INSTRUCTION BOOK FOR

BIRD

Model 6104
Termaline® Wattmeter

LIMITED WARRANTY

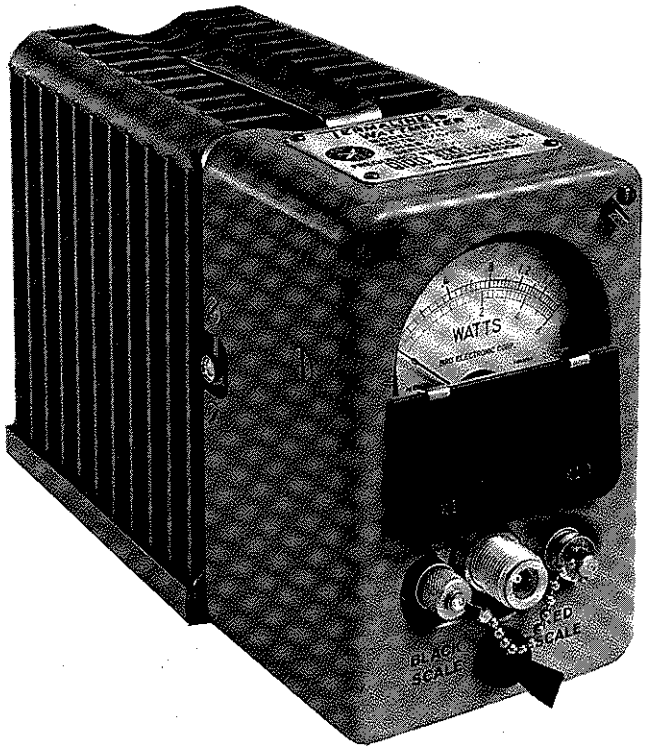
We are proud of the high quality of our product and we warrant to the original purchaser that each new instrument of our manufacture will for a period of one year after original shipment be free from defects in material and workmanship under normal and proper operating conditions and that properly used during such period it will perform in accordance with our applicable specifications.

Our obligation and the purchaser's exclusive remedy for any defect or failure to meet specifications shall be limited, at our option, to repair or replacement or, if we determine said defect or failure to be so defective as to preclude remedying by repair or replacement, the purchaser's sole and exclusive remedy shall be limited to refund of the purchase price. We shall have no obligation if defects result from improper use, operation above rated capacities, repairs not made by us, or misapplication of the equipment. Our warranty does not extend to the failure of semiconductor devices and batteries, or to equipment and parts made by others except to the extent of the original manufacturer's warranty to us. No other warranty is expressed or implied. Bird Electronic Corporation is not liable for consequential damages.

Warranty returns must be first authorized by the factory office and are to be shipped prepaid.

INSTRUCTION BOOK

Termaline® Wattmeter Model 6104



BIRD

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SAFETY PRECAUTIONS

The following are general safety precautions that may not necessarily apply 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.

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************************************************************
*                      C A U T I O N                       *
*                                                          *
* Prolonged breathing of many dry cleaning solvents may    *
* be dangerous to your health. Make certain adequate       *
* ventilation is provided while using any solvent.         *
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6104 TERMALINE® WATTMETER

INTRODUCTION

GENERAL

The Bird Model 6104 TERMALINE® RF Wattmeter is designed to measure RF power under nonradiating conditions. The wattmeter is built around an accurate 50 ohm coaxial load resistor which becomes the transmitter load element, providing a practically reflectionless line termination up to 512MHz.

Power input to the load resistor is measured by a four range crystal voltmeter reading directly in watts. A toggle switch determines the scale. Each scale has two ranges which are selected by plugging the crystal diode into the proper socket.

SPECIFIC USES

a. Troubleshooting and routine maintenance.

b. Transmitting tests.

c. Transmission line loss measurements.

d. Testing of coaxial line insertion devices such as connectors, switches, relays, filters, tuning stub, patch cords, etc.

e. As an RF load resistor, substantially independent of frequency and line length.

f. Modulation monitor - Audio frequency AM may be monitored by connecting phones, amplifiers, or audio voltmeters to the dc meter circuit.

MAJOR COMPONENTS

The Model 6104 consists of a coaxial RF load, dc cable, meter and its housing Figure I-1.

The load portion is comprised of the coaxial load resistor encased in a finned radiator on which the resistor-voltmeter is mounted. A 3-1/2' coaxial cable, RG-58/U, connects the resistor-voltmeter assembly to the meter. On special order, a 25' cable may be obtained for remote meter readings. The meter is sealed and shock mounted in its housing.

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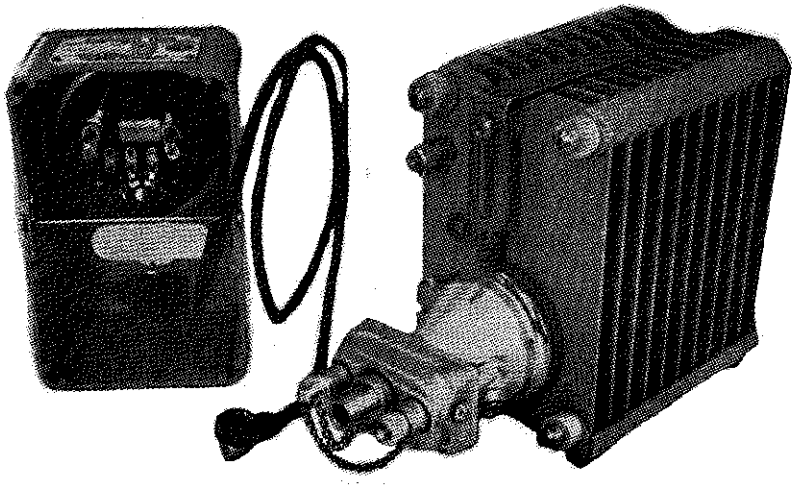
Two specially selected 1N79 crystal diodes, one working and one spare, are furnished with the wattmeter. Both diodes are interchangeable and may be used as a cross-check of the instrument's accuracy. The working diode is housed in the resistor-voltmeter assembly, and the spare on the upper left face of the front radiator fin.

Figure I-1. Meter Housing Detached.



SPECIFICATIONS FOR 6104 TERMALINE® WATTMETER

Power Rating	60W continuous
Impedance	50 ohms nominal
Frequency Range	25-512MHz
VSWR	1.1:1 dc to 512MHz
Power Scales	
Low Scale (Black)	0-2 & 0-20W
High Scale (Red)	0-6 & 0-60W
Accuracy	±5% of full scale
Connector	Female N
Dimensions	9-5/8"L x 3-61/64"W x 6-3/8"H (244.4 x 100.4 x 161.9mm)
Weight	7 lbs. (3.2kg)
Operating Position of Load	Horizontal

SECTION I - INSTALLATION

1-1. LOCATION

1-2. 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 four inch clearance on all sides. The space above the equipment should be kept unobstructed for good heat transfer. Use the Model 6104 Wattmeter in a horizontal position only.

1-3. MOUNTING

1-4. The Model 6104 is essentially a portable test instrument. It should be placed as close as possible to the equipment whose power is being measured.

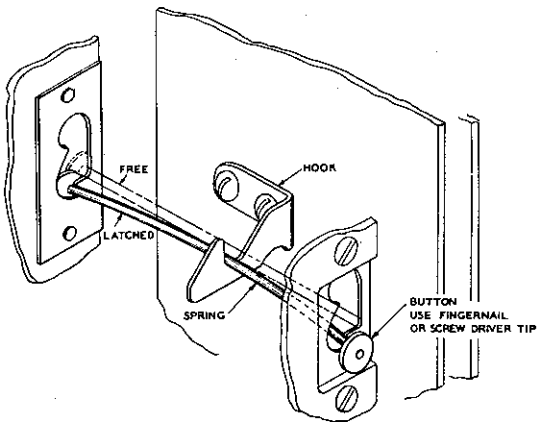
1-5. The wattmeter may be fastened to a work or test bench by removing the four rubber bumpers from the bottom of the radiator. These bumpers are fastened to the radiator brace by #8-32 studs which are set permanently into the rubber feet. The bumpers unscrew easily by hand. The holes are threaded for #8-32 screws and fasteners must be placed up through the bench and into the radiator. These holes are on a 3 x 4-1/2" rectangle (76.2 x 114.3mm).

1-6. LATCH MECHANISM

1-7. If it is desired to use the meter remotely, refer to Figure 1-1. The meter case is retained on the radiator by the bowed spring action of the latch spring, which is a rod of heavy music wire.

1-8. To remove the meter case, raise the buttons at the sides of the case, one at a time, to lift the spring above the notch in the hook. The meter may be read either standing up or on its back.

Figure 1-1. Latch Operation.



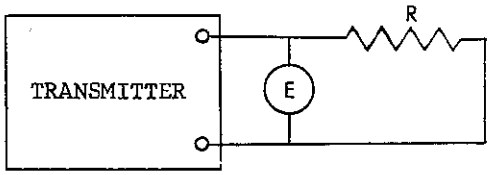
1-9. To reassemble, coil the dc cable in such a manner that it will allow the meter case to be replaced properly on the load. Engage the spring per Figure 1-1, first one button, then the other. The second will resist with stiff spring action. Check by pulling on the meter case.

SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. The method of power determination used in the Model 6104 TERMALINE® Wattmeter may be expressed as $W = E^2/R$, where E is the voltage across the resistor R and W is the power in watts. Figure 2-1 illustrates the E^2/R power measurement used in the Model 6104. RF energy flows from the transmitter through the resistor R, producing a voltage drop across this resistor. The RF voltage is rectified by a crystal diode and voltmeter E records the drop. It is important that the output impedance of the wattmeter be equal to the resistance R, and that the voltmeter is accurate at the operating frequency.

Figure 2-1. E^2/R Method of Power Measurement.



2-3. VOLTMETER CIRCUIT

2-4. Basically, the voltmeter consists of two separate filtered half-wave rectifier circuits. The active circuit is selected by inserting the crystal diode into the desired socket and the scale being selected by the toggle switch.

2-5. RF LOAD RESISTOR

2-6. The RF load resistor of the Model 6104 Wattmeter consists essentially of a cylindrical film type resistor immersed in a dielectric coolant. The resistor, individually selected for its accuracy is enclosed in a specially tapered housing which provides a linear reduction in surge impedance directly proportional to the distance along the resistor. This produces the uniform, practically reflectionless line termination over the frequency range of the wattmeter.

2-7. The dielectric coolant is chosen for its desirable dielectric properties and thermal characteristics. Cooling of the load is accomplished by natural fluid and air convection. The dielectric coolant carries the electrically generated heat from the resistor to the walls of the cylindrical cooling tank. The tank is encased in a set of metal radiating fins, which are firmly pressed on the cylinder. The heat from the dielectric oil is transferred to the surrounding air by the radiating fins.

2-8. A synthetic rubber diaphragm located in the rear dome on the load allows the coolant to expand as the temperature rises.

SECTION III - OPERATING INSTRUCTIONS

3-1. GENERAL

a. Operating Precautions - Carefully check the condition of the RF cable and connectors used in the RF circuitry to the Model 6104 Wattmeter. RF cable lengths, adapters and connectors should be kept to a minimum. Type N or other constant impedance 50 ohm connectors and adapters should be used throughout. A Male N connector, UG-21/U, must be used for connection to the Model 6104. When other than 50 ohm connectors are used, keep at the transmitter jack only. This will keep the RF cable free from standing waves.

b. Operator's Test for Accuracy - Operating checks should consist mainly of comparison between this wattmeter and others of the same type. This will indicate an accuracy of ±10% full scale. A cross-check with results within 3% of full scale may be made between the working and spare crystals. Repeat either method several times to eliminate possible error from transmitter variations.

c. Frequency Response - The Model 6104 is a broad band instrument. Misreadings can occur with the presence of harmonics or spurious frequencies. To prevent misreadings due to harmonics, connect a low pass filter between the transmitter and wattmeter. Do not continue operation of the wattmeter when large spurious responses are present.

d. Frequency Calibration Correction - Upon request at a slight additional cost, frequency and scale data is available for each Model 6104 Wattmeter. This data may be used to obtain a more accurate reading for a given power at a specific frequency.

3-2. MEASURING TRANSMITTER POWER

3-3. Place the Model 6104 Wattmeter in a position where the meter can be read while the transmitter is being adjusted. If the meter pointer does not read zero under no load conditions, turn the zero adjust screw, located below the meter face, slightly with a small screwdriver until the meter is exactly on zero; then follow the procedures below.

3-4. Connect the wattmeter to the transmitter with a short piece of 50 ohm cable, preferably under five feet in length. If transmitter power output is not known, make sure the crystal diode is plugged into the high range and the switch is on the red scale. Do not exceed the power rating of the Model 6104.

3-5. The wattmeter is ready to make power measurements. The meter indicates the power dissipated in the load portion of the instrument. Losses introduced by the cable between the transmitter and the wattmeter, if significant, must be added to the power indicated by the Model 6104.

3-6. During the process of switching from the wattmeter back to the antenna, it may become necessary to retune the transmitter slightly due to the difference in VSWR between the wattmeter and the transmitter's antenna.

3-7. USE AS A DUMMY ANTENNA

3-8. The Model 6104 may be used without the meter and crystal diode as a 50 ohm coaxial termination for transmitters with a power output up to 80 watts from dc to 4000MHz.

3-9. To protect the meter and crystal diode when using the equipment as a dummy antenna, remove the diode from the voltmeter block and disconnect the meter at the dc plug.

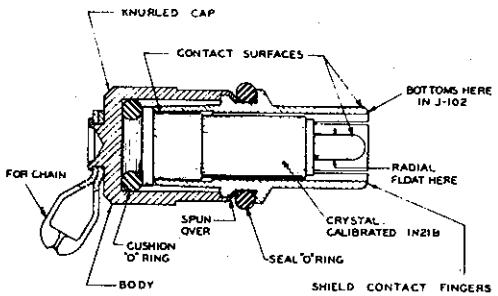
SECTION IV - MAINTENANCE

4-1. INSPECTION

4-2. The Model 6104 TERMALINE® Wattmeter is ruggedly constructed, and periodic inspection will be necessary at about six month intervals. Inspection should include the items listed below:

a. Oil Leakage - Check for coolant seepage around the front and rear clamping bands. The level of the dielectric coolant should remain constant under normal use. The filler plug is on the conical reducer, behind the voltmeter block, at the lower right. Place plug in up position before removing. Use a 3/16 Allen wrench to remove plug. The coolant level should be within 1/4" of the inside thread of the socket. If the coolant appears to be contaminated, replace it. The load has a capacity of 0.1 gallon (378.5ml).

Figure 4-1. Crystal Diode.



b. Crystal Diodes - Occasionally lubricate the O-Ring seal on the crystal diode unit, Figure 4-1, with a nonmelting dielectric compound such as Dow Corning #4. Check contact fingers of shield for proper contact to voltmeter socket. Bend slightly, making sure not to damage the center pin of the diode. Do not allow the two crystal diodes supplied with the instrument to be interchanged with any other Model 6104.

4-3. PREVENTIVE MAINTENANCE

4-4. The Model 6104 Wattmeter requires only simple and routine maintenance. Do not subject the meter and crystal diodes to rough treatment. Keep the dc plug connected to the voltmeter block and the diodes in their sockets at all times. This will prevent dust and dirt from accumulating in the sockets.

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**********************************************************
*                      C A U T I O N                     *
*                                                        *
* Prolonged breathing of many dry cleaning solvents may  *
* be dangerous to your health.  Make certain adequate    *
* ventilation is provided when using solvent.            *
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4-5. Wipe dust and dirt off the unit at regular intervals, especially from between the radiating fins where it may restrict the cooling of the unit. Clean the connector and diode rectifier contacts with a little dry cleaning solvent on a swab stick. An aerosol type contact cleaner is excellent for this purpose.

4-6. If any portions of the radiator or meter housing are scratched, clean the area with a fine flint sandpaper and touch up with grey enamel.

4-7. RESISTOR-VOLTMETER ASSEMBLY REPLACEMENT

4-8. A faulty resistor voltmeter assembly must be replaced in its entirety. No attempt should be made to repair the assembly. To replace it, use the following procedure:

a. Remove the meter case from the load per Paragraph 1-7 and 1-8.

b. Remove filler plug and drain off approximately two ounces of coolant, see Paragraph 4-2a.

c. Disconnect the dc plug from the voltmeter block.

d. Place the load in a vertical position with the voltmeter up.

e. Loosen the #8-32 x 1" screw from the clamping band and remove the clamping band.

f. Lift out the resistor-voltmeter assembly from the radiator allowing the coolant to drain off before removing from over the cylinder.

g. Inspect the O-Ring seal. Do not reuse if it appears to be deteriorated.

h. Inspect the oil, if it's contaminated, replace it. Use only oil specified by Bird Electronic Corporation, P/N 5-030.

i. Reverse the above procedure to replace the assembly.

4-9. DIAPHRAGM REPLACEMENT

a. Stand the wattmeter vertically, with the back end up.

b. Loosen the clamp screw until the clamping band is released.

c. Remove the diaphragm cover and lift the diaphragm from the back end of the radiator tank.

d. Reverse the above procedure to replace.

4-10. METER REPLACEMENT

4-11. The microammeter is a rugged instrument which is shock mounted in its housing. When properly used, not subjected to abuse and overloads, it should not break down. Do not attempt to repair the meter. Follow the procedures below to replace.

a. Remove the meter case from the load per Paragraph 1-7 and 1-8.

b. Remove the dc cable and terminal strip from the meter by loosening the two #8-32 hex nuts on the meter terminals.

c. Place meter face down on a smooth clean surface.

d. Using thumb and fingers of one hand, press down evenly on the retainer ring.

e. Unscrew the two #10-32 flat head machine screws on the sides of the meter case. There is one screw on each side.

f. Remove meter with the retainer ring and sponge rubber strips.

g. To install a new meter, reverse the above procedure.

4-12. SWITCH REPLACEMENT

a. Remove terminal board per Subparagraph 4-11b.

b. Unsolder switch leads from terminal board. Do not overheat the shunt resistor.

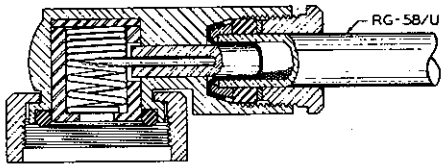
c. Remove the toggle switch by unscrewing the 15/32-32 face nut.

d. Reverse the above procedure to replace the switch.

4-13. DC CABLE AND PLUG SERVICE

a. Remove the cable from the plug by unscrewing the bushing and pulling the cable out. The center conductor of the cable makes snug contact between the turns of the coil spring when assembled.

Figure 4-2. DC Plug.



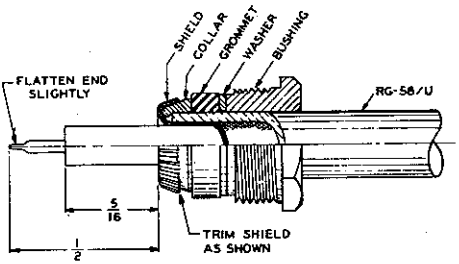
b. To assemble the cable, RG-58/U, to the dc plug, Figures 4-2 and 4-3, slip the bushing, washer and grommet over the end of the cable.

c. Remove the outer insulation 9/16" from the end.

d. Slip the collar over the shielding (unbraided).

e. Fold back the braids and trim them as shown in Figure 4-3; remove the insulation to the dimension shown.

Figure 4-3. Cable Service for DC Plug.



f. Flatten the end of the center conductor to a sharp chisel edge. Push it into the dc plug, making sure the edge of the center conductor is aligned with turns of the coil spring.

g. Push in the grommet and washer, and screw the bushing down snug.

SECTION V - REPLACEMENT PARTS LIST

5-1. MODEL 6104

ITEM	QTY	DESCRIPTION	PART NUMBER
1	1	Shock Strip, Meter Mount	5-1066
2	1	Shock Mount, Meter	4220-087
3	1	Resistor - Voltmeter Assembly	6104-002
4	1	Radiator Assembly	2400-058
5	1	Crystal	7500-147
6	0.1 gallon (378.5ml)	Coolant	5-030-1 (473ml) (1 pint Container)
7	1	Switch, Toggle, SPST	5A2154 ~~5-385~~
8	1	Switch, Assembly (Includes: Toggle Switch, Terminal Strip and Trimmer Potentiometer)	6154-012
9	1	Handle	2400-017
10	1	Clamp Band Assembly	P7500-254
11	1	Meter	2080-034
12	1	Stem Bumper, Meter Mount	4410A261 ~~4220-098~~
13	1	O-Ring	7500-065
14	1	Plug, DC	7500-076
15	1	Cable, Assembly, DC	P4220-097-2
16	1	Diaphragm	2400-015
17	1	Cap, Diaphragm	2400-050
18	1	Chain & Anchor Assembly	6700-021