



# Model 81030 Directional RF Wattmeter



## Instruction Manual



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# **Specifications And Leading Particulars**

The Model 81030 Directional Wattmeter is an accurate and portable insertion Wattmeter using plug-in power detectors and detachable QUICK MATCH RF connectors, which measures forward and reflected CW power. The Model 81030 features a large easy to read LC display, which can display ranges from 100mW to 25 kW. It will also display power in dBm.

## **Specifications**

Power Range.....	100mW to 25 kW
Frequency Range.....	2-2300 MHz
VSWR.....	1.05:1 max with type N connectors
Accuracy.....	±5% of Full Scale
Impedance.....	50 Ohms
Weight.....	4 Lbs (1.8 kg)
Operating Power.....	4 AA Ni Cad Batteries
Display.....	LCD (with annotations)
Case Finish.....	Textured Blue Polyurethane Enamel
Modulation Types.....	CW,FM,AM and TV

## Catalog Numbers For Plug-In Elements used with Model 81030 Wattmeters

### Schedule 1

Standard Elements (Catalog Numbers)

Power Range	Frequency MHz						
	2-30	25-60	50-125	100-250	200-500	400-1000	950-1300
5 Watts		82012	82020	82028	82036	82045	82068
10 Watts		82013	82021	82029	82037	82046	82069
25 Watts		82014	82022	82030	82038	82047	82070
50 Watts	82004	82015	82023	82031	82039	82048	82071
100 Watts	82005	82016	82024	82032	82041	82049	82072
250 Watts	82006	82017	82025	82033	82042	82050	82073
500 Watts	82007	82018	82026	82034	82043	82051	
1000 Watts	82008	82019	82027	82035	82044	82052	
2500 Watts	82009						
5000 Watts	82010						

### Schedule 2

Milliwatt Elements (Catalog Numbers)

100mW	Cat. No.	250 mW	Cat No.	500 mW	Cat No.
20-23 MHz	820A022	70-80 MHz	820B075	25-30 MHz	820C028
44-50 MHz	820A047	72-76 MHz	820B074	65-90 MHz	820C078
62-70 MHz	820A066	105-120 MHz	820B113	72-76 MHz	820C074
74-76 MHz	820A075	310-350 MHz	820B330	105-120 MHz	820C113
105-120 MHz	820A113	416-436 MHz	820B426	130-170 MHz	820C150
135-160 MHz	820A150	800-900 MHz	820B850	300-350 MHz	820C325
190-205 MHz	820A198	900-950 MHz	820C925	800-900 MHz	820C850
310-350 MHz	820A330			900-950 MHz	820C925
416-436 MHz	820A426				
740-760 MHz	820A750				
800-900 MHz	820A850				

## Schedule 3

### Low Power Elements (Catalog Numbers)

<b>1W</b>	<b>Cat. No.</b>	<b>2.50 mW</b>	<b>Cat No.</b>
28-44 MHz	820D036	60-80 MHz	820E070
40-50 MHz	820D045	80-140 MHz	820E110
44-70 MHz	820D057	95-150 MHz	820E123
70-120 MHz	820D095	150-250 MHz	820E200
108-118 MHz	820D113	200-300 MHz	820E250
108-181 MHz	820D145	225-400 MHz	820E313
150-250 MHz	820D200	275-459 MHz	820E363
200-300 MHz	820D250	340-560 MHz	820E450
275-450 MHz	820D363	800-900 MHz	820E850
310-350 MHz	820D330		
327-543 MHz	820D435		
425-850 MHz	820D638		
800-950 MHz	820D875		

## 82000 Series High Power Elements (PEAK MODE ONLY)

<b>Power Range</b>	<b>Frequency MHz</b>					
	<b>2-30</b>	<b>25-60</b>	<b>50-125</b>	<b>100-250</b>	<b>200-500</b>	<b>400-1000</b>
2500 Watts		82053	82054	82055	82056	82057
5000 Watts		82058	82059	82060	82061	82062
10 kW	82011	82063	82064	82065	82066	82067

## General Description

The Model 81030 is designed to measure power in 50-Ohm transmission systems. It is for use with CW, AM, FM and TV modulation envelopes, but is not for use with pulsed or digitally modulated transmitters. The insertion VSWR is less than 1.05:1 for frequencies up to 2300 MHz.

The Model 81030 includes an internal line section with quick-match connectors and a large LCD display to display power. The full-scale power range currently active may be checked by pressing down the **Range Check** switch. The Wattmeter is normally supplied with type “N” female connectors. To avoid measurement errors caused by the use of “between series adaptors” we recommend the use of proper **Quick-Match** connectors.

To make RF power measurements, the plug-in elements are inserted in the line section. Each element is designed and optimized for a particular power and frequency range. A latch is provided on the face of the line section to ensure that the element is properly seated. The contacts on the plug-in elements make connection with the DC pick-up only when the element is in either the forward or reflected direction.

To properly indicate power on the LCD display, the range on the Model 81030 must be set to the range of the element in the line section. To set the range on the Model 81030, press and hold the **range check** switch and push down on the **range set** switch to lower the full scale range and lift up to increase the full-scale power range.

The operation of this Wattmeter is based on the traveling wave concept of RF transmission. As RF is applied to a transmission line, there is a forward wave traveling from the transmitter to the load and a reflected wave traveling from the load toward the transmitter. The closer the load is matched to the transmission line, the smaller the reflected wave will be. To determine RF power dissipated in the load, it necessary to determine the power of the forward wave and the RF power of the reflected wave. The difference between the two is the power absorbed by the load.

The interference between the forward and reflected waves produces a standing wave in the system. In the standing wave concept, VSWR is a widely used tool. There is a simple relationship between forward power, reflected power and VSWR.

Let  $W_f$  represent forward power

$W_r$  represent reflected power

Then

$$VSWR = \frac{1 + \sqrt{\frac{W_r}{W_f}}}{1 - \sqrt{\frac{W_r}{W_f}}}$$

For example: 1% reflected power is about 1.2:1 VSWR and 10% is about 2.0:1 VSWR.

It can be seen that VSWR is an index of the magnitude of the mis-match between the source and the load. The quantities of  $W_f$  and  $W_r$  are also an indication of the mis-match and are read directly on the Model 81030 Directional Wattmeter.

When the Wattmeter is inserted in a transmission line the RF power flows through a precision section of 50-Ohm airline. The element installed in the line section socket is coupled capacitively and inductively to the main line. Voltages proportional to the RF voltage and current in the main line are induced into the element circuitry. The coupling is adjusted such that the induced voltages add in the forward direction and cancel in the reflected direction when looking into a perfect 50 Ohm match. These voltages are rectified and the resulting DC voltage is applied to the circuitry for the LCD display, which is calibrated to represent the RF power in the main line.



## **Installation**

Check all components of the Wattmeter for damage. The battery charger is packed in the box with the Wattmeter. Report any damage promptly to your dealer or to the factory.

Prior to use, make sure to charge the batteries for 8 hours to insure they have a full charge. The batteries used in the Model 81030 are high capacity AA NiCad. If they ever need to be replaced they must be replaced with the same type.

### **DO NOT USE ALKALINE TYPE BATTERIES**

Take reasonable precautions when handling the Wattmeter unit and plug-in elements. Make sure the thumbscrews that secure the spare elements are firmly tightened. Dropping and rough handling may change the calibration of the elements.

Connections are made with any suitable coaxial cable directly to the quick-match RF connectors mounted on the internal line section. Connect one side of the Wattmeter to the source and the other to the load. The Model 81030 Wattmeter is bi-directional, meaning the source and load can be connected to either side, since the direction of the element determines whether forward or reflected power is measured. Use only 50-Ohm cables to connect to the Wattmeter. Impedance mismatches will cause errors in readings.

The Model 81030 is powered by 4 high capacity NiCad batteries. Make sure batteries are charged prior to use with the supplied charger. Do not use any chargers other than the one supplied with the Wattmeter.

### **Safety First**

#### **High Voltage Warning**

When operating this equipment with powers in excess of 200 Watts, the potential on the center conductor of the line section will be 100 Volts or higher. Do not contact the center conductor. If cleaning becomes necessary, turn off the RF power.

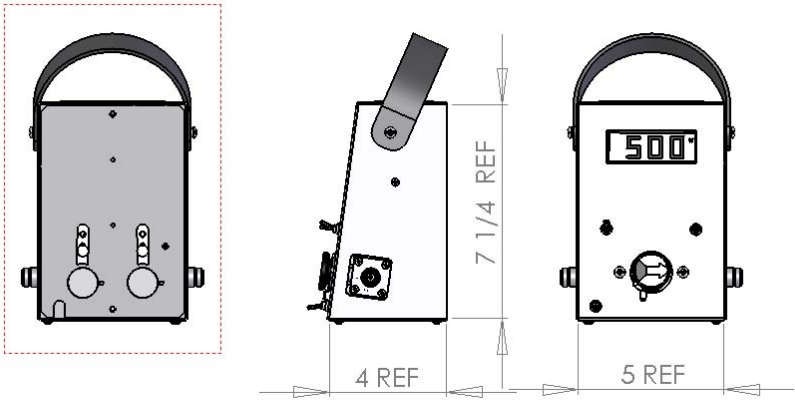


Figure 1 Wattmeter Dimensions

## Operation

To make measurements with the Model 81030, it is necessary to first select an element with the proper frequency and power range, set the full-scale range of the Wattmeter by using the switches on the front. Press and hold the **Range Check** switch and use the **Range Set** switch to either raise or lower the range of the Wattmeter to match the element and connect the unit to the RF transmission line. Turn the arrow on the element toward the load and measure the forward power, turn the arrow toward the source and measure the reflected power. Subtract the reflected power from the forward power to get the power dissipated in the load.

The Model 81030 will also display power in dBm by pressing the Watts/dBm switch.

The zero adjust is an internal electronic zero. There might be some slight deviation from zero with out any power applied, this is normal and will not affect the accuracy of RF power measurements.

Use a plug-in element, which is designed for the frequency of the source, and select an element that is high enough power rating to properly indicate power in the RF line. If the power is not known, start with an element that will adequately cover the maximum power of the source to prevent damage to the Wattmeter. Use a more sensitive element if the indication is too low for accurate power determination.

To determine load power, turn the arrow on the element so it points toward the load. Read the forward power in Watts on the LCD display. Rotate the element so the arrow points toward the source. Read the power in Watts on the display. Subtract the power reflected from the power in the forward direction. This is the power dissipated in the load or antenna.

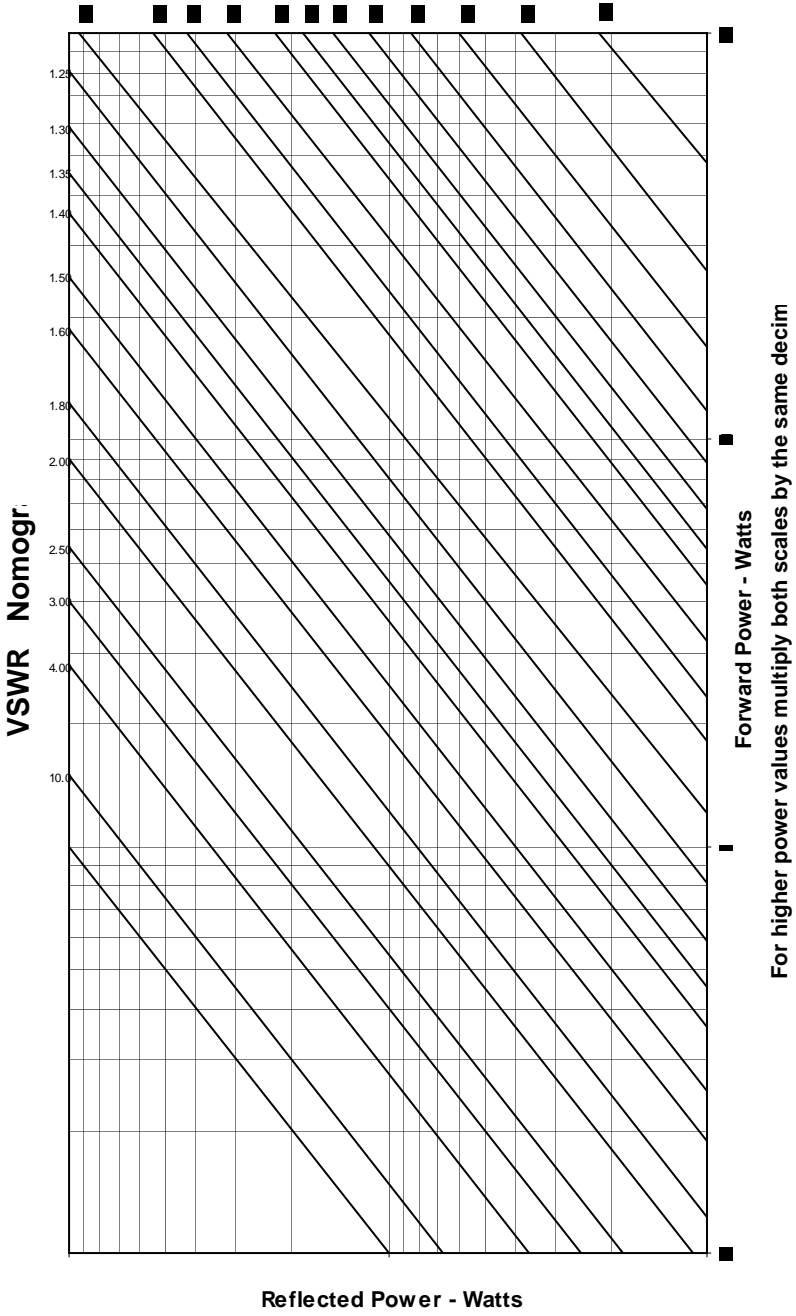
The Wattmeter is not designed to provide direct readings of VSWR. VSWR can be determined by either using the equations on page 3, or by using the chart on page 8. For power higher than represented on the chart, multiply **both** axes by 10 or 100. For lower powers, both axes may be divided by 10 or 100.

When the reflected power is very low with respect to the forward power, it may be desirable to make reflected power measurements with more accuracy than is possible with the element used for forward power.

***Caution must be taken to prevent excessive power being applied to the low power element. When making measurements with the more sensitive element, be sure that the arrow points toward the source to prevent damage to the element.***

When using two elements to measure low reflected power, use a pair of elements with no more than 25 to one ratio between the high power element and the low power element.

Each element is designed and optimized to operate over a specific frequency range. Operation outside of this range is not recommended. The frequency response of the element will drop off above and below the design range.



# Maintenance

Maintenance of the Model 81030 is normally limited to cleaning. The amount of cleaning may be reduced by keeping an element or a dust plug in the socket and keeping the connectors either connected or covered. All connections must be kept clean to assure low resistance contacts.

To clean the element socket, use a commercial contact cleaner or a cotton swab dipped in isopropyl alcohol. Pay particular attention to the bottom rim of the element body and the seat of the socket in the line section. When cleaning the socket in the line section, be careful not to disturb the finger of the DC contact. If necessary, the finger may be adjusted manually. The button must be positioned out far enough to make good contact with the element contact bar, but not far enough to restrict entry of the element.

## Safety First

When using solvents, be sure to use in a well-ventilated area and avoid inhalation of any fumes. Most solvents are flammable, keep away from sparks of flames.

## Troubleshooting

<u>Trouble</u>	<u>Possible Cause</u>	<u>Remedy</u>
No Display	Low Battery Charge	Charge Batteries
Display Reads 000	Arrow on element turned in wrong direction	Correct arrow direction
	No pick -up from DC Contact finger	Adjust finger
Intermittent Readings	Faulty Load	Repair Load
	Faulty Transmission Line	Repair Line
High Reflected Power	Faulty Load	Repair Load
	Poor Connectors	Check All Connections
	Faulty Transmission Line	Repair or Replace Line

## **88000 Series RF Quick Match Connectors**

88000	N Female
88001	N Male
88002	BNC Female
88003	BNC Male
88004	UHF Female
88005	UHF Male
88006	LC Female
88007	LC Male
88008	C Female
88009	C Male
88010	7/8" EIA Swivel Flange
88011	TNC Female
88012	TNC Male
88013	HN Female
88014	HN Male
88020	SMA Female
88021	SMA Male

Others available.

“Specifications are subject to change without notice.”



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