

ASSEMBLY AND OPERATION OF THE HEATHKIT REFLECTED POWER METER MODEL AM-2



SPECIFICATIONS

R. F. Power Handling Capabilities.....	One kilowatt
Input and Output Impedance.....	50 or 75 ohms
Power Requirements.....	None
Band Coverage.....	160 through 2 meters
Meter.....	100 microamperes, full scale
Operation.....	Indicates percentage of forward and reflected power, and standing wave ratio from 1:1 to 6:1
Cabinet Size.....	7 3/8" x 4 1/6" x 4 5/8"
Net Weight.....	1 1/2 pounds
Shipping Weight.....	3 pounds

INTRODUCTION

Primarily, the Heathkit Model AM-2 Reflected Power and S. W. R. Bridge has been made available to provide the Radio Amateur, or operator of similar transmitting equipment, with a reliable but inexpensive means of determining whether the radio frequency power output of which his transmitter is capable is being transferred to the radiating portion of his antenna system with the best practicable efficiency.

The AM-2 will also be found useful, within its specification limits, in any application which requires the measurement or continuous monitoring of reflected power or S. W. R. (standing wave ratio) in a coaxial line of 50 or 70 ohm nominal impedance.

Since the power handling capability of the Heathkit AM-2 is in excess of the legal limit of radio frequency power output for amateur radio transmitters, and since its insertion loss is negligible, it can be permanently installed in the coaxial transmission line of any amateur transmitter installation, at the operating position; this will permit continuous monitoring of transmitter tuning, transmission line to antenna impedance match at the operating frequency, and relative power output. Even though it is installed in this manner, the AM-2 is still conveniently available for occasional or frequent use in connection with the design and construction of coupling networks, antenna systems, etc., since it is small in size, requires no external power source, and employs standard VHF coaxial connectors.

CIRCUIT DESCRIPTION AND OPERATING PRINCIPLES

The circuit of the Heathkit Model AM-2 Reflected Power and S. W. R. Bridge is based upon that of a device developed at the U. S. Naval Research Laboratory, Washington, D. C. and described by NorGorden in N. R. L. report No. 3538, titled "A Reflectometer for H-F Band." Simplified versions have also been described in various amateur radio publications.

In the broadest terms, the AM-2 consists of a short section of transmission line to which two small linear inductors are coupled both inductively and capacitively. The radio frequency current flowing in each inductor and its load resistor is rectified by a germanium diode and filtered by a ceramic capacitor. The "Function" switch selects the direct current output of either diode and applies it to a variable sensitivity metering circuit consisting of a linear potentiometer and a 0-100 microammeter.

The circuit configuration as shown on Page 2, actually constitutes two radio frequency bridges, the "null indicator" being switched from one bridge to another. We will refer to the two bridges as the "Reflected" bridge and the "Forward" bridge, using the "Function" switch terminology. The proportion of capacitive and inductive coupling between the transmission line and the linear inductors or probes is such that the "reflected" bridge will be balanced for the condition of no reflected power (perfect line-to-load impedance match); the meter will therefore indicate a standing wave ratio (S. W. R.) of unity and zero percent reflected power for this condition, when the switch is in the "Reflected" position. If the impedance of the line termination (antenna) at the operating frequency differs from that of the line (50 or 70 ohms), some power will be reflected back from the antenna and the bridge will be unbalanced. The meter will indicate the degree of unbalance in terms of its scale calibrations of "Percent Reflected Power" and approximate "S. W. R.". For example, if the transmission line is either "shorted" or "open" at the load (antenna) end, essentially all of the power will be reflected, and the meter will indicate approximately 100% reflected power, representing an infinitely large S. W. R.

When the "Function" switch is in the "Forward" position, the meter will indicate "forward" bridge balance (zero) only when there is no radio frequency current flowing in the forward direction (toward the transmission line load). As forward current is increased from zero upward, the bridge becomes unbalanced, and the meter swings up-scale. The actual meter indication will depend upon (1), the amount of current flowing toward the antenna in the transmission line, and (2), the setting of the AM-2 "Sensitivity" control. Therefore the AM-2 constitutes, when the "Function" switch is in the "Forward" position, a reliable transmitter tuning indicator, in addition to serving as a continuous monitor of transmitter output. It should be noted that the

meter does not have a scale calibration for forward current. Because of the wide range of frequencies and transmitter power output levels represented in amateur and other installations to which the AM-2 is applicable, inclusion of a meaningful "power output" or "forward current" scale would greatly complicate the design of the instrument and thereby unduly increase its cost. Obviously, it is far more important to know that the transmitter is "putting out" maximum power for a given input than it is to know the exact amount of power involved. Regardless of the operating frequency or the power output level (within the stated power capability of the AM-2), an increase in the amount of current flowing toward the antenna will always produce a higher indication on the meter. The "sensitivity" control makes it possible to establish a reference level or meter reading which represents normal operating conditions. Over a wide range of power levels, this reference indication can be full-scale or "100" on the meter. At power levels below this range, any meter reading within the range of the sensitivity control can be utilized as a normal operation reference; for example, mid-scale or "50" on the 0-100 scale would be convenient.

