INSTRUCTION MANUAL
for
RF POWER and VSWR METER

Model 263

M.C. Jones Electronics Co.
INCORPORATED
BRISTOL, CONN.

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DESCRIPTION

Your new MicroMatch 260 Series Instrument is a compact, versatile, multi scale, yet accurate device for measuring RF Power and VSWR of coaxial transmission lines. This instrument represents the utmost in ease of installation, compact design, and freedom from interference with the equipment being monitored.

Readings of forward or incident power and reflected power may be made directly on the indicator for either of three calibrated scales. The VSWR (Voltage Standing Wave Ratio) may then be determined from the ratio of reflected to incident power.

SPECIFICATIONS.

Frequency Range:	0.5 to 225 MCS.
Impedance:	52 ohms
Wattmeter Scale:	0-10; 100; and 1000 watts
Maximum Power Handling Capacity:	1000 Watts at Unity VSWR
Power Loss thru Coupler:	Less than 0.1 db
RF Connectors:	Type N

	Size	Weight
Coupler Unit	3 x 3 x 5"	9 oz.
Indicator Unit	5-1/4 x 3 x 3	1 lb. 8 oz.

USES

The design, installation, and maintenance of modern transmitter and antenna equipment requires an RF Wattmeter that can be inserted into the transmission line to measure both incident and reflected RF Power.

This instrument was designed to monitor both transmitter and antenna characteristics in the frequency range from 0.5 to 225 MCS while the equipment under test is in use. It measures the RF power from the transmitter and the VSWR of the load.

RF Power and VSWR Monitor. This instrument is particularly useful during the installation and operation of transmitting stations, specifically when several types of antennae are included where the possibility exists for a mismatch on the RF transmission line. With your new 260 Series instrument, trouble can be detected, and its cause isolated to the transmitter, transmission line, antenna tuner, or antenna. Proper interpretation of the data read on this instrument will usually indicate the corrective measures which should be taken. During normal operation, the operator has complete assurance of proper functioning of his entire transmitter and antenna system.

Laboratory Uses. The MicroMatch 260 Series is an excellent laboratory instrument that may be used to measure the performance of transmitter, antennae, RF loads, and inter-stage coupling net-works. With a load resistor, it may be used to measure transmitter power output under various conditions of load impedance. In the design and adjustment of antenna tuners and antenna systems, it may be used to continuously measure the VSWR produced on the transmission line by the antenna.

Absorption Type Wattmeter. When used with a load resistor in the 630 Series, this instrument makes an excellent absorption type RF Wattmeter. This combination provides a means for measuring the performance of the transmitter into a perfect resistive load, and then into the actual load or antenna available. It will also measure the characteristics of the actual load.

Matching Circuits. This instrument can be used to match the input and output circuits used to inter-stage coupling in a transmitter by inserting the instrument in the coaxial line. It is then possible to adjust the grid circuit of the driven stage so that no reflected power is present, and to adjust the plate circuit of the driving stage until the desired amount of driving power is supplied to the subsequent stage.

INSTALLATION and OPERATION.

INSTALL the coupler unit in the transmission line as close to the transmitter as possible. The input and output connectors are plainly labeled on the nameplate, "Transmitter" and "Load", respectively. For permanent installation, it is recommended that the instrument be bracketed to the side of the transmitter, or to a convenient wall

2. Read the FORWARD or INCIDENT POWER in the following manner:
(Caution: Do not operate the unit continuously at more than 1000 watts RF power with Unity VSWR.)

(a.) Set the selector switch on the indicator unit to 1000 FORWARD position.

(b.) Turn on the transmitter, and bring up the power gradually, if possible. If the transmitter is equipped with "Tune" and "Operate" positions of the high voltage, it is advisable to place in "Tune" first, and then advance it to "Operate" position.

(c.) Read the FORWARD or INCIDENT POWER directly on the appropriate meter scale in watts. Move the selector switch until a maximum deflection not exceeding full scale is obtained.

3. Read the REFLECTED POWER by setting the selector switch on top of the indicator to the appropriate reflected power position so that a maximum meter deflection not exceeding full scale is obtained. Then, read the power scale exactly as described above.

4. The NET POWER travelling toward the antenna or load is equal to the difference between the forward and the reflected power.

5 Determine VSWR by first calculating the percent reflected power. This is equal to the reflected power divided by the incident power, times 100 Then, refer to the curve of VSWR versus percent reflected power. For example, if the percent reflected power is 10.0, the VSWR from the curve will be approximately 1.9.

CORRECTION FOR FREQUENCY

All readings taken with this instrument are fundamentally independent of frequency; however, the detector used in the coupler unit loses efficiency in the high frequency region so that the power readings require a correction factor.

Readings of VSWR require no correction for frequency.

To obtain the correct power reading, multiply the meter reading of both incident and reflected power by the following factors corresponding to the frequency used:

Frequency in MCS	10 Watt Scale	100 and 1000 Watt Scales
3 to 20	1.0	1.0
30	1.07	1.05
50	1.15	1.1
70	1.23	1.14
100	1.31	1.2
140	1.41	1.23
162	1.46	1.25
225	1.60	1.35

Figure 1. Table of Power Correction Factors Versus Frequency. Multiply meter readings by the above numbers.

INTERPRETING RESULTS

Effect of Inserting MicroMatch in Line. The 260 Series coupler can be connected permanently into a matched transmission line without affecting the transmitter performance in any way. Connecting the instrument into an unmatched line will change the impedance seen by the transmitter. This change is not due to reflections set up by the instrument; it occurs because the coupler unit is electrically equivalent to a 4" length of transmission line. To compensate for this, a length of line can be added between the transmitter and the instrument, such that the added length of line plus the directional coupler equals one-half wave length.

The table below shows the proper length of coax line to be added:

Transmitter Frequency MCS.	Transmitter Wave Length In.	Cable Length In.
25	470	160
100	117.6	37
200	58.8	19

Note: The added length of cable should be removed from the line together with the 260 Series coupler, and connected into the line whenever the 260 Series Coupler is used, if it is desired to create no change in the loading of the transmitter by the insertion of the coupler.

The above figures are based on RG-9A/U cable which has a propagation constant of 0.7. For other types of coaxial cable, the following formula can be used:

$$\text{Length of Cable (inches)} = \left(\frac{\lambda K}{2} - 4\right)$$

where K represents the propagation constant of the cable and λ represents the wavelength in inches at which the transmitter operates.

Equal Reading of Incident and Reflected Power. When the forward and reflected power readings are approximately equal, the RF transmission line is usually open, or shorted. In general, the transmitter should not be operated for any appreciable length of time under this condition.

Abnormally Low Incident and Reflected Power Reading. This would indicate that the transmission line may be properly matched, but that some fault exists in the transmitter, causing its output to be low.

Abnormally High Reflected Power Readings. This indicates a mismatch of the transmission line system. In general, this may be caused by faults in the transmission line joints, improper adjustment of the antenna, or the antenna tuner or connection of the transmitter to an antenna designed for some other frequency. This type of trouble should be thoroughly investigated, and the appropriate adjustment made to reduce the reflected power to as near a zero value as possible.

This may be done by adjusting the antenna tuning apparatus which may be in the transmission line between the antenna and the transmitter, and by adjusting the antenna elements themselves. After each adjustment, a check should be made to determine whether the reflected power has increased or decreased, and the adjustment continued or reversed, depending upon the results. Efforts should always be made to reduce the reflected power to zero, or to produce a Unity VSWR.

Advantages of Minimized Standing Wave Ratio. There are several advantages of flat transmission lines which will make it worth your while to use the MicroMatch to obtain the best possible impedance match. Some of these advantages are:

1. The transmission line losses are minimized. This means that more of the power generated by your transmitter actually reaches your antenna.

2. Voltage on the transmission line is reduced, reducing the danger of voltage breakdown and increasing the power handling capacity of the line.

3. The antenna system or load may be operated over a much wider band of frequencies without retuning.

4. The transmitter is much easier to load properly and less detuning of the final tank circuits results.

5. Harmonic radiation of the transmitter is reduced and any harmonic filters will generally operate with much improved efficiency.

REPLACEMENT PARTS

Model 263

Coupler Unit

Symbol	Description	Part No.
C2, C6	Capacitor, Variable 0.3-3.0 mmfd., Corning #D-690082	
J1, J2	Connectors "N" Type, UG-58/U	
J3	Jack, open circuit, 3 contact Switchcraft #12B	
L2, L4, L5	RF choke 2.5 mh. 10 ma 3 sect.	1493
Z1	Coupler Assembly	2233

Indicator Unit

Symbol	Description	Part No.
M1	Meter, 0-200 microamps, 750 ohms internal resistance, 0-10; 100; and 1000 watt scales.	1462
P1	Plug, 3 conductor, Switchcraft #267	
R1	Potentiometer; carbon, 2,000 ohms; 1 watt	1068-3
R2	Potentiometer; carbon, 20,000 ohms; 1 watt	1068-4
R3	Potentiometer; carbon, 50,000 ohms; 1 watt	1068-5
S1	Switch, 6 position, rotary	1456

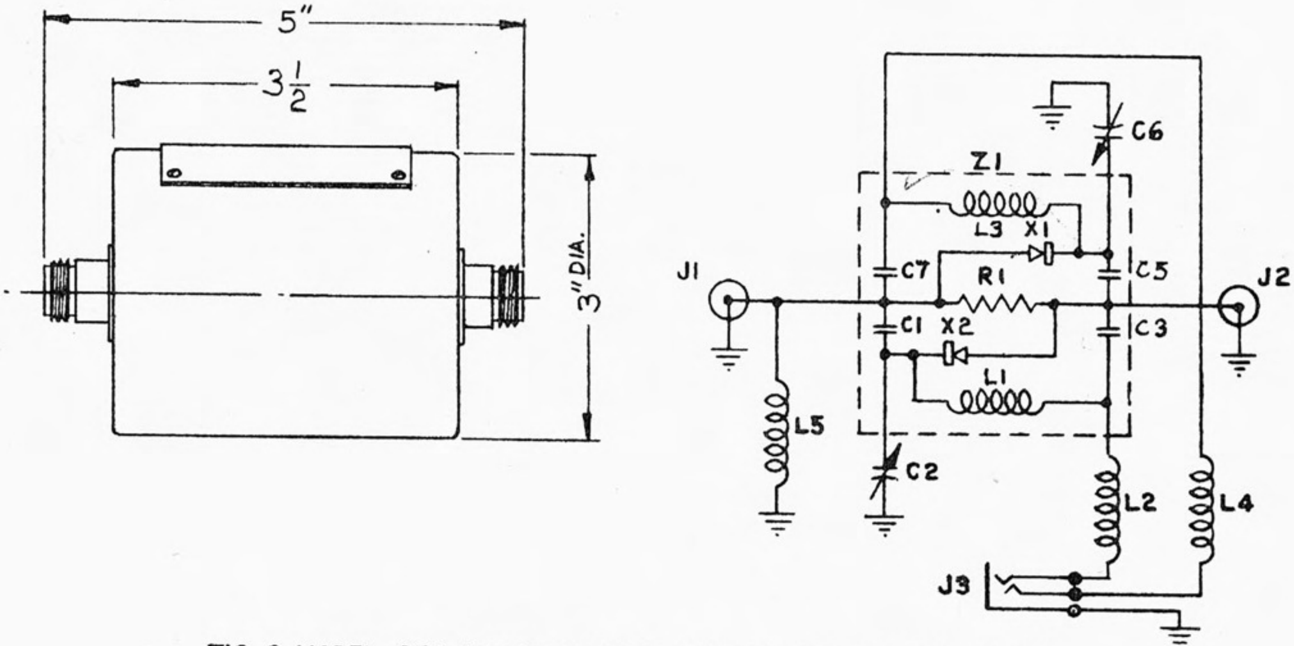


FIG. 2 MODEL 263 COUPLER UNIT OUTLINE DWG. & SCHEMATIC.

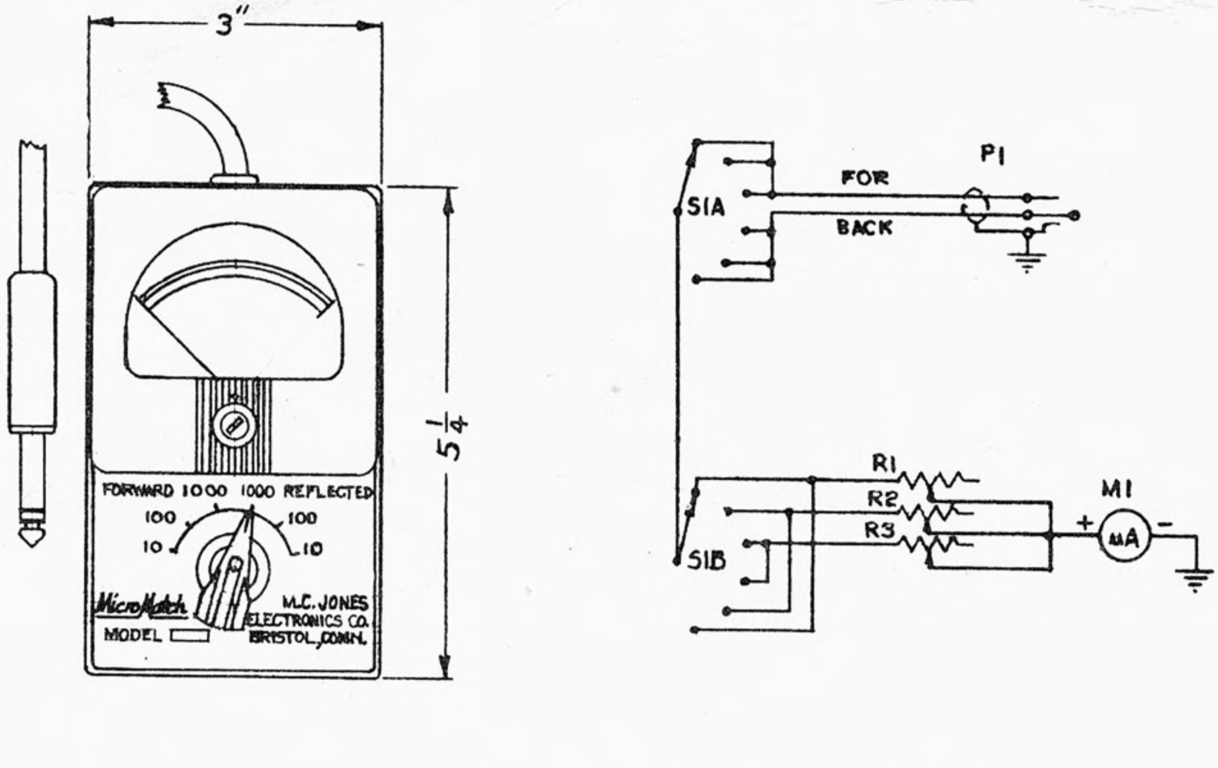
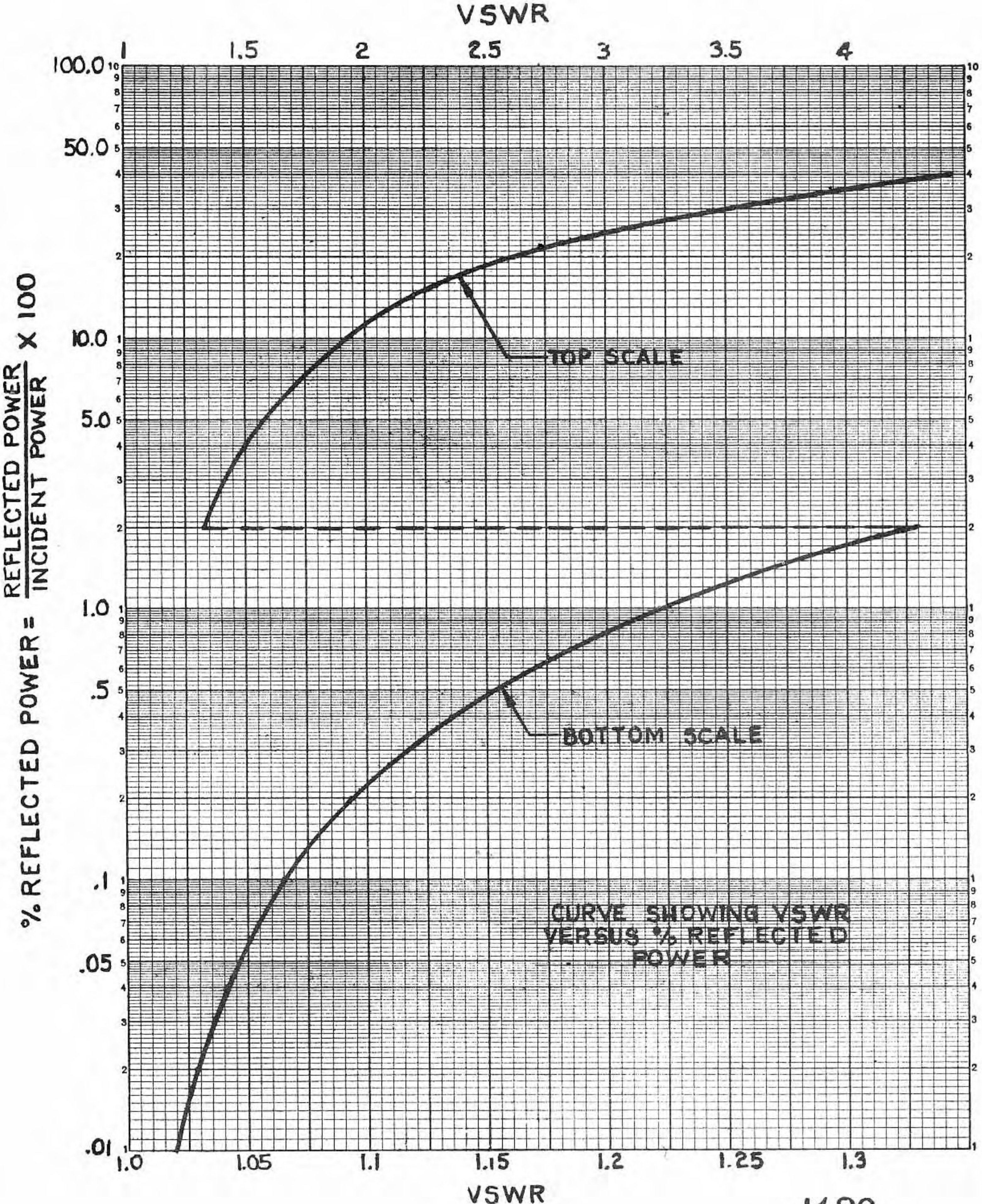


FIG. 3 MODEL 263 INDICATOR UNIT OUTLINE DWG. & SCHEMATIC.


VSWR
1
1.5
2
2.5
3
3.5
4
100.0
50.0
10.0
5.0
1.0
.5
.1
.05
.01
% REFLECTED POWER = REFLECTED POWER / INCIDENT POWER X 100
TOP SCALE
BOTTOM SCALE
CURVE SHOWING VSWR VERSUS % REFLECTED POWER
1.0
1.05
1.1
1.15
1.2
1.25
1.3
VSWR

1490