
INSTRUCTION BOOK

OPERATING INSTRUCTIONS

**TERMALINE[®] WATTMETER
MODEL 6151A**

BIRD

Electronic Corporation
Cleveland (Solon) Ohio USA

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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. These precautions must be thoroughly understood, and apply to all phases of operation and maintenance.

Keep Away From Live Circuits

Operating personnel must at all times observe general safety precautions. Do not replace components inside equipment with the high voltage supply turned on. To avoid casualties, always remove power.

Do Not Service Or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

Safety Earth Ground

An uninterruptible earth ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

Shock Hazard

Do not attempt to disconnect an RF transmission line while RF power is present. Radiated RF power is a potential health hazard.

Resuscitation

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

Safety Symbols

| |
|----------------|
| WARNING |
|----------------|


| |
|---|
| Warning notes call attention to a procedure, which if not performed correctly, 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. |
|--|



This safety symbol appears on the the equipment indicating there is important information in the instruction manual regarding that particular area.

 Note: Calls attention to supplemental information.

6151A Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel and are repeated here for emphasis.

WARNING

Exposure to RF power radiation and the possibility of RF shock or burns exists with some operating conditions.

Always be sure to turn off transmitter when connecting or disconnecting wattmeter. When Plug-In Element is removed from the RF line socket, the line section center conductor is exposed. Do not put fingers or other objects into this Plug-In Element socket while RF power is applied.

WARNING

Do not attempt to operate the Termaline Wattmeter for prolonged periods at higher than read load levels. Damage to the equipment and injury to operator may result.

WARNING

Never attempt to disconnect any RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

6151A Caution Statements

The following equipment cautions appear in the text whenever the equipment is in danger of damage and are repeated here for emphasis.

CAUTION

Do not drop the instrument or Plug-In Elements as damage to the meter could result or impair the accuracy of the elements.

CAUTION

If other than Female N type connectors are used, limit power and frequency to the capabilities of the RF coaxial cable or connectors used. Damage to connectors or errors in reading could result.

CAUTION

Do not replace coolant with anything but the specified fluid. The inner shell of the resistor housing is contoured to the dielectric properties of this fluid. The use of any other type of coolant will affect the electrical performance of the load.

Safety Statements



USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.



SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE-TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERLO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL.

ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRETIEN

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.



RF VOLTAGE MAY BE PRESENT IN RF ELEMENT SOCKET - KEEP ELEMENT IN SOCKET DURING OPERATION.

DE LA TENSION H.F. PEUT ÊTRE PRÉSENTE DANS LA PRISE DE L'ÉLÉMENT H.F. - CONSERVER L'ÉLÉMENT DANS LA PRISE LORS DE L'EMPLOI.

HF-SPANNUNG KANN IN DER HF-ELEMENT-BUCHSE ANSTEHEN - ELEMENT WÄHREND DES BETRIEBS EINGESTÖPSELT LASSEN.

PUEDE HABER VOLTAJE RF EN EL ENCHUFE DEL ELEMENTO RF - MANTENGA EL ELEMENTO EN EL ENCHUFE DURANTE LA OPERACION.

IL PORTAELEMENTO RF PUÒ PRESENTARE VOLTAGGIO RF - TENERE L'ELEMENTO NELLA PRESA DURANTE IL FUNZIONAMENTO.

This instruction book covers the model 6151A Termaline Wattmeter.

This instruction book is arranged so that essential information on safety is contained in the front of the book. Reading the Safety Precautions Section before operating the equipment is strongly advised.

The remainder of this Instruction Book is divided into Chapters and Sections. At the beginning of each chapter a general overview will be given, describing the contents of that chapter.

Operation

First time operators should read Chapter 1 - Introduction, and Chapter 3 - Installation, to get an overview of equipment capabilities and how to install it. An experienced operator can refer to Chapter 4 - Operating Instructions. All instructions necessary to operate the equipment, are contained in this chapter.

Maintenance

All personnel should be familiar with preventative maintenance found in Chapter 5 - Maintenance. If a failure should occur, the troubleshooting section will aid in isolating and repairing the failure.

Parts

For location of major assemblies or parts refer to the part lists and associated drawings in Chapter 5.

Changes To This Manual

We have made every effort to ensure this manual is accurate at the time of publication. If you should discover any errors or if you have suggestions for improving this manual, please send your comments to our factory. This manual may be periodically updated, when inquiring about updates to this manual refer to the part number and revision level on the title page.

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Purpose and Function

The Bird Model 6151A Termaline RF Wattmeter is designed to measure RF power under non-radiating conditions. The Wattmeter is coupled to an accurate 50 ohm coaxial load resistor which becomes the transmitter load element, providing a practically reflectionless coaxial line termination up to 2.3 GHz.

Power input to the load resistor is sampled by a coupler-detector type voltmeter indicating directly in watts.

The Model 6151A is intended for general field and laboratory service use on CW, AM and FM modulation envelopes, but not on pulsed modes.

Description

The Model 6151A Termaline Wattmeter consists of a coaxial load resistor, detector circuit, dc cable, panel meter and its housing.

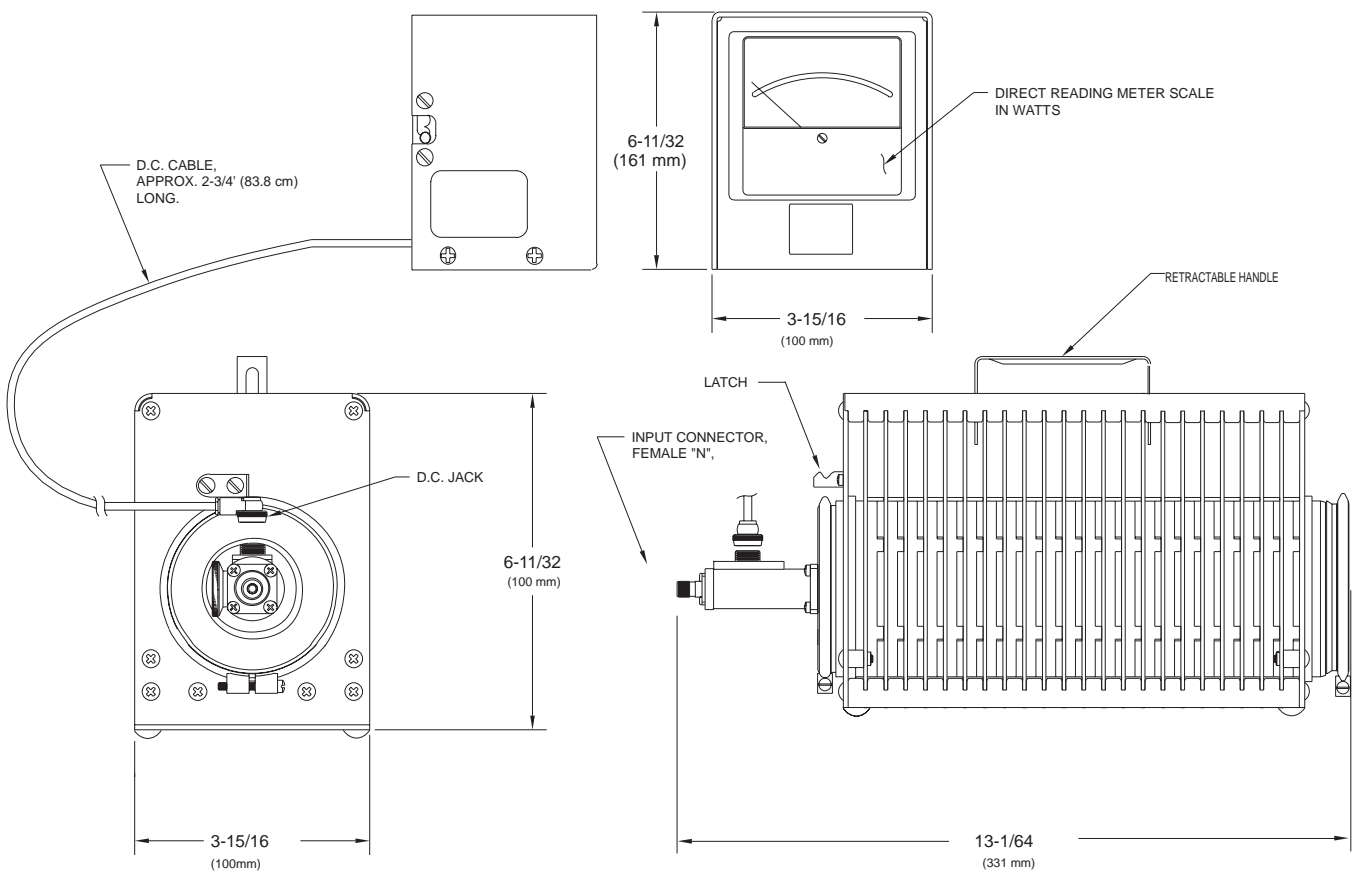
The load portion is comprised of an RF coaxial load resistor assembly encased in a finned radiator. The detector circuit is in the Plug-in Element inserted in a short length of 50 ohm coaxial line mounted on the front of the load portion. A 2-3/4 foot (83.8 cm) coaxial cable (RG-58/U) connects the detector circuit to the meter which is sealed and shock mounted in its housing.

The detector circuit in the Plug-in Element samples the RF energy travelling toward the load, converts it to a small dc voltage for readout on the meter. The meter scale is designed to indicate power directly in watts.

Specifications

| | |
|--|--|
| Power Rating | 100 W continuous |
| Power Ranges | 25/50/100 Determined by plug-in elements* |
| Input Impedance | 50 ohms nominal |
| Frequency Range | 2 to 2300 MHz Determined by plug-in elements* |
| VSWR | 1.1 to 1.0 max. dc to 1 GHz 1.25 to 1.0 max. 1 to 2.3 GHz |
| Accuracy | ± 5% of full scale to 2.3 GHz |
| Input Connector | Bird quick change "QC" type Female N normally supplied. |
| Dimensions | 12-27/32" L x 3-15/16" W x 6-11/32"H (326 x 100 x 161 mm) |
| Weight, Nominal | 8 lb (3.6 kg) |
| Finish | Grey Powder Coat |
| *Refer to the Bird Electronic Corporation Catalog. Any Element, up to 100 watts, may be selected from Tables I, II or III of the Catalog. | |

Figure 1
Model 6151A Outline Drawing



Travelling Waves

The voltage and current present on a transmission line are expressed as the sum of the voltages and currents of two waves; forward and reverse. Both waves are identical except in the direction of travel. The Model 6151A measurement concept basically samples the voltage and current only of the wave travelling from the source to load.

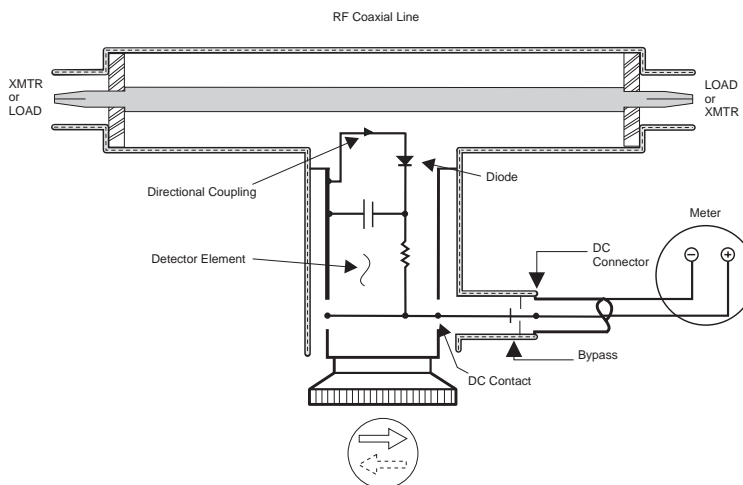
The forward wave travels (and its power flows) from source to the load, and has RF voltage E and current I in phase, with $E/I = Z_0$. Note that the component wave is mathematically simple, and is completely described by a single figure for power; $\text{Watts} = E^2/R = I^2R = EI$. Z_0 is the characteristic impedance of the detector circuit and the coaxial termination, simplifying matters by being a reasonably pure resistance of 50 ohms.

Coupling Circuit

The coupling circuit which samples the RF power from the standing waves is in the Plug-In-Element. The circuitry of the element and its relationship to the other components of the Termaline are illustrated in the schematic diagram in figure 2. Energy will be produced in the coupling circuit of the element by both mutual inductance and capacitance from the travelling waves within the line section. The inductive currents will flow according to the direction of the travelling waves producing them. The capacitive portion of these currents are independent of the direction of the travelling waves.

The electrical values of the element circuits are carefully balanced and designed to be sensitive to the current produced from only the forward wave. Also, due to the practically non-reflective characteristics of the termination, almost no reflected wave will exist.

Figure 2
Coupler Circuit
Schematic Diagram

**RF Load Section**

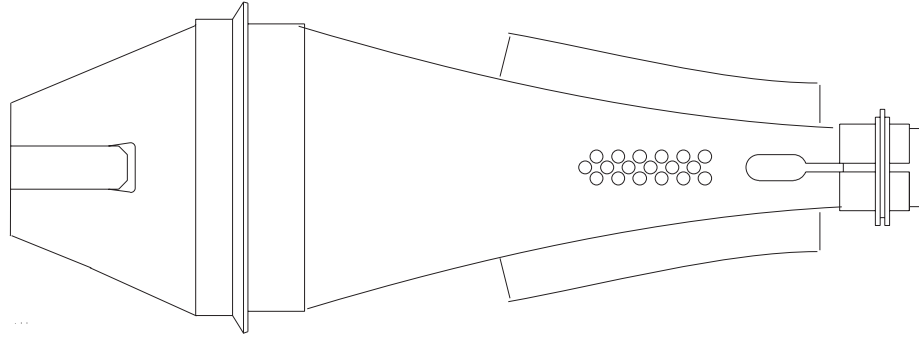
The RF load resistor of the Model 6151A Wattmeter consists of a cylindrical film type resistor immersed in a dielectric coolant. The resistor, individually selected for its resistive film accuracy, is enclosed in a special tapered housing which provides a linear reduction in surge impedance directly proportional to the distance along the resistor. This produces the uniform, practically reflectionless line termination over the stated frequency range of the wattmeter. Refer to figure 3.

The 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 radiation fins to which heat is conducted and carried off by air convection.

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

Figure 3
RF Load Section



This chapter provides information for preparing the 6151A for use.

Location Free air circulation around the wattmeter is essential. Position the Model 6151A with clearance around it and do not place it near heated surfaces. The wattmeter should have at least a 4 inch clearance on all sides. Keep the space above the Model 6151A unobstructed to provide adequate natural air convection for good heat transfer. Use the wattmeter in a horizontal position only.

CAUTION

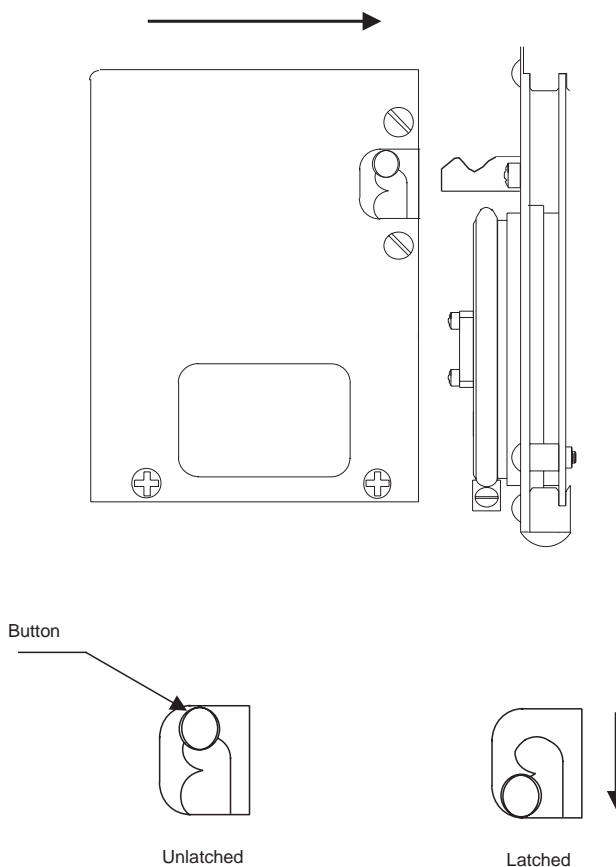
Do not drop the instrument or Plug-In Elements as damage to the meter could result or impair the accuracy of the elements.

Mounting The Model 6151A Termaline Wattmeter is essentially a portable test instrument. It should be placed as close as possible to the equipment of which the RF power is being measured.

The wattmeter may be fastened to a work or test surface 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 molded permanently into the rubber feet. The bumpers unscrew easily by hand. The holes are threaded for 8-32 screws. Fasteners must be placed up through the work surface and into the radiator. These holes are on a 3 by 7 inch rectangle, (76 x 178 mm).

Latch Mechanism The meter housing is retained on the radiator by the bowed-spring action of the latch spring, which is a rod of heavy wire. While following these instructions, refer to figure 4.

Figure 4
Latch Operation



To remove the meter case:

1. Raise the buttons at the sides of the case, one at a time, to lift the spring above the notch in the hook. Use a flat blade screwdriver.
2. Pull the housing straight off of the radiator.
3. Place the meter in a position where the meter can be easily read while the transmitter is being adjusted. The meter may be read either standing or on its' back.

To assemble the meter case:

1. Coil the dc cable so that it will allow the meter case to be replaced properly on the load.
2. Engage the spring, first one button, then the other. The second button will resist with stiff spring action.
3. Check for proper engagement by pulling on the meter case.

Input Connector

CAUTION

If other than Female N type connectors are used, limit power and frequency to the capabilities of the RF coaxial cable or connectors used. Damage to connectors or errors in reading could result.

The Model 6151A is normally supplied with a Female N type connector which is of the Bird Quick-Change design. Other "QC" connectors are available and may be purchased from Bird Electronic Corporation as required. A list of available connectors is in Chapter 5 - Replacement Parts List.


The connectors are quickly changed by following the instructions below:

1. Remove the four 8-32 pan head machine screws from the corners of the connector flange.
2. Pull the connector straight out.
3. Reverse this procedure to install a connector, making sure the center contact pin is properly aligned with the socket.

Transmitter Connection

Connection to the transmitter is made through a suitable coaxial cable equipped with appropriate RF connectors. It is advisable to keep the length of this cable as short as possible.

1. Connect the wattmeter to the transmitter with a short length of 50 ohm coaxial cable such as RG-58C/U (preferably under 5 feet in length).
2. The wattmeter is ready to be used for power measurements.

 Note: There may be a slight deviation in the electrical specifications if a connector, other than a Female N type (normally supplied) is used.

WARNING

Exposure to RF power radiation and the possibility of RF shock or burns exists with some operating conditions. Always be sure to turn off transmitter when connecting or disconnecting wattmeter. When Plug-In Element is removed from the RF line socket, the line section center conductor is exposed. Do not put fingers or other objects into this Plug-In Element socket while RF power is applied.

WARNING

Never attempt to disconnect any RF equipment from the transmission line while RF power is being applied. Leaking RF energy is a potential health hazard.

Operating Precautions

1. Carefully check the condition of the RF cable and connectors used in the circuitry to the Model 6151A.
2. The RF cable lengths, adapters and connectors should be kept to a minimum. Type N or other constant impedance connectors and adapters should be used throughout.
3. When other than 50 ohm connectors are used, keep at the transmitter jack only. This will keep the RF cable free from standing waves.

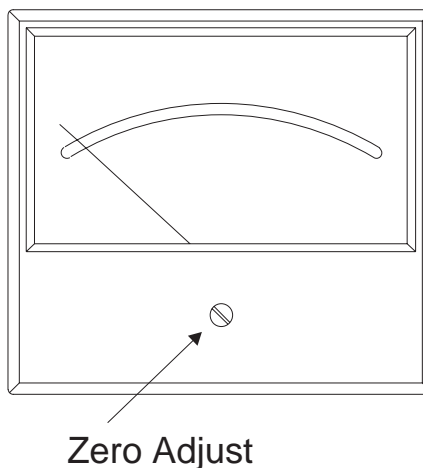
Operator's Test for Accuracy

Operating checks should consist mainly of comparison between this wattmeter and a Thru-line wattmeter or other wattmeters of the same type. This will indicate an accuracy of within ± 10 percent full scale due to the ± 5 percent full scale limits of each instrument. Repeat the cross-check several times to eliminate possible error from transmitter variations.

Zero Adjust

Place the Model 6151A Termaline Wattmeter in a position where the meter can be easily 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 to the right or left with a small screwdriver until the pointer is exactly on the zero mark. Refer to figure 5.

Figure 5
Zero Adjust



Measuring Transmitter Power

WARNING

Do not attempt to operate the Terminal Wattmeter for prolonged periods at higher than read load levels. Damage to the equipment and injury to operator may result.

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 6151A Wattmeter.

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 termination and the transmitter's antenna.

Use As Dummy Antenna

The Model 6151A may be used, without the meter and Plug-In Element, as a 50 ohm coaxial termination load for transmitters with a power output up to 100 watts from dc to 2.3 GHz.

To protect the meter when using as a dummy antenna, the meter can be disconnected at the dc plug. Also turn the element so that the arrow on the identification plate points up i.e. at 90 to direction of power flow.

The load portion will accept an overload of RF power for short periods of time as long as sufficient time between overloading is allowed for cooling.

This chapter covers the cleaning, inspection, troubleshooting, and replacement parts.

Troubleshooting

For corrections requiring repair or replacement of components, refer to the appropriate section for your specific model.

*Table 1
Troubleshooting*

| Problem | Possible Cause | Remedy |
|---|---------------------------------------|--|
| Coolant oil leaking around clamping band or radiator housing. | Clamping bands not tight. | Tighten slightly with a screwdriver. |
| | Faulty O-Ring (front) | Replace O-Ring. |
| | Faulty diaphragm (rear) | Replace diaphragm. |
| Radiator overheating. | Transmitter power too high. | Reduce transmitter power. |
| | Coolant oil level too low. | Add more coolant oil to the radiator. |
| | Accumulation of dirt on cooling fins. | Clean the fins. |
| | Faulty RF section assembly. | Replace RF section. |
| High or low dc resistance values. | Faulty RF connector. | Replace RF connector. |
| | Loose RF connector. | Tighten with a screwdriver. |
| | Faulty RF section assembly. | Replace RF section. |
| Incorrect power reading. | Defective element. | Return element to authorized service facility for replacement and calibration. |
| | Loose meter cable. | Tighten cable connector. |

Cleaning

Outside Surface

It is necessary to keep the following areas clean:

- ♦ The outside surface of the wattmeter
- ♦ Radiator fins
- ♦ Connector

Excessive dust and lint on the cooling fins will interfere with the efficient dissipation of heat. Periodically wipe, with a soft cloth, the accumulated dust and lint off of the radiator fins. If the teflon insulator or metallic contact surfaces of the connector should become dirty, wipe off with a soft cloth. Use a contact cleaner that is self-drying and does not leave a residue on the inaccessible internal parts.

Inspection


Inspection will be necessary at six months intervals. Check for coolant oil seepage around the radiator tank, particularly at the front and back around the underside of the clamping band. If leakage is observed refer to the troubleshooting table and check tightness of the clamping screw and the fasteners around the front cylinder.

Preventive Maintenance

Preventive maintenance is limited to:

- ♦ Cleaning the equipment, particularly the radiator fins. It is important to maintain the heat transfer efficiency of the cooling fins.
- ♦ Check the coolant level in the radiator tank occasionally.
- ♦ Keep the dc plug connected to the line section and the Plug-In Element. in its socket at all times. This will prevent dust and dirt from accumulating in the sockets.

Do not subject the meter and Plug-In Element to rough treatment. Do not drop as a sharp blow may damage meter or alter the ± 5 percent accuracy of the Plug-In Element.

 Note: When using as a termination only, point the Element arrow up or at a right angle to the Line Section.

Disassembly

There are no special techniques required for the repair or replacement of components in these Termaline Wattmeters.

Tools Required

A screwdriver and a small wrench are the only tools needed.

There are no special techniques required for the repair or replacement of components in these Termaline Wattmeters.

RF Connector

The connector is a “Quick-Change” design which permits easy interchange with the use of only a screwdriver. This process does not interfere with the essential coaxial continuity of the load resistor RF input or the coolant oil seal. For replacement, proceed as follows:

1. Remove the four 8-32 x 5/16 round head machine screws from the corners of the RF connector.
2. Pull the connector straight out of its socket.

Diaphragm and Coolant Oil

Remove the diaphragm to replace or examine the coolant oil. For replacement of the diaphragm and coolant oil follow the steps below.

CAUTION

Do not replace coolant with anything but the specified fluid. The inner shell of the resistor housing is contoured to the dielectric properties of this fluid. The use of any other type of coolant will affect the electrical performance of the load.

1. Stand the load vertically, with the back end up.
2. Loosen the clamp screw until the clamp band is released.

3. Remove the diaphragm cover and lift the diaphragm from the back end of the radiator tank. Inspect the diaphragm. If it is no longer soft and pliable or shows signs of surface cracks it should be replaced.
4. The coolant level should be about one inch below the top of the radiator cylinder. The coolant should be a clear to a light yellow color, if not, it may be contaminated and should be replaced.

Assembly

RF Connector

To install a new connector, reverse the disassembly procedures. Be sure that the projecting center pin on the connector is carefully engaged and properly seated within the mating socket of the load resistor input before pressing it home.

Diaphragm and Coolant Oil

Proceed as follows:

1. Put the diaphragm back in place on the radiator tank.
2. Press the cuplike swelling in the center of the diaphragm down into the tank to remove the trapped air bubble. To allow the air to escape, pry the diaphragm away from the edge of the tank.
3. Through the same opening add more oil, if necessary, until the oil level is flush with the top of the tank.
4. Replace the diaphragm cover and the clamping band.
5. Tighten the clamping screw.

Customer Service

Any maintenance or service procedure beyond scope of those provided in this section should be referred to a qualified service center.

Bird Electronic Corporation maintains complete repair and calibration facilities at the following addresses:

Sales/Repair Facility

U.S.A. Sales and Manufacturing
 Bird Electronic Corporation
 30303 Aurora Road
 Cleveland (Solon), Ohio 44139-2794
 Phone: (440) 248-1200
 Fax: (440) 248-5426

Sales Facilities

For the location of the nearest sales office, give us a call or visit our Web site at:
<http://www.bird-electronic.com>

Pan Asia Sales Office
 Bird Electronic Ltd
 3A Unit 6 Tyrwhitt Road
 Singapore 0820
 Phone: 65 299 2537
 Fax: 65 299 8509

Storage

No special preparations for storage are necessary other than to cover the equipment to keep out dust and dirt. Store these units in a dry and dust-free environment where the ambient temperature will remain within the -40°C to +45°C (-40°F to +113°F) working range of the wattmeter.

Shipment

- Load Resistor** Wrap the RF connector with padding, and tape the padding securely in place. Pack and brace the load in a suitable shipping container, a corrugated paper box should suffice. It is not necessary to remove the dielectric coolant before shipping.
- Meter Portion** Disconnect the dc cable from the line section, and then wrap the meter with padding and tape securely in place. The meter can be shipped in the same container as the load portion.
- Low Frequency Line Section** If the low frequency line section is part of the equipment as an extra accessory, wrap and tape it securely in padding before putting it in the container with the load and meter.

Replacement Parts List

| Item | Qty. | Description | Part Number |
|------|------|---------------------|-------------|
| 1 | 1 | RF Section Assy. | 8130-015 |
| 2 | 1 | Line Section Assy. | 6151-006 |
| 3 | 1 | RF Input Connector | *See table |
| 4 | 1 | Meter Housing Assy. | 6151-027 |
| 5 | 1 | Meter | 2080-002 |
| 6 | 1 | Cable Assy. | 4220-097-1 |
| 7 | 1 | DC Plug | 7500-076 |
| 8 | 1 | Radiator Assy. | 2400-053 |
| 9 | 4 | Bumper Feet | 5-049 |
| 10 | 1 | Handle | 2400-017 |
| 11 | 2 | Clamp Band | 7500-254 |
| 12 | 1 | Diaphragm Cap | 2400-050 |
| 13 | 1 | Dielectric Coolant | 5-030-1 |
| 14 | 1 | Diaphragm | 2400-015 |

***Available "QC" Type Connectors**

| Connector | Part Number | Connector | Part Number |
|--------------------------------|--------------------|--------------------------------|--------------------|
| N-Female | 4240-062 | LT-Female | 4240-018 |
| N-Male | 4240-063 | LT-Male | 4240-012 |
| HN-Female | 4240-268 | C-Female | 4240-100 |
| HN-Male | 4240-278 | C-Male | 4240-110 |
| LC-Female | 4240-031 | UHF-Female | 4240-050 |
| LC-Male | 4240-025 | UHF-Male | 4240-179 |
| BNC-Female | 4240-125 | TNC-Female | 4240-156 |
| BNC-Male | 4240-132 | TNC-Male | 4240-160 |
| SMA-Female | 4240-336 | SC-Female | 4240-090 |
| SMA-Male | 4240-334 | Mini UHF-Female | 4240-346 |
| 7/8" EIA | 4240-002 | 7/16" IEC (Plug) Type 169-4 | 4240-363 |
| 1-5/8" EIA Fixed | 4240-096 | 1-5/8" EIA Swivel | 4240-208 |
| 7/16" IEC (Jack) Type 169-4 | 4240-344 | Open Term. #10-32 Nut | 4240-080 |

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.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten (10) days from the date of discovery of the defect.

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.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.