INSTRUCTION BOOK

FOR

MODELS 6256/57/58/59

TERMALINE® WATTMETERS

30303 Aurora Road, Cleveland, Ohio 44139-2794

SAFETY PRECAUTIONS

The following are general safety precautions that are not necessarily related to any specific part or procedure and do not necessarily appear elsewhere in this publication.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect a RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

The following will appear in the text of this publication and is shown here for emphasis.

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* C A U T I O N *
* *
* Do not exceed the rated power of this instrument for *
* any extended period of time as damage may result. *
****

****
* C A U T I O N *
* *
* Testing of the dc meter should only be attempted by *
* someone familiar with circuitry and instruments for *
* testing sensitive dc microammeters, because of the *
* danger of damaging it in unsuitable conditions. *
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TABLE OF CONTENTS

MODELS 6256/9 TERMALINE® WATTMETERS

INTRODUCTION

GENERAL

This instruction book covers the description, theory, operation and maintenance of the Models 6256/57 RF Wattmeter, Figure I-1 and also the similar Models 6258/59, Figure I-2.

The Models 6258/59 are similar to the Models 6256/57 respectively with respect to the voltmeter, metering section and operation.

The Models 6256 and 6257, also the Models 6258 and 6259, are identical in all respects except for frequency range. The Models 6257 and 6259 have a capability of frequencies up to 1000MHz whereas the frequency range of the Models 6256 and 6258 are limited to 512MHz, see Specifications, Page v.

PURPOSE AND FUNCTION

These wattmeters are designed to measure the power output and facilitate the tuning of transmitters of low power output up to 3 watts for the Models 6256/57 and 30 watts for the Models 6258/59. The basic specifications are listed on Page v. These may also be used as dummy loads of 50 ohm characteristic impedance for radio frequency power.

DESCRIPTION

The essentials of the Models 6256/57 Wattmeters are relatively simple. They consist primarily of a load resistor, detecting circuit, calibration circuitry and a direct reading microammeter (in watts).

The higher power ranges of the Models 6258/59, are are derived through the application and use of a 10dB attenuator attached to the input which reduces the effective power into the voltmeter block by 90%.

The RF power of the transmitter to be measured is fed into a F-BNC connector located on the front of the Models 6256/57 and the power indicated by the meter is read directly in watts. A Bird "Quick-Change" input connector is supplied with the Models 6258/59 and may be quickly changed at any time as connection requires.

A selector switch located on the front face of the unit provides a selection of three available power ranges. These are 0.2, 0.8 and 3 or 3, 10, and 30 watts full scale indication. Each division on the 0.2 watt range is equivalent to 5 milliwatts.

Also located on the front face of the instrument is a miniature phone jack. This jack, labeled MOD, is an output for a demodulated audio signal useful in checking audio response and linearity.

An additional feature incorporated in the Models 6258/59 is a BNC output jack located on the upper side of the unit just above the input attenuator. This jack may be used to supply a sample of the RF signal to frequency counters or signal analyzer etc.

The load resistor is mounted on a heat sink inside the wattmeter housing. Its dc output is fed directly to the modulation jack and also the PC board calibrating circuitry. The dc voltage is directed to the range switch mounted inside the front meter panel and then to the meter. The microammeter is specifically calibrated to the detector and is scaled to indicated dc current directly in watts.

The Models 6256/57 are encased in a two-piece heavy gage aluminum housing. It is fastened together with four #6-32 x 1/8 flat head machine screws located near the bottom of the side panels.

SPECIFICATIONS FOR 6256/57/58/59 TERMALINE® WATTMETERS

Impedance	50 ohms nominal
VSWR	
Models 6256/57/58/59	1.10 maximum dc-512MHz
Models 6257/59	1.15 maximum dc-1000MHz
Connectors	
Models 6256/57	Female BNC input jack
Models 6258/59	Bird "QC" Type Female N Normally Supplied
Sampling RF Output 6258/59 only	Female BNC
Demodulator Output (All Models)	3.5mm miniature jack
Power Ranges	
Models 6256/57	0-0.2W, 0-0.8W, 0-3W
Models 6258/59	0-3W, 0-10W, 0-30W
Frequency Range	
Models 6256/58	100 kHz to 512MHz
Models 6257/59	100 kHz to 1000MHz
Power Rating	
Models 6256/57	3W full scale in 3 ranges
Models 6258/59	30W full scale in 3 ranges
Accuracy	
Models 6256/57/58/59	±5% of full scale 100KHz to 512MHz
Models 6257/59 only	±10% of full scale 512MHz to 1000MHz
Dimensions	
Models 6256/57	3-5/16"L x 4"W x 5"H (127 x 101.6 x 84.1mm)
Models 6258/59	4-3/8"L x 7-9/16"W* x 5-11/32"H (135.7 x 192.1 x 111.1mm) *Includes the input attenuator and "QC" connector
Weight	
Models 6256/57	1.6 lbs. (0.74kg)
Models 6258/59	3 lbs. (1.4kg)

Continued

SPECIFICATIONS FOR 6356/57/58/59 TERMALINE® WATTMETERS

Operating Position.....	Vertical
Finish.....	Lusterless black and grey enamel
Type of Modulation.....	CW or AM type signals, not designed for use on pulsed power.

Figure I-1. Outline Drawing of Models 6256/57.

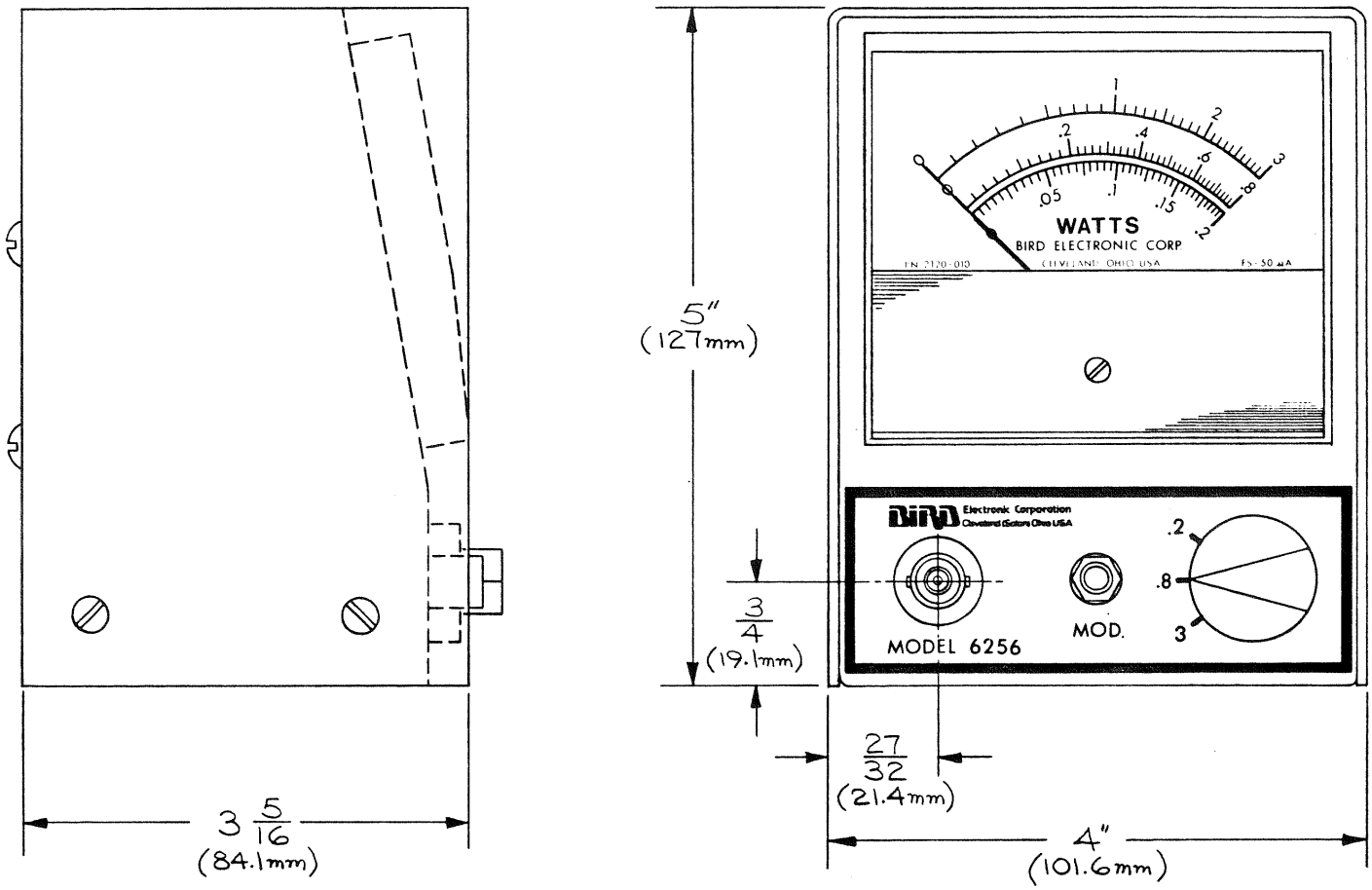
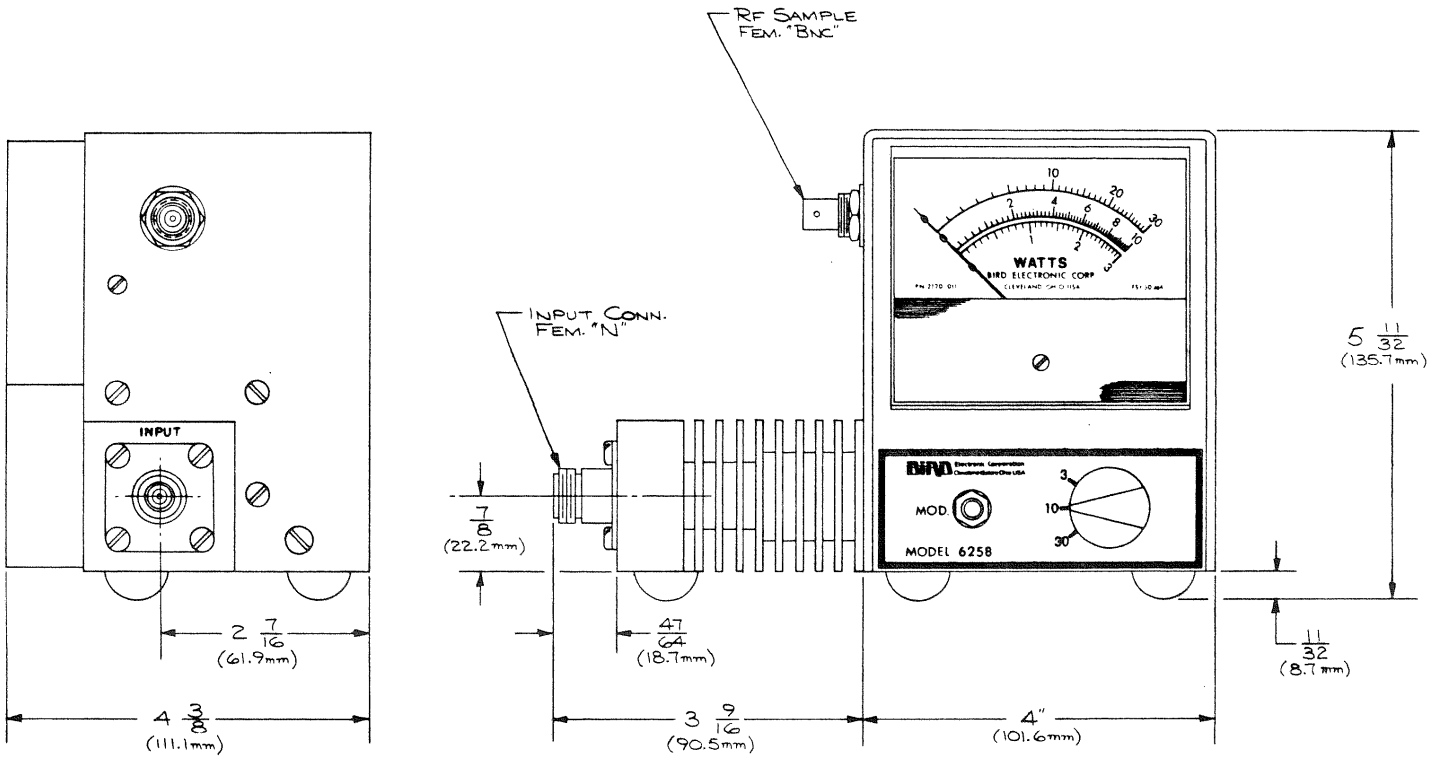


Figure I-2. Outline Drawing of Models 6258/59.



SECTION I - INSTALLATION

1-1. GENERAL

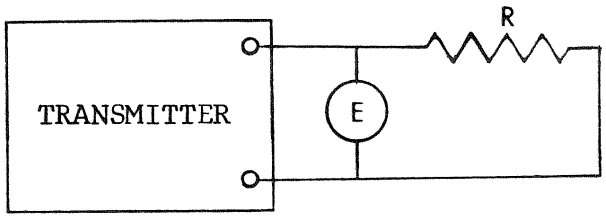
1-2. The Models 6256/59 RF Wattmeters are portable instruments with no provision for fixed mounting and may be used in any desired location. The housing should be used in an upright position wherever possible.

SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. A traditional method of measuring transmitter power at low frequencies utilizes the basic relationship $W = E^2/R$, illustrated in the circuit diagram Figure 2-1. E is the voltage drop across a power dissipating resistor R. Accuracy in this method requires that the voltmeter be connected directly across the resistor terminals as well as the obvious necessity that both the voltmeter and resistor be accurate and correct for operating frequency.

Figure 2-1. E^2/R Method of Power Measurement.



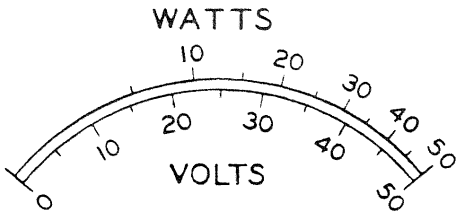
2-3. The resistor and terminals in the Model 6256-59 are designed to have a constant characteristic impedance of 50 ohms over a wide frequency range.

2-4. VOLTS VS WATTS

2-5. The voltmeter of the circuit in Figure 2-1 may be equipped with a direct reading scale in watts, for use with a definite load resistance R. This scale would be linear in watts if the voltmeter were of the square law type, similar to thermocouple or iron vane meters.

2-6. When the voltmeter is a linear type, the watt scale will be as shown in Figure 2-2. This compares equivalent voltage and power scales for a hypothetical 50 ohm, 1 watt and 1 volt instrument. Half full scale deflection is obtained at one-fourth full scale power. The voltmeter used in the Models 6256-59 is approximately linear and the scale is of the type shown in Figure 2-2.

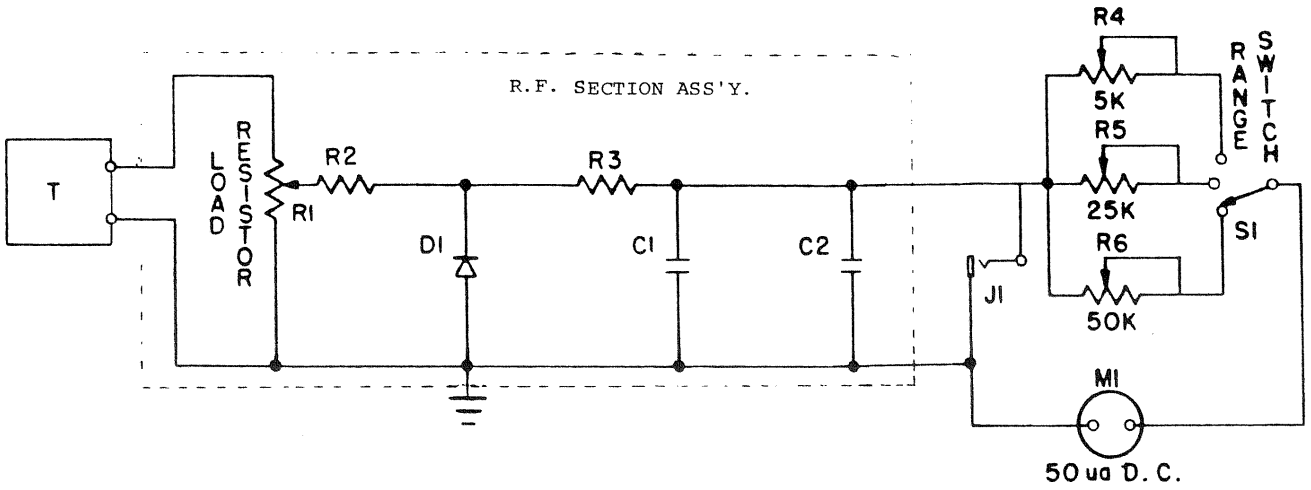
Figure 2-2. Comparison - Illustrative Watt and Volt Scales.



2-7. VOLTMETER CIRCUIT

2-8. The adjustable tap on R1, load resistor, serves as a voltage divider across the input voltage of resistor R1. The sample RF voltage so produced is fed to the diode rectifier D1. Functioning as a half-wave rectifier D1 charges C1 to peak RF voltage impressed on it by the R1 voltage tap. The calibrating pots R4, R5, and R6 and the microammeter form a dc voltage circuit used to measure the dc voltage developed across charge capacitor C1. The entire circuitry is carefully shielded for protection against induced currents caused by external RF fields.

Figure 2-3. Model 6257 TERMALINE® Voltmeter Schematic.



SECTION III - OPERATION INSTRUCTIONS

3-1. GENERAL

3-2. Before applying power check zero position of meter pointer. If required, adjust pointer by twisting screw with a small screwdriver to move the pointer to zero position. Put range selector switch on desired range. Note - If actual transmitter output power is unknown, place the selector switch on the highest indicated power ranges, and then switch to lower ranges as indicated when power is applied.

3-3. Connect a suitable RF cable between the transmitter and the units. A M-BNC UG-88/U type connector will be required to mate with the wattmeter's input connector of the Models 6256/57. A Male N connector is required to mate with the Models 6258/59.

3-4. Now turn on the transmitter and read the power directly in watts on the meter.

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*                      C A U T I O N                       *
*                                                          *
* Do not exceed the rated power of this instrument for     *
* any extended period of time as damage may result.        *
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3-5. For test purposes the demodulator output may be fed to a high impedance input of an oscilloscope or other instrument. Use a suitable cable assembly that has a 3.5mm tini-plug at one end.

3-6. The RF sampler jack, located on the upper side of the wattmeter just above the input attenuator, may be used to supply a sample of RF signal to a frequency counter or signal analyzer etc.

3-7. Below is a table that lists the attenuation level of the sampling port at various frequencies.

Table 3-1. Sampling Port, Attenuator vs Frequency.

Frequency	dB Below Input
25MHz	57dB ±3dB
30MHz	50dB ±3dB
100MHz	48dB ±3dB
200MHz	42dB ±3dB
400MHz	36dB ±3dB
500MHz	35dB ±3dB
750MHz	32dB ±3dB
800MHz	30dB ±3dB
1000MHz	29dB ±3dB

SECTION IV - MAINTENANCE

4-1. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY
No Indication	No radio frequency power	Check transmitter.
	Burned out crystal diode rectifier	Factory replacement.
	Meter M1 damaged or burned out	Replace meter, see Paragraph 4-17b.
	No contact or fault in dc circuit	Check all leads and connections for defect and repair or replace if necessary.
	Load resistor burned out or faulty	Factory replacement.
Intermittent or Inconsistent Meter	Sticky or defective meter M1	Test meter and replace if defective.
	Faulty crystal diode	Factory replacement.
	Faulty load resistor unit	Factory replacement.
	High VSWR on load	Test load resistor with slotted line or with THRULINE® Wattmeter.

4-2. CLEANING

4-3. The simplicity of this equipment makes its care and maintenance relatively limited. Do not drop the wattmeter. A bad drop or hard blow might upset the delicate mechanism of the microammeter or disturb the calibration of the pick-up detector or meter circuits. The equipment should generally be kept clean.

4-4. The BNC jacks should be kept covered as much as practical. If the insides of the connector become dirty, clean carefully with freon or any good dry cleaning solvent on a cotton swab stick. Observe necessary precautions when using toxic solvents and avoid breathing fumes.

4-5. CALIBRATION

4-6. Each power range has its own calibrating potentiometer. Therefore, it is possible to recalibrate the wattmeter in the field. This is done on Model 6256/57 by removing the two #6-32 x 1/4 flat-head screws located on

each side near the bottom of the wattmeter. Then the meter housing cover can be removed exposing the calibrating potentiometers on the circuit board fastened to the back of the meter. In case of Models 6258/59, remove all the screws on the meter housing cover. The cover then can be moved back enough to reach the calibrating potentiometers from the top side of the unit.

4-7. The sensitivity of each range can be increased or decreased by rotating these potentiometers in the proper direction. A reliable standard of known input must be used for this adjustment. No other means of recalibration should be attempted. Adjust each range individually starting with the high-range first, mid-range second then low-range. Potentiometer R6 adjusts the high-range, R5 adjusts the mid-range, and R4 adjusts the low range.

4-8. DIODE AND RF SECTION

4-9. If the meter readings become irregular or questionable, the diode may be faulty. Due to the sensitivity of this wattmeter and its critical calibration techniques, operators should not attempt to change diodes or recalibrate the RF voltmeter section. If a diode or load resistor is suspected of being defective, the entire RF section will have to be replaced. If doubt exists, as to a unit being defective, contact the factory Customer Service Department for instructions. If replacement of the RF voltmeter section becomes necessary, the entire unit should be returned to the factor.

4-10. MICROAMMETER

4-11. If no readings are obtained, it is likely that the meter is burned out and consequently must be replaced. It may be tested by following the procedure in Paragraph 4-12.

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*                                                          *
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* danger of damaging it in unsuitable circuits.            *
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4-12. Test the meter as a microammeter in series with a low voltage battery, variable resistor and an external dc microammeter with an accuracy of ±1%. Full scale current should be 50 microampers ±2%.

4-13. Do not attempt to check it with an ohmmeter. Do not attempt to repair its internal mechanism.

4-14. The meter movement in these units are of the taut band type. If the meter pointer becomes dislodged it is probably due to a broken or disconnected pointer support band. If this happens, the meter is not repairable and the meter will have to be replaced. Unless suitable facilities and

accurate standards are available, the unit should be returned to the factory for meter replacement and recalibration.

4-15. DISASSEMBLY

4-16. Remove meter housing cover as described in Paragraph 4-6b. Before proceeding with Paragraph 4-17a.

4-17. Circuit Board and Meter Removal -

a. Remove the circuit board form the back of the meter by unscrewing the two #4-40 nuts on the meter terminals. Pull the circuit board straight off with all components and wiring intact. At this point the circuit board may be removed from the unit by unsoldering the ribbon cable from the rotary switch S1.

b. The meter may now be removed by loosening and unscrewing the two #4-40 meter mounting hex nuts. These are located inside the front meter panel behind the meter. The meter may now be pulled straight off of the front panel. Note - If any of the trimmer potentiometers R4, R5, R6 are defective, it is not necessary to remove the circuit board assembly. They may be replaced by simply unsoldering them from the PC board and replacing.

4-18. To reassemble the meter and circuit board, reverse procedures in Paragraphs 4-17a. and b.

4-19. Rotary Switch Replacement -

a. Using a 5/64 Allen wrench, loosen the #8-32 x 1/4 set screw found on the circumference of the selector knob. Pull the selector knob straight off the switch shaft exposing the 1/2 inch retaining nut. Removing this nut leaves the switch free to be withdrawn inside the front face of the meter housing base.

b. With the rotary switch free of its mounting, pull it to the side away form the housing. Th leads of the ribbon cable can now easily be unsoldered. Be sure to notice the position of each lead when unsoldering and attach each lead to the proper lug in reassembly.

c. Reverse the procedures in 4-19a. and b. to reassemble. When replacing the switch knob, position the wedge of the knob to point to the proper range indication.

4-20. Miniature Jack -

a. Unscrew the 3/8 inch retaining nut from the jack. Remove the jack from inside the meter housing by pulling it inward. Unsolder the jack leads at the tie points on the RF section.

b. When replacing this jack, solder the red lead to the standoff of the RF section and brown lead to the ground lug.

4-21. QC Connector Replacement - The "QC" input connector on the Models 6258/59 can be replaced or changed to another Bird "QC" type connector if required. A list of other "QC" connectors is found in Section V - Replacement Parts List. To remove the connector, simply remove the four corner screws in the connector flange and pulling the connector straight off. The connector is replaced by reversing the procedure above.

SECTION V - REPLACEMENT PARTS LIST

5-1. MODELS 6256/57

ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	RF Section (R1, R2, R3, C1, C2 & D1 supplied as part of this assembly)	6257-002
2	1	Meter (dc Microammeter)	2120-010
3	1	PC Board Assembly (R4, R5, R6) Consisting of:	6257-007
		PC Board 6257-011	
		Ribbon Cable 6257-014	
		R4, 50K Ohm Trimmer 5-1077-5	
		R5, 25K Ohm Trimmer 5-1077-4	
		R6, 5K Ohm Trimmer 5-1077-2	
4	1	S1 Range Switch	6257-009
5	1	3.5mm Miniature Jack Assembly	6257-008
		OPTIONAL	
6	1	Base, Meter Housing	6257-025
7	1	Cover, Meter Housing	6257-015
8	1	Heat Sink Bracket Assembly	6257-023
9	1	Knob, Range Switch	4110-016

5-2. MODELS 6258/59

1	1	Meter (dc Microammeter)	2120-011
2	1	3.5mm Miniature Jack Assembly	6258-009
3	1	Base, Meter Housing	6258-007
4	1	Cover, Meter Housing	6258-013
5	1	Heat Sink	6258-015
6	1	Cable, Assembly, RF (RF Sampling Port)	6258-006
7	1	TENULINE®, RF Section Assembly	6258-002
8	1	"QC" Connector	*See Below

*Available QC Type Connectors

N-Female	4240-062	C-Female	4240-100
N-Male	4240-063	C-Male	4240-110
HN-Female	4240-268	UHF-Female (SO-239)	4240-050
HN-Male	4240-278	UHF-Male (PL-259)	4240-179
BNC-Female	4240-125	TNC-Female	4240-156
BNC- Male	4240-132	TNC-Male	4240-160