Palomar Engineers™

M827 SWR Meter

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1683

Model M-827

AUTOMATIC SWR & POWER METER

OPERATOR'S MANUAL

PALOMAR ENGINEERS

MODEL M-827 AUTOMATIC SWR & POWER METER

I - DESCRIPTION

The meter computes SWR automatically and displays it on a light bar. The SWR readings is always correct regardless of power level. The SWR scale is 1 to 10 with a logarithmic response that gives high resolution at low SWR values.

A second light bar displays power. Power ranges are 20, 200 and 2000 watts. Power readings are correct at SWR = 1. The light bar will follow SSB peaks.

II - INSTALLATION

Connect the "Input" connector to your transmitter or transceiver using 50 ohm coaxial cable such as RG8/U or RG58/U. Cable length is not critical.

Connect the "Output" connector to the antenna or to your antenna tuner.

Plug the line cord into a source of 115-v 50/60 Hz.

III - OPERATION

Turn on the power switch. The LED indicator should light.

Set the power switch to the range you expect to need (20, 200, or 2000 watts).

Turn on your transmitter in its tune mode. Both power level and SWR will be displayed on the light bars. If you are using an antenna tuner, adjust it for minimum SWR. The SWR light bar is very sensitive near 1.0 SWR.

When the SWR is set to 1.0 the power meter reads correctly. If the SWR is above 1.0 power readings will be high.

IV - SPECIFICATIONS

SWR Range:	1.0 to 10 (Logarithmic scale)
Power Range:	20/200/2000 watts
Frequency Range:	1.7-30 MHz
Power Requirement:	115-v 50/60 Hz @ 3 watts
Dimensions:	4½ inches high, 4 inches wide, 5 inches deep (including connectors and switches)
Weight:	1½ lb.

Palomar Engineers

1924-F, W. Mission Rd., Escondido, CA 92025 • Phone (714) 747-3343

Palomar Engineers is proud of the quality and workmanship of its communication equipment. If properly installed and operated in accordance with our instruction manual, it should give reliable performance.

LIMITED 12 MONTHS WARRANTY

Palomar Engineers warrants to the original owner only of this product, if purchased from an authorized dealer or directly from Palomar Engineers, that this product will be free of defects in material and workmanship for a period of 12 months from date of purchase provided the terms of this warranty are satisfied.

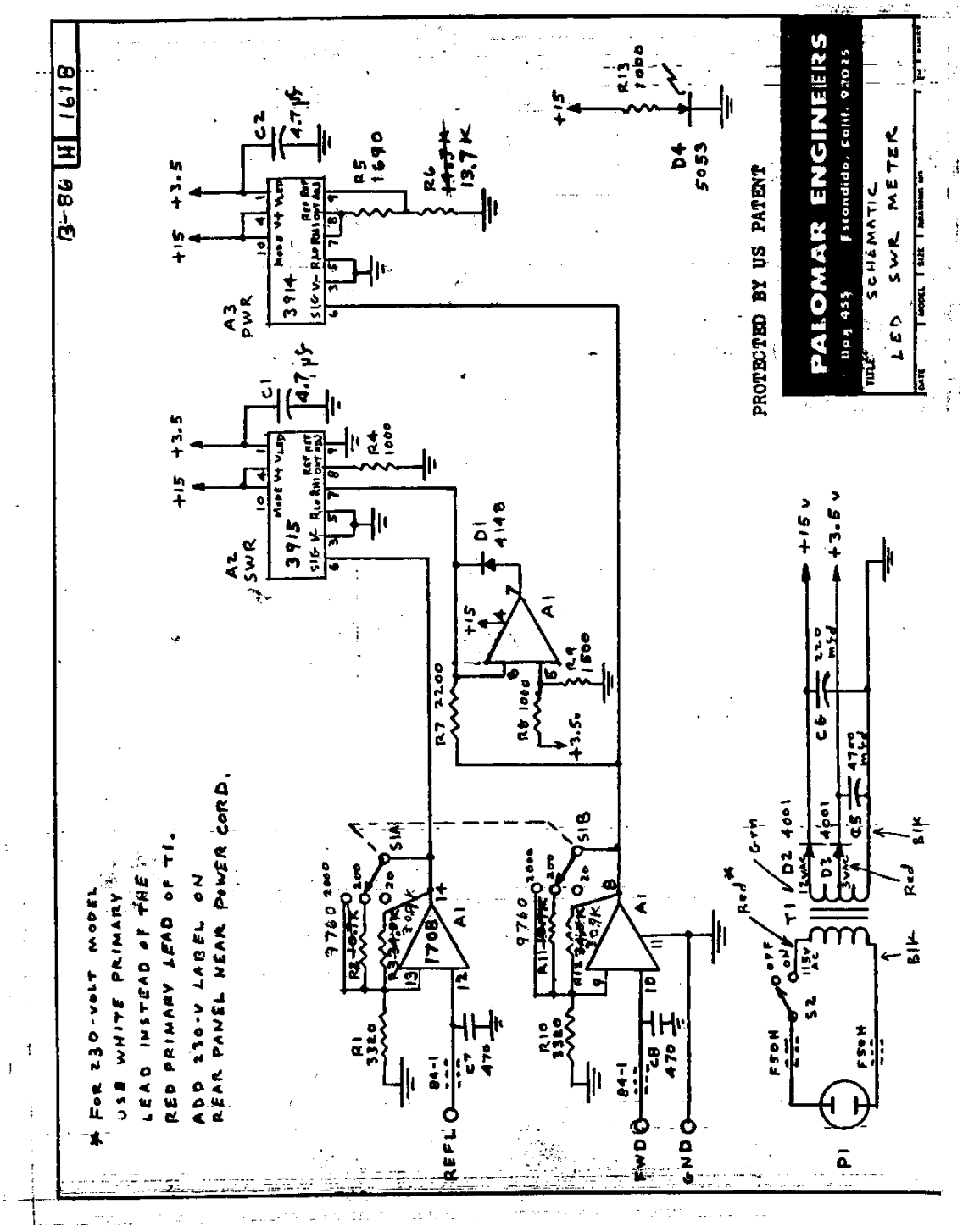
1. The purchaser must retain a dated proof-of-purchase (bill of sale, cancelled check, credit card or money order receipt, etc.) describing the product and must submit the original or a machine-reproduction of such proof-of-purchase to Palomar Engineers at the time of warranty service to avoid unnecessary difficulties in establishing the validity of warranty claim. Palomar Engineers shall have the discretion to deny warranty without dated proof-of-purchase.

2. Along with proof-of-purchase, a detailed description of the problem, including details of the electrical connection to associated equipment and a list of such equipment must be submitted.

3. Under no circumstances shall Palomar Engineers be held liable for any loss of damage, direct or consequential, arising out of the use of, or inability to use, this product. Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

4. This warranty is given in lieu of any other warranty express or implied.

5. Out-Of-Warranty-Service: Palomar Engineers will normally repair any out-of-warranty products. Write or call the factory at the address or phone number below for authorization. An estimate will be given with this authorization.



CQ Reviews:
Palomar Engineers M-827
Automatic S.W.R. and Power Meter

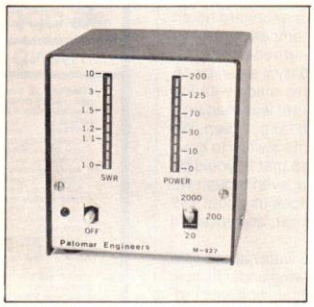
BY JOHN J. SCHULTZ*, W4FA

In recent years s.w.r. meters have appeared on the market scene in just about any imaginable design and/or form. Some of the meters are good measuring instruments, while others emphasize meter size and other frills more than a good, basic measurement capability. Also, the % power reflected scale on some simple s.w.r. meters (not on meters with a true reflected power scale) has led many amateurs to believe that significant amounts of transmitter output power are lost even at relatively low s.w.r. readings (e.g., an s.w.r. of 1:1.2 or less). In fact, those % reflected power scales indicate a theoretically maximum power rejection by an antenna load, which rarely takes place in practice. A not unusual example would be that when such a meter indicates 25% of the output power as being "lost," less than 6% is "lost" in reality.

Scores of articles have appeared in various amateur radio publications to explain the mysteries of s.w.r. to the average amateur. Some articles have served to clarify, while many more simply have served to add to the confusion. But, for the average amateur at least, the solution to the problem of s.w.r. is probably not a lot of theoretical discussion, but rather is the development of an s.w.r. instrument that avoids any ambiguity at the start.

Of course, a lot of efforts have been made over the years to make the s.w.r. meter a straight-forward, easy-to-use instrument that avoids any ambiguity in the meaning of the meter's indication. The cross-needle s.w.r. meter, which has recently been introduced to the amateur radio field, although it dates back to German commercial designs of the 1930's, is a good example. The latest development, thanks to the development of the IC, has been practical designs for automatic, self-calibrating s.w.r. meters using regular single-needle panel meters as indicators. The logical "next step" had to be a complete divorce from mechanical indicating devices for s.w.r., and that is where Palomar Engineers has already taken us with their Model M-827 Automatic SWR and Power Meter.

The M-827 is a "computing" s.w.r. meter that uses LED's for its display elements. One string of 10 LED bar-type displays indicates s.w.r. from 1:1 to 1:10, and another string of 10 LED bar-type displays indicates the forward power output in switch-selectable ranges of 0–20, 0–200, or 0–2000 watts. Since it is a "computing" type s.w.r. meter, there are absolutely no "set" controls, and s.w.r. indication is completely automatic over an extraordinary range of 1 to 2,000 watts of forward power. The frequency range is 1.7 to 30 MHz.



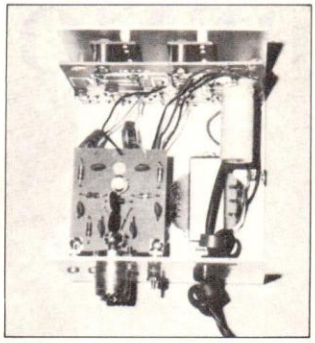
The M-827 is attractively housed in a two-tone enclosure. The illuminated LED's form a continuous bar-type display.

The M-827 is a remarkable instrument for various reasons, some of which will be described in detail. But just to organize a "look" at the M-827, the instrument will be described in terms of its mechanical features, electrical features, and performance results and impressions.

Physically, the M-827 measures about 4¼ × 4 × 5 inches and is housed in an attractive cabinet with a brushed-aluminum front panel and black-vinyl-covered top cover. A look at the front-view photograph clearly demonstrates the **SWR** and **Power** LED displays and the control switches. The back panel of the M-827 contains SO-239 connectors for in/out r.f. power connections and a feed-through for the a.c. line cord. The M-827 has a built-in a.c. power supply mainly because battery operation is not practicable considering the relatively high current drain of the LED bar-type displays, although the 110 volt power drain is less than 3 watts.

A block diagram of the functional sections within the M-827 is shown in fig. 1. A directional coupler is used to sample forward and reflected voltages on the transmission line. This information is then fed to what I'll call a computer board, which in turn develops control voltages for the LED driver IC's which actually switch on and off the LED's.

If one takes the top cover off of the M-827 as shown in a photograph, one will see a PC board layout which almost exactly parallels the functional blocks shown in fig. 1. That is, there are four main PC boards within the unit. The board containing the directional coupler, which


There are several different PC boards inside the M-827 as explained in the text. The most obvious is on the inside rear panel and contains a directional coupler.

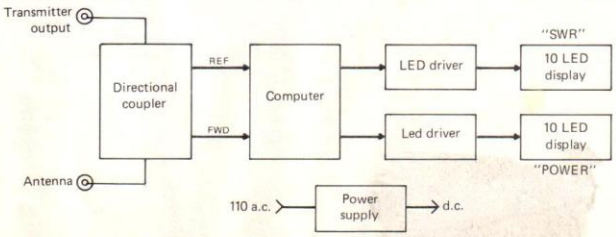


Fig. 1 – Representational diagram of functions within the M-827.

*c/o CQ Magazine

uses a small transformer wound on a ferrite toroid as a pick-up element, is mounted on the rear panel to provide the shortest possible leads to the coaxial line in/out connectors. The main board, which is located on the inside of the front panel, contains the computing circuitry, some power supply components, and also serves as a mounting platform for the two other PC boards, each of which is an integrated assembly containing the IC driver for the LED's as well as the bar-graph-type LED's themselves. The IC driver/LED assemblies appear to be very similar to various solid-state LED VU meter driver/displays which are available on the market (e.g., Radio Shack's RS NSM3916). The power transformer is located on the bottom plate of the enclosure.

If one starts to take a really close look at the construction of the unit, it will be seen that a great deal of care was taken to design it carefully. There are a lot of nice little features such as dual ferrite chokes on the a.c. lines, a faraday shield on the r.f. line which goes through the directional coupler ferrite toroid, large ferrite chokes on each lead from the directional coupler PC board to the main PC board, very neat layout of the components on each PC board, and a generous use of regular board and component mounting hardware with lockwashers where some manufacturers might have compromised a bit and used rivets. Palomar doesn't advertise it as such, but it seems that the power transformer used has dual primaries for both 110 and 220 volt operation.

As pleasant as the foregoing is to discover, the biggest surprise comes when one takes a close look at the "computer" board. Readers who are a bit familiar with "computing" type s.w.r. meters and who have followed various published designs realize that they mostly require a handful of IC's to implement. The computer board in the M-827, on the other hand, contains only a single IC (!) plus a small quantity of RC components. Obviously, someone at Palomar has come up with a very clever circuit idea that will probably make the computing-type s.w.r. meter an extremely common instrument in most amateur radio stations in the future. Unfortunately, the circuitry cannot be published at this time because Palomar has applied for a patent on it and their attorney advised against publication. Their instruction manual for the M-827 also does not contain the circuitry used, although they do publish the circuitry used in all of their other equipment.

Using the M-827 is actually a bit of fun because of the striking visual display. It was used with several solid-state transceivers, and as the s.w.r. LED bar-type would "sink" (fewer LED's illuminated) as an antenna tuner was adjusted for a proper match, the power LED bar graph would "rise" (more LED's illuminated). This seesaw visual effect made tuning very easy to follow, and I would rate the visual indication the most effective one yet to be seen on an s.w.r. meter. It is even clearer than when watching a cross-needle s.w.r. indicator because the response is instantaneous, and there is no possible confusion between the forward and reflected meter movements. About the only possible improvement that could be imagined for the M-827 display would be to have the **SWR** and **Power** LED displays differently colored instead of having both use red LED's.

The automatic s.w.r. readout on the M-827 has an expanded scale such that it is extremely sensitive at low s.w.r. readings and fully 9 LED's cover the s.w.r. range of 1:1 to 1:3. The readout in the s.w.r. range of 1:1 to 1:1.5 utilizes 7 LED's. So, there is no question about being able to read out extremely low s.w.r. values and being able to fine-tune an antenna coupler for an absolute 1:1 s.w.r. ratio when such is possible. In tests using resistive loads to simulate different s.w.r.'s, the s.w.r. scale on the M-827 checked out almost perfectly for s.w.r.'s of 1:3 and below. The most amazing feature, however, was that the automatic s.w.r. indication functioned equally well with transmitter outputs of approximately 1 watt to 700 watts (the latter being the maximum station power available). No test-result table is being presented simply because the differences between the indicated and actual s.w.r. values were so close that a tabular comparison would not be useful (e.g., an indicated 1:1.1 s.w.r. checked out as a 1:1.15 s.w.r.).

The power LED scale on the M-827 also checked out extremely well (see Table I), but one does have to evaluate its usefulness from two distinct viewpoints. On the one hand, the display is extremely useful because of its ability to instantly display peak power output. In that sense it is like using an oscilloscope to monitor a transmitter's output level and to check the effectiveness of speech-processing equipment. On the other hand, the power readings are only correct when the s.w.r. is 1:1 and there is no capability to measure exact power levels. For instance, on the 2000 watt power range only 3 LED's cover the range from 300 to 700 watts, so one could not set a transmitter for exactly 500 watts output. The same situation exists on the other power ranges as one can see from the front view of the M-827. Of course, the relative power output the M-827 displays will remain constant as long as a transmitter is working correctly, and this is usually the main point of interest in actual station operation. For example, a transmitter, when it is properly tuned and at its normal PEP output, might illuminate the LED's up to the 125 watt calibration mark. On speech peaks, if the LED string only illuminates up to the 70 watt calibration mark, this will alert one that something is wrong or that the transmitter is not being modulated fully. This sort of indication is difficult to achieve with analog meters unless they incorporate extra circuitry for a peak reading and hold capability, but doing that then does not allow them to follow low-level s.s.b. modulation changes.

All in all, if one accepts the fact that the M-827 is not an exact-reading power-output meter but primarily a fully automatic s.w.r. meter with an essentially instantaneous s.s.b. peak-power-output indicator, one should have excellent results using the unit. Its s.w.r. display is absolutely clear and unambiguous. There is, of course, hardly anything to do to place the unit into operation; just install it in the antenna line and plug in the line cord. Palomar's warranty is for 12 months against defects in material and workmanship. CQ

CQ
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20 Watt Range		200 Watt Range		2000 Watt Range	
Indicated	Actual	Indicated	Actual	Indicated	Actual
20	19	200	200	2000	*
12.5	12	125	125	1250	*
7	7	70	80	700	700
3	3.5	30	33	300	300
1	1.2	10	10	100	70

* Could not be measured.

Table I – Power measurement test results.