed power measurement.

The RF TERMALINE® Load cooling system is a closed water system consisting of a pump/motor unit, collector tank and heat exchanger with two blower fans. Included in the system is a flow switch for interlock protection of the RF load and transmitter in the event of loss of cooling water flow.

#### CAPABILITIES

The Model 6090 is capable of a continuous power dissipation of 1kW with a VSWR of less than 1.1 to 1 from dc to 1000MHz and 1.25 to 1 from 1000 to 3500MHz. It is designed to be used on CW, AM, FM, and TV modulated envelopes which are fed through a 50 ohm Female N type connector.

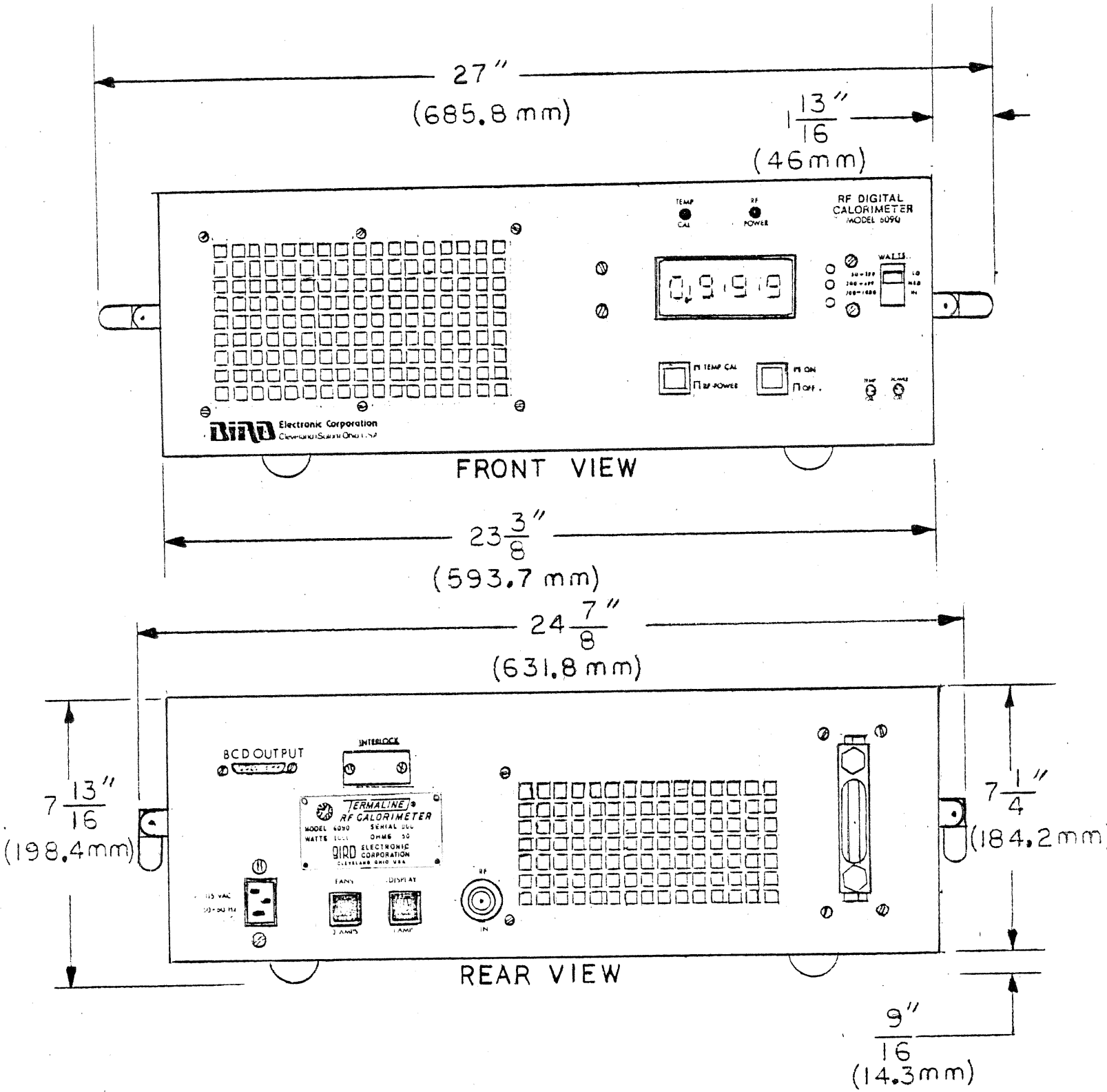
This lightweight, versatile and self-contained unit is enclosed in a rugged formed aluminum housing that will protect against radio-frequency interference (RFI) which may cause error in the function of the electronic circuitry.

SPECIFICATIONS FOR MODEL 6090

Impedance.....	50 ohms nominal
VSWR	
dc-1000MHz.....	1.10:1 maximum
1000-3500MHz.....	1.25:1 maximum
Connector.....	Female N
Power Range.....	50 to 1000W continuous duty
Frequency Range.....	dc to 3500MHz
Accuracy	
100-1000W.....	+1.5% with K factor *
50-1000W.....	+3% without K factor
Dimensions.....	23-3/8"L x 17-3/4"W x 7-1/4"H (593.7 x 184 x 451mm)
Mode.....	CW, AM, SSB, TV & certain pulse types
Ambient Temperature.....	10°C - 30°C (50°F - 86°F)
Cooling Method.....	.75 quarts (710ml) potable water
Weight.....	36 lbs. with water (16.3kg)
Operating Position.....	Horizontal
AC Power.....	115V ac, 60Hz, 2.4 amps 230V ac, 50Hz, 1.2 amps
Interlock Rating.....	15VA NO or NC connections
Stabilization Time.....	3 minutes

\* A K factor chart is supplied with each individual unit to be applied for the various power levels.

Figure I-1. Model 6090 Outline Drawing.





SECTION I - INSTALLATION

1-1. GENERAL

1-2. The Model 6090 was designed primarily for laboratory use and must be operated only in a horizontal position. It may be located on tables, benches, shelves or any support where there is no vibration or excessive heat.

1-3. The calorimeter may be operated anywhere ac line power and adequate air supply is available and ambient temperatures do not exceed those given on Page vi, Specifications. Allow room for unobstructed air flow over the whole surface of the square grilles on both the front and rear of the calorimeter.

1-4. LINE ATTACHMENT

```
*****  
*                               C A U T I O N                               *  
*                               *                                           *  
* Before any RF operation of the calorimeter is attempt- *  
* ed, transmitter interlock and ac line attachment to the *  
* equipment must be made. Using a shielded line, attach *  
* the transmitter interlock connections first to the two *  
* binding posts on the panel. Even momentary operation *  
* with RF power and without coolant flow will cause re- *  
* sistor burnout. *  
*****
```

```
*****  
*                               C A U T I O N                               *  
*                               *                                           *  
* The 115V or 230V ac line may be connected, but ac power *  
* must not be applied unless coolant is in the system and *  
* filled to the correct level. Damage to the pump will *  
* result otherwise. *  
*****
```

1-5. AC power is supplied to the three prong panel socket through a three conductor 7-1/2 foot cable and matching plug that is furnished with the calorimeter. The third wire in the cable, coded green, is a ground wire. For proper protection, if a 3-wire type plug and outlet are not used, fasten the green wire at the supply end to a satisfactory ground.

1-6. Always use a transmitter interlock in conjunction with the Model 6090 Calorimeter. Use a shielded cable connected to the interlock binding post which is located on the back panel of the unit for this purpose.

1-7. Do not attempt any operation of the calorimeter unless the coolant is at the proper level and the transmitter interlock is connected. Note - The interlock connections of the Model 6090 are rated for low current application, 15VA. If the interlock of the transmitter used has a higher current rating, an intermediate relay of higher current capacity must be used between the 6090 interlock connections and the transmitter interlock connections. For further information and recommendations consult with the factory.

1-8. Connection of the line power and depressing the ON/OFF switch will start the coolant pump/motor, fans and close the flow switch contacts for the interlock circuit. The line power supply to the calorimeter may be remotely controlled and operated in conjunction with the RF power loading of the system.

1-9. COOLANT

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not use any sealants, leak stopping material, or                    *
* automotive antifreeze in the coolant. Use only potable                 *
* water. Damage may result to the cooling system or load                  *
* resistor.                                                                *
*****
```

1-10. The unit operates with 1.5 U.S. Pints (710ml) of coolant. Use only potable water\* and never operate pump/motor without sufficient coolant in the system, damage to its working parts will result. \*Standards for potable water have been established by the U.S. Public Health Service at a maximum of 500 ppm of total dissolved solids (ppm - parts per million or 1 mg. per liter). Hardness of water, content of calcium and magnesium salts, is also an essential factor, and should be less than 75 ppm. Cases where either of these limits, particularly the hardness, is exceeded may be remedied by mixing with a sufficient proportion of distilled water.

1-11. Check the coolant level at regular daily intervals when the unit is in prolonged use or when starting after a period of inaction. The coolant gauge is located on the back face, right hand side, of the calorimeter. Whether the pump is on or off, the liquid level should remain at the high level mark on the sight gauge when the unit is properly filled. Always add coolant if necessary to maintain this level.

1-12. DRAINAGE AND FILLING

1-13. Drainage of the system is accomplished by removal of the bottom sight gauge screw. Momentarily turn on the unit to purge the remaining coolant from the system. This may have to be done several times to complete drainage. Replace the screw when the system is drained.

1-14. To refill the system, remove the reservoir filler plug located at the top of the unit and pour the coolant in until the tank is at the correct level stated previously and 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 approached the bottom of the sight gauge.

1-15. Do not run it too long on original pouring, as partially dry operation of the pump might occur with possible damage to the pump mechanism. Repeat filling in this manner until the fluid level remains steady at the proper level, then run calorimeter for approximately three minutes and recheck fluid for proper level before applying RF power.

1-16. BLOWER FANS

1-17. The fans are wired in parallel with pump/motor assembly, connected to the ac line switch and will always operate along with the pump when the ac power is turned on.

1-18. In addition to the basic function of producing requisite air flow through the radiator, this ventilation materially assists in cooling the pump/motor unit.

## SECTION II - THEORY OF OPERATION

### 2-1. BASIC CALORIMETER

2-2. 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/min or cal/sec.

2-3. The "First Law" of thermodynamics states that energy can neither be created nor destroyed, but only converted from one form to another. This, then 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, or more commonly referred to as one calorie. In the English system, if one pound of water will increase in temperature one Fahrenheit degree, one Btu of heat has been transferred into it.

Equation 1.

$$\begin{aligned} 1 \text{ Btu} &= 1 \text{ lb} \times 1^\circ\text{F} \\ 1 \text{ Calorie} &= 1 \text{ gram} \times 1^\circ\text{C} \end{aligned}$$

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

2-4. 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 would require more or less 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.

$$\begin{aligned} 1 \text{ Btu} &= \text{lb} \times 1^\circ\text{F} \times 1 \text{ Btu/lb}^\circ\text{F} \\ \text{heat} &= \text{mass} \times \Delta T \times C_p \end{aligned}$$

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.

$$\text{Btu/h} = \text{mass (lb/h)} \times \Delta T (^\circ\text{F}) \times C_p (\text{Btu/lb}^\circ\text{F})$$

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

#### 2-5. DIGITAL RF CALORIMETER

2-6. Calorimetry as applied to this calorimeter series, is essentially the same as described in the preceding paragraphs. The availability of RF loads, such as the Series 8700 TERMALINE®, installed in the Model 6090 with almost 100% transfer of RF power into a cooling liquid, in this case water, has made possible such an arrangement that the elementary calorimetric formula could be utilized.

Equation 4.

$$\text{RF Power} = \text{flow} \times \Delta T \times \text{constant} \times C_p$$

2-7. The electronic calorimeter synthesizes the flow rate, temperature differential and conversion factor, displaying the final result in watts on a digital readout. To determine the temperature it is necessary to linearly track temperatures between 0°C and 80°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 output. Their voltage outputs are fed into a differential amplifier and the resulting output will be the temperature difference.

2-8. Flow rate is measured by a optoelectronic sensor which is located at the output of the radiator. This metering device utilizes a turbine rotor which generates 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 watts.

#### 2-9. FLOW INTERLOCK CONTROL CIRCUIT

2-10. 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 (.25 gallon per minute) at all times regardless of system water temperature.

2-11. The water flow switch, installed directly on the pump output, is a "normally open" type; i.e., its electrical contact opens when deactivated. Closed during normal equipment operation, the switch is factory calibrated to open whenever water flow drops below the prescribed minimum. When this occurs, the flow switch contacts open thereby opening the transmitter interlock circuit and causing immediate transmitter shutdown. Also, 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.

## SECTION III - OPERATING INSTRUCTIONS

### 3-1. GENERAL

3-2. The Model 6090 Calorimeter is very simple to operate yet is a very accurate power measuring device. The digital panel meter displays the measured power in easy to read one-half inch digits with an accuracy of less than +3% of reading without correction factors or within 1.5% with applied correction factors, see page vii, Specifications.

### 3-3. USE AND FUNCTION OF CONTROLS

3-4. The following is a list of connections and controls with call out letters. The call out letters, designated by brackets [], correspond to the circled letters of Figure 3-1.

- a. ON/OFF Switch [A] - Controls line power, a double action switch which actuates in the IN position and is off in the OUT position.
- b. Calibration Switch [B] - Determines the calibration or operating mode, similar in action to the ON/OFF Switch. Depress to calibrate the unit, read power in the OUT position.
- c. Temp/Cal Control [C] - Controls the temperature sensors adjustment when calibrating.
- d. Power Range Switch [D] - Selects power range to be measured. If power is unknown, select the high range initially then adjust if necessary.
- e. Power/Cal Control [E] - Adjusts panel meter for a .000 indication to the power range selected. (A zeroing device)
- f. Temp/Cal Indicator [F] - Illuminates when the unit is in the calibration mode; i.e., switch [B] is depressed.
- g. RF/Power [G] - Illuminates when the unit is in the power measurement mode; i.e., [B] is in the OUT position.
- h. DPM [H] - Digital panel meter displays RF power directly in watts.
- i. Range Switch Indicators [I] - Illuminate individually to correspond to the power range being used.
- j. Front Grillework [J] - Air exhaust grille for heat exchanger cooling.
- k. RF Input [K] - RF input N type connector.

- l. Fuse [L] - Circuit board and DPM protection.
- m. Fuse [M] - Fan and pump/motor protection.
- n. Receptical [N] - Input for 115/230V, 50/60Hz, ac power cord.
- o. Gauge [O] - Water level gauge and cooling system drain.
- p. Rear Grille [P] - Air intake grille for heat exchanger cooling.
- q. Interlock [Q] - Transmitter interlock connection.
- r. Connector [R] - BCD output.

3-5. INITIAL ADJUSTMENT AND START-UP

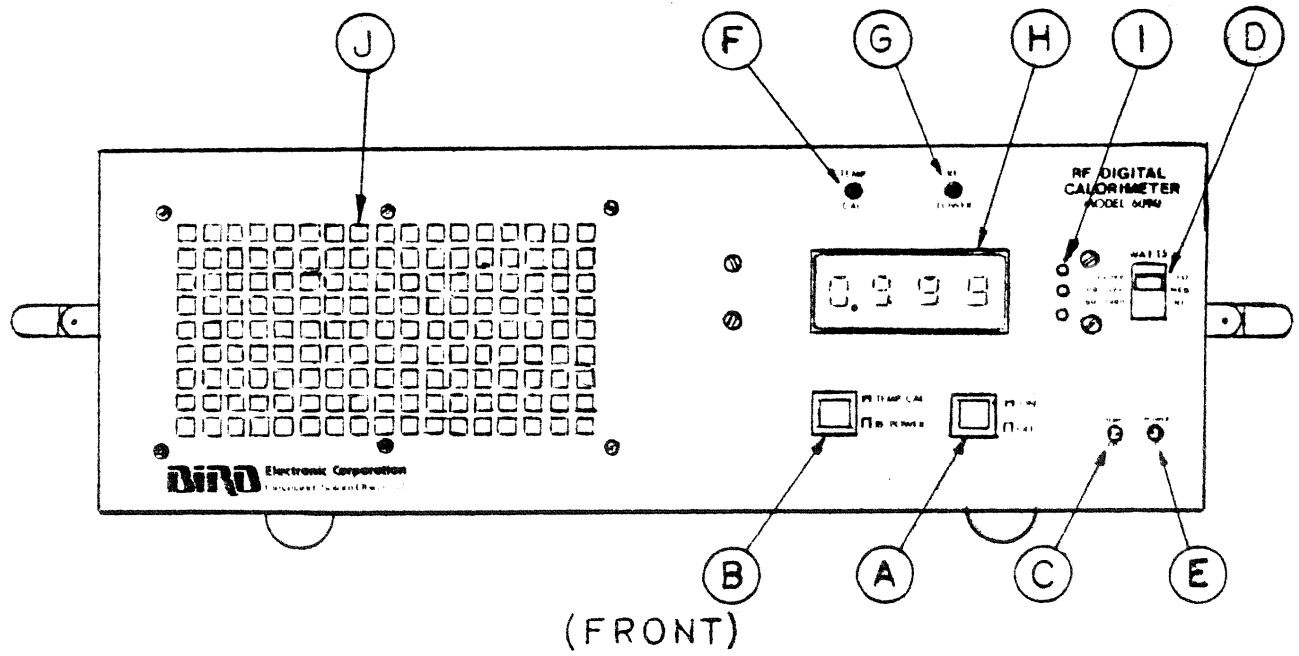
```

*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not apply more than the units rated RF power as dam- *
* age to the load resistor will result. Do not block air *
* flow. Air enters through the back panel and exhaust *
* through the front. Restricted air flow could cause *
* load resistor failure. Use only potable water for *
* coolant and fill to the proper level. High mineral *
* content water could form scales in cooling system caus- *
* ing blockage and system failure or impaired accuracy. *
*****

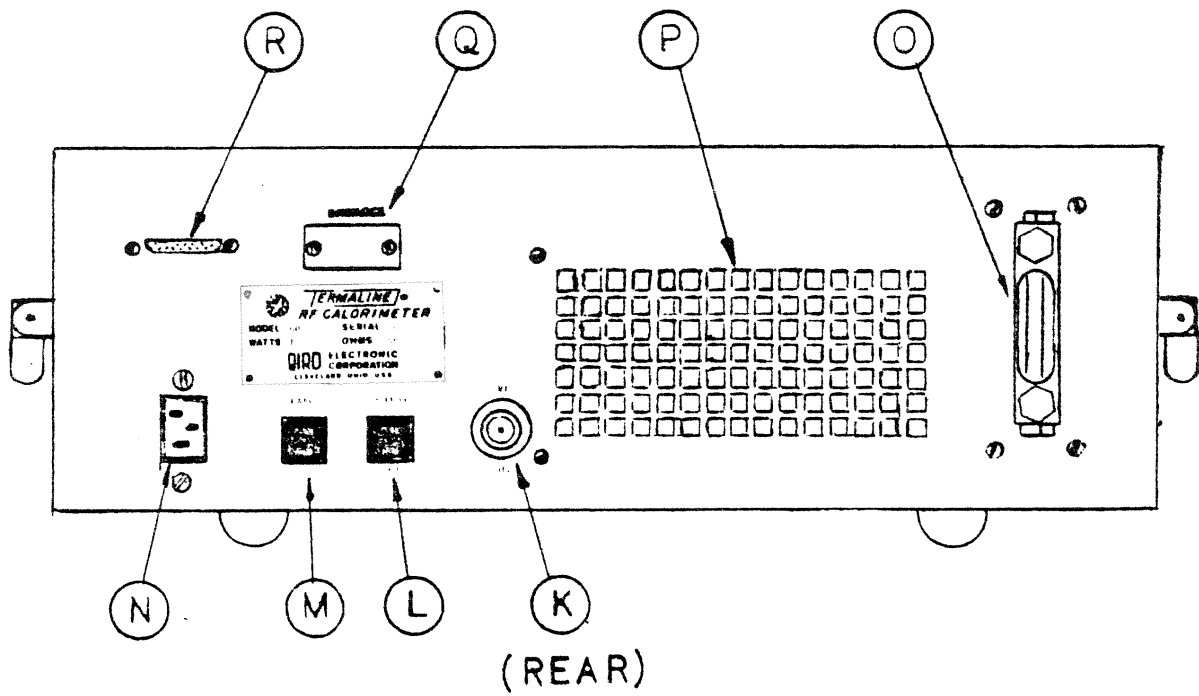
```

- a. Connect the 50 ohm coaxial transmission cable to the load on the back panel of the calorimeter and make sure it is tightened securely.
- b. Connect the interlock cable to the interlock terminal strip and attach the ac power line cord to the input receptical. Both interlock and input recepticals are located on the rear face of the unit. Note - The interlock cable must be shielded and grounded to the unit and to the transmitter or intermediate relay, see Paragraph 1-6.
- c. Turn the unit on, ON/OFF Switch [A] controls the ac line power, double action switch, in for ON and out for OFF.

Figure 3-1. Model 6090 Connections and Control Diagram.



(FRONT)



(REAR)



3-6. CALIBRATION

3-7. The Model 6090 can be calibrated only after water has circulated through the system for approximately five minutes. This is necessary to stabilize the unit temperature.

a. Depress the calibration button [B], IN position, note that the temperature cal light [F] comes on and adjust temp. cal potentiometer [C] until display [H] indicates .000. Select the desired power range, watts [D].

b. Release the calibration button [B], OUT position, note the RF power light [G] comes on, and adjust power cal potentiometer [E] so that the display [H] indicates .000. The unit is now ready to make power measurements.

SECTION IV - MAINTENANCE

4-1. GENERAL

4-2. Only a moderate amount of preventive maintenance is required for the Model 6090 RF Digital Calorimeter. Use reasonable care in handling; do not subject the unit to sharp blows as accuracy may be impaired or other damage could result.

4-3. CARE AND CLEANING

```
*****  
*                               W A R N I N G                               *  
*                               *                                           *  
* When using dry cleaning solvents, provide adequate ven- *  
* tilation and observe normal safety precautions. Many *  
* dry cleaning agents emit toxic fumes that may be harm- *  
* ful to your health if inhaled. *  
*****
```

4-4. A main factor in effective preventive maintenance is cleanliness. For optimum performance and service life, the 6090 must be kept in a clean and dust-free condition. When not in use, keep the unit covered in a clean, cool environment. Carefully clean the metallic contacts and connector bodies. Use a spray type contact cleaner or any dry cleaning solvent, using a swab stick is helpful. The operating panel should be wiped clean with a soft cloth. Wipe the meter face only when necessary. A soft cloth dampened with a mild detergent solution may be used for cleaning.

4-5. Most important to the operation is that the grille work and heat exchanger on the front of the unit be kept free of dust and lint. These parts should be checked at regular intervals and cleaned with a stiff bristle brush and vacuum cleaner if necessary. This is especially true if the unit is used in a dusty environment. If necessary, remove the fans to clean the heat exchanger, see Paragraph 4-15.

4-6. LOAD RESISTOR

4-7. It is good practice to occasionally check the resistance of the RF load especially if the unit has been inadvertently overpowered. Accurate measurement of the dc resistance between the inner and outer conductors of the RF input connector will provide a good check on the condition of the load resistor. For this measurement, a resistance bridge or ohmmeter with an accuracy of 1% or better at 50 ohms should be used. Use low resistance leads, preferably a short piece of 50 ohm coaxial cable with test clips attached. The measured resistance should not deviate more than +2 ohms from the nominal value. If the resistance substantially exceeds this value replacement of the load may be necessary. A faulty load is not repairable and must be replaced in its entirety. It may be replaced in the field and usually recalibration will not be necessary. For replacement follow the disassembly procedure.

#### 4-8. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
Panel Meter Does Not Illuminate	Defective fuse	Check lamp fuses.*
	Defective ON/OFF switch	Check voltages between pins "15" and S of DPM connector.
	Defective DPM	If DPM is receiving proper supply voltage, 115V +10V or 230V +10V, 50-400Hz.
Panel Meter Will Not Adjust to Zero	Defective component	Return to factory.
Transmitter Won't Activate	Incorrect hookup	Check connections.
No Indication of RF Power	Interlock open due to inoperative flow switch	Check pump fuse.*
	Defective flow switch	Return to factory.
	Burnout load	Return to factory.

\*The fuses on the back panel of the calorimeter are released by pushing the insert in and slightly downward and allowing the fuse cap to spring out. The fuse is replaced in the cap. For protection of the equipment, do not replace a fuse with any of a higher rating than the specified value.

Replacement Fuse: Fuses for 115V ac model  
 Fans - 3 amps type 3AG Slo-Blo  
 Display - 1 amp type 3AG Slo-Blo

Fuses for 230V ac model  
 Fans - 1-1/2 amps type 3AG Slo-Blo  
 Display - 1/2 amp type 3AG Slo Blo

#### 4-9. REPLACEMENT OF PARTS

4-10. Failure of the unit due to defective parts, etc., other than the load resistor is highly unlikely. If failure should occur, certain parts may be field replaceable but in some cases the entire unit must be returned to the factory for repair and/or replacement and recalibration. No replacement or repair should be attempted during the first year while the unit is in

warranty. It should be returned to the factory. After this period the parts that may be replaced without recalibration or effecting accuracy are:

- a. Load Resistor
- b. Heat Exchanger
- c. Cooling Fans
- d. Pump/Motor Assembly
- e. Related Fittings

4-11. For any parts related to the calorimetric electronic circuit the unit must be returned to the factory. Consult with the factory.

4-12. DISASSEMBLY

```
*****  
*                               W A R N I N G                               *  
*                               *                                           *  
* Unplug the device before removing the cover to perform *  
* any repair or replacement work to avert the possibility *  
* of accidental shock. The potential for electrical      *  
* shock exists.                                           *  
*****
```

4-13. Before any parts can be replaced or the unit repaired, removal of the top cover will be necessary. This is easily accomplished by removing the (26) #8-32 pan head screws securing the cover. These screws are located on the perimeter of the cover, ten on the top side and eight on each side of the cover. When these screws are removed the cover may be lifted straight up and off the main chassis. Once removed, follow the steps listed for replacement of the various parts. For reference to call outs see the following illustrations in this section.

4-14. Load Resistor -

- a. Drain the unit, see 1-12, Drainage and Filling.
- b. Unscrew the compression fitting nuts on the load [1], cooling water tubes and slide back to release the junction.
- c. Firmly grasp the load in your hand and turn it in a counter-clockwise direction to unscrew the load from the inside.
- d. To reinstall a new load simply reverse the procedure above. Be sure that the input, center tube, of the load is connected to the line that is connected to the output of the pump and flow switch.

4-15. Heat Exchanger -

- a. Drain the unit as thoroughly as possible, see 1-12, Drainage and Filling.
- b. Unscrew the compression fitting nuts on the cooling water supply input and output junctions. Slightly retract the tubes to open the connection.
- c. To release the heat exchanger, [2] remove the six #8-32 pan head screws from around the grille work on the front panel. Hold the nuts, securing the screws from inside the unit on the top and bottom edge of the heat exchanger. The nuts on the bottom edge may require a 5/16" nut driver or socket wrench with extensions to reach. Be careful not to lose the brass retaining strips under the 5/16" nuts. These must be replaced when reinstalling the heat exchanger.
- d. With the heat exchanger free from its mounting, position it so that the eight #8-32 pan head screws securing the fans to the heat exchanger may be easily removed. These screws are located in the four corners of each fan. There is no need to disconnect the wiring of the fans for heat exchanger removal.
- e. To reinstall a heat exchanger simply reverse the procedures previously listed. Be sure to replace the brass retaining clips on the #8-32 screws that secure the heat exchanger as originally placed.

4-16. Fan Replacement -

- a. To remove the fans [3] it is not necessary to drain the cooling system.
- b. Disconnect the two wires, coming from the fans at the terminal block located just under the coolant pump [4]. Note - The wires from the two fans are spliced within the cable wrap. If just one fan is to be replaced, the cable wrap may be removed and disconnection made at the splice.
- c. The fans are held in place on the heat exchanger by the screws located on the corner edge of each fan. There are four #8-32 pan head screws securing each fan. Disassembly is made by removing these screws.
- d. Reassemble the fans by reversing the above mention procedure.

4-17. Pump/Motor Replacement -

- a. Drain the cooling system, see 1-12, Drainage and Filling.
- b. Disconnect the pump/motor electrical connections at the terminal block located just under the pump [4].

- c. Disconnect the compression fitting nut on the pump input side. This is the line coming from the coolant reservoir. Retract the supply line and position it out of the way.
- d. Unscrew and disconnect the compression fitting nut on the output of the flow switch [5] to open the connection.
- e. Remove the wire wrap from the wires that go to the flow switch.
- f. Firmly grasp the flow switch in your hand and turn it in a counterclockwise direction to unscrew it from the pump connection. The flow switch wires will twist with the rotation of the switch, but they will allow enough turns to free the switch. Disconnection of the wires should not be necessary.
- g. Remove the six #8-32 screw and nut sets that secure the pump/motor base to the housing. The pump/motor unit [4] should be free to lift it straight out of the unit. Be sure not to lose the sponge rubber pad that is situated under the base of the pump/motor. This must be reinstalled when the unit is reassembled.
- h. With the pump/motor free and outside of the Model 6090 housing, the input and output water nipples may be removed if still attached to the pump.
- i. Store all loose parts in a bag with Model 6090 for future re-assembly.
- j. To reinstall the pump/motor unit, reverse the procedure above. When replacing the flow switch, turn the switch several turns counterclockwise to twist the wires so that they will unwind when installing the switch on the pump, in a clockwise direction. If the rubber pad under the pump/motor base has moved, reposition it before securing the pump base to the chassis.

4-18. DPM Replacement - The DPM is fastened to an aluminum plate inside the front face of the Model 6090 housing. This is fastened to the front panel by four #8-32 screw and nut sets. This aluminum plate, which also supports the ON/OFF and calibration switches, must be first detached before the DPM or switches, can be removed. This removal is described in Subparagraph 4-18b-e. See Figures 4-3 and 4-4.

- a. Remove the two #4-40 x 1/2" binder head screws that secure the green connector [7] to the back of the DPM [6]. Pull the connector straight off and position it out of the way.
- b. On the outer edge of the aluminum panel that supports the DPM, and just to the right and left of the DPM are the four nuts that secure the aluminum panel. Remove these nuts from the screws that project through the front panel. Observe the spacers on these screws between the front panel and the mounting plate. Do not lose these spacers; they must be replaced when reinstalling the plate.

c. When the plate is free from its mounting, gently pull it back and upward at the front to expose the DPM front where its mounting screws are located.

d. Using a small Phillips screwdriver, loosen the screws in the corners of the DPM housing a few turns. This will adjust the four mounting cams on the screws behind the mounting plate to an unlock position. The meter may be withdrawn straight out through the mounting plate.

e. When reinstalling a DPM, simply reverse the above procedure. When securing the DPM to the mounting plate, turning the mounting screws in a clockwise direction will automatically set the mounting cams, locking the DPM in place.

#### 4-19. Fuse Holder Replacement -

a. Remove the fuse by pushing the insert in and slightly downward allowing the fuse cap to spring out.

b. Unsolder the connections to the back of the defective fuse holder.

c. Depress the grey expansion strips on the sides of the fuse holder and at the same time push the holder out through the back panel.

d. When installing a fuse holder, reverse the above procedure making sure the word "TOP" on the fuse holder is facing up.

Figure 4-1. Model 6090 Calorimeter Section With Guide to Call Outs, Inside View.

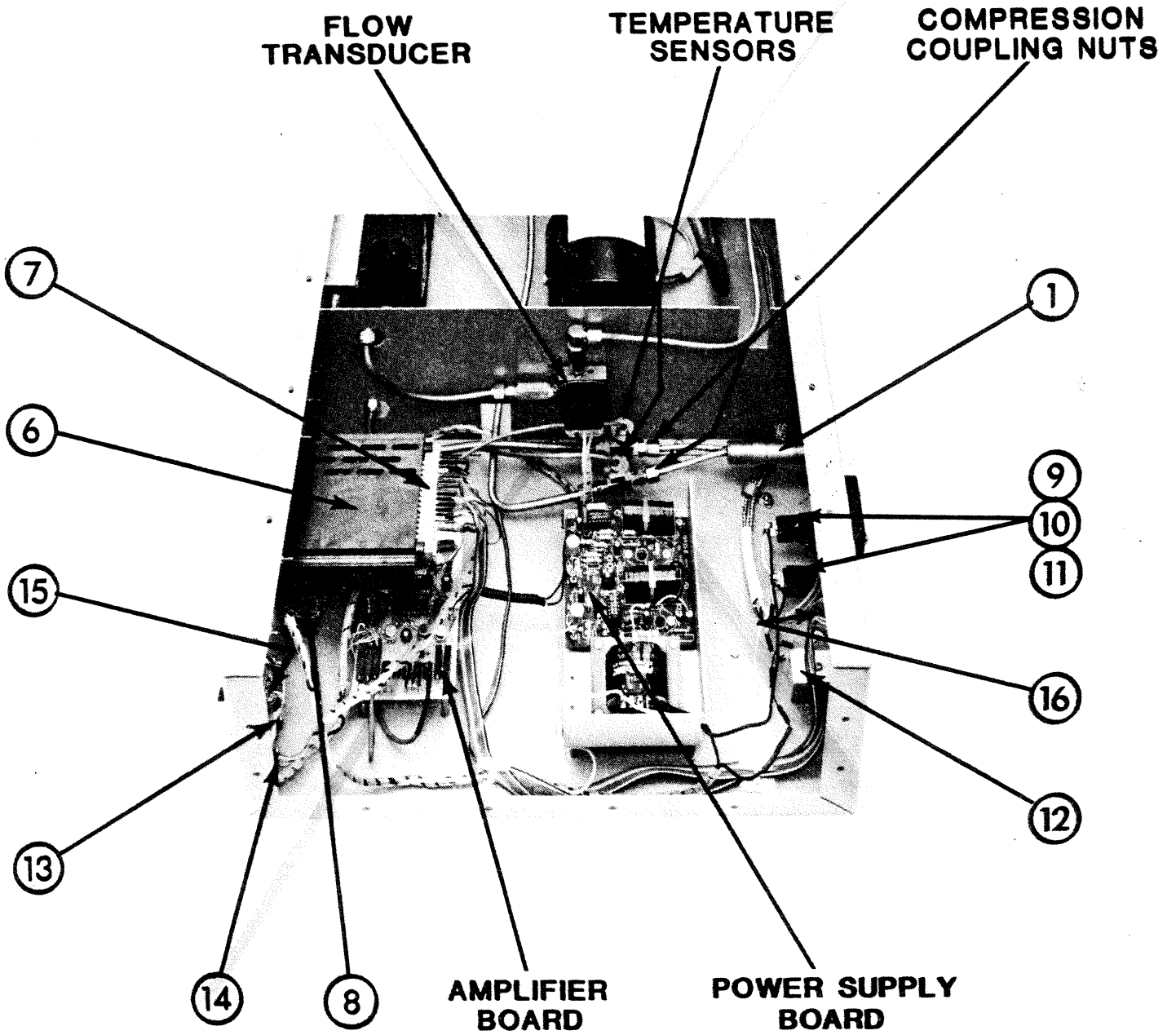




Figure 4-2. Model 6090 Pump and Heat Exchanger Section, Inside View.

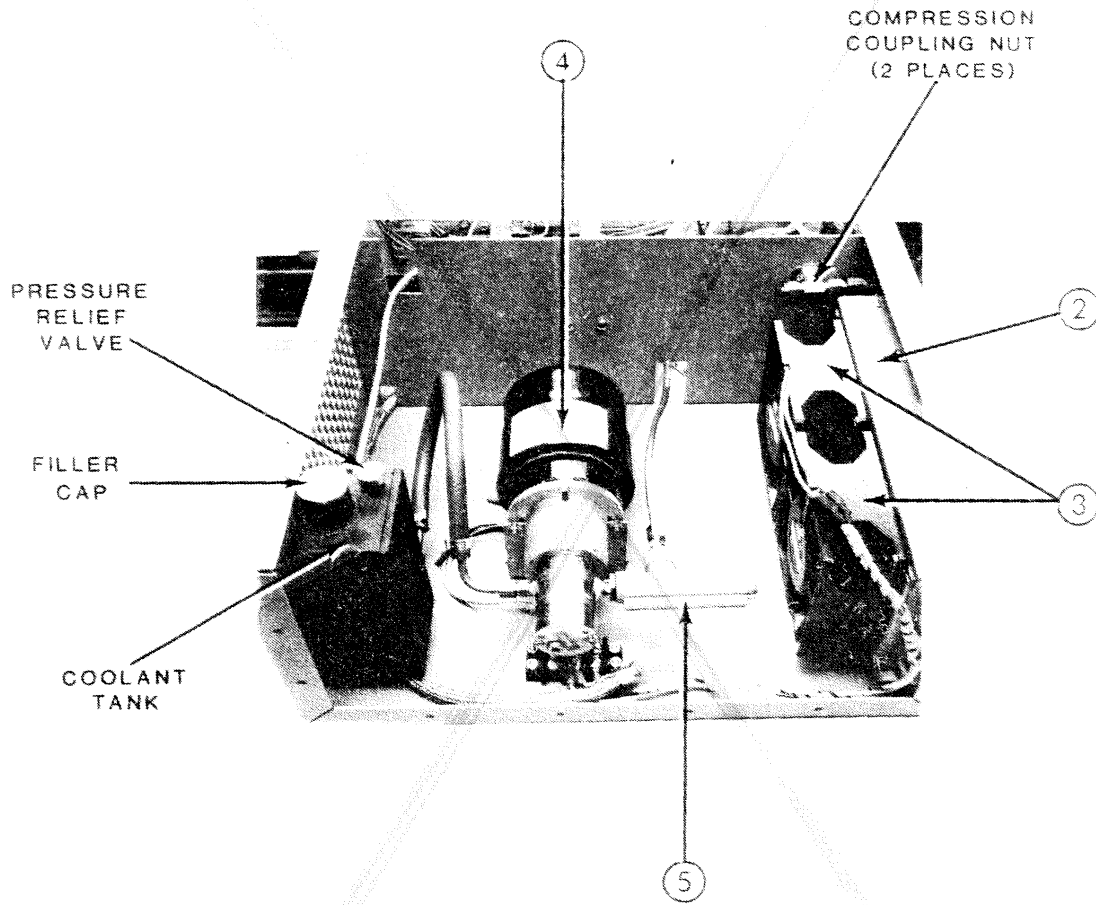


Figure 4-3. DPM Mounting Plate Removed from Chassis.

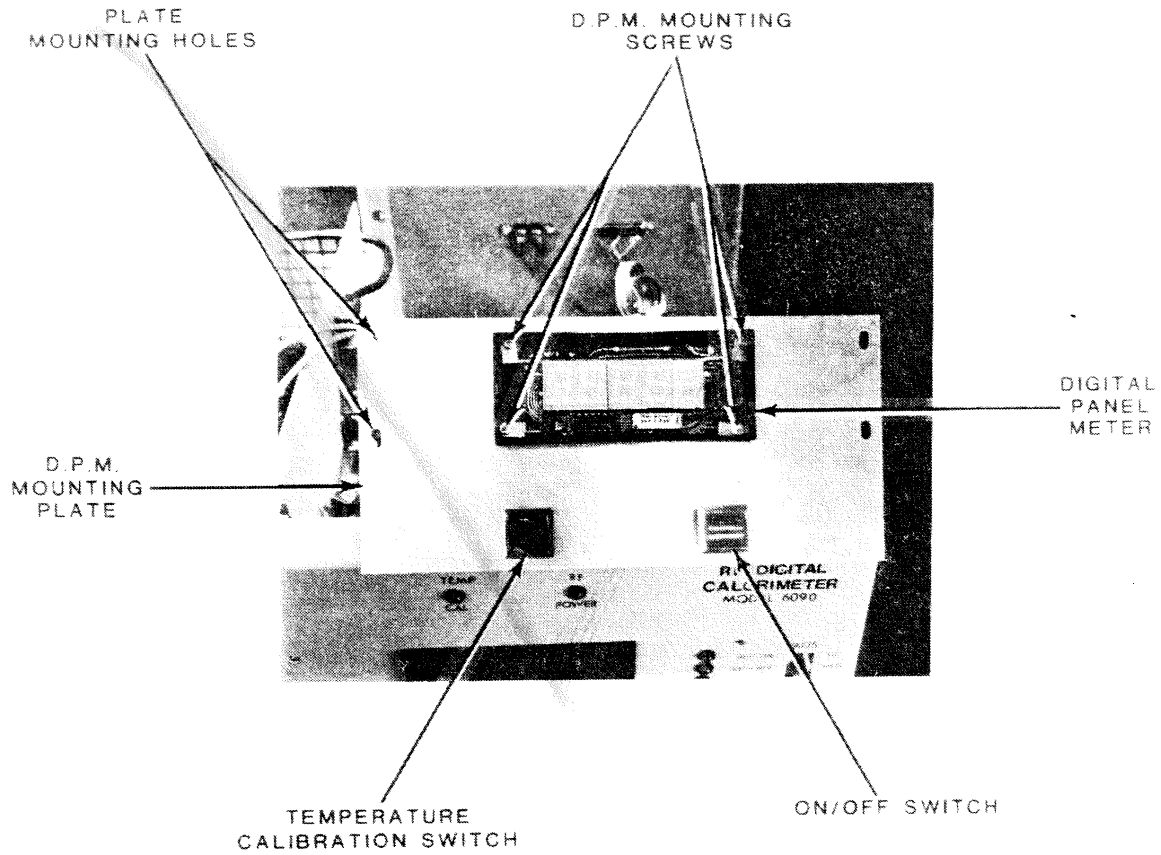
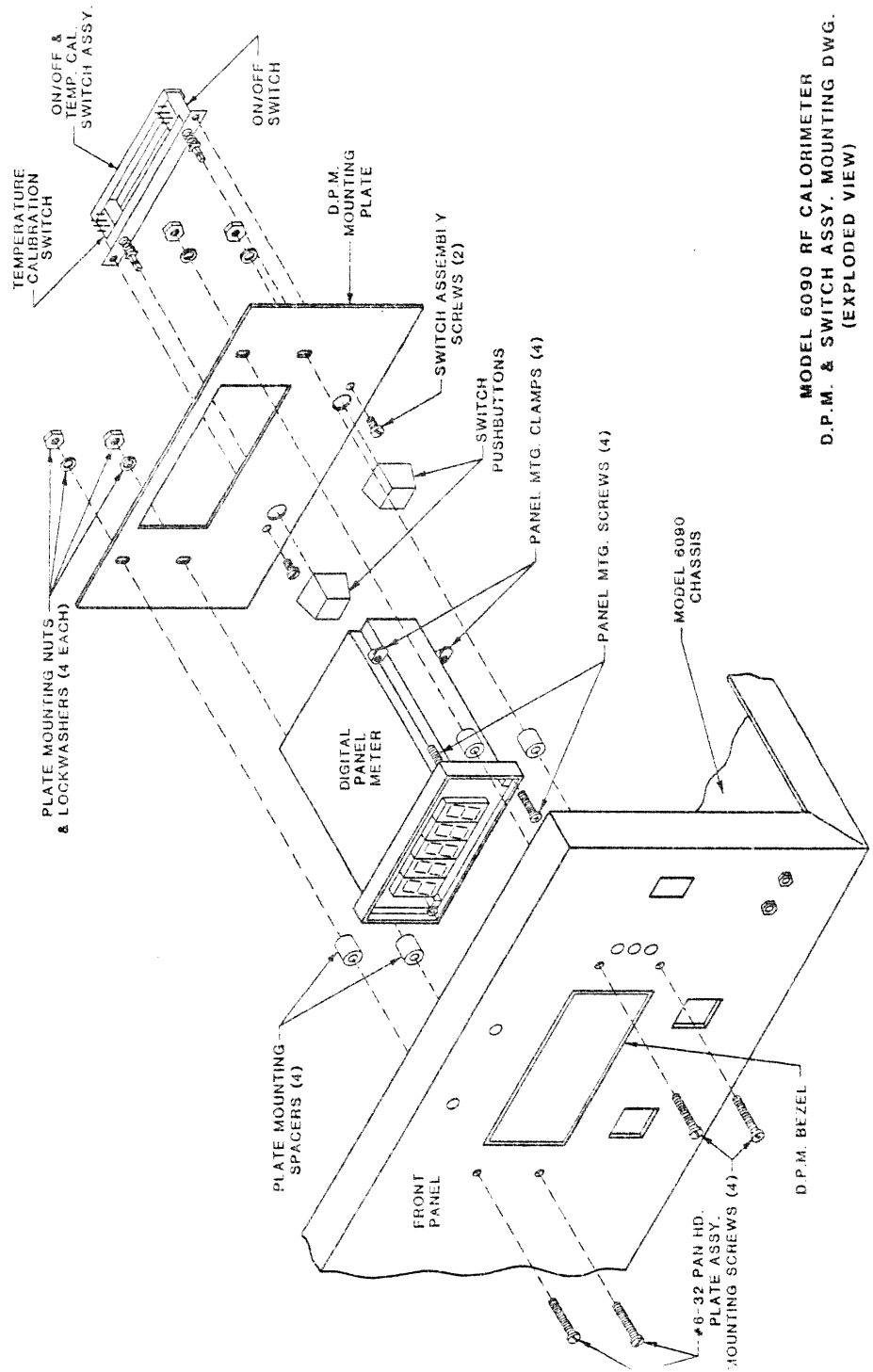


Figure 4-4. Model 6090 Meter Mounting Drawing.



MODEL 6090 RF CALORIMETER  
D.P.M. & SWITCH ASSY. MOUNTING DWG.  
(EXPLODED VIEW)

4-20. EMERGENCY REPAIR

4-21. Proceeding are brief outlines for emergency repair procedures. The user is urged not to attempt any major repair other than the components mentioned. Return the unit to Bird Electronic Corporation whenever feasible, see Paragraph 4-10.

SECTION V - PREPARATION FOR RESHIPMENT

5-1. GENERAL

5-2. If the unit is to be reshipped or returned to the factory, first drain the coolant, see 1-12, Drainage and Filling.

## SECTION VI - STORAGE

### 6-1. GENERAL

6-2. If the unit is to be unused for any length of time, cover it with a cloth or plastic film and store it in a cool dry place. If the coolant is to remain in the unit, do not store at an ambient temperature below 6°C (40°F). If necessary the unit may be stored in an ambient temperature lower than freezing; i.e., 0°C (32°F). However all the coolant must be drained to avoid expansion damage caused by freezing water. Storage such as this is not recommended.

SECTION VII - REPLACEMENT PARTS LIST

7-1. MODEL 6090

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	RF Load Resistor	6090F
2	1	Heat Exchanger	6090-632
3	2	Fans, Heat Exchanger	
		Model 6090-115 (115V)	5-1494-1
		Model 6090-230 (230V)	5-1494-2
4	1	Pump/Motor Assembly	6090-603
5	1	Switch, Flow	5-1492
6	1	Panel Meter	
		Model 6090-115 (115V)	2080-058-1
		Model 6090-230 (230V)	2080-058-2
7	1	Meter Connector	2080-040-2
8	2	ON/OFF, CAL/POWER Switch Pushbutton	5-1493
9	2	Fuse Holders	5-998
10	1	Fuse, Fans	
		Model 6090-115 (3A)*	Standard
		Model 6090-230 (1.5A)*	Standard
11	1	Fuse, Display	
		Model 6090-115 (1A)*	Standard
		Model 6090-230 (.5A)*	Standard
12	1	Receptical, ac Line	5-1470
13	1	Temperature Calibration Potentiometer, 10K ohm	5-1431-1
14	1	Power Calibration Potentiometer, 20K ohm	5-1431-2
15	1	Switch, Power Range	5-1498
16	1	Receptical, BCD Output	5-1111
17	1	Gauge, Coolant Level	5-1489

\*All fuses 3AG Slo-Blow (313 Series).

Figure 7-1. Model 6090 Schematic Diagram.

