Instruction Book

for

Model 6835 TERMALINE®

RF Wattmeter

Litho in USA

Model 6835 TERMALINE® Wattmeter

I GENERAL DESCRIPTION

1. SCOPE OF MANUAL

This Instruction Book covers the description, theory, operation and maintenance of RF Wattmeter Model 6835.

2. PURPOSE OF EQUIPMENT

a. RF Wattmeter Model 6835 is designed to measure output power and facilitate tuning of transmitters falling within the following limits:

Characteristic Impedance.	50 ohms, nominal
Power Input	1000 watts average 1200 watts (1/2 hr.)
Power Measurement	0-120, 600, and 1200 (Three full scale ranges)
Accuracy.	±5% full scale
Frequency Range (Power Meas.)	30 to 500 MHz
VSWR	1.1 to 1.0 max.
Type of Modulation.	CW, AM, FM or TV type signals. Not designed for use on pulsed power similar to radar.
Input Connector	Female Type LC connector normally supplied.
Ambient Temp.	-40°C to +45°C (Useful Load)

b. It can be used to measure RF power from any source within its rating.

c. It may be used as a Dummy Load of 50 ohms impedance.

3. DESCRIPTION

a. Power is measured under non-radiating conditions, i.e., with the transmitter disconnected from its antenna and feeding into the wattmeter only. This an absorption wattmeter as distinguished from the other general class of "transmitted power" or "thru" wattmeters.

b. The wattmeter is built around an accurate, coaxial resistor which is the terminating element. This resistor terminates 50 ohm lines so well that the voltage standing wave ratio remains below 1.1 up to 500 MHz. The transmitter, when loaded by the wattmeter, then operates into a known resistance of the value for which it was designed, and to a degree not often realized with antennas, particularly broad band types.

c. The RF power input to the load resistor is measured by means of a three-step crystal voltmeter arrangement. The output of this voltmeter is fed thru 10 feet of shielded cable (RG-58/U) into a free-standing dc meter. This meter is direct reading in RF Watts, and no reference to calibration charts is needed in normal use, with ±5% full scale accuracy overall.

d. The Model 6835 is designed for use of the Bird quick-change "QC" type input connectors. These connectors are of the standard AN Types, the unit being normally supplied with a Female LC input. Other standard type "QC" connectors, as listed in the close of this manual, may be procured on special order. These connectors may be readily interchanged with only a screwdriver, see Maintenance Section.

4. SPECIFIC USES

Measurements from the RF Wattmeter Model 6835 may be useful for the following purposes: -

a. Checking installation of transmitter.
b. Routine and trouble-shooting maintenance.
c. Production and acceptance tests.
d. Transmitting tests.
e. Loss measurements on transmission lines.
f. Testing of coaxial line insertion devices, such as connectors, switches, relays, filters, tuning stubs, patch cords, etc.
g. As an accurate RF resistance, substantially independent of frequency and line length.

II THEORY OF OPERATION

1. INTRODUCTION

There is very little lumped-constant, conventional circuitry in this instrument. Circuit elements are of the distributed constant type, machined and fabricated, as in microwave components.

2. CRYSTAL VOLTAGE LEVEL

The crystal operates at 1.2 volts and 100 microamps, rectified dc, for full scale deflection. This value is conservative with respect to overload damage. It has been determined that four times full scale power can be applied momentarily without appreciable change in crystal characteristics or calibration. Since the crystal voltmeter is connected across the load resistor, substantial power is required for voltage overload.

3. CRYSTAL STABILITY - RELIABILITY

a. ADVANTAGES - The silicon crystal rectifier used is comparable and in some respects superior to electron tube diodes. Some of their advantages are: Smaller size, no filament supply, and no zero shift with time or change in line voltage.

b. STABILITY - The application of crystal diodes in calibrated direct reading voltage or power measuring instruments is relatively uncommon. Most people are familiar with crystal diodes in different applications, such as detectors in receivers. The stability realized may prove surprising to those who have not had the opportunity to use such crystals with good standards of RF measurement. From a long program of measurements in the laboratory and from field experience with many similar instruments in industrial use, it has been found that calibrations will hold as well as in electron tube voltmeters. There is no indication of long time aging, and calibrations may be expected to hold within 2% for variations attributed to the crystals.

4. LOAD RESISTOR

a. The load resistance equipment of the Model 6835 Wattmeter consists essentially of a carbon film-on-ceramic resistor immersed in a dielectric coolant. The resistor, individually selected for its accuracy, is enclosed in a exponentially tapered housing. This provides a linear reduction in surge impedance, directly proportional to the distance along the resistor. When surrounded by the dielectric coolant, the characteristic impedance is therefore 50.0 ohms at the front (connector end) and 25.0 ohms halfway down, to compensate for resistance already passed over. It is zero ohms at the rear, where the resistor joins the housing, forming the return conductor of the coaxial circuit. This produces the uniform, practically reflectionless line termination.

b. The dielectric coolant, GE Type 10C Transil Oil, is chosen for its chemical inactivity (to prevent damage to the resistor), high flash point, and its low dielectric constant, to which the diameters of the resistor housing are matched. When this oil is heated, thermal expansion would cause an increase of internal pressure in the coolant tank. To prevent this, the filler hole at the top of the radiator must be opened by removing the shipping plug before using the equipment, see below.

c. When input power is applied, the resistor generates heat in the adjacent dielectric coolant. By convection, the heated oil flows through slotted openings in the coaxial shell to the walls of the fabricated metal tank. The series of radiating fins brazed to the tank transmit the heat of the dielectric coolant into the surrounding air.

d. A synthetic rubber O-ring around the body of the resistor housing mount furnishes the oil seal for the radiator opening. A beveled flange retains the O-ring. This flange, with the O-ring between, is pressed against the radiator face by the resultant action of the drawing up of the radial V-band clamp around opposing beveled flanges of the radiator and the resistor housing.

III INSTALLATION

a. RF Wattmeter Model 6835 is equipped for either fixed installation or movable use. Base mounting brackets are secured to the front and rear faces of the unit. The unit may stand free or be secured to a bench, etc. by means of four suitable fasteners. Four elongated 3/8" holes, for use with screws up to 5/16" diameter, are arranged in a 5-3/8" x 21-1/4" rectangle. The load is designed for operation in a horizontal plane only, with mounting brackets down. NOTE: DO NOT OPERATE IN ANY OTHER MANNER.

CAUTION

Shipping plug #2450-049 (3/4 in. hex head, painted red) must be removed before the unit is placed in operation. Failure to do this could result in damage to equipment and danger to safety. Screw the breather fitting, part #5-835 into the vent hole. Shipping plug should be replaced whenever the unit is to be shipped.

b. Place the read-out meter (10 ft. cable) for the most convenient reading standing up or down.

c. Provide for circulation of air around the wattmeter. This is especially necessary if operated at high power for more than a few minutes. Keep space above the wattmeter clear and allow six inches on the sides. Avoid mounting it on, or alongside of heated surfaces.

IV OPERATION

1. VOLTMETER CONTROL

a. The wattmeter has only one control, the voltmeter block (located behind the input connector) which is used to select the desired scale on the meter. The number lined up with vertical mark shows RF power for full scale meter deflection.

CAUTION

Do not try to turn the voltmeter block beyond the outer stops. The block rotates 60° for each of the three settings, viz: 0-120, 600, and 1200 watts full scale, respectively.

2. TO MEASURE TRANSMITTER POWER

a. Locate the wattmeter where a short patch cord, preferably not over 5 ft. long, will connect the transmitter to the wattmeter in the most direct manner.

b. With the TRANSMITTER OFF, disconnect the antenna line and connect the wattmeter. For this use a patch cord of 50 ohm cable, such as RG-17B/U, or RG-18A/U or RG-218/U with appropriate coaxial plug.

CAUTION

When the approximate transmitter output is not known, always set voltmeter block to 1200 watts. Adjust to the appropriate scale after preliminary reading, so as not to overload the crystal and microammeter in case of too high a transmitter output.

c. Turn the TRANSMITTER ON. The wattmeter will directly indicate the power being absorbed. If an adjustment of the transmitter is necessary, follow the pertinent instruction book. OBSERVE SAFETY PRECAUTIONS about high voltages in the transmitter. The wattmeter indicates result in watts of direct tuning into the standardized termination of 50 ohms afforded by the wattmeter.

d. When desired output power has been obtained, NOTE THE READINGS of the wattmeter, and of the meters provided on the transmitter, particularly of the plate current and voltage meters on the final stage, and of antenna line monitor. These readings bear a direct relationship to power output, and are useful in relating the transmitter output into its antenna to its output into the wattmeter.

e. TURN TRANSMITTER OFF before opening RF connections to the wattmeter.

f. RECONNECT THE ANTENNA LINE, TURN TRANSMITTER ON and note its meter readings. If the antenna impedance (VSWR) is correct, the transmitter readings will read as they did with wattmeter connected. Some allowances should be made for the fact that VSWR's around 2 to 1 are normal at some frequencies in the range of good broad-band antennas.

V MAINTENANCE

1. INTRODUCTION

a. The circuit simplicity and essentially mechanical design of the wattmeter result in a minimum of maintenance, since all electrical circuits are sealed and rigidly mounted and contain simple type components.

b. Generally, the unit will require only routine wiping and cleaning coupled with reasonable care in handling.

c. Preventive and corrective maintenance are grouped in this section.

2. GENERAL MAINTENANCE

a. Dust off the unit when necessary, removing any deposits of dirt or grime. Especially important - keep the jacks and plugs clean.

b. Keep the meter cable plug firmly in place on the dc jack at the side of the voltmeter block. This excludes dirt and mositure. If this connection has been stationary for a long time, slightly loosen (unscrew) the knurled nut on the plug, rotate its cable sleeve back and forth a few times to clean the contacts, then retighten securely.

c. Protect the power input jack by keeping it plugged or covered when not in use. If the connector parts become dirty, clean carefully. Use a cotton swab stick dipped in a suitable dry solvent, such as Inhibisol* or trichlorethylene. CAUTION - AVOID BREATHING FUMES if carbon tetrachloride is used. Give special attention to cleaning the exposed faces of the insulator (teflon) and also to all of the coaxial contact surfaces.

d. Dropping is the most likely source of damage to the wattmeter. DO NOT DROP IT. The microammeter movement in the read-out meter or the voltmeter parts might be damaged.

3. REPAIR AND REPLACEMENT

NOTE: If difficulty should occur, particularly in electrical functioning, it is generally advisable to return the unit to the factory for repair and re-calibration. Specified accuracy of the unit is then assured, and qualifications of a new instrument are maintained. The following are the significant electrical components of the Model 6835, which may be serviced as described: -

a. The Resistor-Voltmeter Unit R.F. Section, Bird part #6835-002

1) This is an integral component, not subject to further disassembly by field maintenance. The condition of the load resistor proper may be checked by means of its dc resistance. An accurate resistance bridge such as Leeds & Northrup Model 5305 Test Set, good to 1% or better at 50 ohms, is required. Using low resistance leads (preferably a short length of low resistance cable with a suitable plug attached to the input jack, measure the load resistance. A change of more than 2 ohms from the value of the resistance stamped on the nameplate will cause wattmeter readings beyond tolerance. It should be noted that even within allowed dc tolerance of the load resistor, a change in this resistance will produce a small corresponding apparent change in the wattmeter reading.

* A non-toxic, non-flammable dry cleaning agent manufactured by Penetone Company, Tenafly, New Jersey.

2) To remove the RF Section from the radiator tank, unscrew the knurled nut from the jack on the voltmeter block and disconnect the meter cable.

3) Stand the wattmeter vertically with the nose up, and support the radiator so that it is properly stable. Unscrew the 10-32 clamping screw on the V-band clamp in the top face of the radiator. Remove the V-band and pull the resistor-voltmeter unit part #6835-002 (RF Section) straight up and out from the radiator tank. Allow sufficient time for coolant drainage before removing the unit from face of tank. Replace RF Section if required (including spare crystal in meter box).

WARNING

ANY PARTS REPLACEMENT IN THE VOLTMETER WILL AFFECT THE CALIBRATION

DO NOT ATTEMPT REPAIR ON THIS PORTION -
RETURN UNIT TO FACTORY

4) To assemble, reverse procedure in above paragraphs. When possible, use new external seal O-ring part #8110-039 when re-attaching the RF Section. This oil seal for RF Section should be completely clean and correctly placed - against the beveled flange all around and without twists. Tighten the clamp band securely, and then place unit horizontally.

5) After a short time, check carefully for possible oil leakage at the front of the RF Section. Re-attach dc meter cable to the voltmeter block. Note that when replacing resistor voltmeter unit, crystal, and spare crystal (to be stored in holder in the back of meter box) accompany the assigned resistor unit and must not be interchanged between units.

b. Microammeter (Meter Assy. - Bird part #8240-092-13)

1) As previously stated, substitution of the microammeter without wattmeter recalibration may produce errors (possibly up to 4%, but ordinarily perhaps 2% of full scale).

2) These meters can be checked for accuracy. However, this should be attempted only by one familiar with procedures for testing sensitive dc instruments - they may be readily damaged. USE CARE. Test the meter as a microammeter in series with a low voltage battery, variable resistor, and an external microammeter. Full scale current on the meter should be 100 microamperes ±2%.

3) To replace microammeter proceed as follows:

(a) Place the meter case face down on a smooth, clean surface.

(b) Using the thumb and the fingers of one hand, press down evenly on the retainer ring to compress the sponge-rubber meter retaining strips.

(c) Unscrew the (two) oval-head machine screws on the sides of the case. These screws can be seen below the end of the handle on either side of the case.

(d) Remove the meter with the retainer ring and rear sponge-rubber strip.
(e) Strip the vinyl lacing and the tubing from the terminal lugs on the back of the meter, and unsolder the leads.
(f) Replace the tubing on the center conductor and solder the cable into the new meter. Remove rosin flux from the soldered joints with cleaning compound.
CAUTION: Use the soldering iron sparingly.
(g) Reverse the procedures in (b) through (d) above to install the new meter in the case, after restoring vinyl lacing.

4. COOLANT

a. The level of the dielectric coolant should remain constant in the unit after prolonged usage under normal operating conditions. Inspect occasionally around lower portion of the clamping band for possibility of coolant leakage. Tighten clamping screw if required. Under very unusual conditions it might be necessary to replace the resistor housing O-ring 8110-039. Proceed as described in text above.

b. To check coolant level, measure through the filler and vent socket on the top surface of the unit. Unscrew the plug with a 3/4-inch wrench. Coolant level should be within 2 to 2-1/4 inches below the top surface of the filler socket. The unit is factory-filled to the proper level with 1.7 gallons of GE Transil Oil. NO OTHER COOLANT MAY BE USED.

5. RF INPUT CONNECTOR

a. The input connector is of a special quick-change (QC) design which permits easy interchange of connectors with only simple tools. This process does not in any way disturb the coolant seal or interfere with the essential coaxial continuity of the load resistor RF input.

b. To replace the RF input connector, proceed as follows:

1) Remove the four #8-32 x 5/16 round head machine screws from the corners of the RF connector.
2) Pull connector straight out.
3) Reverse above procedure to install new connector, making certain that the projecting center contact pin of the "QC" connector is carefully engaged and properly aligned with the mating socket on the load resistor.

The "QC" connector may be readily replaced, as above, with other AN Standard Type connectors if specially obtained. Available types are listed on the following page.

N - Female	4240-062	LC - Female	4240-031
N - Male	4240-063	LC - Male	4240-025
HN - Female	4240-268	LT - Female	4240-018
HN - Male	4240-278	LT - Male	4240-012
C - Female	4240-100	UHF - Female (SO-239)	4240-050
C - Male	4240-110	UHF - Male (PL-259)	4240-179
	7/8" EIA Air Line		4240-002

6. REPLACEMENT PARTS LIST

Description	Part Number
RF Section (Load Resistor and Voltmeter Assy)	6835-002
Meter and Housing Assy	8240-092-13
Meter Housing Assy	8240-121
Meter Assy	8180-095-11
Meter Cord	8180-021-1
Clamping Band Assy	2430-043
O-Ring, RF Section	8110-039
Coolant - 10C Oil (1.7 gallon)	5-030
O-Ring, Vent	5-502
Vent, Breather	5-835
Plug, Shipping	2450-049
Radiator	2450-100-1
Optional Equipment (Extra):-	
Thermoswitch, Overtemperature	2450-056