

**BIRD**  
Electronic Corporation

## Section I - General Description

This Instruction Manual covers the description, theory, operation and maintenance of RF Wattmeter, Bird Model 6140.

### 1. Purpose of Equipment

- a. The RF Wattmeter is designed to measure output power and facilitate tuning of transmitters.

Frequency Range	20 to 1000 MHz
Power Rating	150 watts max.
Power Ranges	0-3 watts, 0-15 watts 0-50 watts, 0-150 watts
Nominal Impedance	50 ohms
Type of Modulation	CW, FM and SSB
Accuracy 20-30°C	20-512 MHz ±5% OFS 512-1000 MHz ±10% OFS
-10 to +55°C	20-512 MHz ±10% OFS 512-1000 MHz ±15% OFS
Input Connector	QC Type Female N
Physical Dimensions	4 x 6-1/2 x 12-1/2 inches
Weight	9 lbs Max.

- b. RF Power is measured under essentially non-radiating conditions. This is an absorption type Wattmeter as distinguished from a "THRULINE" type Wattmeter.
- c. The Wattmeter is built around a precision coaxial load resistor which becomes the transmitter load element. This load resistor is designed to provide a termination with extremely low reflections. Since cooling is accomplished without the use of liquid dielectric coolants, it is classed as a dry termination.
- d. Power is measured with a voltmeter arrangement and a direct reading meter calibrated in watts. Range selection is accomplished with a four-position switch on the front of the meter housing.

e. Specific uses:

1. Routine and trouble shooting maintenance.
2. Transmitting tests.
3. Loss measurements on transmission lines.
4. Testing of coaxial line insertion devices such as connectors, switches, relays, filters, etc.
5. As an RF termination.

2. Major Components

Figure 1-1 illustrates the major components of the Model 6140 Wattmeter

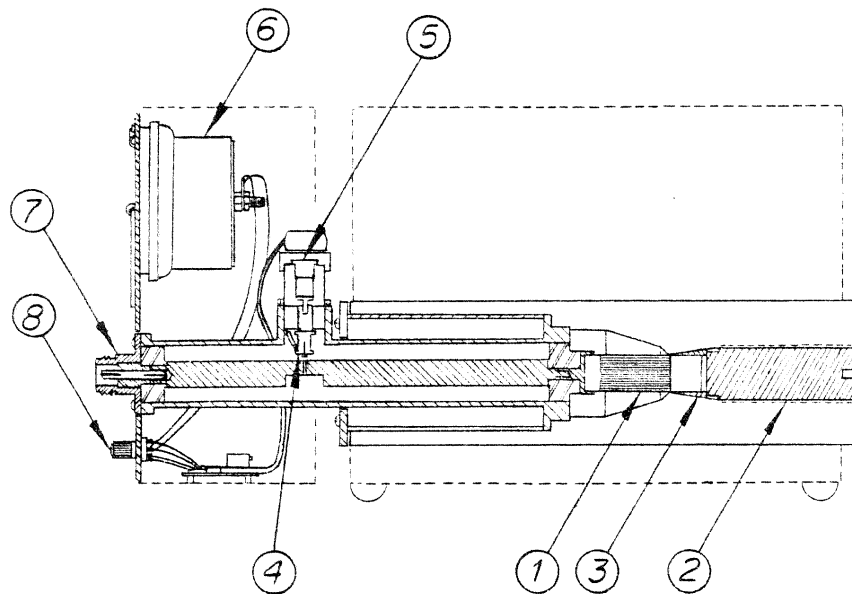


Figure 1-1

1. Resistor
2. Screw
3. Clamp
4. Voltmeter
5. Diode
6. Meter
7. QC Connector
8. Switch Assembly

## SECTION II - Theory of Operation

### 1. Basic Principles

- a. The method of power determination used in the model 6140 RF Wattmeter is shown by the expression;  $W = E^2/R$ , where  $E$  is the voltage across the resistor  $R$ , and  $W$  is power in watts. Figure 2-1 illustrates the  $E^2/R$  configuration used in this wattmeter. RF energy flows from the transmitter through the resistor  $R$ , producing a voltage drop  $E$ , across the resistor which is detected by the voltmeter. The resistors in series with the voltmeter provide calibration for the four power ranges of the instrument.
- b. In the Dummy Load, the load resistor and connector are designed to have a constant characteristic impedance from D.C. to 1000 MHz.

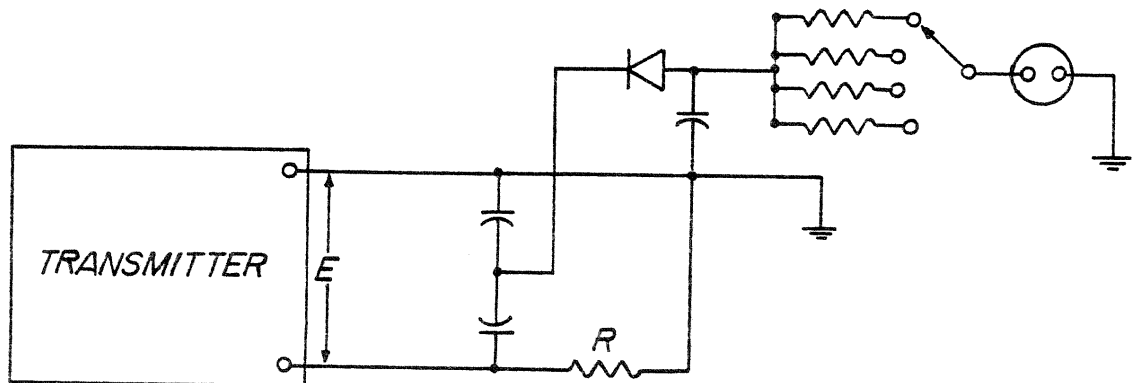


Figure 2-1

c. Voltmeter Circuit

Basically, the voltmeter circuit consists of a filtered half-wave rectifier with a switching network in the meter circuit to provide the required four voltage ranges. The wattmeter, therefore measures four power ranges. These ranges are changed by switching in selected resistance values in series with the meter. The switch control knob is located on the front face of the meter housing.

d. RF Load Assembly

The RF load assembly consists of a film-on-ceramic resistor mounted in a finned heat sink with a specially designed clamp and screw arrangement. The resistor, individually selected for its characteristics, is enclosed in a specially designed tapered housing. This provides a linear reduction in impedance, proportional to the distance along the resistor. The characteristic impedance is therefore 50 ohms at the connector, 25 ohms at the mid-point and zero ohms at the end of the resistor. This provides a termination with extremely low reflections up to 1000 MHz.

### SECTION III - Installation

- a. Free air circulation around the Wattmeter is essential. Keep the equipment in the clear, and do not place it near heated surfaces. The Wattmeter should have at least a 4-inch clearance on all sides. The space above the equipment should be kept unobstructed for good heat transfer. Use the Model 6140 Wattmeter in a horizontal position only.

The Model 6140 is essentially a portable test instrument. It should be placed as close as possible to the equipment whose power is being measured.

The Wattmeter may be fastened to a work or test bench by removing the four rubber bumpers from the bottom of the radiator. These bumpers are fastened to the radiator brace by #8-32 studs which are set permanently into the rubber feet. The bumpers unscrew easily by hand. The holes are threaded for #8-32 screws, and fasteners must be placed up through the bench and into the radiator. These holes are on a 3 x 7 inch rectangle.

- b. Connections

The RF input connector on the Model 6140 is a female N type. It is of the "Quick-Change" design which permits exchange of connectors of the Bird "QC" Family to substitute connectors. Remove the four screws and pull the connector straight out. When replacing, make sure the connector is properly aligned in the socket. The center contact pin can be damaged by careless handling. With the transmitter off, connect it to the Wattmeter with a short length of 50 ohm coaxial cable of proper rating.

## SECTION IV - Operation

### 1. Controls

The Wattmeter has only one control - the selector switch located on the front face of the meter case. This is a five position switch, which will select the desired power ranges; and transit position.

### 2. Transmitter Power Measurement

- a. With the transmitter turned off, connect the output of the transmitter to the input connector of the Wattmeter. Use a short piece of appropriate 50-ohm cable. Set the selector switch to the desired range. If the approximate power of the transmitter is not known, set the selector switch on the 150 watt scale and then turn the transmitter on to determine the proper meter range. If the transmitter is turned on when the switch is set for a range that is too low, the meter and the diode may be damaged.
- b. The power indicated by the meter is that which is applied at the input connector of the Wattmeter. If significant losses are introduced by the cable connecting the transmitter to the Wattmeter, they must be added to the power indicated by the meter.
- c. When reconnecting the transmitter to its antenna, it may become necessary to return the transmitter to the desired output. Differences in VSWR between the Wattmeter and the transmitter antenna are possible.
- d. NOTE: Do not disturb the calibration on the voltmeter block.

### 3. Using as a Dummy Antenna

In order to protect the meter and diode when using as a Dummy antenna, turn the switch to the "Transit" position. The Wattmeter is now ready to be used as a dummy antenna up to its full ratings without fear of damage to the metering circuit.

## SECTION V - Inspection and Maintenance

### 1. Inspection

This equipment is rugged and relatively simple in construction and should require only periodic inspection at about six month intervals. Checking procedure should include the items listed below:

- a. Check tightness of the dc plug fastened to the crystal diode block on the dummy load.
- b. Inspect the equipment for frayed, strained or deteriorated cords and cables.
- c. Inspect contact pins in connectors for possible damage.
- d. Check operation of meter switch. Tighten knob if necessary.
- e. Inspect the meter. Clean glass face if necessary, check zero position of pointer and freedom of movement.
- f. Inspect for completeness and general condition of equipment.

### 2. Preventive Maintenance

- a. This Wattmeter will require only simple routine maintenance. Do not subject the meter and diode to rough treatment. Keep the dc connector in place when the equipment is not in use. This will prevent dirt accumulation on contact portions of the connector.
- b. Cleaning. Wipe dust and dirt off regularly. Clean dirty contacts with a dry solvent such as Inhibisol or trichlorethylene on a cotton swab stick. Remove all grime and dust from contact and insulator surfaces. If any portions of the radiator are corroded or rusted, clean the area carefully with a fine lint sandpaper and touch up with grey enamel.



### 3. Switch and Line Section Assembly Replacement

A faulty switch and circuit board assembly must be replaced in its entirety. No attempt should be made to repair the assembly. To replace, follow the procedure below:

- a. Remove the knob by loosening the set screw with a hex allen wrench, and pull off.
- b. Unscrew the (4) #8-32 screws holding the meter housing to the load and remove the meter assembly.
- c. Unscrew the dc plug located on the top of the voltmeter cartridge and detach the cable from the meter terminals by removing the (2) #4-40 screws with a screwdriver.
- d. Unscrew the 5/16-32 hex nut from the switch shaft on the front of the meter housing.
- e. Remove the (4) four screws that mount the circuit board to the meter housing. The switch assembly can now be removed through the back of the meter housing.
- f. To replace the switch and circuit board assembly, reverse the above procedure.

### 4. Meter Replacement

To replace the meter (M-850), first follow the procedure outlined in paragraph 3b and c of this manual, and then the steps below:

- a. Place the meter face down on a smooth, clean surface.
- b. Using the thumb and fingers of one hand, press down evenly on the retainer ring to compress the sponge-rubber strips.
- c. Unscrew the (2) #10-32 oval-head machine screws on the sides of the meter housing. There is one screw on each side of the meter housing.
- d. Remove the meter with the retainer ring and the sponge-rubber strips.
- c. To install meter, reverse the procedure.

## 5. Load Resistor Testing and Replacement

- a. Accurate measurement of the dc resistance from the RF input connector to ground will provide a good check of the condition of the Load Resistor. For these measurements, a Resistance Bridge with an accuracy of one percent or better at 50 ohms (such as the Leeds & Northrop 5305 Test Set) should be used. Use low resistance leads, preferable a short piece of 50-ohm cable attached to a Male plug which will mate with the Female connector on the dummy load. The resistance should be 50 ohms  $\pm 4\%$ . If the resistor is faulty replace the resistor.
- b. If it should become necessary to replace the resistor, proceed as follows:-
  1. Remove the meter housing as outlined in 3b and c.
  2. Remove the (4) four #8-32 screws on the retaining clamp.
  3. Carefully slide the line section assembly straight out of the load.
  4. Insert tool T6140-004 Part "A" into assembly. Drop in retaining sleeve and install clamp. See Fig. "X"
  5. Remove completely 7/8-20 copper screw from rear of load.
  6. Install screw T-6140-004 part "B" and tighten until resistor is loose then remove Part "B" completely.
  7. Apply a thin film of heat transfer compound to inside and outside surfaces of clamp.
  8. Push clamp about half way on long terminal of resistor and drop in to load section.
  9. Apply film of never-seize compound to copper screw and tighten in load assembly to 750in. lbs.
  10. Remove retaining clamp, sleeve and tool T-6140-004, Part "A".
  11. Reverse steps 1, 2, and 3 for final assembly.
  12. Check calibration of wattmeter against a standard of known accuracy.

6. Do not attempt any calibration of the Wattmeter without the proper calibration procedures. These may be obtained under separate cover from the factory.

7. Trouble Shooting Chart

Trouble	Probable Cause	Remedy
1. No meter indication	1a. No RF signal	1a. Check that transmitter is turned ON. If ON, check instructions of the transmitter. If other remedies below check ok, test transmitter.
	b. No power input	b. Check RF power cable and connections to Wattmeter. Do not adjust any connections with RF power on.
	c. Diode	c. Check seating (contact) of crystal diode.
	d. Defective voltmeter switch.	d. Replace.
	e. DC meter cord defective.	e. Tighten connection of plug on dc jacks. Test cord for open or short circuit.
	f. Defective meter	f. Test for stuck pointer. Check meter. Replace if necessary.
2. Irregular or Improbable Indications	2a. Faulty Transmitter	2a. Check transmitter.
	b. Loose connections	b. Check RF connectors.
	c. Switch assembly not operating properly.	c. Replace per par. 17.
	d. Faulty diode.	d. Replace

NOTE: Always be sure the transmitter is operating properly.

Model 6140 TERMALINE<sup>R</sup> RF Wattmeter

Replacement Parts List

<u>Item</u>	<u>Qty.</u>	<u>Description</u>	<u>Part Number</u>
1	1	RF Load & Line Section	6140-002
2	1	RF Load Resistor (P/O Item 1)	6140-004
(2T)	-1-	Assy., Tool for Item 2	T6140-004
3	1	Resistor	8160-010
4	1	Clamp, Resistor	8160-008
5	1	Screw, Clamp Resistor	8160-011
6	1	Radiator Assy., (p/O Item 2)	6140-008
7	4	Bumper Foot	5-049
8	2	Spacer, Meter Case	7500-070
9	2	Pin, Locating	7500-071
10	2	Spacer, Meter	6150-006
11	2	Pin, Locating	6150-007
12	1	Handle Radiator	2400-017
13	1	Line Section Assy., (P/O Item 1)	6140-005
14	1	Female N Connector "QC" (Input)	4240-062
15	1	Resistor Retaining Sleeve	6140-025
16	1	Resistor Retaining Clamp	6140-024
17	1	Voltmeter Cartridge Socket	6733-007
18	1	Voltmeter Cartridge	6733-009
19	1	Crystal Diode	5-1180
20	1	Meter Housing Assy.	6140-003
21	1	Meter	2120-008
22	1	Meter Mounting Bracket Assy.	6140-022
23	1	Printed Circuit (PC) Board	6140-006
24	1	DC Connector Body Assy.	6733-045
25	1	Knob, Range Selector	5-1187