



RF DIRECTIONAL  
THRULINE® WATTMETER  
MODEL 4308

OPERATION MANUAL

©COPYRIGHT 2016 BY BIRD ELECTRONIC CORPORATION  
INSTRUCTION BOOK PART NUMBER 920-4308 REV. E

THRULINE® AND TERMLINE® ARE REGISTERED TRADEMARKS  
OF BIRD ELECTRONIC CORPORATION

## 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.

**WARNING**

**Keep Away From Live Circuits**

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

**WARNING**

**Shock Hazard**

Do not attempt to remove the RF transmission line while RF power is present.

**WARNING**

**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.

**WARNING**

**Safety Earth Ground**

An uninterruptible earth safety 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.

**WARNING**

**Resuscitation**

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

**WARNING**

**Remove Power**

Observe general safety precautions. Do not open the instrument with the power on.

## Safety Symbols

---

### WARNING

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

### CAUTION

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



The caution symbol appears on the equipment indicating there is important information in the instruction manual regarding that particular area

**Note:** *Calls attention to supplemental information.*

## 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

Leaking RF energy is a potential health hazard. Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

Refer to page 5.

## 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 Thruline Wattmeter equipment or submit it to hard blows. The voltmeter circuitry or microammeter, even though it is shock mounted, may be damaged by severe impact.

Refer to page 5.

## **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 EFFETTUARRE 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.**

**PUEDA 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.**

## About This Manual

---

This manual covers the operating and maintenance instructions for the following models:

4308
------

## Changes to this Manual

---

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

## Literature Contents

### Chapter Layout

---

**Introduction** — Describes the features of the 4308 Wattmeter, lists equipment supplied and optional equipment, and provides power-up instructions.

**Theory of Operation** — Describes how the 4308 Wattmeter works and

**Installation** — Describes how to set up and prepare the 4308 Wattmeter for use.

**Operation** — All instructions necessary to operate the equipment appears in this chapter.

**Maintenance** — Lists routine maintenance tasks as well as troubleshooting for common problems.

# TABLE OF CONTENTS

<b>Safety Precautions</b> .....	<b>i</b>
Safety Symbols .....	ii
Warning Statements .....	ii
Caution Statements .....	ii
Safety Statements .....	iii
<b>About This Manual</b> .....	<b>vi</b>
Changes to this Manual .....	vi
Chapter Layout .....	vi
<b>Chapter 1 Introduction</b> .....	<b>1</b>
Purpose and Function .....	1
Performance Characteristics and Capabilities .....	1
<b>Chapter 2 Theory of Operation</b> .....	<b>2</b>
Traveling Wave Viewpoint .....	2
Traveling Wave vs Standing Wave .....	2
Power .....	3
Coupling Circuit .....	4
<b>Chapter 3 Installation</b> .....	<b>5</b>
Portability .....	5
Connections .....	5
Installing in a 50 Ohm Line .....	5
<b>Chapter 4 Operation</b> .....	<b>7</b>
Zero Adjust .....	7
Range Switch and Power Measurement .....	8
<b>Chapter 5 Maintenance</b> .....	<b>11</b>
Troubleshooting .....	11
Cleaning .....	12
Repair and Replacement .....	12
Line Section or Element Coupling Circuit .....	12
Meter Housing .....	12
Line Section and Circuit Board .....	13
Connector Replacement .....	13
Element Removal .....	14
Element Installation .....	14
Meter Replacement .....	14

Calibration Checks ..... 15

Customer Service ..... 16

Specifications ..... 17

Replacement Parts ..... 18

    Available “QC” Type Connectors ..... 19

**Limited Warranty ..... 20**

## **Purpose and Function**

---

The Model 4308 ThruLine Wattmeter is a portable multi-range RF wattmeter. It is a device which requires no external power source or batteries for operation. It is used to measure RF power when inserted into a transmission line of 50 ohms impedance. When operated in this manner, it is used to determine power flow and load mismatch in coaxial transmission lines. It may be used to make measurements of CW, FM, or PM (Plane Modulated) RF Power.

## **Performance Characteristics and Capabilities**

---

On the front face of the unit, there are four power ranges which are controlled by a selector switch. Each position of the selector switch corresponds to a power range on the read-out meter, refer to the Specifications. There is also a "TRANSIT" position to be used when transporting the unit. This position effectively shunts the delicate meter movement to avoid damage from harsh blows.

The meter, line section, and related circuitry of the instrument are contained in a rugged aluminum housing. This housing is equipped with a carrying strap, four rubber bumper feet on the bottom, and four rubber bumper feet on the back. These bumper feet allow the unit to be used in a standing (vertical) or flat (horizontal) position.

## Traveling Wave Viewpoint

---

The operation of the Model 4308 wattmeter is based on the traveling wave concept of RF transmission. As RF power is applied to a transmission line, there is a forward wave traveling from the transmitter to the load and a reflected wave traveling from the load back to the transmitter. The closer the line termination, or load, is matched to the line impedance, the smaller the reflected wave will be. To determine the number of watts dissipated in the load, it is necessary to determine both the power of the forward wave and the power of the reflected wave. The difference between the two will indicate effective power dissipation.

## Traveling Wave vs Standing Wave

---

The interference between the forward and reflected waves, produces a standing wave in a coaxial system. In the standing wave concept, VSWR (voltage standing wave ratio) is a widely used tool. There is a simple relationship between forward power, reflected power, and VSWR.

$$VSWR = \frac{1 + \sqrt{\frac{W_f}{W_r}}}{1 - \sqrt{\frac{W_f}{W_r}}}$$

**Note:** Where  $W_f$  = forward power; and  $W_r$  = reflected.



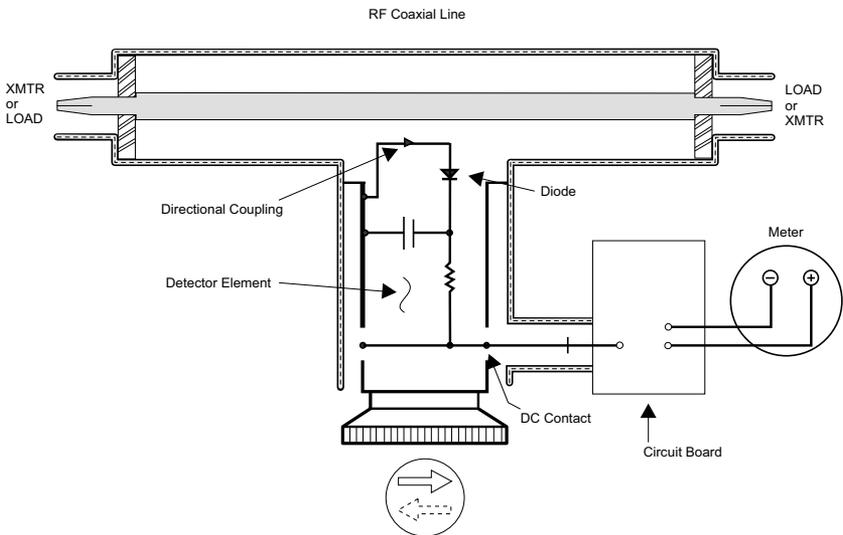
## Coupling Circuit

The coupling circuit which samples the traveling waves is in the Plug-In Element. The circuitry of the element and its relationship to the other components of the ThruLine Wattmeter are illustrated in the schematic diagram, see figure 2.

Energy will be produced in the coupling circuit of the element by both mutual inductance and capacitance from the two traveling RF waves in the line section. The inductive currents will flow according to the direction of the traveling waves producing them, whereas the capacitive portion of these currents is independent of the direction. Therefore, in either position of the Plug-In Element, the coupling currents produced from the waves of one direction will add in phase, and those produced from waves of the opposite direction will accordingly subtract in phase. The additive direction is indicated by the arrow.

The electrical values of the element circuits are carefully balanced and designed so that the inductive current produced from the reverse wave will cancel its portion of the capacitive current almost completely. The result is a directivity greater than 25 dB, which means that the element is highly insensitive (i.e. produces little or no signal) from the reverse direction wave. By being so highly directional, the Detector element is sensitive at either one of its settings, but to only one of the two traveling waves. ThruLine Wattmeter measurements are also independent of their position along the standing waves.

**Figure 2 Schematic Diagram**



## Portability

---

### CAUTION

Do not drop the Thruline Wattmeter equipment or submit it to hard blows. The voltmeter circuitry or microammeter, even though it is shock mounted, may be damaged by severe impact.

The Model 4308 is a portable instrument, and the housing is not designed for fixed mounting. A strap is provided for carrying purposes. To protect the meter movement during periods of transit, put the range switch in the “TRANSIT” position. This effectively shunts the meter movement and dampens the pointer action.

## Connections

---

### WARNING

Leaking RF energy is a potential health hazard. Never attempt to connect or disconnect equipment from the transmission line while RF power is being applied. Severe burns, electrical shock, or death can occur.

## Installing in a 50 Ohm Line

---

1. Attach the transmission line to the connectors on either side of the wattmeter housing.

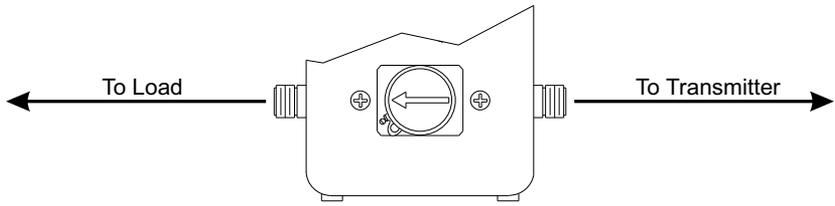
**Note:** *It makes no difference which sides the RF power source and the load are connected.*

**Note:** *Use of a short length of 50 ohm cable fitted with the appropriate mating connectors may be useful when inserting the wattmeter in the transmission line.*

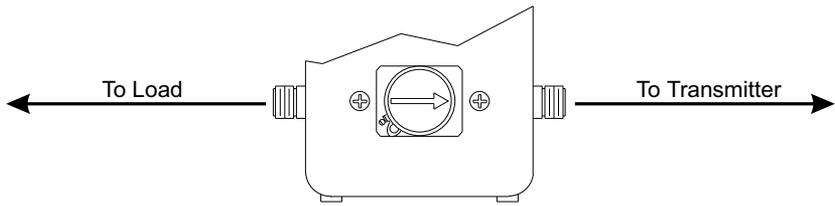
2. Rotate the element so that the arrow points in the direction of power flow.

**Note:** *If coaxial cables other than 50 ohm impedance are used, a mismatch will occur which may cause serious inaccuracies in the readings.*

**Figure 3** *Element Direction*



Forward Power Measurement



Reflected Power Measurement

A description of the features of the Thruline Wattmeter have been discussed in the previous sections. Read and become familiar with the following instructions before operating the Model 4308. As mentioned, no batteries or external power sources are required to operate the meter. A small but sufficient amount of power is obtained from the transmission line into which the unit is connected.

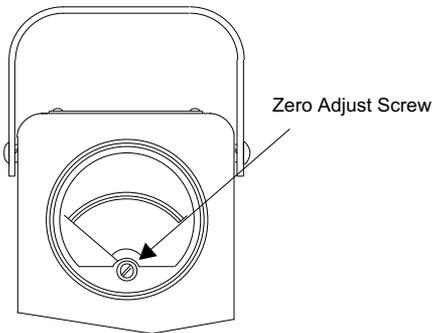
## Zero Adjust

---

Before applying any RF power, check to see that the meter pointer is set at zero. If adjustment is required, it will be necessary to zero adjust the meter under power off conditions. Refer to figure 4.

Turn the zero-adjust screw on the bezel of the meter, using a small screwdriver, clockwise or counterclockwise as necessary. Turn until the pointer exactly aligns with the zero of the meter scale.

**Figure 4** Zero Adjust



---

## Range Switch and Power Measurement

---

The range switch should be placed at the highest power setting, (i.e., 50 Watts). This is especially true when the amount of power being applied is unknown. After the RF power is applied the range switch may be switched down so that a power indication is given in the upper one-third of the scale.

The Model 4308 is supplied with a special broadband 50 W element with a frequency range of 440-960 MHz. This element is capable of operating at lower power levels and up to 50 watts equally as well. At lower power levels, the range switch should be turned to a lower setting for better resolution. Do not select a range lower than necessary or damage to the meter may result.

Forward power (i.e., the forward direction of power flow) is indicated when the element's arrow is pointing towards the load. Reflected power can be indicated by rotating the element in the line section so that the arrow points in the direction of the reflected power flow, i.e., towards the source of power. Refer to figure 4. When the reflected power is decisively lower, switching the range switch to a lower level, if possible, will give better resolution.

Where appreciable power is reflected, as with an antenna, it is necessary to subtract the reflected from the forward power to get load power. Power delivered to, and dissipated in a load is given by:

$$W_1 = \text{WattsIntoLoad} = W_f - W_r$$

This correction is negligible (less than one percent) if the load is such as to have a VSWR of 1.2 or less. Good load resistors, such as Bird Termline Load Resistors, will produce a negligible or unreadable reflected power.

Figure 5 VSWR Conversion Nomograph, Sheet 1

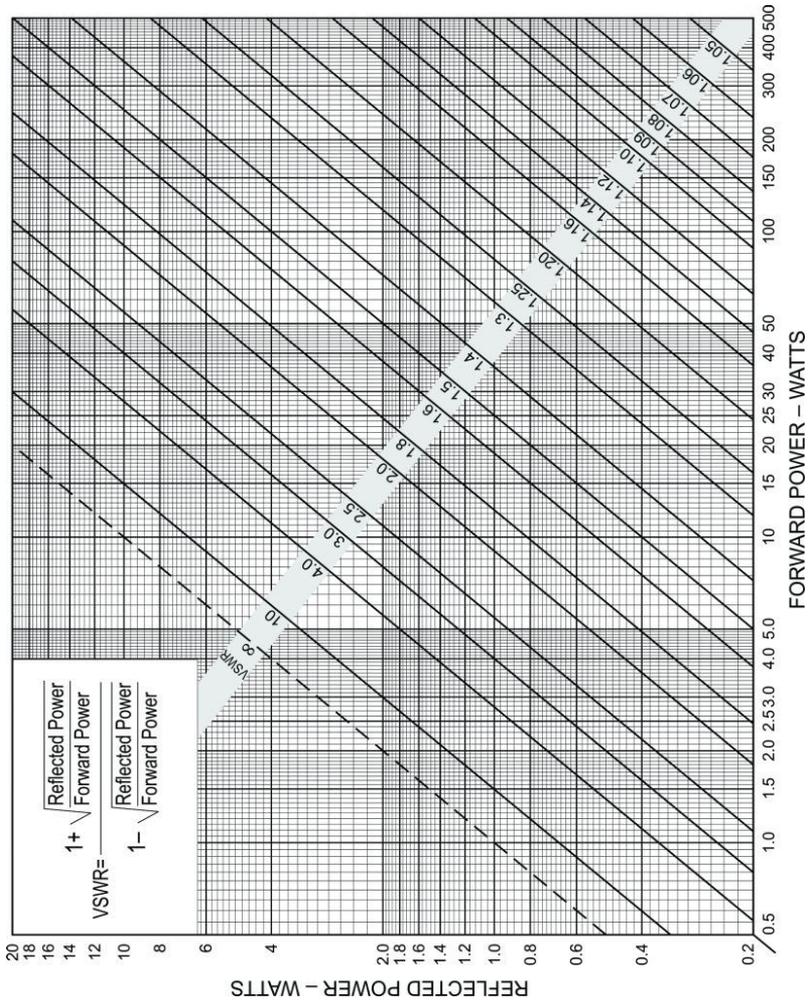
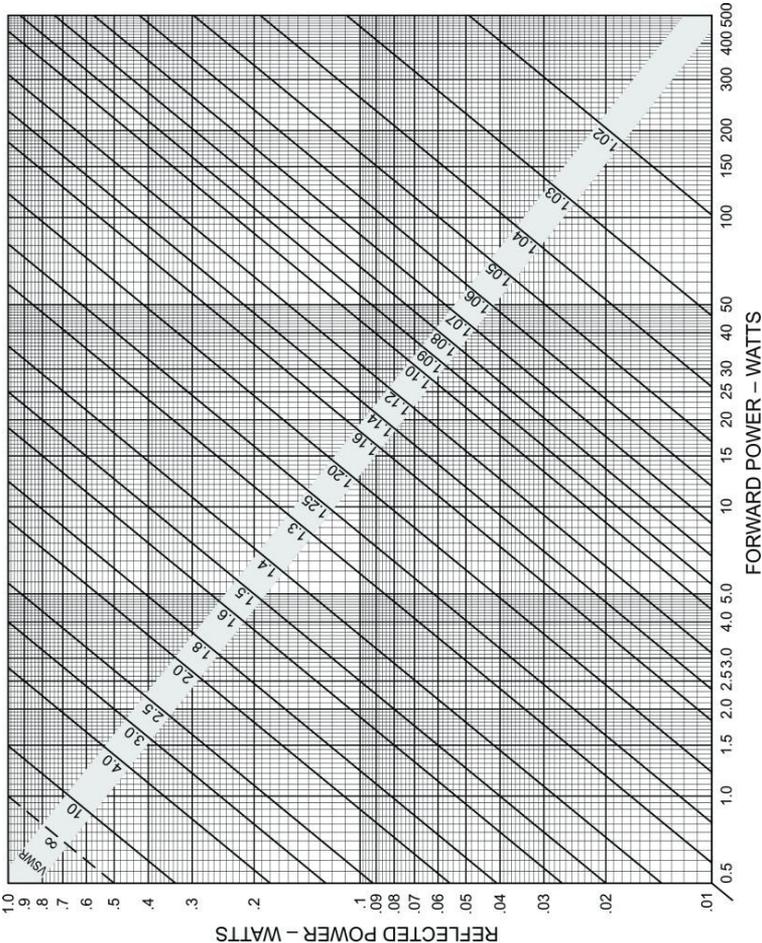


Figure 6 VSWR Conversion Nomograph, Sheet 2



## Troubleshooting

---

Use the following table to aid in isolating problems, their possible cause, and corrections.

<b>Problem</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
No meter reading	No RF power	Check RF source and cables
	“Arrow” on element pointing wrong way.	Rotate element
	No pick-up from DC contact finger.	Adjust contact finger
	Open or short circuit in DC circuit.	Check switch connections, circuit board, and meter leads
	Meter burned out or damaged	Return wattmeter for service
Intermittent or inconsistent meter reading	Dirty DC contact on element	Clean contact
	Faulty transmission line or antenna	Inspect line
	Sticky or defective meter	Return wattmeter for service
High VSWR or reflected power	Foreign material in line section or in RF connector	Clean connectors
	Open or shorted transmission line	Inspect line
	Bad load or poor connectors	Inspect load, antenna, and connectors

## Cleaning

---

Care and cleanliness is a main factor in maintenance. If any of the contacts or line connectors become dirty, they should be cleaned with a dry cleaning solvent that does not leave a residue.

It is important to keep these areas clean:

- All contact surfaces and especially the exposed faces of the Teflon insulators.
- The meter face and the housing, clean with a soft cloth dampened with a mild detergent solution.

## Repair and Replacement

---

Although the Model 4308 is designed to for long term, trouble free operation. In the case of malfunction of the unit, the repair or replacement procedures in this section should be followed.

**Note:** *Do not perform unauthorized maintenance work during the first year. It could be cause to void the warranty.*

## Line Section or Element Coupling Circuit

---

If a problem should occur in the line section or element coupling circuit, it is advised that the unit be returned to Bird Electronic Corporation for repair and recalibration.

## Meter Housing

---

For access to the inside of the meter housing, the back cover must be taken off. To do this:

1. Remove the four screws located near the back at the top and bottom of the sides.
2. Pull the cover straight off.

## Line Section and Circuit Board

---

1. Loosen the nuts on the meter terminals using a 5/16 inch wrench.
2. Remove the connecting wires on the meter terminals.
3. Remove the range switch knob.

**Note:** Use a 1/16 inch hex wrench to loosen the set screw.

4. Remove the two 10-32 Phillips head screws located on the front of the meter housing on either side of the detector element.
5. Support the line section while removing the 10-32 screws.

**Note:** The line section with the attached circuit board will fall straight out the back.

6. Detach the circuit board by removing the two screws that secure it to the line section.

Be careful not to distort the spring finger of the dc contact that protrudes into the line section. Also be careful not to lose either; the Teflon insulator on the spring contact finger or the small spacers on the circuit board mounting screws. It is important that the operating position of this part be properly maintained for correct contact with the DC contact on the element body. Also take special care not to disturb the setting of the potentiometers on the circuit board. These potentiometers are for calibration purposes and the accuracy of the unit will be altered if the setting of these potentiometers is changed.

These parts are not subject to further disassembly and must be replaced in their entirety if defective. The circuit board is only replaceable at the factory.

7. Reassemble the unit by reversing the above procedures.

## Connector Replacement

---

The Model 4308 is normally supplied with two Female TNC Bird Quick-Change Connectors. Other "QC" connectors are available. These connectors may be obtained from Bird Electronic Corporation. Refer to the Available Connector List.

1. Remove the four 8-32 round head machine screws from the corners of the connector flange.
2. Pull the connector straight out.
3. Install connectors by reversing the above procedure. Making sure the center contact pin aligns properly with the socket.

## Element Removal

---

1. Remove the screw and sleeve on the lower left corner of the element port flange.
2. Grasp the knurled part of the element knob and gently pull up while turning slightly in a clockwise direction.

**Note:** *The element should easily pull right out.*

## Element Installation

---

When reassembling the element in the line section, be sure the retaining clip on the front face of the line section is repositioned. It must be on the shoulder of the element, *before* replacing the retaining clip, stop-sleeve, and screw.

**Note:** *If a defective element must be replaced, the unit must be returned to the factory for element replacement and recalibration.*

## Meter Replacement

---

1. Disconnect the meter leads from the terminals on the back.
2. Remove the screws securing the meter in place.  
**Note:** *The screws are located on each side of the housing.*
3. Pull the meter, with the shock mount assembly, out of the unit.
4. Reinstall the meter, be sure the bumper feet, shock mount strip, and shock mount ring are in place on the meter.
5. Position the mounting ring on the meter so that the side mounting holes are parallel to the meter lugs.
6. Place the wattmeter housing on a flat surface with its front face down.
7. Position the meter with the shock ring in place and press down on the shock ring, manipulating it until its side holes are aligned with those in the housing and the fastening screws can be inserted.
8. Insert the fastening screws into the housing and shock ring.
9. Ensure the meter is correctly positioned.
10. Tighten the fastening screws.

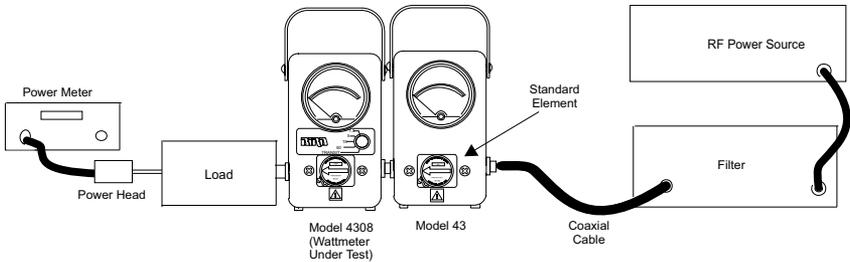
## Calibration Checks

If a calibration check of the Model 4308 is necessary, set-up the Model 4308 Wattmeter in series with a standard wattmeter of a known accuracy.

**Example** - A Bird Model 43 Thruline Wattmeter could be used. Refer to figure 7 for a sample set-up. Follow the guidelines outlined below.

- Use a suitable low pass filter between the wattmeters and the RF power source.
- Terminate the set-up in a suitable 50 ohm load, similar to the Bird Model 8201.
- Make all connections as short as possible to avoid mismatches and additional insertion losses.
- Make all calibration checks on each range at the upper one-third of the scales.
- If the unit is found to be outside the stated accuracy, the unit must be returned to the factory for recalibration.

**Figure 7 Calibration Check Set-Up**



## Customer Service

---

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

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

### **Bird Service Center**

30303 Aurora Road  
Cleveland (Solon), Ohio 44139-2794  
Fax: (440) 248-5426  
E-mail: [bsc@birdrf.com](mailto:bsc@birdrf.com)

For the location of the Sales Office nearest you, visit our Web site at:

<http://www.birdrf.com>

## Specifications

<b>Impedance</b>	50 ohms nominal
<b>Full Scale Power Range</b>	1.5, 5, 15, 50 Watts
<b>Insertion VSWR (Max.)</b> Female "TNC" Connector	1.05 max. from 440-512 MHz 1.07 max. from 512 to 960 MHz
Female "UHF" Connector	1.08 max. from 440-512 MHz 1.12 max. from 512 to 960 MHz
<b>Insertion Loss (Max.)</b>	0.1 dB, 25 – 512 MHz 0.15 dB, 512 – 1000 MHz
With Female "UHF" Connectors	0.1 dB, 25 – 512 MHz 0.13 dB, 512 – 1000 MHz
<b>Accuracy</b>	440-960 MHz ± 5% Full Scale
<b>Weight (Approx.)</b>	4 lb. (1.8 kg) with N-Connectors
<b>Dimensions, Nominal</b> Without Connectors	3-29/32" L x 4" W x 6-7/8" H (99 mm x 102 mm x 175 mm)
With Female "TNC" Connectors	3-29/32" L x 5" W x 6-7/8" H (99 mm x 127 mm x 175 mm)
<b>Connectors</b>	Bird Quick Change "QC" type, Female TNC normally supplied.
<b>Operating Position</b>	Any
<b>Finish</b>	Grey Powder Coat
<b>CE</b>	Meets European EMC Standards: EN55011 and EN50082-1, which are in accordance with council directives 89/336/EEC & 92/31/EEC. Meets European Safety Standard EN 61010-1, Which is in accordance with council directive 73/23/EEC & 93/68/EEC.

---

## Replacement Parts

---

<b>Item</b>	<b>Qty.</b>	<b>Description</b>	<b>Part Number</b>
1	1	Micrometer Meter	2120-017
2	1	Housing Assembly	4410-003
3	1	Cover Assembly	4210-005-1
4	1	Line Section Assembly	4308-003
5	1	Carrying Strap	8580-003
6	1	RF Connectors	*See table
7	3	Meter Bumper Feet	4220-098
8	1	Range Switch Knob	5-1852
9	1	Range Switch Label	4308-006
10	1	Cushion Strip, Shock Mount	5-1066
11	4	Rubber Feet	5-1388
12	1	Meter Shock Mount Ring	4220-087

**Available “QC” Type Connectors**

---

<b>Connector</b>	<b>Part Number</b>
N-Female	4240-062
N-Male	4240-063
HN-Female	4240-268
HN-Male	4240-025
LC-Female	4240-031
LC-Male	4240-025
BNC-Female	4240-125
BNC-Male	4240-132
SMA-Female	4240-336
SMA-Male	4240-334
7/8" EIA	4240-002
1-5/8" EIA Fixed	4240-096
7/16" EIC (Jack) Type 169-4	4240-344
LT-Female	4240-018
LT-Male	4240-012
C-Female	4240-100
C-Male	4240-110
UHF-Female	4240-050
UHF-Male	4240-179
TNC-Female	4240-156
TNC-Male	4240-160
SC-Female	4240-090
Mini UHF-Female	4240-346
7/16" EIC (Plug) Type 169-4	4240-363
1-5/8" EIA Swivel	4240-208
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. Routine (regularly required) calibration is not covered under this limited warranty. 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.