

Instruction Book
(Interim)

Model 4159 THRULINE
Directional RF Wattmeter

Patent Notice

This device is manufactured under one or more of the following U.S. Patents: 2,966,645; 2,891,221; 2,852,741. Other patent rights reserved.

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE AND APPLICATION

The Model 4159 THRULINE Wattmeter is a directional RF wattmeter, which measures power flow and load match in coaxial lines. It is intended primarily for original equipment installation in a transmitter with a remote indicating meter mounted on the panel of the transmitter. When used with the appropriate meter, switch and calibrating resistors, it will accurately indicate incident power, reflected power and voltage standing wave ratio. The meter (30 microampere dc full scale), is expanded down scale for convenient reading, with a full scale of 250 watts. The Model 4159 indicates average power, and is for use with CW, AM and FM, but not for use with pulsed transmitters.

2. DESCRIPTION (See Fig. 1-1)

The Model 4159 THRULINE Wattmeter consists of a nominal 50-ohm line section with interchangeable RF connectors and two permanently attached directional couplers. Each coupler has its own silicon diode used as a half-wave rectifier which converts the sampled RF energy to dc. One directional coupler is used to measure the forward or incident power, and the other coupler the reflected power. Selection of one directional coupler to the other is accomplished by a remote switch. This switch is only in the dc circuitry.

The function of the remote switch as used with the Model 4159 THRULINE Wattmeter is as follows:

POSITION 1, Marked "INC"

In this position, the meter will indicate forward or incident power. The meter can be read directly in watts without correction with an accuracy of +5% of full scale.

POSITION 2, Marked "RFL"

In this position, the meter will indicate the reflected power. In a like manner, the meter can be read directly in watts without correction with an accuracy of +5% of full scale.

POSITION 3, Marked "CAL"

In this position, the meter reading is adjusted to read full scale regardless of the forward or incident power level. This adjustment is accomplished by setting the variable potentiometer, marked "ADJ. F.S."

POSITION 4, Marked "VSWR"

In this position, the meter will indicate the voltage standing wave ratio of the RF load. This is read on the meter scale marked "VSWR". This reading is accurate only when the "ADJ. F.S." has been carefully made with the switch in Position 3. The two meter scales (watts and VSWR) are related as follows:

$$\frac{\text{WATTS REFLECTED}}{\text{WATTS INCIDENT}} = \left[\frac{\text{VSWR} - 1}{\text{VSWR} + 1} \right]^2 \quad (\text{See Figs. 1-4 and 1-5})$$

In order to facilitate remote switching, the line section of the Model 4159 THRULINE Wattmeter is marked "LOAD" and "TRANSMITTER". These markings must be observed when connecting the wattmeter in the transmitter. (See Bird Electronic Corporation Dwg. No. 415901.)

The dc output of each directional coupler is brought out of the coupler housing by means of a Female "MB" Connector. The "MB" Connector with the RED marking is the INCIDENT POWER output and is located on the "LOAD" end of the line section. The Male "MB" Cable Connector with the RED marking is to be connected to the above-mentioned RED Female "MB" Connector. The unmarked Male and Female "MB"

Connectors are connected together to complete the REFLECTED POWER output circuit. (See Bird Electronic Corporation Dwgs. Nos. 415900 and 415901.)

3. SPECIFICATIONS (See Figs. 1-1, 1-2, 1-3 and Dwgs. 415900, 415901, 208002, 208003)

Overall Dimensions:

Fitted with two (2) Female "N" Connectors.
3-11/16" x 2-35/64" x 1-1/16"

Weight:

10 ounces. THRULINE Wattmeter consists of Line Section and Couplers.
(See Fig. 1-3)

Frequency Range:

225-400 Megacycles.

Power Range:

0-250 Watts.

VSWR Range:

1-20

Connectors:

RF - Male or Female "N" Quick-Change Type (QC). (See Fig. 1-3)
DC - MB Male

Directivity:

35 db minimum

Accuracy:

$\pm 5\%$ of full scale

Insertion VSWR:

Less than 1.05. (Line Section plus one Female "N" and one Male "N".)

Impedance:

50 ohm nominal.

Meter:

Weston Model 306 (30 microamperes dc F.S., 1400 ohms, $\pm 5\%$ at 25°C.)
Special Scales of 0-250 watts and 1-20 VSWR.

Frequency Response			
Frequency Megacycles	Incident Power	Reflected Power	Model 4159 Reads
200	200 Watts	No Indication	197.5 Watts
300	200 Watts	No Indication	200 Watts
350	200 Watts	No Indication	199 Watts
400	200 Watts	No Indication	200 Watts
Maximum Frequency Error 1.25%			

Insertion VSWR (One Female and One Male "N" Connector)		
Frequency Megacycles	VSWR of Load Used	VSWR Model 4159 Plus Load
200	1.01	1.015
300	1.018	1.031
350	1.025	1.035
400	1.032	1.033
Equipment Used: Bird Slotted Line, Impedance 49.8 ohms Bird Load Model 80M, Serial No. 689		

Scale Correction (Incident Power)			
Frequency Megacycles	Incident Power	Model 4159 Reads	Error % of Full Scale
300	50 Watts	54 Watts	1.6%
300	100 Watts	102 Watts	.8%
300	200 Watts	200 Watts	0%
300	250 Watts	250 Watts	0%

VSWR Error (Model 4159 Adjusted to Full Scale in "CAL" Position)			
Frequency Megacycles	Actual Incident Power	Actual VSWR	Model 4159 Reads
300	150 Watts	1.5	1.6
300	180 Watts	1.5	1.6
300	150 Watts	2.0	2.05
300	165 Watts	2.0	2.1
300	180 Watts	2.0	2.2
300	150 Watts	3.0	3.05
300	180 Watts	3.0	3.3
Test Conditions: Mismatch caused by Double Stub ahead of Bird 500 watt TERMALINE Load. This combination was adjusted to read actual VSWR on Bird Slotted Line. The mismatched combination then transferred to the Model 4159. No attempt was made to match the transmitter to the 50-ohm system.			



FIG. 1-1

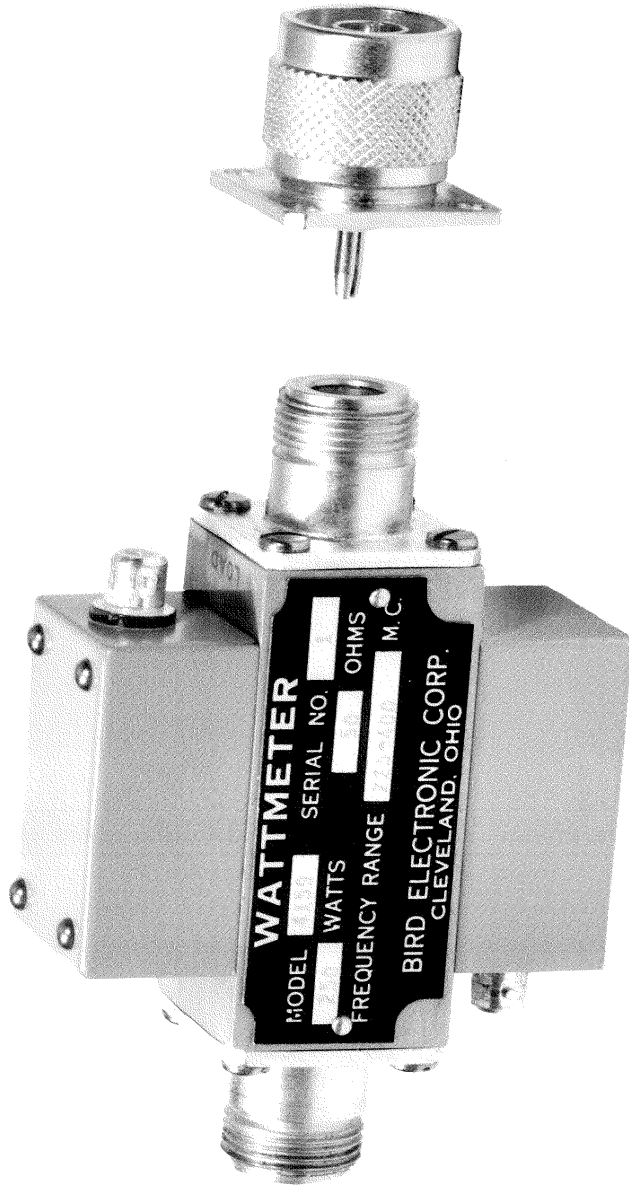


FIG. 1-2

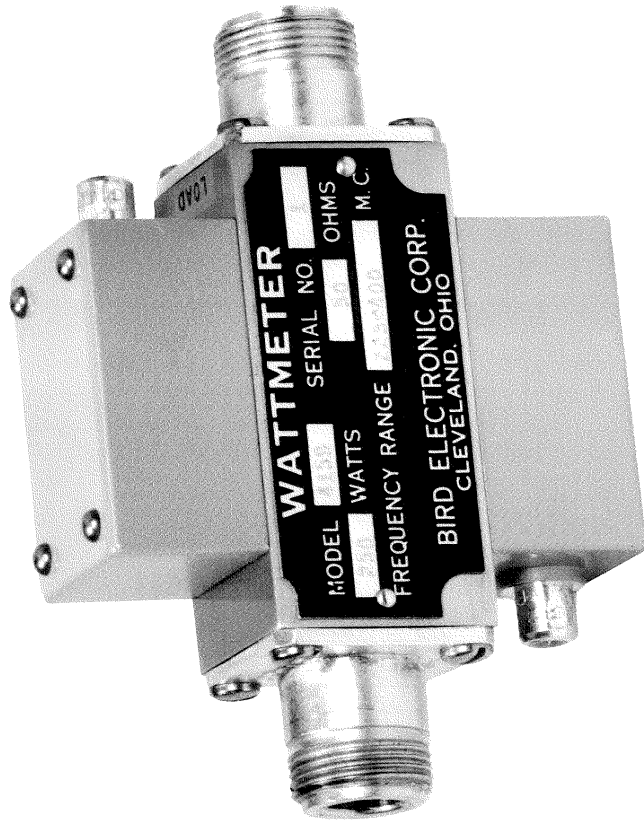


FIG. 1-3