

INSTRUCTIONS

WM1 COMPUTING METER

Autek Research

PRICE: \$2 ppd. USA

Your WM1 was thoroughly tested before shipment. Please read the instructions carefully for best results, and file them for future reference.

A. POWER

The WM1 needs +9 to +18 VDC at approximately 15 ma. Plug the 115 VAC adaptor into the rear panel jack. If you use external power, note that some WM1's have jacks with inner connector "+", but most have inner connector "-". To avoid damage to the unit, temporarily connect your external power supply or battery "-" lead to the cabinet, and connect the battery "+" lead to the WM1 rear power jack to see which lead is ground. Or check with an ohmmeter between chassis and power jack.

The WM1 can also be powered from a 9 volt battery, but this is marginal. (If using a small battery, you may want to clip one lead to the LED ...does not void warranty... since the LED uses about 2/3 of the power.)

In 220 volt countries, obtain an AC adaptor locally, since we do not stock them.

B. RF HOOKUP

Connect the transmitter to the coax connector so marked. Connect the antenna coax or an antenna tuner to the output connector. (If these are reversed, the meter reads reflected, not forward, power, and the SWR reading will be off scale.)

C. OPERATION

Select the lowest range scale for the power in use. Select average or PEP. PEP stands for "peak envelope power" and shows the peak output power, even if this peak lasts for just a few milliseconds. PEP is measured by electronic circuitry which responds much faster than the meter. (The meter takes a fraction of a second to swing to the true reading.)

Note that SWR is computed automatically and displayed directly. Unlike other meters, there is no need to use nomographs or look at crossed needles to read SWR. Any variation in SWR with power level is due to small diode drops in the RF head. The indicated SWR will drop noticeably at 1/10 full scale, and at even higher scale readings on the 20 watt scale. However, the meter is usable for nulling antenna tuners and checking general antenna condition at powers as low as 1/2 watt or lower.

For best accuracy, use the lowest range scale that does not peg the power meter.

When using PEP you may be surprised that the PEP reading on SSB is not much different than the PEP or AV reading with "key-down" CW. This is normal. Modern SSB transmitters are peak-

power limited on SSB and CW. You will probably notice a higher PEP when sending a string of dots than with keydown. This is due to a larger droop in transmitter supply voltage when keydown. You may also notice a slightly higher PEP than AV reading even with key down CW. This is due to a slight ripple on the transmitter supply voltage, which shows up on the peak reading.

PEP is generally used on SSB and AV is used for tuneup. Switching to AV on SSB produces a noisy, low power reading. The PEP position allows you to comply with FCC rules that allow up to 1500 watts PEP output on many bands.

The SWR reading in the PEP position will be accurate for reasonably continuous speech, but is designed to decay much faster than the PEP power reading. This allows almost instant response to antenna tuner adjustments when talking on SSB.

Occasionally, you may want the meters to decay faster when switching to a lower range scale. Simply switch momentarily to AV, which discharges the PEP circuit.

D. CALIBRATION

The WM1 is carefully calibrated before shipment. It is unlikely you have other equipment of this accuracy. For example, common 50 ohm dummy loads can vary from 38 to 63 ohms, in our experience, especially if they've been overheated once. Also, bear in mind that two 5% instruments can differ by as much as 10%.

However, calibrating the unit against another wattmeter is easy: (Note: Steps 1,2, and 3 may be done without fear of degrading factory accuracy. Step 1, in particular, may have to be performed occasionally.)

1. Turn off the WM1. Turn off your transmitter. Mechanically zero both meters with the front-panel meter screws using a screwdriver.

2. Connect the remote head to your transmitter and a load known to 50 ohms to the remote head output. Since most loads are less accurate at high frequencies, we recommend doing this at 7 mhz or below. While transmitting CW adjust the trimmer in the remote head until SWR nulls at 1:1, or as close as possible. Use 20-200 watts if possible.

3. Disconnect the 50 ohm load from the RF head, leaving **NOTHING** connected to the output of the RF head, not even a short piece of coax. Adjust the SWR trimpot on the circuit board in the main cabinet (see drawing) so that so that the SWR reads infinity (full scale.) Do this with 20-200 "watts," not with high power.

4. Connect your accurate 50 ohm load as in step 2. With a power meter of known accuracy in series with the WM1, adjust the PWR trimpot on the circuit board in the main cabinet (see drawing) until the WM1 reading agrees with the reference power meter. Be sure SWR is close to 1:1.

E. OPERATING CAUTIONS

Never run the WM1 at an SWR greater than 4:1 with power greater than 400 watts. This could damage the RF head. (However, your linear is likely to arc over before the WM1 could be damaged.) Never short the WM1 RF head output at high power. (This could melt the power-carrying wire in the RF head.) Note: We have never heard of a burned-out unit due to these causes. But, if you're running a KW, you should be cautious to avoid a problem.

F. IN CASE OF TROUBLE

Problems with the WM1 are extremely rare. This is a list of those that have occurred in the past:

1. Meter Damaged or Sticking

Occasionally, a tiny piece of plastic left over from its manufacture will find its way into the meter movement causing the meter to stick..pause for a second at a certain reading. This can happen after our tests. To cure this, hold the unit upside-down, sideways, etc. while slapping the side of the case to dislodge any tiny particle of plastic.

2. Meter Dead

If the LED does not light when the unit is turned on you have a bad power connection or bad power supply. We do not check each AC adaptor as they come from the manufacturer, since they're rarely bad. We'll replace any defective adaptor you receive, of course.

If the LED comes on, visually check the RF head to see if it might have been damaged. Lightning can damage the head, or even the entire meter. Note that a direct hit is not necessary. Homeowners insurance usually covers this.

3. SWR or Power Reading Drastically Wrong

First, be sure the input and output on the RF head are not reversed, and that the connectors are not intermittent.

If the power reading does not agree with another meter, you always have the option of turning the power trimpot (see calibration, above) until they agree.

We've received several reports of a momentary jump in SWR when the transmitter is first turned on, or when the mike is first keyed. This is most noticeable in the PEP position. This is somewhat of a mystery. The meter is truly seeing a very high SWR for a few tens of milliseconds after transmission starts. Possible causes are: 1. Arcing in the antenna 2. Relays have not fully energized 3. The transmitter is briefly putting out energy outside the desired band so the antenna has a high SWR briefly. If you see this

phenomena, it is not the fault of the WM1. If you can't determine the reason, you'll have to ignore it.

The final reason for large errors in power/SWR is RFI.

4. RFI (RF Interference)

The WM1 is tested in a high-power RF environment. But its electronics are not totally immune to interference in extreme cases. Suspect RFI if the readings are drastically off (more than 30%) on some bands but not others. Usually this will show up on 10 meters, but it can also occur on 80 meters if the antenna is close to the house or the shack. (Please note that one popular meter which uses "slugs" tends to read high on 10 meters, so the WM1 wrongly appears to be low in comparison. Also note that transmitter manufacturers may set their built-in wattmeters to read high to avoid complaints that power drops on 10 meters.) With extreme RFI, the meters may actually read backwards....a sure sign. If readings change when you touch the WM1 case, you also have RFI. In mild cases, the power usually reads low, and the PEP reading is less affected than the AV reading.

Be sure the meter is not near unshielded feedlines or coils carrying power. The top of the tuner or linear may not be the best location. Experiment with the location of the meter.

However, it is more likely that there is a ground loop. Your house wiring can pick up RF, which circulates through the remote-head wires and back out the coax. Also, some transmitters feed significant RF into power lines directly. To verify this source, you could try 9 volt battery power on the RF1. Or simpler, please note that when you unplug the AC adaptor from the wall 115 v socket there is enough charge in the adaptor to keep the WM1 powered for a moment. If the problem disappears **instantly** when you unplug the adaptor, before the stored DC in the adaptor dies out, then you have a ground loop.

Try: 1) Plug the AC adaptor into an outlet away from the transmitter 2) Connect a good earth ground to your transmitter or linear 3) Move the WM1 to another location.

The WM1 is heavily bypassed for RF, so additional RF bypass capacitors will probably not help. In extreme cases, you might have to connect RF chokes in series with the AC line or AC adaptor outputs. Both the hot **and** ground leads should have a series choke. Remember, we're trying to stop current flow, which also appears on the ground lead.

Fortunately, this problem is rare. The solution depends on the exact conditions in your station. We really can't add any more suggestions than those discussed above. We would not find anything wrong with the unit if we examined it, so returning the unit is useless. If you send us \$2 and a SASE we will send you two 47 to 100 uH RF chokes for you to install in series with the AC adaptor if you wish.

G. THEORY OF OPERATION

We're sorry, but we cannot supply a complete schematic of the RF1 at this time due to its proprietary nature. The RF head is shown in the schematic. This is the popular Bruene RF head originated at Collins Radio. We also use a compensation inductor (1.2 uH) to avoid the high-frequency dropoff seen in other meters above 14 MHz, and we use bifilar windings for broadbanding.

The forward and reverse voltages are both referenced to a regulated 5 volts generated on the main board. Operational amplifiers on the main board divide forward and reverse voltages electronically with extreme (<1%) precision to yield SWR. The PEP detector is not a simple diode, as in many so-called "PEP" meters, but is an OP amp peak detector which, again, has negligible error since it cancels out the peak detector diode drops.

Thus, the "electronics" of the meter have essentially no error or drift. The error sources are primarily the linearity of the meters away from full scale and, as mentioned above, drops in the germanium diodes in the RF head at extremely low power levels. These drops result in slightly different power scales on the lower power ranges, and the drop in SWR reading at very low powers mentioned above.

H. TYPICAL PERFORMANCE

Impedance: 50 Ohms

Insertion VSWR: Less than 1.1:1

Accuracy: 5% of full scale (8% worst case)

Insertion loss: Negligible

SWR at Low Power: Less than 10% drop at 3:1 SWR and 10 watts
Usable to 1/2 watt.

PEP Charge Time (Internal): 20 ms. or less

Frequency Range: 1.5 to 30 MHz. Usable at 50 MHz.

Note: The meter may be calibrated at 70-75 ohms or another impedance by following the calibration procedure, above, except using a 75 ohm load, or the desired impedance. Accuracy will not be degraded significantly, if at all. (We don't recommend calibration above 100 ohms or below 35 ohms. Also, if the SWR won't null, the capacitor in parallel with RF head trimmer may need to be made smaller or larger.) Sorry, we **cannot** supply any further details, or solve any problems you may find if you try this! We've never done it, but it should work.

I. WARRANTY

Autek research warrants this product against manufacturing defects for one full year after the original date of consumer purchase. This warranty does not include damage resulting from accident, misuse, abuse, or unauthorized repair or alteration, excepting that if the owner attempts a minor repair or alteration and we judge this not to have been the cause of the problem, we will honor the warranty. Autek Research will not be responsible for consequential damages to person or property caused by the use of our products. This warranty is in lieu of any other warranty express or implied.

If the product becomes defective during the warranty period, we will repair or replace it if mailed to us postpaid with a check for \$6 enclosed to cover

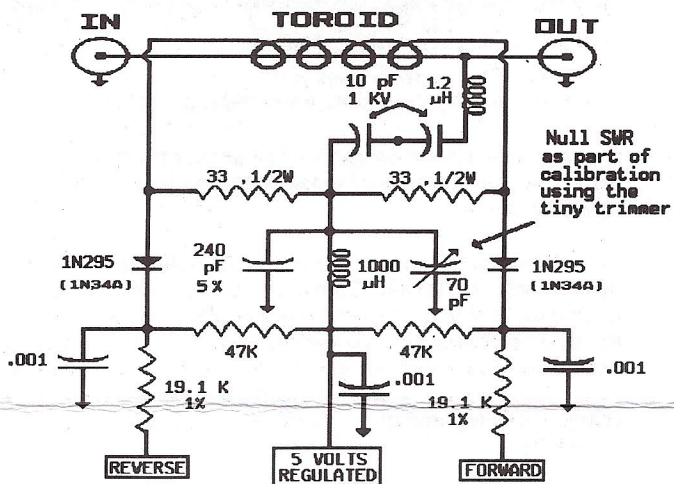
shipping and handling enclosed inside the package. We have records of your name and date of purchase. Simply enclose a statement of your purchase date (within a month,) so we can verify warranty coverage. You will probably not receive an invoice or charge-card statement with your unit. Your check or monthly charge statement to Autek would suffice in case of confusion. This is rare. This warranty gives you specific legal rights, and you may have other legal rights which vary from state to state.

Please note that if the \$6 check is not enclosed with any return, we will have to add an **additional** COD charge (currently \$5) to return the unit COD.

Service outside the warranty period, or for problems not covered by warranty, is available. Currently (1994) our minimum charge is \$25 plus \$6 shipping for repairs or estimates. However, we can fix 95% of problems for the minimum; the exception usually being units heavily damaged by lightning. We cannot look at the unit unless this minimum charge is enclosed in the package. If the charge will be higher than the minimum, we will inform you before proceeding.

Please note that the majority of returns have **nothing wrong with them!** These returns, and returns for "checkout," are almost as time consuming as failed units so are still subject to the minimum charge.

WM1 REMOTE HEAD



ADJUSTMENTS

