INSTRUCTION BOOK FOR

BIRD

SERIES 4900
THRULINE® WATTMETER

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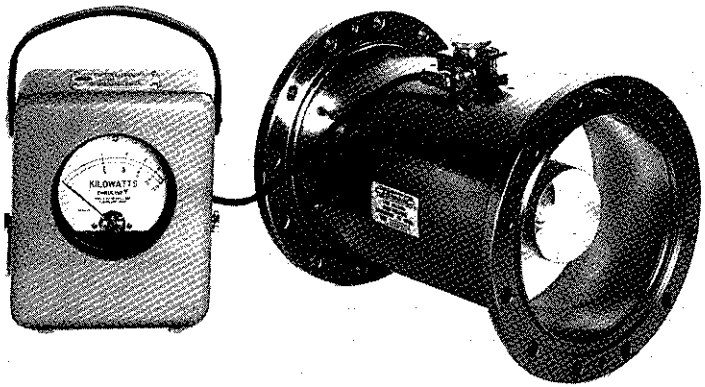
MODELS COVERED IN THIS INSTRUCTION BOOK

Single Socket	Double Socket
4902	4905-200
4902-037	4905-300
4902-080	4909-200
4907	
4907-080	

INSTRUCTION BOOK FOR

SERIES 4900 THRULINE® WATTMETER



BIRD

Electronic Corporation

30303 Aurora Road, Cleveland (Solon), Ohio 44139-2794

SAFETY PRECAUTIONS

The following are general safety precautions that are not necessarily related to any specific part or procedures 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 an RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

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

CAUTION

The wattmeter, The THRULINE® Element and the RF line section, collectively referred to as THRULINE® in the remainder of this section, all have matching serial numbers. Do not intermix these parts with parts from other THRULINE® equipment.

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.

Continued

CAUTION

Under no circumstances attempt to remove the RF center conductor. It is tightly frozen in place and any attempt to remove it will ruin the assembly.

TABLE OF CONTENTS

TABLE OF CONTENTS [CONT.]

SERIES 4900 THRULINE® WATTMETERS

INTRODUCTION

PURPOSE AND FUNCTION

The Series 4900 THRULINE® Wattmeters are directional RF wattmeters that detect and measure power flow in either direction in 6-1/8 inch coaxial transmission lines. They are designed for a 50 ohm characteristic impedance. Therefore, they are useful for load matching in standard coaxial lines. Power levels are indicated on a direct reading meter corresponding with the elements selected by the user.

PERFORMANCE CHARACTERISTICS AND CAPABILITIES

Elements are available for measuring power levels up to 250 kW (60 kW for Models 4902-037 and 4905-300, and 80 kW for 4902-080 and 4907-080) full scale in stated frequency bands from 2 to 1000 MHz (50 to 750 MHz for Models 4902-037, 4905-300, 4902-080, and 4907-080). The maximum measurement error is ±5 percent of the full scale power rating of the element. The insertion VSWR (voltage standing wave ratio) will not exceed 1.05:1.00 over the stated frequency band.

DIMENSIONS AND WEIGHT

The flanged line sections of Models 4900, 4905-200, 4902-037, 4905-300, and 4902-080 are 10-7/32 inches from flange face to flange face. The barrel of the line section is 6-1/8 inch diameter and the flange fittings are 8-1/8 inch diameter. The weight of the flanged single socket line section is 16-3/4 lb (7.6 kg) and the double socket 17 lb (7.7 kg). The unflanged line sections of Models 4907, 4909-200, and 4907-080 are 9-5/8 inches from end to end and the barrel 6-1/8 inch diameter. The single socket line section weighs 12-1/2 lb (5.7 kg) and the double socket 12-3/4 lb (5.8 kg). The meter and housing are 5-9/16 inches W x 6-1/2 inches H x 3-3/8 inches L (141 x 165 x 86 mm) and weigh 5 lb (2.25 kg). Add 2 lb (0.9 kg) for the overall shipping weight.

POWER AND UTILITY REQUIREMENTS

Because THRULINE® Wattmeters are passive and self-contained devices, they do not require any utility service other than the RF power in the coaxial line for operation.

ENVIRONMENTAL REQUIREMENTS

THRULINE® Wattmeters should be used preferably in a dust and vibration free environment. Measurements should be made at 25°C ±5°C (77F ±9F) for maximum measurement accuracy.

ITEMS FURNISHED

The 4900 Series THRULINE® Wattmeter consist of a line section, Plug-In Elements, a meter in a housing, and connecting cables.

The line section is a short length of matching 6-1/8 inch coaxial transmission line. The Models 4902, 4905-200, 4902-037, 4905-300, and 4905-080 line sections have bolt flanges that are fixed on one end and swivel type on the other. Models 4907, 4909-200, and 4907-080 are unflanged line sections.

The meter is scaled in 5, 10 and 25 ranges for Models 4902, 4905-200, 4907, and 4909-200. Models 4902-037 and 4905-300 are scaled for 15, 30, and 60 ranges and the Models 4902-080 and 4907-080 are scaled for 8 and 80 ranges. Multiple factor depends on power range of element used.

A standard ten foot (3 meter) cable/s is supplied with each wattmeter and is equipped with a dc connector plug on one end and lugs on the other. Alternate lengths are available on request. This instruction book is the only other item supplied.

ITEMS REQUIRED

The coaxial transmission line must be equipped with 6-1/8 inch flanged or unflanged connectors to match the line section. Additional elements may be ordered for the desired frequency ranges and power levels (See Element Tables, Page viii.)

TOOLS AND TEST EQUIPMENT

A screwdriver, end wrench or crescent wrench, for the clamp band or flange screw and nut sets, are the only tools required for the Series 4900 Wattmeters.

SPECIFICATIONS FOR SERIES 4900 THRULINE® WATTMETER

Impedance	50 ohms nominal
Insertion VSWR	1.05:1.00 maximum
Connectors	
Models 4902, 4905-200, 4902-037, 4905-300 & 4902-080	6-1/8" EIA Flanged
Models 4907, 4909-200 & 4907-080	6-1/8" Unflanged
Power Range	
Models 4902, 4905-200, 4907 & 4909-200	2.5-250 kW
Models 4902-037 & 4905-300	3-60 kW
Models 4902-080 & 4907-080	8-80 kW
Frequency Range	
Models 4902, 4905-200, 4907 & 4909-200	2-1000 MHz
Models 4902-037, 4905-300, 4902-080 & 4907-080	50-750 MHz

Note: Actual frequency and power ranges are determined by the element used (see page viii).

Accuracy	±5% of full scale
Dimensions	
Flanged line section	10-7/32"L x 8-1/8"DIA (260 x 206 mm)
Unflanged line section	9-5/8"L x 6-1/8"DIA (245 x 156 mm)
Meter	3-3/8"L x 5-9/16"W x 6-1/2"H (86 x 141 x 165 mm)
Weight	
Flanged line section	Approx. 17 lb (7.7 kg)
Unflanged line section	Approx. 12-3/4 lb (5.8 kg)
Meter	5 lb (2.27 kg)
Ambient Temperature	25°C ±5°C (77F ±9F)

SPECIFICATIONS FOR SERIES 4900 THRULINE ® WATTMETER [CONT.]

Finish

Meter housing	Light navy gray baked enamel (MIL-E-15090)
Line section	Bright silver plate

TABLE I-1. ELEMENT TABLES FOR SERIES 4900 THRULINE® WATTMETER

TABLE 6-1/8 A STANDARD ELEMENTS (CATALOG NUMBERS)* Frequency Bands (MHz)						
Power Range	**2-30**	**25-60**	**50-125**	**100-250**	**200-500**	**400-1000**
2500 W		2500A6	2500B6	2500D6	2500D6	2500E6
5000 W		5000A6	5000B6	5000D6	5000D6	5000E6
10 kW		10KA6	10KB6	10KC6	10KD6	10KE6
25 kW	250KH6	25KA6	25KB6	25KC6	25KD6	25KE6
50 kW	50KH6	50KA6	50KB6	50KC6	50KD6	50KE6
100 kW	100KH6					
250 kW	250KH6					

TABLE 6-1/8 B STANDARD ELEMENTS (CATALOG NUMBERS)* Frequency Bands (MHz)			
POWER RANGE	**50-125**	**100-250**	**470-750**
3000 W	3000B6	3000C6	3000U6
6000 W	6000B6	6000C6	6000U6
15 kW	15KB6	15KC6	15KU6
30 kW	30KB6	30KC6	30KU6
60 kW	60KB6	60KC6	60KU6

TABLE 6-1/8 C STANDARD ELEMENTS (CATALOG NUMBERS)* Frequency Bands (MHz)			
POWER RANGE	**50-125**	**100-150**	**470-750**
8 kW	8KB6	8KC6	8KU6
80 kW	80KB6	80KC6	80KU6

*When ordering, specify catalog number and line section model number.

FIGURE I-1. OUTLINE DRAWING OF LINE SECTION

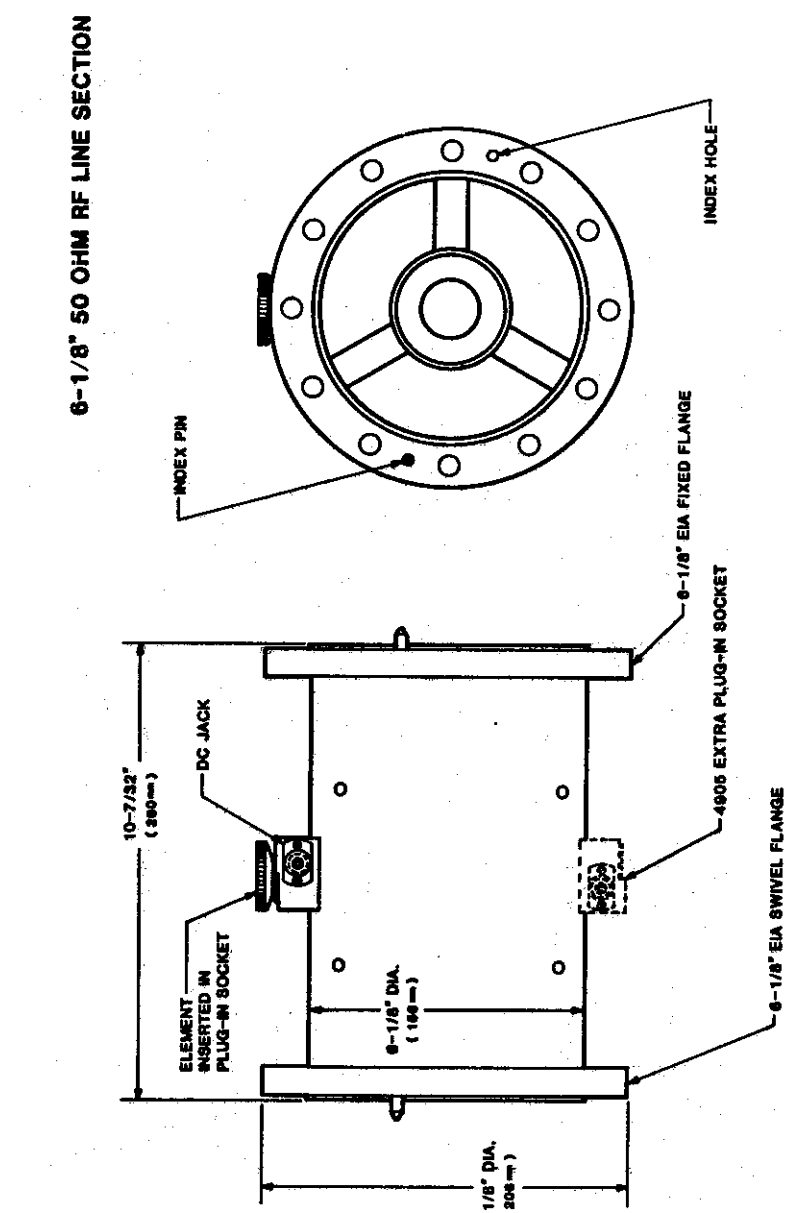
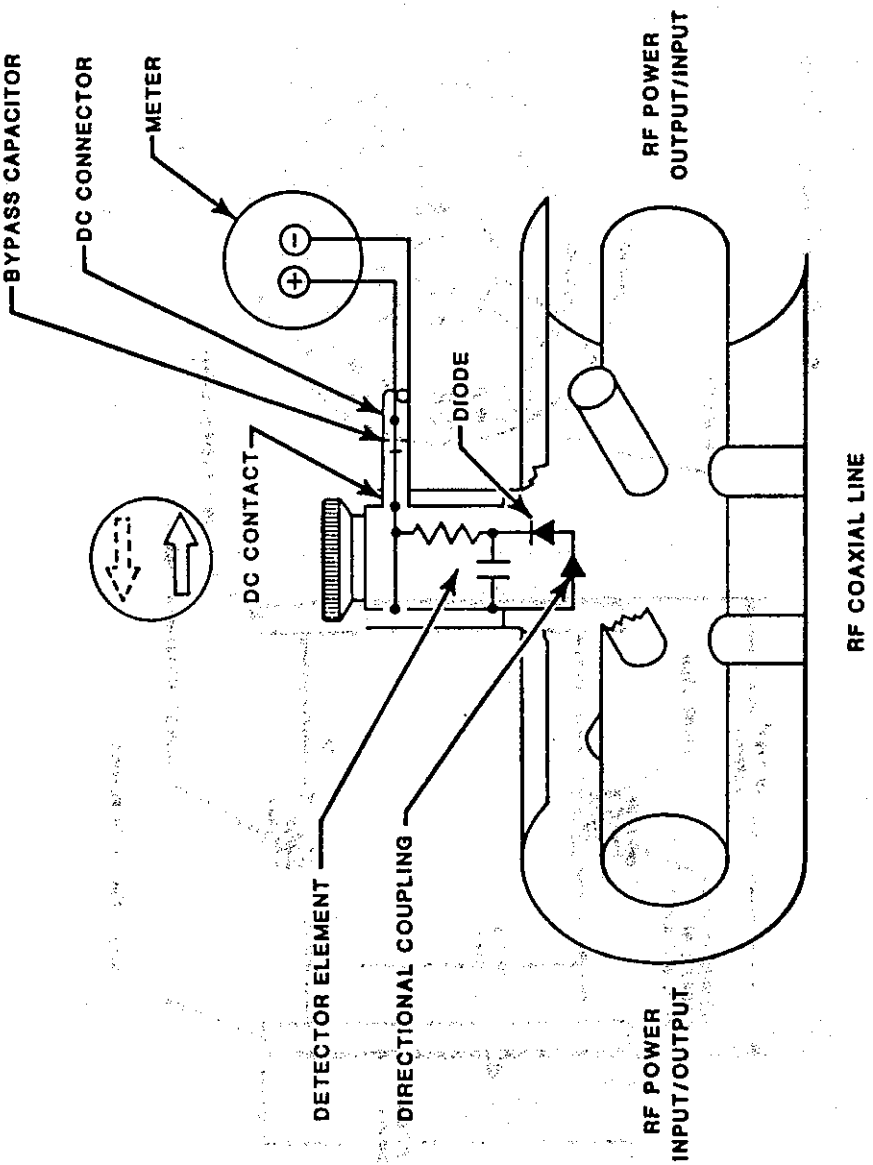


FIGURE I-2. SCHMETIC DIAGRAM - ELEMENT



SECTION I - INSTALLATION

1-1. LOCATION

1-2. The measuring section is installed in a 6-1/8 inch 50 ohm coaxial line where measurement is desired and the insertion coupling is feasible. Be sure that all exposed electrical surfaces, both on the metal contacts and insulators, are thoroughly clean and free of moisture before making the installation.

1-3. COUPLING KITS

1-4. The line section is a short length of matching 6-1/8 inch coaxial transmission line. For Models 4902, 4905-200, 4902-037, 4905-300, and 4902-080 the line section has bolted flanges that are fixed on one end and swivel type on the other. It is inserted into the existing transmission line using a coupling kit, P/N 4902-020.

1-5. For Models 4907, 4909-200, and 4907-080, the line section is unflanged. It is inserted into the existing transmission line using an unpressurized straight coupling kit, P/N 5-1322.

1-6. MOUNTING

1-7. For the models with flanged line sections, Models 4902, 4905-200, 4902-037, 4905-300, and 4902-080 Wattmeters, the center conductor anchor bullets, P/N 4902-015, mate with the center conductor of the 6-1/8 inch 50 ohm coaxial transmission line. This line should be fitted with 6-1/8 inch EIA bolt-type flanges. It is permissible for both the mating flanges of the stationary line to be of the rigid type because the line section has a rigid type flange on one end and a swivel type flange on the other. Before fitting bolts to the coupling flanges, make sure the measuring element socket is oriented for easy access and operation of the Plug-In Element. Also, check that the center conductor anchor bullets have been positioned with insulators properly seated in the counterbores. Use 12 suitable bolt assemblies for attachment, 3/8-16 x 1-1/2 inch nut and bolt assembles are recommended. These nut and bolt assemblies and the center conductor anchor bullet, P/N 4902-015, are available in a coupling kit, P/N 4902-020. It is usually better to attach the fixed flange of the measuring section first. Tighten evenly all around to get a firm and uniform contact on the periphery of the outer conductor of both flanges. When properly installed, the coaxial line should be continuous with no bends or offsets in its axial line.

1-8. For the models with unflanged line sections, Models 4907, 4909-200, and 4907-080 Wattmeters, the connector bullets mate with the center conductor of the 6-1/8 inch 50 ohm coaxial transmission line. Insert the bullets firmly in the center conductor of the line section and push them in until they bottom in the conductor. The insulator discs will approximately touch the inside face of the outer conductor.

Slide the outer sleeves over the transmission line first and then insert the line section into the transmission line. Both bullets should be firmly seated in the center conductor with the ends of the line section butted snugly against the ends of the transmission line. Then slide the outer sleeve over the junctures of the line section and the transmission line and tighten the clamping band screws to complete the installation.

1-9. METER PLACEMENT

1-10. Connect the dc cable plug to the jack on the measuring element socket. Make certain that the connection is tight and clean to ensure accurate readings (see Section IV - Maintenance). The meter may be placed anywhere within the reach of the dc cable, but avoid locations that are dusty or subject to temperature extremes.

SECTION II - THEORY OF OPERATION

2-1. TRAVELLING WAVE VIEWPOINT

2-2. The best way to visualize the THRULINE® Wattmeter idea is from the Travelling Wave Viewpoint on transmission lines, which illustrates that the voltages, currents, standing waves, etc., on any uniform line section are the resultants of two travelling waves.

2-3. COUPLING CIRCUIT

2-4. The coupling circuit which samples the travelling waves is in the Plug-In Element. Energy will be produced in the coupling circuit of the element by both mutual inductance and capacitance from the travelling RF waves of the line section. Of course, the inductive currents will flow according to the direction of the travelling waves producing them.

2-5. The capacitive position of these currents are naturally independent of the direction of the travelling waves. Therefore, it is apparent that the inductive portion of the current produced from the waves of one direction will add in phase to the capacitive portion of the current, and those of the opposite direction will subtract in phase. Of course, the additive direction is the forward or arrow direction of the element.

2-6. The forward wave travels and its power flows from the source to the load. It has an RF Voltage E_f and current I_f in phase, with $E_f / I_f = Z_o$.

2-7. The reflected wave originates by reflection at the load, travels and its power flows from the load back to the source, and also has an RF voltage E_r and current I_r in phase, with $E_r / I_r = Z_o$.

$$W_f = \text{Watts Forward} = E_f^2 / Z_o = I_f^2 Z_o = E_f I_f$$

$$W_r = \text{Watts Reflected} = E_r^2 / Z_o = I_r^2 Z_o = E_r I_r$$

2-8. Z_o is the characteristic impedance of the uniform line, and simplifies matters by being a pure resistance, usually 50 ohms for useful lines. The main RF line circuit of the THRULINE® Wattmeter is a short piece of uniform air line section, whose Z_o is exactly 50 ohms, in which accurate measurements may be made.

2-9. The electrical values of the element circuits are carefully balanced and so designed that the inductive current produced from the reverse direction wave will cancel its portion of the capacitive current almost completely. The result is a directivity always higher than 25 dB, which means that the element is highly insensitive (nulled) to the reverse direction wave. By being highly directional, the

THRULINE® Element is sensitive at one of its settings, but to only one of the two travelling waves which produce standing waves by interference. THRULINE® Wattmeter measurements are also independent of their position along the standing waves. It may be said that the THRULINE® Wattmeter doesn't know, doesn't care, and doesn't need to care where it is along a standing wave. The circuitry of the element and its relationship to the other components of the THRULINE® Wattmeter are illustrated in fig I-2.

2-10. ELEMENT SOCKET

2-11. An accurately positioned socket for inserting a radio frequency coupling device, called a THRULINE® Plug-In Element, is mounted on the outer conductor. The line sections for 4905-200, 4909-200, and 4905-300 have two such sockets. The socket is precision bored to hold the rotatable element in its calibrated position, with a spring-loaded clasp to keep the element firmly seated. The machined step on the top face of the socket engages a stop-pin on the element. Rotary movement of the element is thereby restricted to 180° and is stopped on the axial center line.

2-12. The measuring socket has a hole bored through the wall through which an insulated phosphor bronze contact finger projects. The Plug-In Element has terminals on diametrically opposite sides of its body, so that pick-up can be made from either side. A small silvered button tip can contact the element only in the precise forward and reflected measuring position (against the end stops). A specially designed jack mounted on the side of the socket mates with the plug on the dc cable furnished with the read-out meter. The dc jack assembly has a built-in filter capacitor shunted across the meter circuit. This more fully protects meter readings against the adverse effects of any stray RF energy generated in the Plug-In Element. The line section is bright silver plated over practically all of its metal parts.

2-13. MATCHING

2-14. The scale on the read-out meter indicates full scale for the power rating stamped on the cap of the Plug-In Element. The meter box, the Plug-In Element and the THRULINE® Section are all stamped with matching serial numbers. This equipment is supplied as a matched and calibrated set, and the parts, particularly the elements, should not be interchanged with any other Series 4900 unit. Such an interchange of the measuring elements could produce readings with an error greater than the stated ±5 percent of full scale accuracy.

2-15. LOAD POWER

2-16. Power delivered to and dissipated in a load is given by:

$$W_l = \text{Watts into Load} = W_f - W_r$$

Where appreciable power is reflected, as with an antenna, it is necessary to subtract the reflected power from the forward power to get the effective radiated power.

This correction is negligible (less than 1 percent) if the load is such as to have a VSWR of 1.2:1.0 or less. Good load resistors, such as Series 8700 RF Loads, will thus show negligible or unreadable reflected power.

2-17. VSWR scales and their attendant controls for setting the reference point, have been intentionally omitted from the THRULINE® Wattmeter for two reasons.

a. Why make something similar to a hypothetical dc volt-ohm-meter with control pots for the voltmeter multipliers? Even more complications arise when diodes at RF are involved.

b. Experience using the THRULINE® Wattmeter on operating problems, such as transmitter tune-up, antenna matching etc., shows that the power ratio $\emptyset$ is no mean competitor, in practical usefulness, to the standing wave ratio P - VSWR.

2-18. A trial is suggested for a few days - forget VSWR and try thinking in terms of $\emptyset = W_r / W_f$ when the THRULINE® Wattmeter is used. It will be noted that even without bothering to calculate the ratio exactly, the two meter readings W_r and W_f give an automatic mental impression which pictures the situation. Thus, in an antenna matching problem the main objective usually is to minimize W_r, and anything done experimentally to this end is noted directly when the THRULINE® Element is turned to the reflected position. Furthermore, the ratio of readings even if only mentally evaluated, is a reliable guide to the significance of the remaining reflected power.

2-19. P VS $\emptyset$ AND ITS SIGNIFICANCE

2-20. Since there are definite simple relationships

$$P = \frac{1 + \sqrt{\emptyset}}{1 - \sqrt{\emptyset}} \quad AND \quad \emptyset = \left[\frac{P - 1}{P + 1}\right]^2 \qquad where\ P = VSWR \quad and\ \emptyset = \frac{W_r}{W_f}$$

between standing wave ratio P and the reflected/forward power ratio $\emptyset$ indicated by the THRULINE®, Wattmeter the latter may be conveniently used to measure VSWR. Note that around $\emptyset$ = 10 percent, below which W_r will appear insignificant and may be hard to read, you are close to the commonly accepted lower limit P = 2. Trying to adjust to an even lower value of $\emptyset$, in order to improve antenna match still further, becomes less and less worthwhile in many systems.

Experimentally by using the THRULINE® Wattmeter it can be readily shown that reducing Ø below 10 percent produces little in the way of increased W_f. TV transmitter antenna lines, and VHF omnirange transmitters are among those systems that require much lower levels of reflected power but for reasons other than simple power transmission. A very small level of reflected power; i.e., Ø = .06 percent corresponds to P = 1.05. With just a single element suitable for measuring W_f, detection of reflected power is possible down to about Ø = 1 percent (P = 1.2), providing W_f approaches full scale. However, measurement is possible only down to about Ø = 5 percent, (P = 1.5).

2-21. MEASUREMENT AND MONITORING OF TRANSMITTER POWER

2-22. Like diode devices in general, the THRULINE® Wattmeter indicates the carrier component on amplitude modulation, with very little response to side band components added by modulation.

SECTION III - OPERATING INSTRUCTIONS

3-1. USE AND FUNCTION OF CONTROLS

CAUTION

The wattmeter, the THRULINE® Element and the RF line section, collectively referred to as THRULINE® in the remainder of this section, all have matching serial numbers. Do not intermix these parts with parts from other THRULINE® equipment.

3-2. The salient features of the THRULINE® equipment have been discussed in Section I - Installation and Section II - Theory Of Operation . Measurements are made by the insertion and operation of the Plug-In Elements previously mentioned. The elements will have a power range that matches one of the scales on the meter face, and the major markings are the power values for that element. Elements are also marked for frequency range. The transmitter power and frequency must be within the range of the element used.

3-3. The arrow on the Plug-In Element indicates the sensitive direction; i.e., the direction of power flow which the meter will read. Forward and reflected are directional terms used in reference to the THRULINE® Element, and mean respectively the sensitive and null directions of the element. Rotate the element 180° to reverse the sensitive direction. Forward and reflected are directional terms used in reference to the source-load circuit. Note that the transmitter line may be attached to either connector of the RF line section. It makes no difference which external RF connection is selected, since the elements are reversible and the RF circuit is symmetrical end for end. For Models 4905-200, 4909-200, and 4905-300 a FWD (Forward) and RFL (Reflected) selector switch is provided. Used in conjunction with the double socket line section included with these models, it makes measuring the desired power flow much more convenient.

3-4. INITIAL ADJUSTMENTS AND CONTROL SETTINGS

3-5. Before taking readings, be sure that the meter pointer has been properly zeroed under no-power conditions. Direct power readings are made from the wattmeter dial. For double socketed line section models, set the selector switch for the desired direction of power measurement, unless separate meters are used for forward and reflected power.

3-6. START-UP

3-7. After the line section is properly installed in the transmission line and the dc connector cables from the element socket to the meter have been attached (see Section I - Installation), nothing more is required.

3-8. NORMAL OPERATION

3-9. Insert the appropriate element in the socket of the line section and rotate the element so that the arrow on its nameplate is pointed away from the RF source for forward power and towards the source for reflected power. Turn on the RF source and read the power level indicated on the appropriate meter scale.

3-10. OPERATION UNDER EMERGENCY, ADVERSE, OR ABNORMAL CONDITIONS

3-11. The elements for THRULINE® Wattmeters can withstand at least a 20 percent overload. If the transmitter power output is greater, by a reasonable amount, than the maximum power value of elements available, the THRULINE® Wattmeter and element may be used to give an indication of power flow even though the pointer is over ranged and it is not possible to ascertain the true maximum power value.

3-12. SHUTDOWN

3-13. Because these THRULINE® Wattmeters are passive devices and require no external source of power, they can not be shut off. The RF source must be shut off instead.

3-14. EMERGENCY SHUTDOWN

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.

3-15. In case of an overload, it is possible to rotate the element to the midpoint between the forward and reflected positions and thereby electrically decouple the element from the RF power. For safety's sake, do not remove the element while RF power is still flowing through the line section.

SECTION IV - MAINTENANCE

4-1. TROUBLESHOOTING

4-2. As a brief guide to the operator in isolating occasional difficulties that may occur in the use of the THRULINE® Wattmeter, the following summary is included. The remedies for some are referenced to the text in this section or are self-evident.

PROBLEM	POSSIBLE CAUSE	REMEDY
No meter indication	No RF power	Check RF source.
	Arrow on plug-in element pointed in wrong direction	Re-position element.
	No pick-up from dc contact finger	Adjust per para 4-21.
	Open or short circuit in dc meter cable	Replace defective cable (RG-58/U).
	Meter burned out or damaged	Return wattmeter, line section, and elements to the factory for meter replacement and recalibration.
Intermittent or inconsistent meter readings	Faulty transmission line	Inspect line.
	Faulty load	Check load or antenna.
	Dirty dc contact on elements	Clean per para 4-3, Cleaning.
	Sticky or defective meter	Return wattmeter, line section, and elements to the factory for meter replacement and recalibration.

TROUBLESHOOTING [CONT.]

PROBLEM	POSSIBLE CAUSE	REMEDY
High VSWR or reflected power	Bad load or poor connectors	Replace load or connectors, check and repair antenna.
	Shorted or open transmission line	Have line serviced. Check connections.
	Foreign material in line section or in RF connector bodies	See para 4-12.

4-3. CLEANING

4-4. If any of the contacts or line connectors become dirty, they should be wiped off with a clean dry cloth. Use a contact cleaner that is self- drying, but leaves no residue, on the inaccessible internal parts. Clean all contact areas and especially the exposed faces of the Teflon insulators.

4-5. It is particularly important to keep the mating surfaces of the socket and Plug-In Element clean. This applies not only to the bore of the socket and the circumference of the THRULINE® element body, but most particularly to the bottom rim of the element body and the seat at the base of the socket in the line section. Also check the ends of the insulated dc contacts on the THRULINE® element. They should be clean and smooth. These parts can be carefully cleaned with a soft cloth and contact cleaner as mentioned. There must be a good contact between the base of the Plug-In Element and its socket to assure stable operation of the THRULINE® Wattmeter.

4-6. INSPECTION

4-7. Inspect the THRULINE® equipment from time to time for cleanliness and proper adjustment. See para 4-3, Cleaning and para 4-8, Preventive Maintenance. Make sure all connections are clean and tight. Disconnect the meter lead and check without power, adjust the zero setting if necessary.

4-8. PREVENTIVE MAINTENANCE

4-9. With the simple construction and generally self-contained nature of the THRULINE® equipment, there is only a moderate amount of maintenance required. One of the major precautions is in handling: use reasonable care and

do not drop the THRULINE® equipment or especially the Plug-In Elements.

4-10. The main factor in maintenance is care and cleanliness. The element socket should be kept plugged as much as possible to prevent the intrusion of dust. If a Plug-In Element is to be used for this purpose, use the highest power element available. The element should be positioned so that the arrow is pointing midway between the forward and reflected measuring positions. This will not only protect the meter but will also avoid exposing the element crystal to dangerous potentials if the RF line section should be energized.

4-11. **LINE SECTION CARE**

> **CAUTION**
>
> Under no circumstances attempt to remove the RF center conductor. It is tightly frozen in place and any attempt to remove it will ruin the assembly.

4-12. If there is any evidence of contamination inside the RF line section, the reachable portions should be cleaned and the interior carefully blown out. Keep all connections tight, and keep the nut of the meter cord plug turned tight on the line section dc jack. This connection may often be serviced by simply loosening the nut of the dc plug, rotating the body several times through a fraction of a turn, and retightening the knurled nut securely.

4-13. **DISASSEMBLY**

4-14. There is no disassembly possible of the THRULINE® Wattmeter other than the disconnection of the line section and the dc cable per Section I - Installation.

4-15. **REASSEMBLY**

4-16. See para 4-14.

4-17. **REPAIRS**

4-18. There are no replacement parts furnished with this equipment. As previously mentioned, components of these matched units cannot be interchanged or individually replaced. The only replaceable portions of the line section are standard parts of coaxial line fastenings.

4-19. Repairs beyond what are covered in this instruction book will require return of the equipment to the factory service. Please consult the factory.

4-20. CONTACT ADJUSTMENT

4-21. In cleaning the socket bore, the operator should be careful not to disturb the spring finger of the dc contact. It is important that the operating position of this part be properly maintained. If the spring finger of the dc contact requires adjustment, it may be done manually if carried out with care. The tip must be positioned far enough out to maintain good contact with the element, but not so far as to interfere with easy entry of the element body. The dc jack, with attached spring finger, may be detached for service by removing the two no. 4-40 fillister head machine screws which fasten it to the side of the RF line section. Then lift off the jack assembly carefully to avoid losing the small Teflon insulating bead that straddles the base of the phosphor bronze spring and nests in a counterbore on the side of the RF body. When replacing the assembly, be sure that the bead is again properly inserted.

SECTION V - PREPARATION FOR RESHIPMENT

5-1. ELEMENTS

5-2. The elements can be left in the sockets of the line section with their arrows turned midway between the measuring positions. Two additional elements can be placed in the storage sockets in the sides of the meter housing, if so equipped. Any additional elements should be well padded and wrapped before being put in the shipping container.

5-3. LINE SECTION

5-4. Wrap the connectors on the flanged models with padding and tape them securely in place. Cover both ends of the line section and the socket to keep out dust and foreign material. Place the line section in a sturdy shipping container; a corrugated paper box should suffice.

5-5. DC CABLES

5-6. Pad and wrap the dc connector plugs and then coil the cables tightly. For convenience, place them in the open back of the meter housing.

5-7. METER

5-8. Cover the meter face with padding to protect the glass window, then wrap the housing and place it in the same box as the line section.

SECTION VI - STORAGE

6-1. GENERAL

6-2. 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 -10°C to +40°C (14F to 104F). As an extra precaution, leave an element in the socket with the arrow turned midway between the measuring positions.

SECTION VII - REPLACEMENT PARTS LIST

7-1. **SERIES 4900**

7-2. As mentioned previously, there are no field replaceable parts except the following:

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	Meter & housing assembly	
		Model 4902	6810-009-7
		Model 4902-037	6810-007
		Model 4905-200 & 4909-200	6810-020
		Model 4902-080	6810-005
		Model 4905-300	6810-030
		Model 4907	6810-055
		Model 4907-080	6810-065
2	1	Meter (only)	
		Model 4902 & 4905-200	2000-030
		Model 4902-037, 4905-300, 4907 & 4909-200	2000-059
		Model 4902-080 & 4907-080	2000-068
3		Cable assembly	
	1	Model 4902 & 4902-037	8180-021-1
	2	Model 4905-200, 4905-300 & 4909-200	6810-036-1
	1	Model 4902-080, 4907 & 4907-080	6810-057-1
4	1	DC cable connectors	
		Model 4905-200, 4905-300 & 4909-200 (require 4)	7500-237
5	1	Meter & cable assembly	
		Model 4902 & 4907	8180-095-10
		Model 4902-037	8180-095-15
		Model 4902-080 & 4907-080	8180-095-19
6	1	Housing assembly	
		Model 4902, 4902-200/-037/-080, 4907 & 4907-080	6810-008-5
		Model 4905-200/-300 & 4909-200	6810-022
7	2	Shock ring	8240-056

REPLACEMENT PARTS LIST [CONT.]

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
8	1	Mounting ring	8240-093
9	1	Carrying strap	8240-05510
10	4	Bumper stem	5-1388
11	1	Line section	
		Single socket EIA flanged	4902
		Double socket EIA flanged	4905
		Single socket unflanged	4907
		Double socket unflanged	4909
12	1	DC connectors, line section	3610-027
13	2	Coupling kit	
		Model 4902, 4902-037/-080, 4905-200 & 4905-300	4902-020
		Model 4907, 4907-080 & 4909-200	5-1322

QUALITY INSTRUMENTS FOR RF POWER MEASUREMENT

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