PEP Wattmeter – à la Heath

See how much pep your transmitter really has. With the addition of this circuit, use your existing rf wattmeter for measuring peak power.

By George D. Rice,* W6OGR

Two amplitude values are associated with the modulation envelope of a single-sideband signal. One is the *maximum or peak amplitude* (PEP), the greatest amplitude reached by the envelope at any time. The other is the *average amplitude*, which is the average of all the amplitude values contained in the envelope over some significant period of time, such as the time of one word of speech.

Envelope peaks occur only sporadically during voice transmission, and have no direct relationship to meter readings. The meters respond to the amplitude (current or voltage) of the signal averaged over several cycles of the modulation envelope. This is true in practically all cases, even though the transmitter rf output meter may be "calibrated" in watts. Unfortunately, such a calibration means little in voice transmission since the meter can be calibrated in watts only by using a sine-wave signal – which a voice-modulated signal definitely is not!

But, have faith, readers, there is a way to modify your existing power meter to read PEP. Yes, it's true. With a few modifications incorporated into your station wattmeter, it is possible to read your transmitter peak-power output. I will confine my discussion to applying the modification to the Heath HM-102 wattmeter, but it should be possible to use this circuit in 'most any power meter.

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Design Objectives

One of the desired design features of the wattmeter modification circuit was not to impair the performance of the HM-102 as offered by Heath. This is accomplished by removing the wire from the positive terminal of the meter and terminal 1 of the function switch (S3 on the HM-102), and then installing the new pc board (see Fig. 1). A front-panel switch provides for returning the power meter to its original operating configuration (before modification).

Circuit Description

The circuit is designed around an LM-1458 IC. The IC requires a –9 and

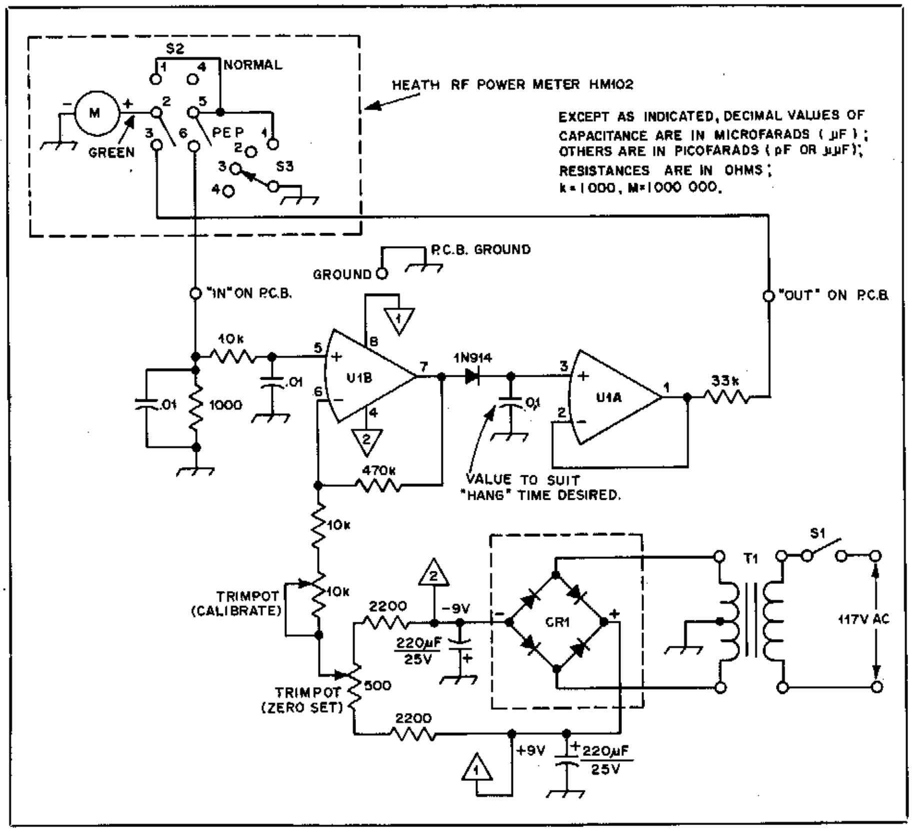

Fig. 1 – Schematic diagram of the amplifier/rectifier circuit added to the Heath HM-102 wattmeter. The upper left portion of the drawing indicates the location of normal/PEP read-select switch, S2, and wiring of the meter and function switch.

CR1 – 2-A, 50-PIV bridge rectifier, Radio Shack part number 276-1151 or equiv.
S1 – Spst toggle switch, Radio Shack part number 275-612 or equiv.
S2 – Dpdt toggle switch, Radio Shack part number 275-614 or equiv.
T1 – 117-V ac primary, 12.6-V ct, 100-mA secondary, Mouser Electronics part number 81FG100 or equiv.
U1 – Dual op-amp IC, type LM-1458 or equiv.

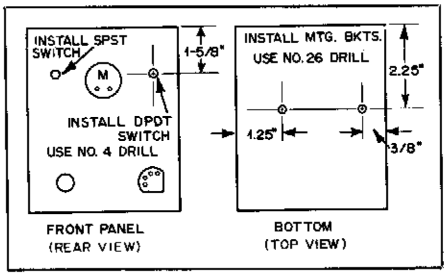

Fig. 2 – Hole-drilling template (not to scale) for mounting the spst and dpdt toggle switches on the HM-102 front panel, and for the pc-board mounting brackets on the rear panel of the wattmeter.

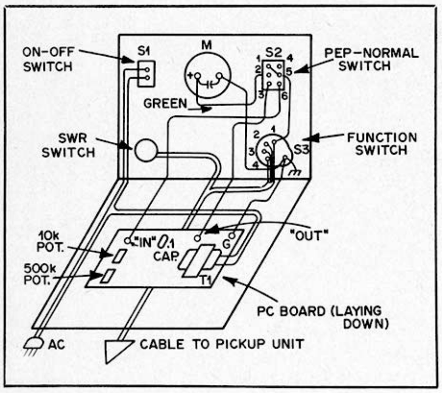

Fig. 3 — Guide for suggested installation of the amplifier/rectifier pc board into the HM-102.

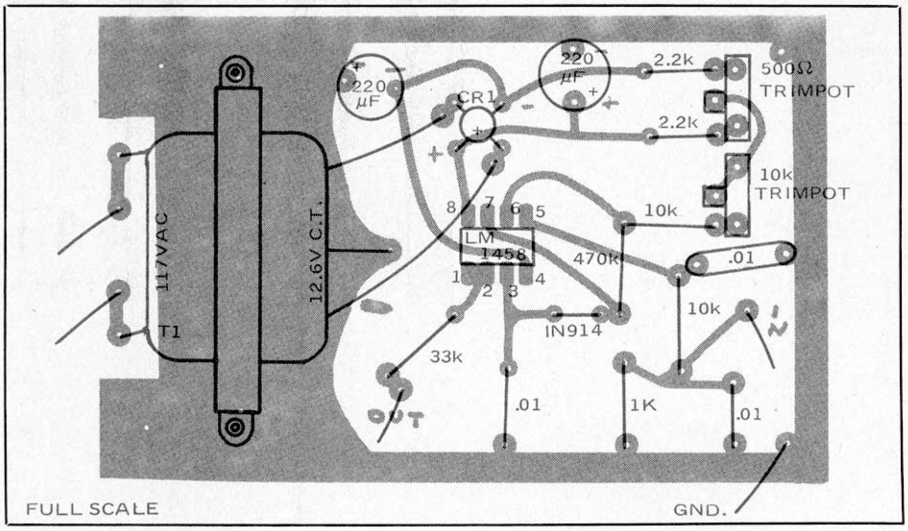

Fig. 5 — Foil-side, full-scale pattern of the pc board. Circuit board is single-side glass-epoxy material. Grey represents copper.

+9-volt power supply for proper operation. Current passing through the diode (1N914) between pin 7 of U1B and pin 3 of U1A charges up the 0.1-µF capacitor at pin 3 on U1A, causing the meter to delay from returning to zero long enough for a reading at the peak-meter movement. The peak presentation falls off just slow enough so that between words the meter movement is just starting its downward excursion when the next spoken word "kicks" it back up to the peak-reading value.

Various values of capacitors were tried and one having a value of 0.1 µF provided a delay suitable for my purposes. However, if a longer or shorter delay is desired, a different value of capacitor can be substituted to obtain the delay time you want. It might also be worth mentioning here that I did find some noticeable differences in time delay from one LM-1458 to another. Most performed about the same with the 0.1-µF capacitor. I did find a few that required a 0.2-µF capacitor to give the time delay I liked.

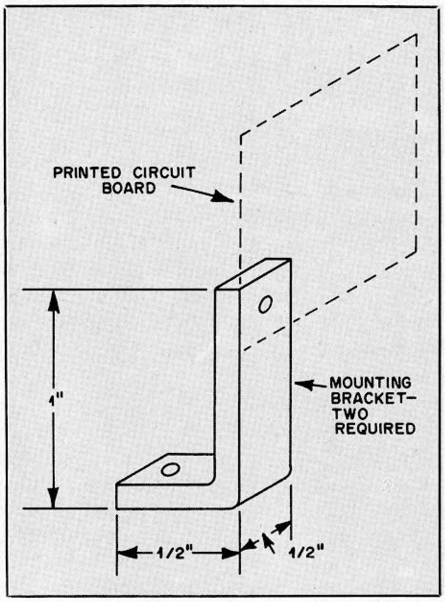

Fig. 4 — Dimensions of the mounting bracket for the pc board.

Modification

Proceed with the installation of the amplifier-delay circuit board in the HM-102 as follows:

The green wire running from function switch S3 to the meter should be removed from the function switch and rerouted to terminal 2 on S2 (see Fig. 1). A new wire should be installed from function switch S3 to terminals 5 and 1 of front-panel-mounted switch, S2. Install a wire from S2, terminal 6, to the "in" connection on the amplifier printed circuit board. Next, solder a wire from terminal 3 on S2 to the "out" connection on the pc board.

When S2 is in the up position the HM-102 functions in its "normal" fashion just as if no modification had taken place. With S2 in the down position, voltage to the amplifier is routed via terminals 5 and 6 on S2, and is returned through a 33-kΩ resistor to the meter via terminals 2 and 3 of switch S2.

Zeroing the Meter

Before soldering the 0.1-µF capacitor in the circuit, the 500-Ω trim pot (zero set control, Fig. 1) should be adjusted for a zero reading on the HM-102 meter. After the meter has been adjusted to read zero, the 0.1-µF capacitor may be soldered in place on the pc board and any fine adjustment, if required, can be made later. With the resulting delay times of this circuit, it is nearly impossible to make the initial zero adjustment with the 0.1-µF capacitor installed.

Calibration

Assuming your HM-102 was calibrated and in correct working order before the modification was started, only one additional adjustment is required to complete this modification.

The 10-kΩ pot is used for calibration of the wattmeter in the peak-power mode, and must be adjusted to make the peak reading (S2 in the PEP position) equal the normal reading (S2 in normal-reading position) while using the transmitter cw output as a test signal. To make this adjustment, put your transmitter in the cw mode. Place the power meter controls in the normal (up) position. Key the transmitter and read the power level indicated on the meter. Next, switch to the peak-reading mode (S2 in the down position). Key the transmitter again, and adjust the 10-kΩ calibration control until you obtain a meter reading equal to the meter reading you observed in the normal position. Check the meter zero and if necessary adjust the 500-ohm pot for zero on the meter. Repeat the calibration procedure as many times as necessary to obtain the correct reading.

One final note: I have a long-wire antenna. The L matching network for this antenna is located inside the shack, and when I use this antenna the rf field is too much for the IC amplifier to handle, causing the meter to malfunction. However, I have a few radio amateur friends who have built this modification into their HM-102 power meters and are more than delighted with the results. They have not experienced any rf problems to date (none of them use long-wire antennas).

I wish to give credit to Bob Peterson, K6YHJ, for providing the idea and designing the circuit for the unit described herein, and for answering hundreds of my questions, and for his help in debugging the circuit. Without his help and guidance this project would not have been possible. QST