U.S. Patents
5,471,402 & 5,710,710

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M1

USER MANUAL

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CE

⚠ CAUTION

WARNING - Maximum input voltage is 12VDC. Automotive voltages may exceed 12V causing damage to internal circuitry. Damage resulting from excessive input voltage is readily apparent and will not be covered under warranty. Units returned for warranty service that have damage resulting from excessive supply voltages will incur service charges.

WARNING - Maximum antenna input signal is +15dBm (50mW). Under no circumstances should the M1 be directly connected to an RF transmitter or be used in close proximity to a radio transmitter of more than 5 watts. Damage to the input amplifier circuitry is readily apparent and will not be covered under warranty. Units returned for warranty service that have damage to the input circuitry will incur service charges.

This manual covers connection and operating instructions for the Optoelectronics M1. The Optoelectronics M1 is covered under U.S. Patent Numbers 5,471,402 and 5,710,710.

Introduction

The M1 is the latest advancement in hand-held frequency test instruments. It excels at finding and recording frequencies for security, law enforcement, commercial and recreational applications. Patented technology developed by Optoelectronics employs statistical analysis to filter out actual radio transmission frequencies from the background RF.

The M1 is more than a test instrument in the traditional sense because it is useful for finding frequencies being used for two way radio communications. Designed to work with an antenna to pick up transmitted radio frequencies, it is actually a frequency recorder. Up to 100 unique frequencies can be stored in memory. For in circuit measurement of frequencies from oscillators or test points, the 1Meg input impedance amplifier can be used with a scope probe for direct connection to test points.

The counter circuitry produces a coherent and stable count when there is a single dominant signal 10 to 20 dB stronger than any other signal or the RF floor. An embedded microprocessor evaluates each measurement statistically to determine when an actual RF frequency is dominant. This is the digital filter processing which makes automatic capture and recording possible.

The M1 includes an AC-90 power adapter.

POWER ON/OFF

To turn the M1 on press the Power ON button. Upon power-up, an LCD self-test will be displayed for two seconds. To turn the M1 off press the Power OFF button.

GATE

The GATE button is used to change the measurement period of the M1. The GATE button is also used to scroll forward through the M1's 100 memories. To see the different GATE times for the M1 turn to the specifications page.

RANGE

The RANGE button is used to change the three different M1 ranges. A, B and Prescale. The RANGE button is also used to scroll backward through the M1's 100 memories.

1. **A** 1Meg Ohm High Impedance Range: 1Meg Ohm range is indicated with a "A" in the top right hand corner of the LCD. The frequency range of the 1Meg Ohm range is 50Hz-40MHz. This range is useful for in-circuit measurement using a scope probe
2. **B** .50 Ohm Direct 250MHz Range: Direct range allows for the fastest count from 10 MHz-250MHz. 50 Ohm Direct range is indicated with a "B" in the top right corner of the LCD.
3. **Prescale** Prescale Range: Prescale range is used to count the frequency range from 30MHz-2.8GHz.

The 2.8GHz (Prescale) range completely covers all VHF and UHF communications so it is fine to leave the M1 in this range all the time. The advantage of the direct 250MHz range is that it is much faster to respond and it gives a measurement with more digits of resolution. If you are frequency finding and do not know the range to look it is best to use the 2.8GHz range. If you know the approximate frequency being transmitted is less than 250MHz then use the direct 250Mhz range.

Mode
The MODE button is used to select the different operating modes of the M1. When powered on the M1 defaults to Normal mode. Normal mode is indicated by the oscillating digits on the LCD.

Pressing the MODE button once will activate Filter mode. Filter mode is indicated by “Filter” being displayed on the top line of the LCD.

Pressing the MODE button again will activate Capture mode. Capture mode is indicated by “Capture” flashing on the top row of the LCD.

Pressing the MODE button again will activate Recall mode. Recall mode is indicated by “Recall” being displayed on the top row of the LCD.

CI-5
The jack labeled CI-5 on top of the M1 is used for interfacing to the Optoelectronics Optolinx for the purpose of computer controlled operation or datalogging.

9-12VDC
The connector labeled 9-12VDC on top of the M1 is used for accepting the plug from the supplied AC90 power adapter. The AC90 is a nominal 9VDC (9-12V) adapter. Plug the AC90 into the M1 to charge the unit. A full charge will take approximately 8-10 hours. When using the internal NiCad batteries as the power source the M1 will operate approximately 4-5 hours on a full charge.

Antenna
The BNC connector labeled antenna is used for a 50 Ohm antenna or 1 Meg Ohm scope probe.

Optoelectronics frequency counters are unique in their ability to find RF transmission frequencies quickly. Immediate response to frequencies that are 10 to 15 dB greater the the background RF floor is possible. This is simply done by moving the M1 in the nearfield of the transmitter. The nearfield is the area close to the antenna where the field strength is high but falling off rapidly as distance increases.

Several factors may prevent a stable frequency counter reading even when there is a bargraph response.

The signal is simply too weak. While the M1 is a very sensitive counter it does not react well to extremely weak signals.

Amplitude Modulation (AM). Since the counter is measuring the zero crossings of the signal, it is sensitive to the amplitude of the received signal. AM signals such as TV video carriers, aircraft radios, etc. can be difficult to count since their peak amplitude may be high enough to cause a bargraph indication, but the valley is too low in amplitude for reliable counting. AM signals can be very frustrating in this regard, looking like a signal that should easily count and yet never giving a stable count.

Multiple signals. The M1 may not be able to separate adjacent carriers. The FM broadcast band is a good example of this, a 20MHz wide band with channels on 200kH centers. In any city numerous stations will exist within a given area. It is possible that none of the signals will be 10-15dB higher than the rest which makes accurate counting difficult.

Operating Modes

Normal Mode
The M1 defaults to normal mode when powered on. Normal mode is indicated by the oscillating digits on the LCD. In normal mode a frequency will be displayed as long as a signal is present. As soon as the carrier drops the digits will resume oscillation. All three ranges (A, B, or Prescale) may be selected during normal mode. Prescale range automatically corrects the Gate time and display..

Filter Mode
To enter filter mode press the MODE button until "Filter" is displayed in the top left hand corner of the LCD. In this mode, the patented Digital Auto Filter is activated. Each time a frequency passes the filter the red gate LED will flash and the display will update. The purpose of Filter mode is to reduce random counting, noise and false signals. A unique filtering algorithm permits only meaningful measurements to be displayed. All three ranges (A, B, or Prescale) may be selected during filter mode. The gate time may be changed according to the range selected.

Capture Mode
To enter capture mode press the MODE button until flashing "Capture" is displayed in the top middle portion of the LCD. In capture mode, the patented Digital Auto Capture is activated. Capture mode is also where unique frequencies will be logged to one of 100 memories. Upon capture of a frequency, the red gate LED will flash once and the frequency will be displayed. At the same time the frequency will be logged to memory. The corresponding memory location will be displayed to the left of the frequency starting at 00 and ending at 99. The M1 will only log a unique frequency to a memory location. If the M1 captures the same frequency repeatedly it will not write those frequencies to separate memory locations. All three modes (A, B, or Prescale) may be selected during capture mode.

Recall Mode
To enter recall mode press the MODE button until “Recall” is displayed on the LCD. The first memory location, (00), will be displayed along with the frequency logged to that memory. To scroll forward through the frequencies in memory press the RANGE button. The next frequency in memory will be displayed, up to 99. To scroll backward through the frequencies in memory press the GATE button. Pressing and holding down either the RANGE button or GATE button will rapidly advance the memory location in the respective directions. Note: It is possible to scroll continuously in either direction.

Clear Memory
To clear the frequencies in memory press and hold down the mode button when turning power on.

Multiple Transmissions
If two transmitters are operating at the same time within the pass band and they appear to have the same signal strength, then the bargraph will display a strong signal indication but the counter display will not stabilize. To compensate you must physically move closer to the transmitter of interest until the counter sees its signal as 10-15dB greater in strength.

Strong Signal Overload
The M1 can be overloaded in the presence of a strong RF signal. In this situation the bargraph will also display a strong signal indication. It may be necessary to reduce the signal level by moving away from the transmitter or removing/shortening the antenna before the counter begins to count properly.

Multipath Cancellation
The distance at which the signal can be detected may be much greater than the distance at which it can be counted. At 800MHz for instance the wave length is about 35cm and multipath cancellations can repeat at very close intervals. As you decrease the distance the problem goes away. If you are in a vehicle best results can be obtained when you come to a complete stop and the transmitter also stops motion, providing a stable signal without multipath dropouts. Always operate the counter on the fastest measurement time possible.

RF SIGNAL STRENGTH BARGRAPH

The 16-segment bargraph display is a part of the M1 LCD front panel display which provides a relative indication of RF signal strength. The bargraph indication at a given time does not necessarily reflect the signal strength of the frequency shown on the display, rather an aggregate signal level indication of all RF energy detected by the M1 at that instant. It is important to note that the RF signal strength bargraph always provides a real-time signal level indication, whereas the frequency display may show a frequency which was detected at some time in the past. The RF signal strength bargraph is ideal for uses such as the location of nearby transmissions and antenna pattern testing.

Display Resolution

Frequency Display Resolution

Least significant digit displayed (LSD) as a function of Gate Time and Range

Range	Gate Time	Meas. Time	LSD	Sample Display
250MHz	100us	13mS	10kHz	150.00
	1mS	13mS	1kHz	150.000
	10mS	13mS	100kHz	150.0000
	100mS	110mS	10Hz	150.00000
	1S	1S	1Hz	150.000000
	10S	10S	0.1Hz	150.0000000
2.8GHz	6.4mS	13mS	10kHz	2000.00
	64mS	75mS	1kHz	2000.000
	640mS	640mS	100Hz	2000.0000
	6.4S	6.4S	10Hz	2000.00000

The M1 has the maximum amount of broad gain possible without driving the front end circuitry into hard self oscillation. The purpose of this concept is to permit the maximum possible pick-up distance from radio transmitters. There is no gain or sensitivity adjustment possible in the circuit. Specific sensitivities at particular frequencies are difficult to predict with precision in production units. The input sensitivity specifications below are intended to be a rough indication as to what may be expected. Defective components such as blown amplifiers, broken or unsoldered chip resistors, capacitors and inductors will cause a drastic reduction in performance. These typical sensitivity specifications should not be relied upon for the purposes of incoming inspection or evaluation. Contact the factory if the results obtained are significantly different than those below. Performance on an antenna does not always relate exactly to input sensitivity as measured on a signal generator. The purpose is to provide the best possible antenna performance regardless of sensitivity.

Input Amplifier:	**1Meg Ohm**	**50 Ohm**
Impedance:	1Meg Ohm, 30pF	50 Ohm VSWR <2:1
Range:	50Hz-40MHz	10MHz-2.8GHz
Sensitivity:	<20mV 1KHz-10MHz <50mV 10MHz-40MHz	<10mV @ 10MHz <1mV@ 150MHz <7mV @ 800MHz <12mV @ 1GHz <100mV @ 2.8GHz
Maximum Input:	50V AC + DC	+15dBM, 50 milliwatts

Time Between Measurements:	10 milliseconds, all range & gate times
Display:	10 digit LCD. Decimal at MHz point
Timebase:	10MHz setable to +/- 1ppm (Option 1ppm TCXO)
RF Signal Strength Bargraph:	16 segments, approximately 3dB segments, Relative indication only
Size:	3.7” x H x 2.75”W x 1.2” D
Weight:	8.5 oz
Battery:	Internal shrink wrapped 4 cell AA NiCad
Operating Time:	Approximately 5 Hours
Charging Time:	Approximately 8 hours
Power:	9-12VDC AC90 adapter supplied
Power Connector:	2.1 mm coax, center positive
Cabinet:	Stamped aluminum with black painted finish

ANTENNAS

The small dual band, VHF/UHF, DB32 antenna is a very good multi-purpose antenna capable of picking up a very wide range of frequencies from 100MHz to 2GHz. There are other antennas available that are useful for specific frequency ranges.

RD27	26-150MHz
RD150	144-165MHz
RD440	440-480MHz
RD800	500MHz-1GHz
RD2400	2400-2500MHz.
BB85	100MHz-2GHz
TA100S	100MHz-600MHz

FILTERS

The N100 FM broadcast notch filter will remove the influence from local FM stations.

SERIAL DATA INTERFACE

In order to download the memories of the M1, the Optoelectronics Optolinx serial data interface is needed. The Optolinx universal PC interface adapts for use with a wide variety of receivers, frequency counters and frequency recorders for the purpose of computer control of a receiver and downloading memories of the M1. The Optolinx comes supplied with the CB-CI5 cable, which is necessary in order to interface the M1 to the Optolinx for downloading.

Factory Service

PRODUCT WARRANTY
Optoelectronics, Inc. warrants all products and accessories for one (1) year against defects in materials and workmanship to the original purchaser. Products returned for warranty service will be repaired or replaced at Optoelectronics' option.

Specifically excluded are any products returned under this warranty that upon examination, have been modified, had unauthorized repairs attempted, have suffered damage to the input circuitry from the application of an excessive input signal, have suffered damage to the charging circuitry or internal batteries from the application of excessive voltage, or show other evidence of misuse or abuse. Optoelectronics reserves sole right to make this determination.

No other warranties are expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Optoelectronics, Inc. is not liable for consequential damages.

WARRANTY
Products under warranty must be returned, transportation prepaid, to Optoelectronics' service center. All parts replaced and labor performed under warranty are at no charge to the customer.

NON-WARRANTY
Products not under warranty must be returned, transportation prepaid, to Optoelectronics' service center. Factory service will be performed on a time and materials basis at the service rate in effect at the time of repair. A repair estimate prior to commencement of service may be requested. Return shipping will be added to the service invoice and is to be paid by the customer.

RETURN POLICY

The Optoelectronics Service Department will provide rapid turnaround of your repair. A return authorization is required. Enclose complete information as follows:

1. Copy of sales receipt if under warranty.
2. Detailed description of problem(s).
3. Complete return address and phone number (UPS street address for USA).
4. Proper packaging (insurance recommended). Note: Carriers will not pay for damage if items are improperly packaged.
5. Proper remittance including return shipping, if applicable (Visa/MasterCard number with expiration date, Money order, Company PO, etc.). Note: Personal checks are held for a minimum of two weeks before shipment.

Address all items to:

Optoelectronics, Inc.
Service Department
160 West Camino Real #233
Boca Raton, FL 33432

If in question, contact the factory for assistance. Service Department: (954) 642-8997
Monday - Friday 8:30 AM to 5:00 PM Eastern Time.