SECTION 4
OPERATION

1. GENERAL

The apparent features of the THRULINE equipment have been discussed in Section 1, GENERAL DESCRIPTION, and in the instructions of Section 3, INSTALLATION. Measurements are made by the insertion and operation of the Plug-In Elements previously mentioned.

The Elements determine the power range to be read on the meter scale, and the major markings (viz. 50W, 100W, etc.) are the FULL SCALE POWER value for that Element. Elements are also marked for FREQUENCY RANGE. The transmitter frequency must be within the band of the Element used. Elements are available according to those identified in the tables on page 4-6.

See paragraph 6 of this chapter for frequency band flatness, and performance of the Elements outside of stated frequencies. Elements for additional ranges (power or frequency) may be ordered without returning the THRULINE for calibration, since the RF bodies and meters are standardized, and are designed for a wide range of coaxial transmission power values and frequencies.

ARROW on Plug-In Element indicates Sensitive DIRECTION, i.e., the direction of power flow which the meter will read. ARROW and REVERSE are directional terms used in reference to the THRULINE ELEMENT, and mean respectively the sensitive and null directions of the Element. ROTATE ELEMENT to reverse the sensitive direction. FORWARD and REFLECTED are directional terms used in reference to the source - load circuit. Note that the transmitter may attach to either connector of the THRULINE. It makes no difference which external RF connection is selected, since the Elements are reversible and the RF circuit is symmetrical end for end. Before taking readings be sure that the meter pointer has been properly zeroed under no-power conditions.

The THRULINE used with a TERMALINE resistor of proper power rating forms a highly useful absorption wattmeter. With ARROW set toward the load, it is unnecessary to reverse because reflected power may be neglected.

In cases where readings are being made when the meter unit is connected to an auxiliary RF line section body, always remove any measuring Element from the unused RF line section. Otherwise, the dc circuit will be unbalanced or shorted according to the arrow position of the other Element, causing inaccurate or no reading on the meter.

2. LOAD POWER

Power delivered to (and dissipated in) a load is given by:

$$\overset{L}{W} = \text{Watts into Load} = \overset{F}{W} - \overset{R}{W}$$

i.e., where appreciable power is reflected, as with an antenna, it is necessary to subtract reflected from forward power to get load power. This correction is negligible (less than 1 percent) if the load is such as to have a VSWR of 1.2 or less. Good load resistors, such as our TERMALINES, will thus show negligible or unreadable reflected power.

VSWR scales, and their attendant controls, for setting the reference point, have been intentionally omitted from the THRULINE for two reasons:

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

(b) Experience using the THRULINE on transmitter tune-up, antenna matching etc., i.e., on OPERATING PROBLEMS shows that the power ratio ϕ is no mean competitor, in practical usefulness, to the ratio ρ = VSWR.

A trial is suggested for a few days — forget VSWR and try thinking in terms of $\phi = \overset{R}{W} / \overset{F}{W}$ when the THRULINE is used. It will be noted that, even without bothering to calculate the ratio exactly, the two meter readings $\overset{R}{W}$ and $\overset{F}{W}$ give an automatic mental impression which pictures the situation. Thus, in an antenna matching problem, the main thing usually is to minimize $\overset{R}{W}$, and anything done experimentally to this end is directly indicated when the THRULINE is in the reflected position. Furthermore, the ratio of readings, only mentally evaluated, is a reliable guide to the significance of the remaining reflected power.

3. GRAPH—ρ VS. ϕ AND ITS SIGNIFICANCE

Since there are definite simple relationships

$$\rho = \frac{1+\sqrt{\phi}}{1-\sqrt{\phi}} \text{ and } \phi = \left[\frac{\rho-1}{\rho+1}\right]^2 \text{ where } \rho = \text{VSWR and } \phi = \frac{\overset{R}{W}}{\overset{F}{W}}$$

between standing wave ratio ρ and the reflected/forward power ratio ϕ indicated by the THRULINE, the latter may be conveniently used to measure VSWR. The relationship is given in Fig. 4-1a and b.