BIRD

INSTRUCTION book

MODEL 4345

THRULINE ® WATTMETER

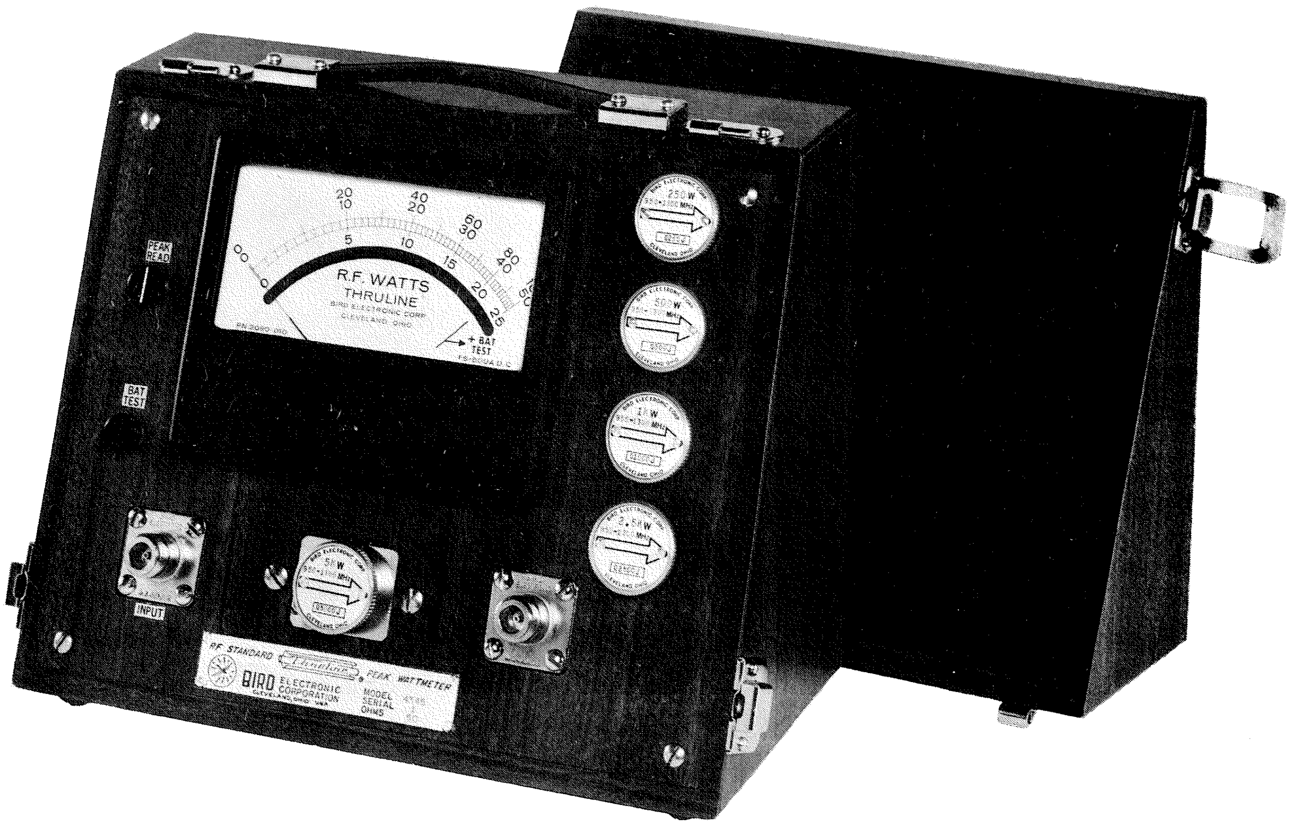

Fig. 1-1 Thruline Peak Reading Standard Wattmeter Model 4345

SECTION 1

INTRODUCTION AND DESCRIPTION

SCOPE

This technical manual provides operation, service, maintenance, troubleshooting, calibration, and repair instructions for the Thruline Wattmeter Model 4345, manufactured by Bird Electronic Corporation, Cleveland (Solon), Ohio. It is prepared for use by the technicians to whom this equipment is issued and who are responsible for its operation and maintenance.

PURPOSE

The Model 4345 is a directional wattmeter which measures and monitors RF power flow and load match in coaxial lines. It is used for measurement of CW, AM, FM, SSB, TV, and pulsed transmitter outputs, or practically any types of RF transmission in 50-ohm coaxial systems. It indicates either average or peak power as required. See Fig. 1-1

LEADING PARTICULARS

Leading particulars for the Thruline Wattmeter Model 4345 are given in Table I.

TABLE I. LEADING PARTICULARS

Measuring medium	RF transmission in 50-ohm coaxial systems
Insertion VSWR (with N Connectors)	1.08 max.
RF Power Ranges	0-0.25, 0.5, 1, 2.5, 5kW
Impedance	50 ohms
Frequency Range	950-1300 MHz
Pulse Parameters:	
Square pulses:	
Minimum duty factor	1×10^{-4}
Minimum repetition rate	30 pps
Minimum pulse width	0.4 microseconds
Gaussian Pulses:	
Minimum duty factor	3.5×10^{-4}
Minimum repetition rate	30 pps
Minimum pulse width	3 microseconds at 10% of height
Temperature Range	Laboratory environment 20°C to 30°C
Line Connectors	Quick-Change, Female "N" Type
Weight	11-1/2 lbs.
Plug-in elements	3 oz. each
Basic Overall Dimensions:	
Height	8-1/4 in.
Width	10-7/8 in.
Depth	5-5/8 in.
Battery Requirements:	
5.40 V	Mallory TR-164R or equal
12.60 V	Mallory TR-169 or equal

DESCRIPTION

The wattmeter is a portable unit, encased in a wood grained cabinet, equipped with a leather carrying strap. It is provided with a removable cover to allow access to the main operating components. The front panel can also be removed for access to the units various sub-assemblies. The meter is mounted on the front panel of the unit. It has three scales to facilitate use with any of the available elements.

A line section casting, through which the RF transmission flows, is mounted in the housing so that one connector end extends from the right side of the housing and the other connector end extends from the left side. These ends are quick-change type connectors secured to the line section body with four screws. Transmission lines connect to these threaded ends through mating connectors. Line connections can be reversed without affecting the accuracy or operation of the unit. A socket in the line section casting is provided for the insertion of the plug-in elements. This nickel-plated brass line section is a precision unit that provides unimpaired impedance of the RF coaxial line into which it is inserted.

The wattmeter uses plug-in elements of the required frequency and wattage range to sense the transmission through the line section. These cylindrical elements are interchangeably inserted into the socket on the front face of the housing below the meter. By use of these plug-in elements the wattage range andfrequency range is greatly expanded over those which could be provided in a fixed-element type meter. The plug-in elements incorporate the coupling circuits which sample the traveling waves in the line section. The elements are retained by a flange of the line section. This catch assures proper retention and contact of the element in the line section.

Plug-in elements are available in wide range of frequencies and wattages. Most of them are designed to read both average and pulse-mode wattage. Some of them are designed exclusively for pulse-mode reading operation. Available plug-in elements are listed in Table II. The plug-in elements of earlier average-reading-only wattmeters can be used with the average- or peak-reading Model 4345 for reading wattage in either average or peak modes of operation.

In the Model 4345, batteries are mounted inside the wattmeter. Battery types used are listed in Table I, Leading Particulars. These batteries power the amplifier section during peak-reading operation. The amplifier is mounted within the housing.

TABLE II

ELEMENT MODEL NO.	FREQUENCY (950-1300Mhz)	POWER RATING
Q250J	"	250 Watts
Q500J	"	500 Watts
Q1000J	"	1000 Watts
Q2500J	"	2500 Watts
Q5000J	"	5000 Watts

THEORY OF OPERATION

The operation of this 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 to the transmitter. The closer the load is matched to the transmission line, the smaller the reflected wave will be. To determine the watts dissipated in the resistance, it is necessary to determine the wattage of the forward wave and the wattage of the reflected wave. The difference between the two will indicate load power.

In the traveling wave concept, VSWR (voltage standing wave ratio) has become a widely used tool. The standing waves which are produced by interference between the forward and reflected waves do not affect the readings of the wattmeter, since the wattmeter reads only traveling waves. However, after the percentage of reflected power $\left(\frac{\text{Watts Reflected}}{\text{Watts Forward}}\right) \times 100$ is determined, the VSWR(voltage standing wave ratio) can easily be determined by use of graphs (figures 3-2 and 3-3), without requiring the use of unwieldly, expensive, slotted line equipment. However, many users find that the $\frac{\text{Watts Reflected}}{\text{Watts Forward}}$ ratio is a more useful tool that VSWR.

When the wattmeter is connected into the system, the transmission is directed through the meter line section, which is a short, uniform section of air line that provides unimpaired impedance of the RF coaxial line into which it is inserted. When the plug-in element is installed into the socket in the line section, the RF waves traveling through the line produce energy in the coupling circuit of the plug-in element by inductance and capacitance (see figure 1-2). The inductive currents will flow according to the direction of the traveling waves producing them. The capacitative portion of these currents is independent of the traveling waves. It is therefore apparent that the current produced from the waves traveling in the opposite direction will subtract in phase. The arrow on the plug-in element indicates the additive direction of wave travel. The element is so designed that the wave components traveling in the opposite direction of the arrow will cancel each other out almost completely, making the element highly insensitive to the reverse wave direction. Because of the highly directional characteristics of the element, the resultant direct current which is sensed by the microammeter indicates the power level of only the RF waves traveling in the arrow direction.

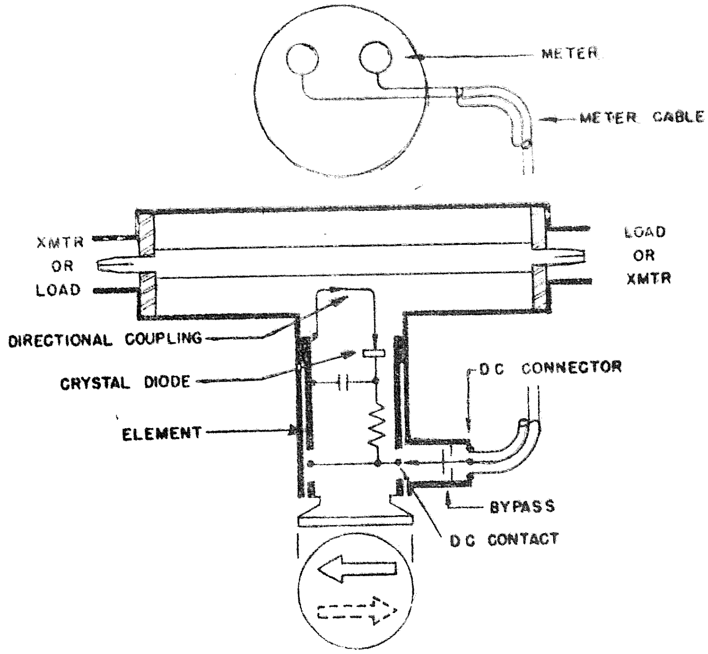

Figure 1-2. Wattmeter Average-Reading Operation, Schematic Diagram

The plug-in element is designed so that it can be rotated 180 degrees in its socket in the line section. When it is rotated, the meter will indicate the wattage in a direction opposite that of the initial reading, so that if the forward direction power was read first, the reflected direction power will be read after the plug-in element is rotated. The energy resulting from the inductively coupled component of the forward wave will bring about cancellation as described above.

Besides reading average power as described above, Wattmeter Model 4345 is designed to read peak power when the PEAK button is depressed. This is accomplished by use of the battery-powered amplifier system. Diodes CR1 and CR3 are installed in the battery circuit to protect the amplifier against incorrect installation of the batteries. The battery check circuit is energized when the pushbutton of switch S2 is pressed. If the voltage of the 12-volt battery is within the limits necessary to properly operate the amplifier circuit, the needle of the meter will deflect beyond the battery test mark on the meter. If it fails to reach the mark, the batteries require replacement. The battery test circuit reads only the output of the 12-volt battery, but experience has indicated that the life of the 6-volt battery exceeds that of the 12-volt battery. Replacement of the two batteries simultaneously will assure that sufficient battery power will be available when the meter indicates in the required battery test range.

The amplifier circuit is designed to provide current to the meter which will indicate at a steady state the peak of the power applied to resistor R1. Resistor R1 exactly matches the resistance provided meter M1, so that the existing circuit in the plug-in element is loaded exactly the same as during average reading mode.

When switch S1 is pressed, the dc input which is normally applied instead to resistor R1 and differential amplifier AR1 which gives a current gain of approximately 100:1. This output is applied to a resistance bridge consisting of resistors R3, R4, R5, R6, and R7. Variable resistor R5 of this bridge permits zero calibration of the amplifier curcuit. Bridge output is applied to differential amplifier AR2 which provides a voltage gain of about 1000:1. The voltage gain ratio of this is extremely important in determining the minimum pulse duration which can be indicated, since it is the surge of voltage from this amplifier which charges capacitor C1. Capacitor C1 applies a potential to differential amplifier AR3 as long as the capacitor remains charged. This amplifier provides a massive current gain ratio, but unity or slightly less voltage gain. This is applied to meter M1 to indicate the peak of the line input. A portion of the dc output of amplifier AR3 is fed back to resistor R2 and to amplifier AR1. Resistor R2 is matched to resistor R1 to within a tolerance of 0.2 percent to provide unity gain to the amplifier. This feedback curicuit maintains the output from AR1 and in turn from AR2 to deep capacitor C1 charge to that value which yields unity closed loop gain. The capacitor continues to energize AR3 to maintain the reading of the meter even though the peak of the pulse is no longer applied to the amplifier assembly input. In this manner, only peak power is indicated, even though there is a wide fluctuation of input power.

Because of capacitor leakage, diode back resistance, and transmitter input current (low as it may be), there will be a decay in the circuit to limit the time the amplifier system will retain its output level. As the circuit decays, the meter will return to zero provided no additional pulses are received at resistor R1.

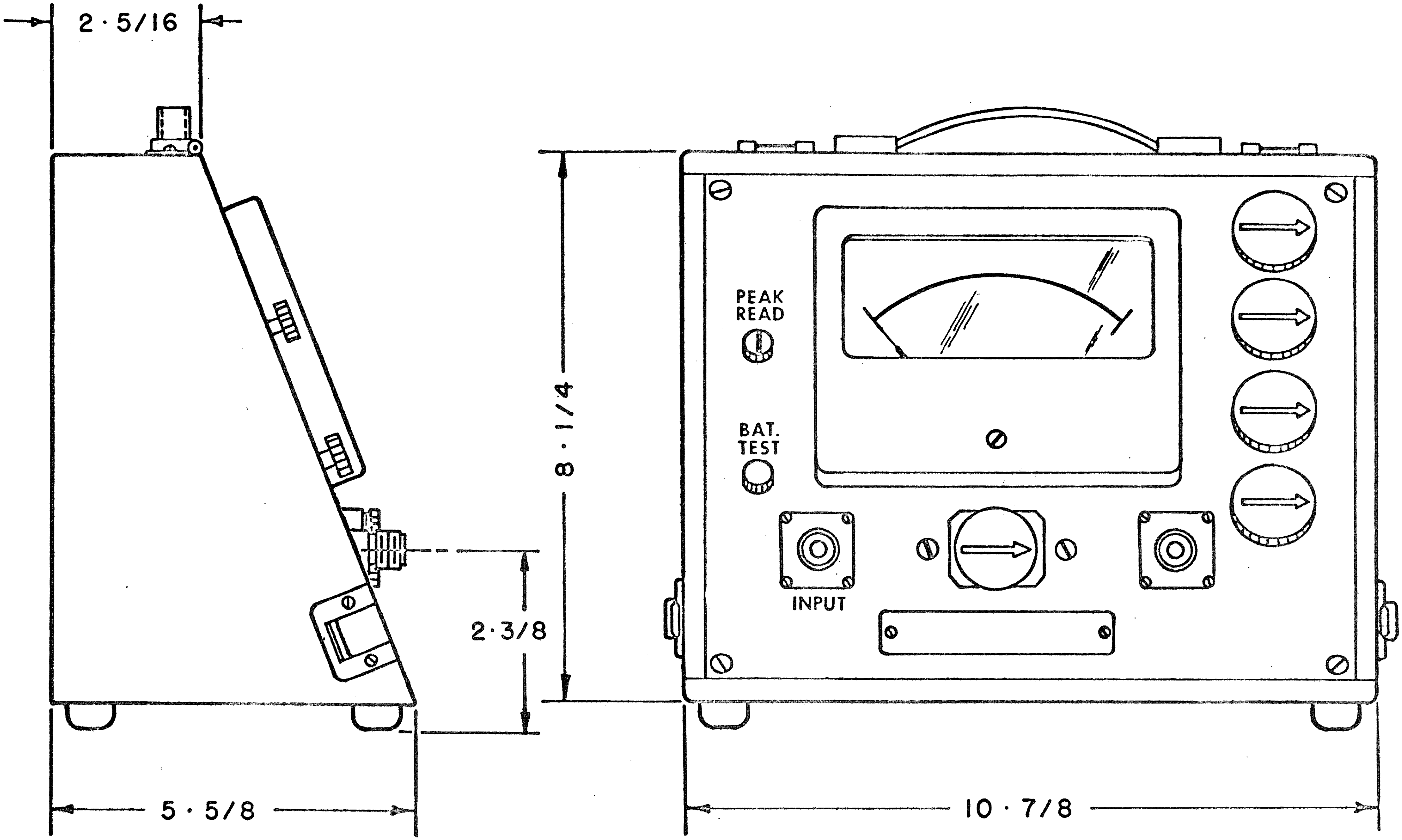

Fig. 2-1 Model 4345 Outline drawing

SECTION II

PREPARATION FOR USE

BATTERY INSTALLATION

This wattmeter uses battery power to operate the amplifier which provides peak watt readings. Two batteries are required. Refer to Table I, Leading Particulars, for a listing of battery type requirements.

To install batteries, proceed as follows:

a. Remove the screws that secure the front panel to the cabinet. Carefully pull the panel from the housing.

b. Open the metal retaining strap and insert batteries in position, carefully observing the polarity markings on the battery bracket.

c. When batteries are positioned in the brackets provided, install the retaining strap to retain them.

CAUTION

> After batteries are installed, make sure the unit is not allowed to stand unused with the PEAK READ switch pushbutton locked in the down position. Battery life with the button down is approximately 50 hours.

d. Press the BATTERY TEST pushbutton and watch the meter indication. The meter pointer must move to the area to the right of the BATTERY TEST mark. This indicates that sufficient battery power is available to operate the amplifier circuit. If the meter fails to indicate to the required level with new batteries, it is probably due to incorrect installation of the batteries, or battery leads that were damaged due to rough handling. Reposition the batteries, carefully following the polarity markings, or repair damaged leads.

e. When proper meter indications are attained, reinstall the meter front panel.

WATTMETER INSTALLATION

Wattmeter Model 4345 is a portable instrument, not specifically designed for attached mounting. It is designed with a leather carrying strap to facilitate movement from one location to another. When transporting the wattmeter, turn the plug-in element in the line section of the meter so that the arrow points up. This will shunt the meter connection circuit and dampen needle action during handling and shipment. Make sure the spare plug-in elements are securely mounted in the sockets of the unit. Secure with the thumbscrews provided. See Figure 2-1 for wattmeter dimensions.

CAUTION

Dropping or rough handling ofthe wattmeter plug-in elements will disrupt the calibration. Handle them with reasonable care at all times. The micrammeter is shock mounted in the housing, but dropping or other sever impact can damage the delicate mechanism of the meter.

Install the wattmeter into an RF circuit having a 50-ohm impedance only. Connecting into lines of other impedance values will cause a mismatch, resulting in seriously inaccurate readings. Avoid this condition if possible. In case of exceptional need, the unit can be connected to lines of mismatched impedance. Refer to paragraph entitled IMPEDANCE MISMATCH.

CONNECTIONS

The line section of the wattmeter is normally fitted with two female "N" type connectors. Connections are readily made using male "N"type cable plugs. However, other types are available from Bird Electronic Corporation as required. The quick-change connectors can be replaced by removing the four screws from each corner of the square flanges of the connector and pulling straight outward, carefully disengaging the spring fingers of the center conductor. Install the new connector by reversing the removal procedure. The alternate connectors available are listed in the parts section in the back of this manual.

Normally, the RF line is connected to the threaded ends of the line section of the wattmeter. No other connections are required for operation. Take care that the plug-in element installed in the socket of the line section has a sufficient watt rating to indicate the line load when the load is applied to the RF line. Severe damage to the plug-in element or meter can result from a mismatch between the watt rating of the element and the line.

SECTION III

OPERATING INSTRUCTIONS

CONTROLS AND INSTRUMENTS

The location, purpose, and use of operating controls and instruments are given in Table III and figure 3-1.

ZEROING THE METER

Before taking any readings with the wattmeter, it is necessary to zero the meter under no-power conditions. Proceed as follows:

a. Rotate the plug-in element so that the arrow points up.

b. Using a small screwdriver, turn the meter zero screw (4) clockwise or counterclockwise as necssary so that the meter pointer exactly aligns with the zero of the meter scale.

PLUG-IN ELEMENT SELECTION AND INSERTION

Use a plug-in element (6) which has a high enough wattage rating and the required frequency range to properly indicate the power of the RF line. If the approximate wattage of the line is not known, start with an element which will be sure to adequately cover the maximum wattage of the transmitter to prevent overloading the wattmeter. Substitute a lower reading element for the first element it its indicating range is too high for accrate power determination. Remove and insert elements as follows:

a. Remove a spare element from its socket (1, figure 3-1)

b. Release the catch (7) that secures the element in the line section body of the wattmeter; remove the element (6).

c. Hold the catch in the released position and insert the replacement element in the line section body. Release the catch to retain the replacement element. Place the removed element in the spare element socket available on the front meter panel.

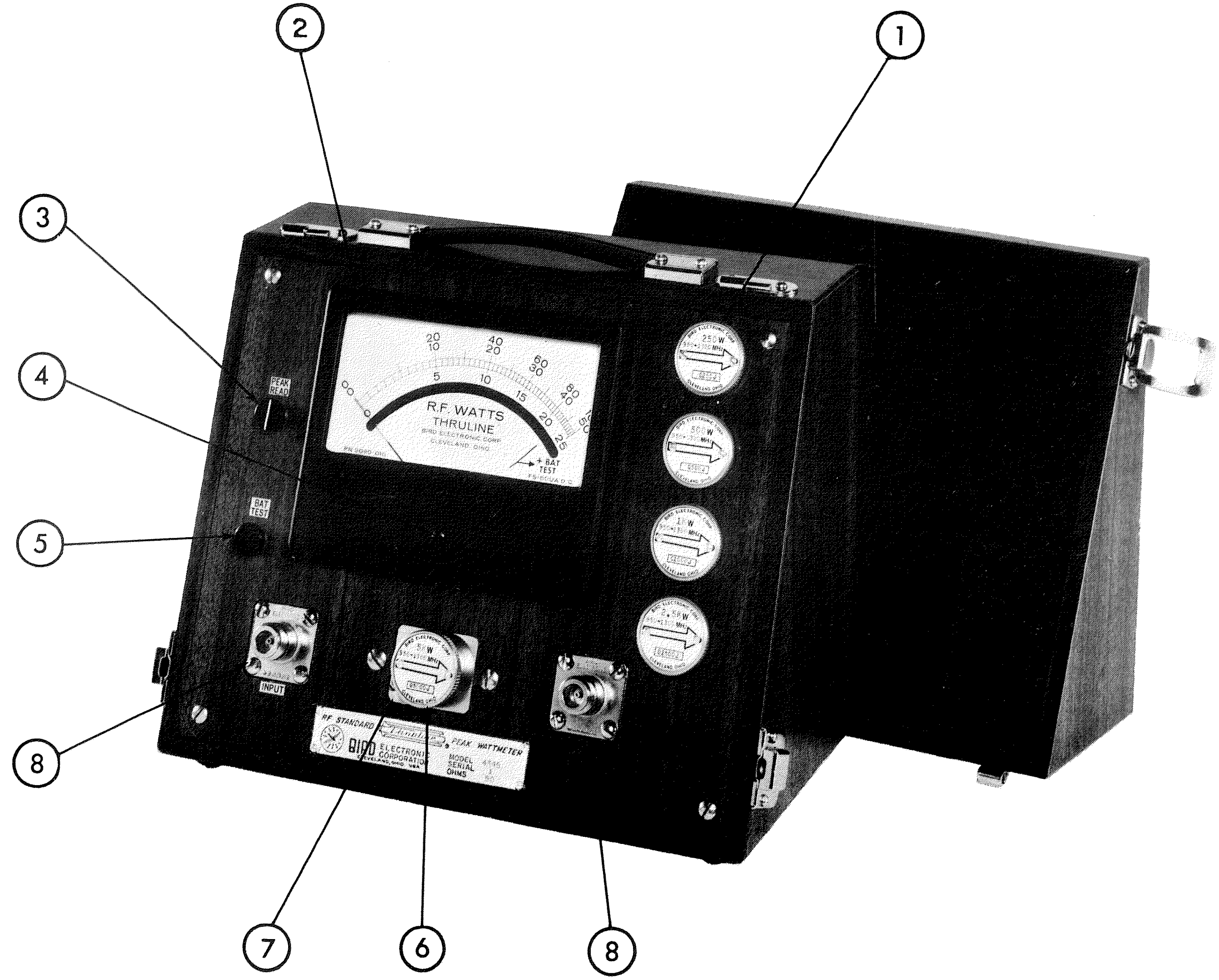
1
2
3
4
5
6
7
8
8
PEAK READ
BAT TEST
INPUT
R.F. WATTS
THRULINE
BIRD ELECTRONIC CORP.
CLEVELAND, OHIO
RF STANDARD
PEAK WATTMETER
BIRD ELECTRONIC CORPORATION
MODEL
SERIAL
OHMS

Fig. 3-1

TABLE III. CONTROLS AND INSTRUMENTS

Index No. Fig. 3-1	Control Name	Purpose and Use
2	Meter	Indicates watts sensed by the instrument. Contains three scales proportional to ratings of various plug-in elements.
1	Spare Plug-In Elements	When it replaces the installed plug-in element, it changes the wattage range of the instrument.
3	PEAK READ Switch	In normal position, meter indicates average wattage. When operated, meter indicates peak pulse power or peak envelope power.
6	Plug-In Element	Determines whether forward or reflected waves are being sensed. When arrow points to load, instrument senses forward waves. When arrow points to transmitter, instrument senses reflected waves.
5	+BAT TEST Switch	When depressed, it causes meter to indicate state of battery charge.
7	Element Catch	Retains and releases plug-in element in element socket of line section.
4	Meter Zero Screw	Provides a zero adjustment for the meter.
8	RF Connectors	QC Type, permits connection of wattmeter into RF line system. Interchangeable with other QC types. See Gen. Cat.

DETERMINING AVERAGE LOAD POWER

This wattmeter provides easy measuring or monitoring of transmitter power. Assuming that the proper element is installed in the wattmeter and that the RF lines are connected to the threaded ends of the wattmeter, determine average load power as follows:

a. Rotate the plug-in element (6, figure 3-1) so that the arrow on the element points in the line direction of the load. Note the reading given on the meter (2). This is the forward power.

b. Rotate the plug-in element so that the arrow on the element points in the line direction of the transmitter. Note the reading given on the meter. This is the reflected power.

c. Subtract the reflected power from the forward power to get watts delivered to and dissipated in the load as follows:

Watts(load)=Watts(forward)-Watts(reflected)

d. The importance of the reflected power varies depending upon the load. Where appreciable power is reflected, as with an antenna, the subtraction of the reflected power is necessary to obtain a true average wattage reading. However, this step may be unnecessary when the load is a good resistor so that the reflected power becomes negligible (less than 1 percent).

DETERMINING PEAK POWER

To determine peak pulse power or peak envelope power of the traveling waves, proceed as directed in the paragraph entitled PLUG-IN ELEMENT SELECTION AND INSERTION for average power, except that the PEAK READ switch (3) must be operated to peak reading.

CAUTION

> After using the wattmeter in the peak reading mode, be sure to release the PEAK READ switch so that the switch button is up. Battery life with the button down is approximately 50 hours. Releasing the button will extend calendar life of the batteries.

DETERMINING VSWR

This unit is not designed to provide direct VSWR (volts-standing-wave-ratio) readings. It is felt that VSWR readings are no more valuable than the ratio of forward to reflected power. In fact, most operators find that in transmitter tune-up, antenna matching, and similar problems dealing with RF circuits, the forward power-to-reflected power ratio is a highly useful tool. However, VSWR readings can be determined by use of graphs as follows:

a. Determine the forward power and the reflected power as directed in the paragraph entitled ZEROING THE METER.

b. Refer to the appropriate graph (figure 3-2 or 3-3) to convert the forward wattage reading and the reflected wattage reading to VSWR. Note that the graphs convert the readings directly into VSWR values without any intermediate computations.

MAKING LOW REFLECTION READINGS

When checking TV transmission antenna lines and VHF Omnirange transmitters, it is often desirable to make very accurate low reflection readings. This can be done using two elements, provided that care is taken to prevent application of high forward power to the low-reading element. This procedure is limited to use with higher powered transmitters only. Proceed as follows:

a. Measure watts forward, using the proper plug-in element. Reverse the arrow direction of the element and get a reading to determine the general level of reflected power.

HIGHER RATIOS

POWER VALUES vs. VSWR

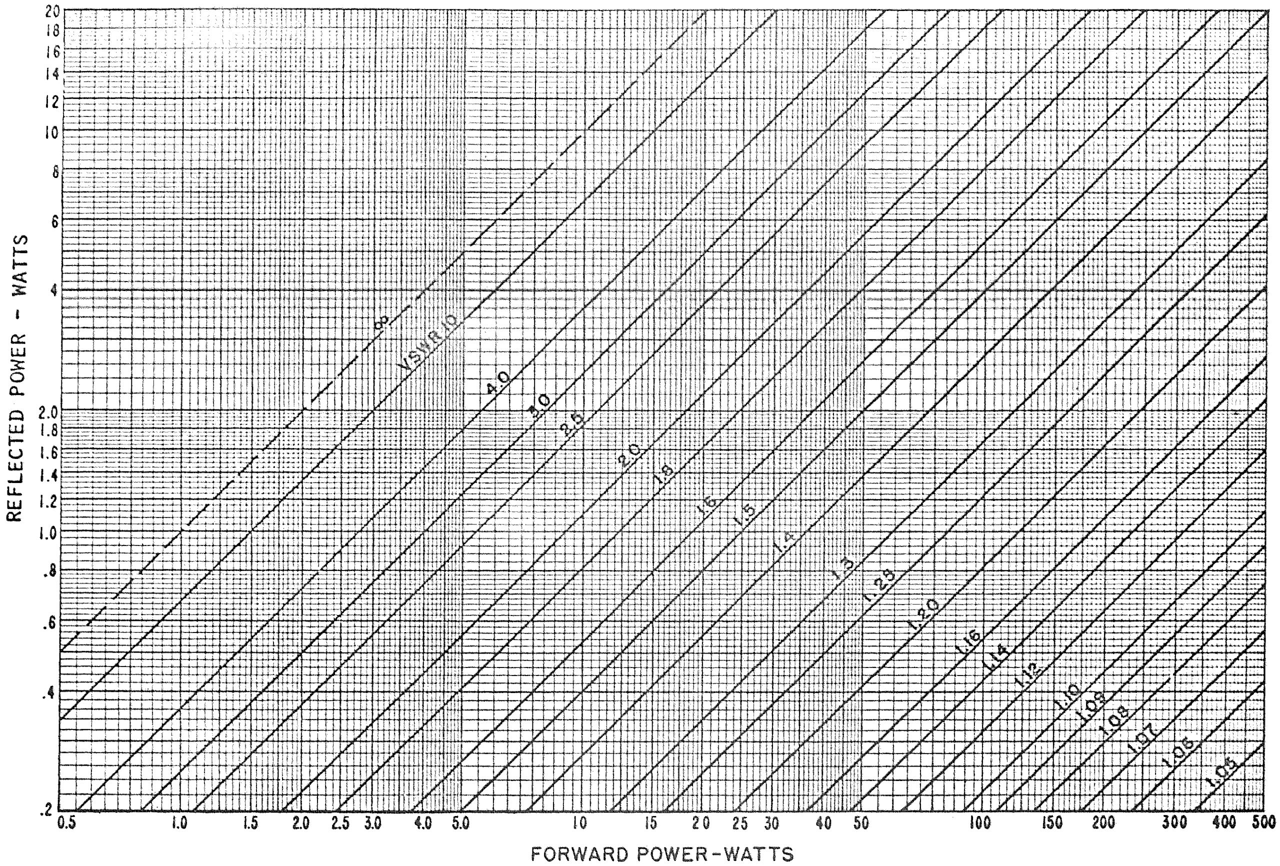

Fig. 3-2 FOR HIGHER POWER VALUES MULTIPLY BOTH SCALES BY THE SAME DECIMAL FIGURE

LOWER RATIOS

POWER VALUES vs. VSWR

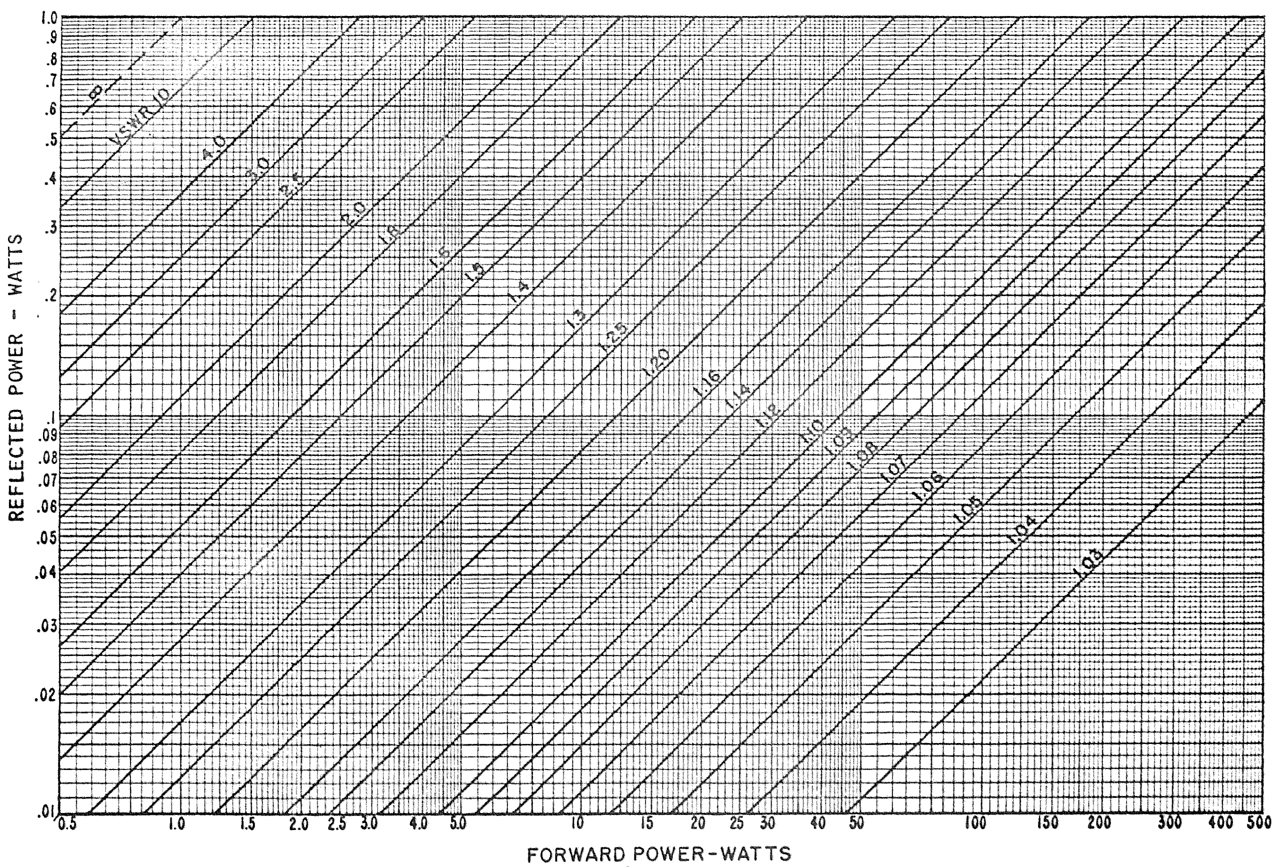

Fig. 3-3 FOR HIGHER POWER VALUES MULTIPLY BOTH SCALES BY THE SAME DECIMAL FIGURE

b. Remove the plug-in element and insert a second, lower reading element which has a maximum rating of more than the reflected power indicated in step a above. Insert the element so that it reads reflected power only.

CAUTION

When making low reflection readings using two elements, take care to insert the lower reading element so that it senses reflected power only. Do not rotate the lower reading element in the socket so that it is subjected to forward power. This will result in damage to the plug-in element, to the microammeter, or both.

c. Read the reflected power on the meter in the usual manner.

d. When using the two-element method of reading low reflected power, do not use a pair of elements which has a difference of greater than 10 to 1, or , at the very greatest, 25 to 1.

FREQUENCY RESPONSE

The plug-in elements of the wattmeter are designed to operate within a specific frequency range. The use of these elements to measure direct power outside of the stated frequency range is not recommended. The frequency response of the elements is very flat over their designated range.

Harmonics outside of the element frequency bank may be known to exist in the measure circuit. If so, proper filters should be used.

TESTING LINES, CONNECTORS, FILTERS, AND RELATED COMPONENTS

Lines, connectors, filters, and related components can be tested using the Thruline Wattmeter, Model 4345. The method of testing used depends upon the circumstances involved for any particular test. Some of these tests are as follows:

a. The standing wave ratio or the reflected power-to-forward power ratio of a line can be determined by terminating the line with a good load resistor, such as a Termaline. Proceed as described in the paragraph entitled PLUG-IN ELEMENT SELECTION AND INSERTION. Low reflected power may be measured as described in the paragraph entitled MAKING LOW REFLECTION READINGS.

b. Line attenuation (power lost by heat in the line) can be determined by inserting the line of unknown value between two wattmeters or between two wattmeter line section. If the latter method is used, one wattmeter unit and one element can be used to make both readings. In either case, the end of the line must be terminated by a load resistor. By comparing readings made at the two places, the attenuation of the line can be determined. Where very small values of attenuation are involved, allowances must be made for normal instrument error. Slight juggling of zero settings is permissible for convenience of eliminating computations, provided the readings are fairly high on the meter scale.

c. Attenuation can also be determined by the open circuit method. The wattmeter exhibits good equality between forward and reflected readings when the load connector is open or short circuited. When this is checked on an open circuit and an open circuited length of line of unknown attenuation is connected to the load connector, the new ratio shown is the attenuation in two passes along the line (down and back). This can be converted to decibels as follows:

$$\text{Attenuation (decibels)} = 10 \log \frac{\text{forward power}}{\text{reflected power}}$$

The decibel reading must be halved because twice the line length is being measured (down and back). This measurement must be supplemented with a reflected power-to-forward power ratio check (subparagraph a above) or with a dc continuity check or leakage check, since open circuits or shorts may exist part of the way along the line.

d. Attenuation can also be determined as described in c above by using a short circuit rather than an open circuit. The open circuit method is preferred because the initial equality (forward power-to-reflected power) is more easily achieved in an open circuit.

MEASURING PERCENTAGE OF POSITIVE MODULATION

Measuring the percentage of positive modulation in an amplitude modulation system is easily done by employing the average and peak reading characteristics of the unit, since:

Percent pos. mod. =

$$\frac{E\ max - E\ carrier}{E\ carrier} \times 100$$

By substitution we get:

Percentage pos. mod. =

$$\frac{\sqrt{P_p} - \sqrt{P_c}}{\sqrt{P_c}}$$

When:

P_p = peak power as read with PEAK READ switch down.

P_c = carrier power as read with PEAK READ switch up.

or:

Percent pos. mod. =

$$\frac{\sqrt{P_p}}{\sqrt{P_c}} - \frac{\sqrt{P_c}}{\sqrt{P_c}} \times 100$$

and by cancellation

Percent pos. mod. =

$$\frac{\sqrt{P_p}}{\sqrt{P_c}} - 1 \times 100$$

These computations are shown graphically in figure 3-2. After determining average and peak readings, consult the graph to determine the percentage of positive modulation.

IMPEDANCE MISMATCH

This wattmeter is designed to check power in a 50-ohm circuit. When the wattmeter is connected into the RF line, it inserts a 4-inch section of 50-ohm line into that circuit. When this is inserted into a line having an impedance other than 50 ohms, the load on the transmitter will change because of the insertion. This change is not too serious if the power reflection factor is less than 10 percent or if the frequency is less than 200 MHz. At values higher than these, the insertion of the 50-ohm line will result in a very different load impedance even if the transmitter is tuned up with the wattmeter inserted into the line. The wattmeter will indicate zero reflection when the unit is connected into a 50-ohm, pure resistive line. When a 70-ohm line is connected on the load side of the wattmeter, under ideal conditions, the 50-ohm wattmeter will indicate 3 percent reflected power or a VSWR of 70/50 - 1.4. The wattmeter can show this same reflected percentage when a 50/1.4 = 35.7-ohm, pure resistive load is applied to the 70-ohm line. This could exist with 10 percent reflected power on the 70-ohm line (VSWR =2). From this it can be seen that when the 50-ohm wattmeter is applied to a 70-ohm line, the line could have 10 percent reflected power with a VSWR of 2.0, but the meter would indicate only 3 percent reflected power (VSWR = 1.4). If it is necessary to make wattage readings on a 70-ohm line with the 50-ohm wattmeter, it is especially important to subtract the reflected power from the forward power.

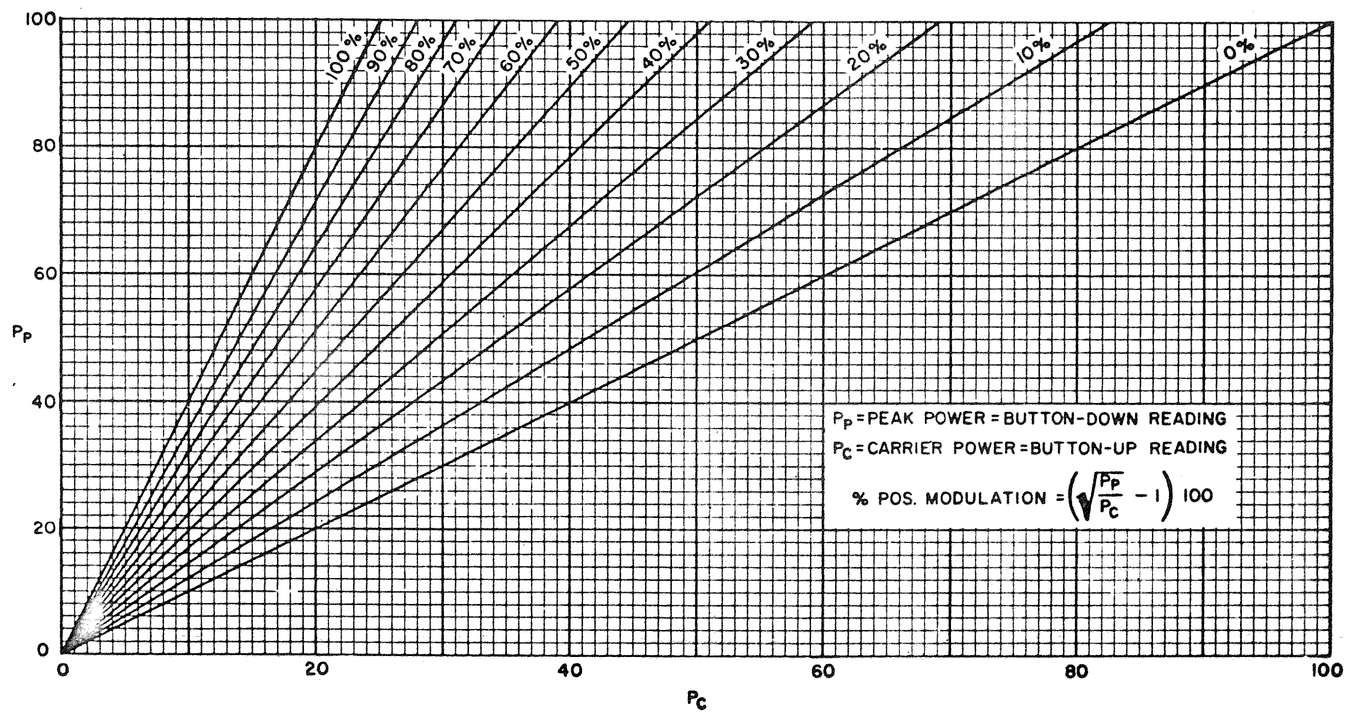

Figure 3-2 Graph Converting Carrier Power and Peak Power to Percent Positive Modulation

SECTION IV

MAINTENANCE INSTRUCTIONS

MAINTENANCE

Maintenance of the Thruline Wattmeter Model 4345 is normally limited to cleaning. The amount of cleaning necessary can be minimized by taking the following precautions:

a. Keep the plug-in element in the socket of the line section as much as possible. This serves as an effective seal against the entry of dust and dirt. Cover the socket opening when the element is removed.

b. Protect the RF connectors on the line section against the entry of dust and dirt by keeping them connected to the line or by covering them when the line is disconnected.

CLEANING

All contacts must be kept clean to assure low resistance connections to and within the unit. Clean contacts as follows:

a. Clean RF connectors with a cotton swab stick dampened with carbon tetrachloride.

<u>WARNING</u>

> Do not use any solvent other than carbon tetrachloride for cleaning the wattmeter. When using this fluid, avoid inhalation of fumes and avoid unnecessary and repeated contact with the skin.

b. Clean the inside of the line section socket bore and the entire circumference of the plug-in element with a cotton swab stick dampened with carbon tetrachloride. Pay particular attention to the cleaning of the bottom rim of the element body and to the seat of the socket in the line section.

c. When cleaning the socket bore, take care not to disturb the spring finger of the dc contact. If necessary, the spring finger of the dc contact can be adjusted manually. The button must be positioned out far enough to make good contact with the element body, but it must not restrict the entry of the element body. Remove two machine screws that secure the dc jack to the line section. Remove the dc jack from the line section, taking care not to lose the small positioning bead that straddles the base of the phosphor bronze spring and nests in a counterbore on the side of the RF body. After adjusting to meet the requirements, make sure that the bead is properly inserted.

d. Check the inside of the line section for dirt and contamination. Clean the reachable portions of the line section with a cotton swab stick. Blow out the remaining dirt with low-pressure, dry compressed air.

CAUTION

Do not attempt to remove the RF line conductor from the line section. Any attempt to remove it will ruin the assembly.

SECTION V

TROUBLESHOOTING

TROUBLESHOOTING CHART

Table IV, Troubleshooting Chart, provides a list of the most probable causes of trouble which might develop in the wattmeter. For each trouble there is a list of probable causes and remedies. Refer to the troubleshooting chart in the event of trouble in the unit.

TABLE IV. TROUBLESHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
NO METER INDICATION (AVERAGE OR PEAK)	Arrow on plug-in in wrong direction.	Correct arrow direction
	No radio frequency power.	Check transmitter for faults.
	No pickup from dc contact finger in line section.	Adjust finger (Section C under CLEANING).
	Open or shorted dc meter cable.	Return to Bird Electronic Corporation.
	Meter burned out or damaged.	Return to Bird Electronic Corporation.
NO METER INDICATION (PEAK ONLY)	Battery leads broken	Repair battery leads.
	Defective component in amplifier section.	Return to Bird Electronic Corporation.
INTERMITTENT OR INCONSISTENT METER READINGS	Faulty load.	Correct fault in load.
	Faulty transmission line.	Correct fault in transmission line.
	Dirty dc contacts on elements.	Clean dc contacts (See section on CLEANING).
	Sticking or defective meter.	Return to
HIGH PRECENTAGE OF REFLECTED POWER	Faulty load.	Correct fault in load.
	Poor connectors.	Check for high resistance connections.
	Shorted or open transmission line.	Correct fault in transmission line.
	Foreign material in line section.	Clean line section thoroughly