

Instruction book for

**BIRD**

VHF model 4362

HF model 4360



RF Directional  
Wattmeter

## **WARRANTY CLAUSE NEW EQUIPMENT**

We warrant to the original purchaser that each new instrument of our manufacture will for a period of one year after original shipment be free from defects in material and workmanship under normal and proper operating conditions and that properly used during such period it will perform in accordance with our applicable specifications. Our obligation and the purchaser's exclusive remedy for any defect or failure to meet specifications shall be limited, at our option, to repair or replacement or, if we determine said defect or failure to be so defective as to preclude remedying by repair or replacement, the purchaser's sole and exclusive remedy shall be limited to refund of the purchase price. We shall have no obligation if defects result from improper use, operation above rated capacities, repairs not made by us, or misapplication of the equipment. Our warranty does not extend to the failure of tubes, transistors, fuses and batteries, or to equipment and parts made by others except to the extent of the original manufacturer's warranty to us. Warranty returns must first be authorized by the factory office, and are to be shipped prepaid.

The one year warranty does not provide for a free calibration check or verification. Where equipment returned to the factory is found to be within specifications, the customer must bear all charges connected with the calibration check, inclusive of transportation charges, customs, broker and clearance fees, and other. Please contact factory for permission to return the instrument for such rechecks and for a cost estimate. The original purchaser may not transfer the warranty to a second purchaser.

## CONTENTS

SECTION 1	General Description Purpose and Application Description
SECTION 2	Installation
SECTION 3	Operation
SECTION 4	Maintenance – Service Calibration Trouble Shooting
SECTION 5	Replacement Parts List
SECTION 6	Schematic
APPENDIX	VSWR Nomographs

## HAM-MATE® SPECIFICATIONS

	Models	
	4360	4362
Forward Power Range . . . . .	0-200/2000W	0-25/250W
Reflected Power Range . . . . .	0-200/2000W	0-25/250W
Frequency Range . . . . .	1.8-30 MHz	140-180 MHz
Impedance $Z_0$ . . . . .	50 ohm*	
Insertion VSWR . . . . .	1.1 to 1.0 Max.	
Accuracy . . . . .	$\pm 5\%$ of Full Scale	
Directivity . . . . .	20dB Min.	
Dimensions — Case . . . . .	3-15/16" H x 4-13/16" W x 2-29/32" Deep 100.0 mm x 122.2 mm x 73.8 mm	
Weight . . . . .	1 lb. 3 oz. — 0.54 kg	
Connectors — Input & Output . . . . .	Two Female UHF (SO-239), fixed	

\*May be used with 50-52 ohm cable.

## SECTION 1 GENERAL DESCRIPTION

### 1. PURPOSE AND APPLICATION

The Model 4360 HAM-MATE® RF Wattmeter is designed specifically for amateur radio service in the 1.8-30 MHz range. The Model 4362 is for use in the 140-180 MHz range. The design of the HAM-MATE is basically that of all Bird THRULINE® Wattmeters, except that the sensing element is built into the equipment, and is rotatable from the front panel to provide the choice of reading the forward or reflected power. One of two power ranges can be selected by a front panel rotary switch. Model 4360 has a 0-200 watts (low range) scale, with the high range being 0-2000 watts. The Model 4362 has ranges of 0-25 and 0-250 watts. The meter reads directly in watts, with the high range being read on the upper arc, and the low range on the lower arc. The down scale portion of each range is expanded for easier reading. These wattmeters will measure the average power output of CW, AM, FM, and SSB transmitters. The HAM-MATE Wattmeters are useful in tuning all types of antennas and are accurate instruments for continuous monitoring of power output of amateur transmitters. The HAM-MATE can help ensure maximum radiated RF power, as well as reduction of VSWR, with the added advantage of reduced TVI and less adjacent channel interference to other amateurs.

### 2. DESCRIPTION

The HAM-MATE is contained in a rugged and attractive, custom-designed black plastic housing. The viewing window and control face plate are both permanently cemented into fitted locations to furnish a complete and concise one-piece case. This kind of design allows a very spacious dial and viewing face for its size, and handy, simple control knobs below. The meter dial is observable with reasonable accuracy to at least five feet and the knobs are easily operated from varied positions.

The basic line section and couplers, the dial, controls and back-plate are all assembled into a unit component that makes for ruggedness

and simplicity of the wattmeter. The line section has UHF (SO-239) female input and output connectors permanently attached. The line section (coupler) through which the RF power flows, is a 4-inch length of rigid air type coaxial line, whose  $Z_0$  is a very accurate 50 ohms. VSWR conversion nomograph charts, furnished in this handbook, will provide a quick method of determining the VSWR on the antenna feed system.

### 3. DIRECTIVITY

One of the most important requirements of any insertion type RF wattmeter is the directivity, or the capability of differentiating between power flowing in opposite directions in the coaxial transmission line. All Bird THRULINE RF Wattmeters have this capability to a high degree, and the HAM-MATE is no exception. It has a minimum directivity of 20dB — i.e. a ratio of 100 to 1 — against detecting the power flowing in the opposite direction from the power being measured. This feature is especially important when adjusting the antenna to match the transmission line, as it is vital to know the magnitude of the reflected power accurately. The user can be sure, if the HAM-MATE does not indicate any reflected power, there just isn't any.

## SECTION 2 INSTALLATION

The HAM-MATE® is designed for use as an integral unit. Do not attempt to separate the indicating meter from the rest of the unit, or to remove the line section from the case. Select a convenient location close to the transmitter, so that the transmitter can be adjusted while reading the meter. Cables are not supplied with the HAM-MATE, but it is important that all connecting cables be 50-52 ohms impedance. If cables other than 50 ohm impedance are used, the resulting mismatch may cause serious inaccuracies in the readings.

If the pointer does not properly zero under no-load conditions, zero-adjust by the following procedure: Pull the two front knobs directly off their shafts, and remove the two #4-40 flat head machine screws

on the bottom side of the case (next to skid rails). Grasp the ends of the connectors with finger-tips, and slide the whole operating component backwards out of the case. Now very carefully rotate the small slotted and winged brass tab at the base of the meter movement to obtain zero reading. Avoid air drafts and the presence of static, as they will affect pointer position. Reverse process to restore unit.

#### CAUTION

It is important that the cable coming from the transmitter be attached to the connector marked "TRANS". This will prevent damage to the meter, and avoid confusion when the readings are being taken during tune-up. Be sure that the connecting cables are tightened securely to the HAM-MATE connectors. To safeguard the Wattmeter, the range selector knob should be turned to the "High" position (particularly in the event that the initial power output is expected to exceed 200 watts, or 25 watts for Model 4362).

### SECTION 3 OPERATION

#### TUNING-UP

It is strongly recommended that the initial tune-up include a reliable 50 ohm dummy load able to handle the average power output of the transmitter. In this way it can be established that the transmitter is operating correctly. If the maximum legal input of 1000 watts DC is being used, the dummy load should be capable of dissipating at least 900 watts of RF power. The Bird Model 8401 Dummy Load is recommended (although rated for 600 watts continuous operation, it will dissipate 900 watts safely for a period of 15 minutes). With the HAM-MATE properly connected between the transmitter and the dummy load, and the knob turned to "FWD", the transmitter should be adjusted to its maximum allowable power output. At this point the knob should be turned to the "RFL" position, and a zero reading will indicate that the dummy load is operating properly.

The transmitter is now switched off, and the HAM-MATE is disconnected from the dummy load and reconnected to the coaxial cable feeding into the antenna. The knob is now turned to the "FWD" position and the transmitter switched on. A preliminary reading should be taken of both the "FWD" and "RFL" positions, and if there is an indication of excessive reflected power, it is recommended that the tune-up be discontinued until recheck can be made of all connections and of the transmitter itself. If, however, there is only a minor reading of reflected power, tune-up may proceed. The directional knob is now returned to "FWD" position and the driving and final stages of the transmitter are adjusted for maximum power output. When these adjustments have produced the maximum power output, readings should be taken of the reflected power. A zero reading is gratifying but is usually obtained only at the antenna's resonant frequency. A small percentage of reflected power is usually indicated, and reference to the power ratio nomographs in this handbook will readily provide the VSWR (see APPENDIX).

## INTERPRETING READINGS

While every effort should be made to reduce the reading of reflected power to the lowest possible value, it is useless to try to attain perfection. This is illustrated by the fact that a VSWR of 1.225:1 would only cause a loss of 1% of the forward power. The compromises present in the popular multiband antennas make it impossible to attain unity VSWR between the antenna, the feed line, and the transmitter across an entire band. The HAM-MATE will accurately indicate if and how much reflected power is present, and with this information it is up to the user to obtain the best possible operation of the transmitter and the antenna system.

## CONTINUOUS MONITORING

The HAM-MATE can be left in the transmission line as a constant indicator of the power output. Occasional checks should be made of the reflected power, especially during periods of severe weather. Damage to an antenna caused by high winds, heavy rain, or icing, can upset the impedance of the antenna, causing a severe mismatch between



the antenna and coaxial feed line. In turn, the transmitter can also sustain damage if operated into a severely mismatched load. The accuracy of the HAM-MATE is affected by the magnitude of harmonics of the fundamental signal. If strong harmonics are present in the signal, the HAM-MATE will add the power in the harmonics to that of the main signal, as long as the harmonics fall within the frequency range of the HAM-MATE. Many amateurs use low pass RF filters as a precaution against radiating harmonics, and where this is done the filter should be placed between the transmitter and the Wattmeter.

## SECTION 4 MAINTENANCE SERVICE

The Bird HAM-MATE Wattmeters are relatively simple and rugged, and with proper care should give long-time trouble-free service. The warranty clause shown at the front of this handbook gives a full 12 months warranty on new Bird equipment. If the HAM-MATE fails to perform within the published specifications during the 12-month period after shipment from the factory, it will be repaired at the factory free-of-charge. Each unit is adjusted, balanced, and calibrated at the factory and is ready for use. While certain parts such as the meter can be replaced, the HAM-MATE is not basically intended for general maintenance work by the user.

This is not meant to imply that the amateur operator who has the requisite accessory equipment and techniques is not capable of servicing the HAM-MATE Wattmeter. However, when it is understood that recalibration of the HAM-MATE requires an accurate RF wattmeter, a variable RF power source and a 50 ohm dummy load capable of dissipating at least 900 watts of power, it will be realized that all these items are not usually available to the average amateur operator. In the event that a malfunction or accidental fall disables the HAM-MATE, it is strongly recommended that it be returned to the factory for service. If the HAM-MATE is suspected of inaccuracies, it can be returned to the factory for recheck and recalibration, at a cost not to exceed 10% of the current list price of a similar new HAM-MATE.

## RF Connectors

The RF connectors at each end of the line section (coupler) are Female UHF. They are permanently attached and are not replaceable. If it is intended to use the HAM-MATE only for periodic checking of the RF output, it is recommended that the connectors be checked before use for dust accumulation, and cleaned if necessary with a dry solvent such as trichloroethylene or rubbing alcohol. If not connected to plugs, keep connectors covered by caps to exclude dirt, etc.

## Meter

Although the meter will withstand a reasonable overload, the user should exercise care while it is in use. When the power output of the transmitter is not expected to exceed 200 watts on the Model 4360 or 25 watts on the Model 4362, no precaution against overloading is necessary. However, where the power output exceeds the full scale value of the low range, the user should develop the habit of always switching back to the high range, after making an observation on the low range. Overloading will result in a bent meter pointer and consequently erroneous readings — use care to protect the meter. Zero adjustment of the pointer is easily accomplished, as described in Section 2, Installation.

However, DC accuracy check or replacement of the meter movement requires further disassembly of the operating component. This should be attempted only by those familiar with fine instrument work of this sort. Proceed as follows: With the operating component out of its case (as for zero adjustment), place the unit on its back — meter dial face upward. Using a 1/8-inch screwdriver, loosen the two #4-40 x 1/4 pan head screws adjacent to the movement and take the screws out. Use care not to damage needle. Slide the scale dial outwards gently, avoiding the needle, and remove. Now restore unit to normal position (backplate vertical), and remove the two respective 3/16-inch screws securing the meter covers to top of line section. Be sure the stop pin on the left-hand shaft is in the outward position, then take both covers off carefully — lifting first at the outer face of boxes. Watch not to lose spacers P/N 4363-018 at top end of meter-holding studs; remove them for safekeeping.

The performance of the meter can be checked with the use of an accurate DC microammeter standard. Test with it in series with the HAM-MATE meter, a low-voltage battery, and variable resistor. This should be attempted only by one familiar with sensitive DC circuitry — the microammeters may be easily damaged. Do not have selector switch in OFF position as the meter will be shorted. The dial face may be temporarily repositioned for accuracy of reading. With small alligator clips, connect the positive lead to green (or orange) wire at solder connection on underside of circuit board and ground lead to the stamped brass meter frame. Microamp. values for full scale should be as follows:

Model	uA	Lead	Meter P/N
4360	50	Green	5-1079-1
4362	100	Orange	5-1079-2

To replace the meter movement proceed from above condition by simply unsoldering the lead at lug under circuit board. Carefully lift the stop-pin yoke from the studs and save; then slide the whole movement off of the studs. Reverse all of above to replace. Be sure to replace the stop yoke and spacers over yoke before restoring the meter movement covers.

Observe positions of mounting holes in the covers to determine the correct side (left or right) for each, and gently hold the pointer near mid-position when introducing covers. Be sure they do not interfere with meter movement when placed. Put the two short pan head screws in mating holes on top of line section, fasten only very lightly. Slide dial under pointer. Replace the two longer screws holding dial, cover boxes, spacers, and fastening into the studs of meter movement. Check that all are aligned and that the meter pointer moves freely, then tighten the four screws evenly. Restore component to case in usual manner (as with zero-adjust, Section 2).

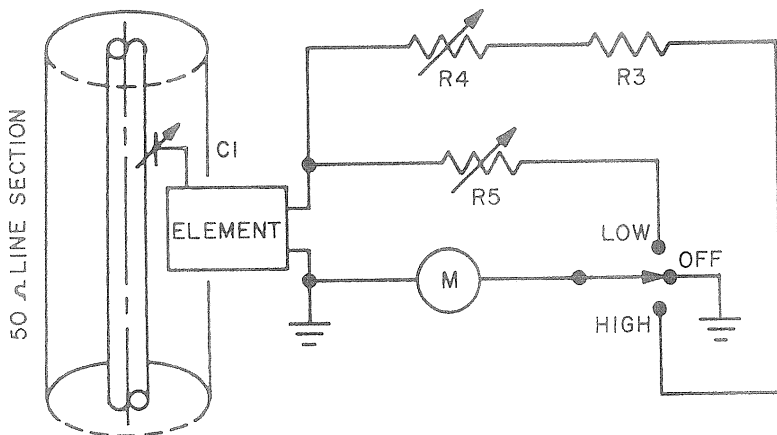
### Wattmeter Case

The Case Assembly P/N 4360-035 is provided as a replaceable part, see Parts List, Section 5. If it should be accidentally damaged or stained, just remove case as described in procedure for zero-adjust, Section 2, and transfer the operating component to new Case Assy.

## SECTION 5 FIELD REPLACEMENT PARTS LIST FOR 4360 & 4362

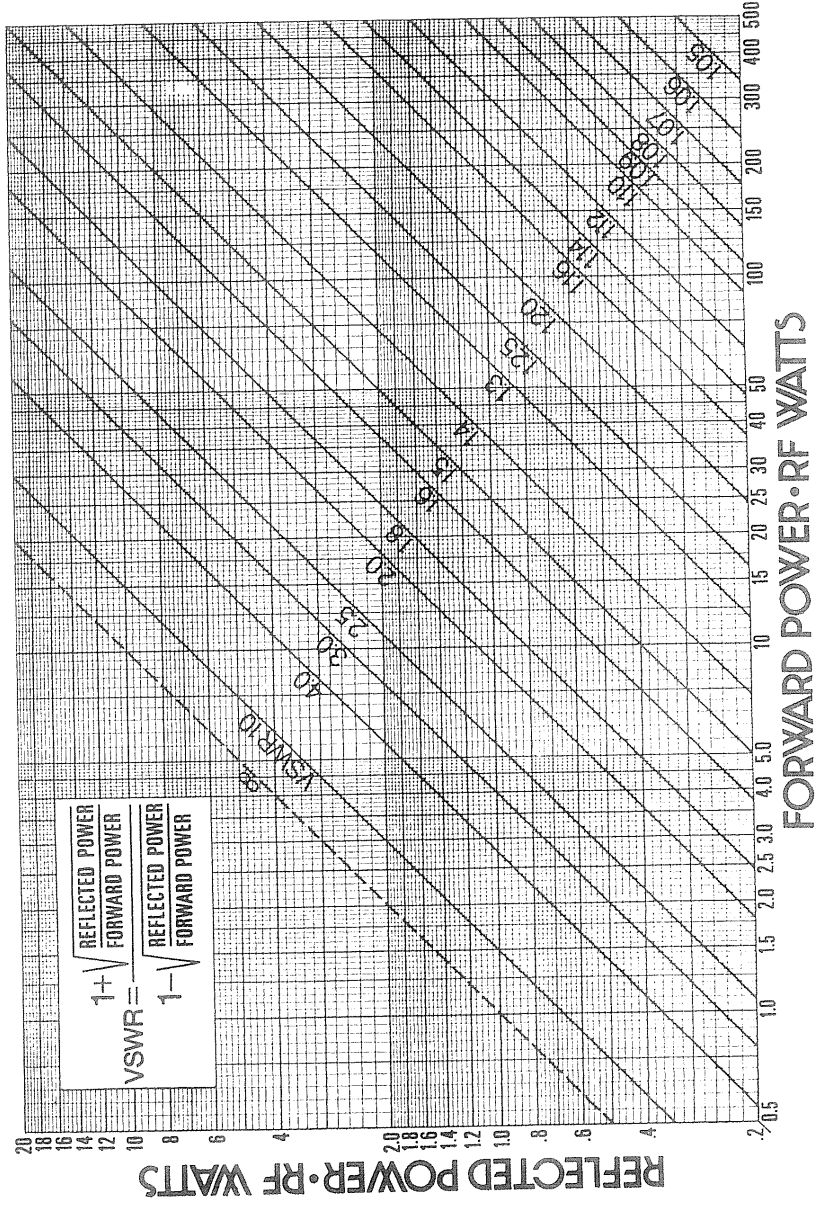
Description	Part No.	
	4360	4362
Meter Case	4360-035	4360-035
Knob	5-1078-1	5-1078-1
Meter Scale	4360-028	4362-006
Meter Movement	5-1079-1	5-1079-2
Spacer Meter Scale	4363-018	4363-018

## SECTION 6 SCHEMATIC

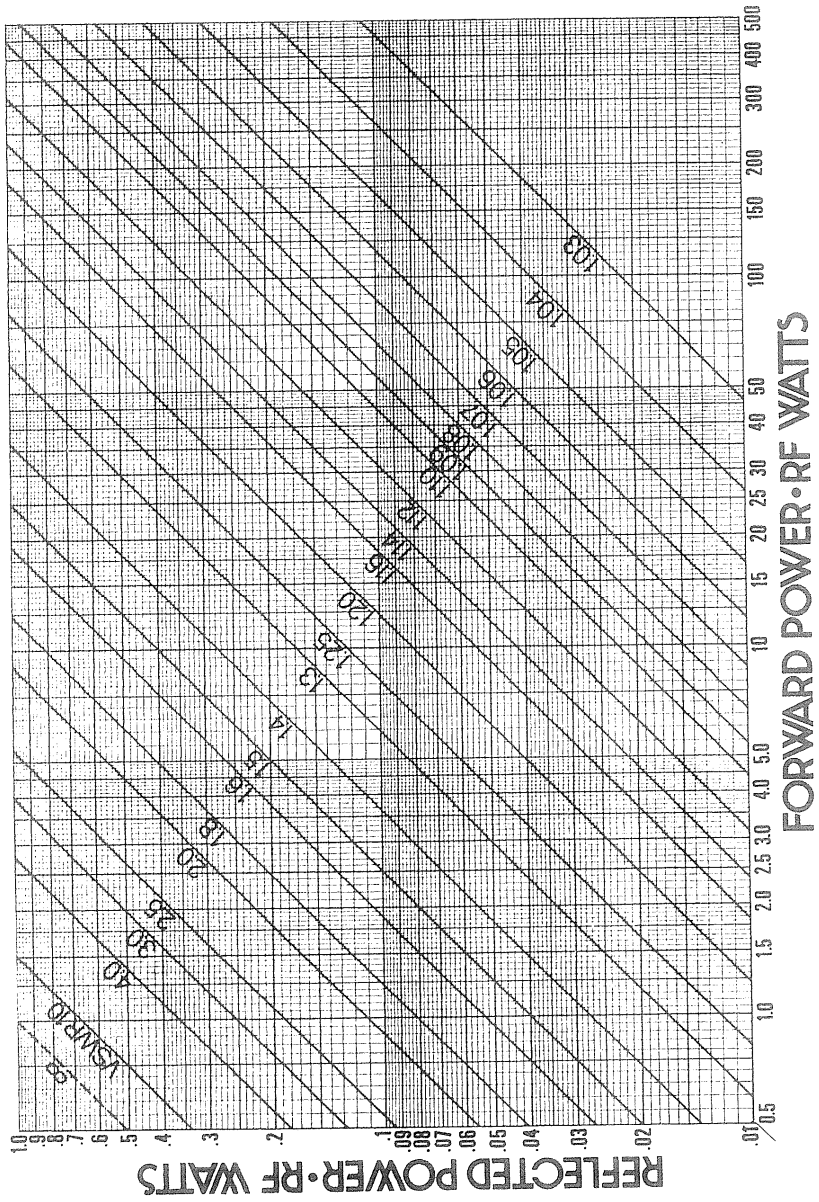


CIRCUIT DIAGRAM FOR MODEL 4360/4362

- C1 - Capacitor, balancing
- R3 - Resistor, calibrate
- R4 - Resistor, trimmer - High range
- R5 - Resistor, trimmer - Low range
- M - Meter, 50 ua
- SW1 - Switch, Low - High range



Following the vertical and horizontal grid, determine intersection of forward and reverse power values. Slanted lines passing closest to this point indicate VSWR.



# HAM-MATE RF WATTMETER

## TROUBLE SHOOTING

Symptom	Possible Causes	Remedy
No meter indication.	Directional knob turned in wrong direction.	Orient control knob properly.
	No RF power.	Check transmitter and cables.
	Defective sensing element.	Factory repair, see Section 4.
	Defective final stage of transmitter.	Check transmitter.
	Open wiring. Faulty switch.	Factory repair, see Section 4.
	Defective meter.	See Section 4.
Intermittent or inconsistent meter readings.	Faulty transmission line or antenna. Also, transmitter may have developed troubles.	Check cable and antenna. Check transmitter.
Abnormal reflected power.	Damaged antenna, shorted or open transmission line.	Check antenna and/or coax line.

In the event the above checks do not reveal the reason for the malfunction, the Wattmeter should be returned to the factory for service.

**BIRD**

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