

DM-1 Deviation Meter Operating Manual

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Introduction

Congratulations on your purchase of the DM-1 Deviation Meter. The DM-1 was designed to permit easy measurement and adjustment of the deviation of FM transmitters operating in the 140, 220 or 440 MHz. amateur bands.

Even though the DM-1's functions are straightforward and easy to use, please read through this manual. The following pages contain some excellent notes and tips to help you get the most from your Deviation Meter.

Features

- Fixed-tuned to ensure stability and to eliminate the need for tuning.
- Dual ranges allowing sufficient resolution for accurate measurement of voice, data, DTMF and subaudible modulation.
- External digital or analog meter expandability for increased resolution.
- A low-level de-emphasized audio output for monitoring audio quality through an external amplifier.
- Compact and battery-powered for convenient use anywhere.

Specification

Frequencies:	147.9 MHz., 222.1 MHz., 444.1 MHz.
Deviation Ranges:	± 1 kHz.; ± 5 kHz. full scale
Readout:	10 segment LED bar and provisions for external meter
Deviation resolution (LED):	50 Hz. on 1 kHz. range; 250 Hz. on 5 kHz. range (<i>Greater with external meter</i>)
Accuracy:	$\pm 5\%$ of full scale
Audio Freq. Response:	± 2 dB. from 10 Hz. to 300 Hz. (1 kHz. range); ± 3 dB. from 10 Hz. to 5000 Hz. (5 kHz. range)
Sensitivity (WHIP input):	< 100 mV.
Operating power (through):	100 mW. - 100 Watts
SWR:	<1.3
Audio de-emphasis:	750 us.
Battery:	Standard 9 Volt alkaline
Battery current:	60 mA. typical
Battery life:	6-8 hours typical
Size:	6 ^{1/8"} W x 4 ^{3/4"} L x 1 ^{3/8"} H
Weight:	1 lb.

Operation

Battery installation

Turn the DM-1 Deviation Meter off before installing a battery. Two screws (one on each side of the DM-1) allow access to the battery compartment. Use one standard 9-volt alkaline battery.

Replace the screws on the sides of the Deviation Meter and battery installation is complete. Replace batteries following the same procedure.

NOTE:

When the battery voltage drops below approximately 5.5 Volts, the DM-1 is automatically disabled to prevent erroneous readings.

To turn on

Press the ON/OFF button to turn the Deviation Meter on.

Selecting a deviation range

Select the deviation range. When making measurements on sub-audible tones, use the ± 1 kHz. range. Otherwise, use the ± 5 kHz. range.

NOTE:

When the ± 1 kHz. range is selected, frequencies above 300 Hz. are rolled off to avoid errors due to high frequency noise. Therefore, deviation readings with modulating frequencies above 300 Hz. must not be made on this range.

Connections

Connect your transmitter to the INPUT coaxial connector on the DM-1, and the antenna to the OUTPUT connector, using adaptors if necessary. (If it is more convenient, you can swap the input and output cables.) Insertion loss and SWR are low enough that the DM-1 may be left in the line if desired.

Alternatively, a short piece of #12 AWG wire (or smaller wire soldered to a standard pin plug) may be used as a pickup antenna by plugging it into the WHIP pin jack on the rear of the DM-1. In most cases, this will provide enough signal from a nearby transmitter such as a handheld transceiver in close proximity.

Measuring Deviation

Set the transmitter frequency to 147.9, 222.1 or 444.1 MHz. Key the transmitter, apply modulation, and read the deviation from the LED bar using the scale corresponding to the selected range.

If you wish, you can connect a voltmeter to the METER pin jacks on the rear panel to give an analog readout with better resolution than the LED bar can provide. A full scale reading (1 kHz. or 5 kHz., depending on the selected range) produces 1 Volt at these jacks.

If you have a spare ammeter (200 uA. to 1 mA. full scale), you can use it instead with an appropriate series resistor. (Depending on the meter, you may need to adjust R45. If you do so, you may want to mark the factory setting first.) Make sure the meter you use has a linear response.

NOTES:

- 1) *When two adjacent segments of the LED bar are lighted, the deviation is approximately halfway between the values represented by those two bars.*
 - 2) *Sometimes a transient, for example from keying the transmitter, may “peg” the LED bar or external meter. Make sure the DM-1 has had a couple of seconds to recover from the transient before reading deviation.*
 - 3) *Random indications of deviation may occur with no signal, or a signal of the wrong frequency, applied. Turn the unit off to conserve the battery when not actually making a measurement.*
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Calibration

NOTE:

The DM-1 was calibrated at the factory. Recalibration should not be necessary unless repairs are made.

- 1) Remove the cover.
- 2) Turn the DM-1 on.
- 3) Using a frequency counter and a 10:1 scope probe, measure the frequency at test point TP. Adjust C28 with a non-metallic tool for a frequency of 74.000 MHz. Make sure the frequency is within +/- 1kHz. (73.999 - 74.001).

The next steps require the use of a calibrated frequency-modulated signal source of either 100 kHz., 74.1 MHz., or one of the three frequencies printed on the front of the DM-1.

- 4) Connect the signal source to either the INPUT or OUTPUT connector on the DM-1. Adjust the output of the signal source for at least 100 mV., and the deviation for +/- 5 kHz. at a modulating frequency of either 400 Hz. or 1 kHz.
- 5) Preset trimpot R6 fully counter-clockwise. The LED bar should have segments lighted near the center of the bar. Adjust trimpot R6 clockwise until the right two segments are lighted. (They may be flickering slightly.) Adjust the trimpot further clockwise until the right-most segment is lighted, and the segment next to it just goes out and stays out (stops flickering).
- 6) Connect a digital voltmeter between the METER jacks on the back. Adjust R45 for a reading of 1.0 Volt.
- 7) Disconnect the test equipment and replace the cover.

Circuit Description

Radio frequency enters the DM-1 either directly through the WHIP input J1 or the stripline coupler between coaxial connectors J2 and J3. The stripline coupler provides 20 - 30 dB. of attenuation to the input signal, depending on frequency. The signal is limited by diodes D1 and D2 to prevent damage to mosfet mixer Q1, with the remaining voltage getting dropped across R30.

Q1 mixes the input signal with 74 MHz. from crystal oscillator Q3 and buffer Q4, producing an intermediate frequency (IF) of 100 kHz. L1 and C3 resonate at this frequency, and L2, R3 and C4 provide additional filtering of any the input and local oscillator signals appearing at the drain of Q1. Q2 is biased to translate the low level 100 kHz. output of Q1 to a TTL-compatible signal to drive U1.

U1 is a retriggerable one-shot with Schmitt-trigger inputs and an output pulse width of approximately 5 microseconds, as determined by R6, R7 and C7. Since this pulse width is fixed, the duty cycle of U1's output is determined by the instantaneous IF frequency. Since the output levels of U1 are fixed TTL levels, U1 acts as a limiter to remove amplitude variations from the IF. Changes in the IF due to frequency modulation cause changes in the duty cycle of this square wave, so that its average value is a linear representation of the modulation. Adjusting R6 changes the quiescent duty cycle enough to allow calibration.

Active lowpass filters U2A and U2B remove the IF, leaving the original modulation. U2 is biased to half the battery voltage by R17, R20 and C14. R9 and C10 attenuate the output of U1 enough to prevent it from overloading U2A at low battery voltages.

U4A is configured as a peak detector. The response of the display is determined by the time constant of R58 and C35. D7 prevents transients from over-charging C35, which would result in longer recovery times.

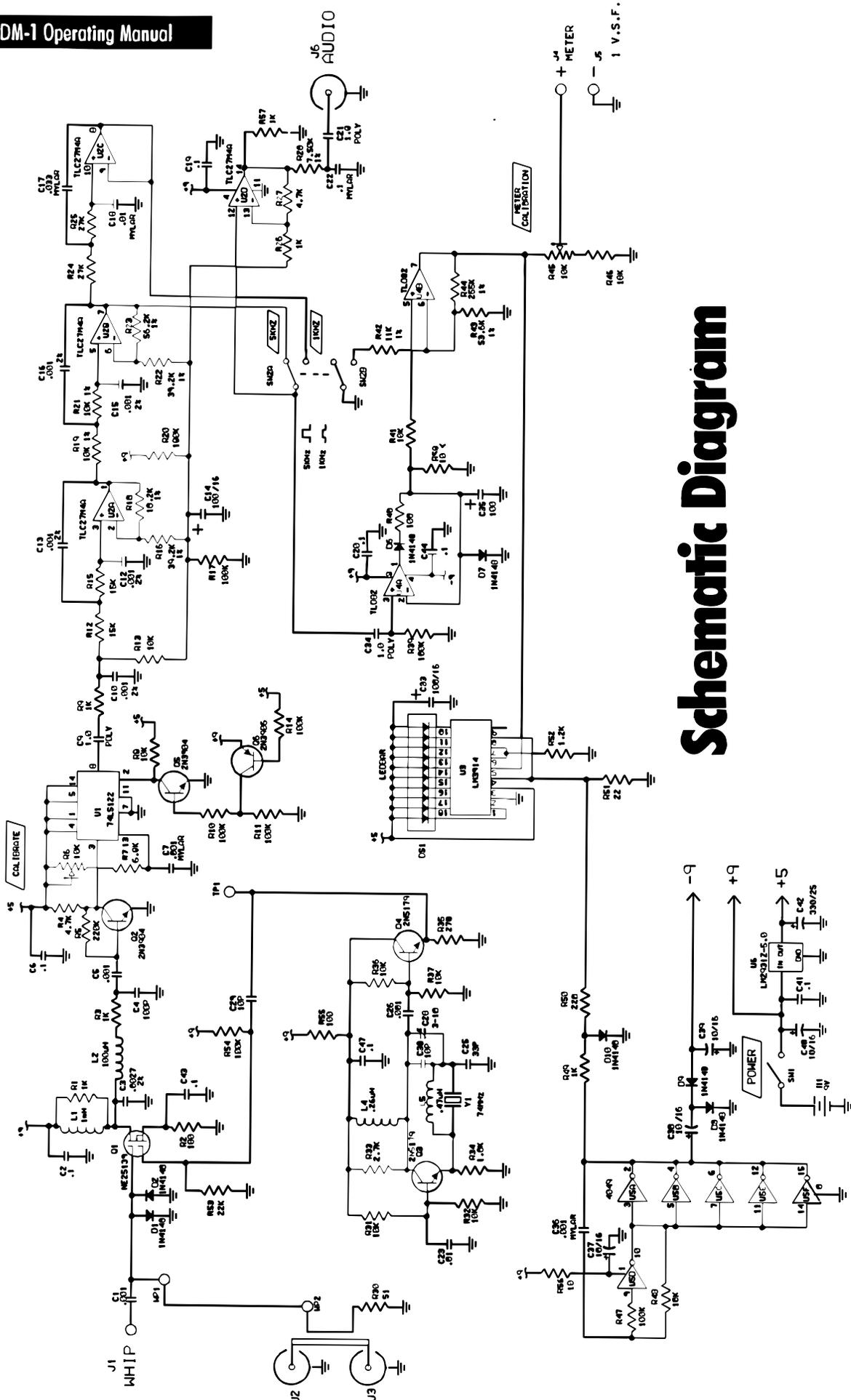
U4B provides the gain required for full-scale readings. When the 1 kHz. range is selected, U4B's gain is increased by a factor of 5, and low-pass filter U2C cuts off at 300 Hz. to remove high frequency noise, allowing accurate readings with sub-audible tones.

U2D provides audio for an external monitor amplifier. R28 and C22 provides 750 uS. de-emphasis.

U5 is configured as a square-wave oscillator driving a charge pump to provide a negative potential for U4.

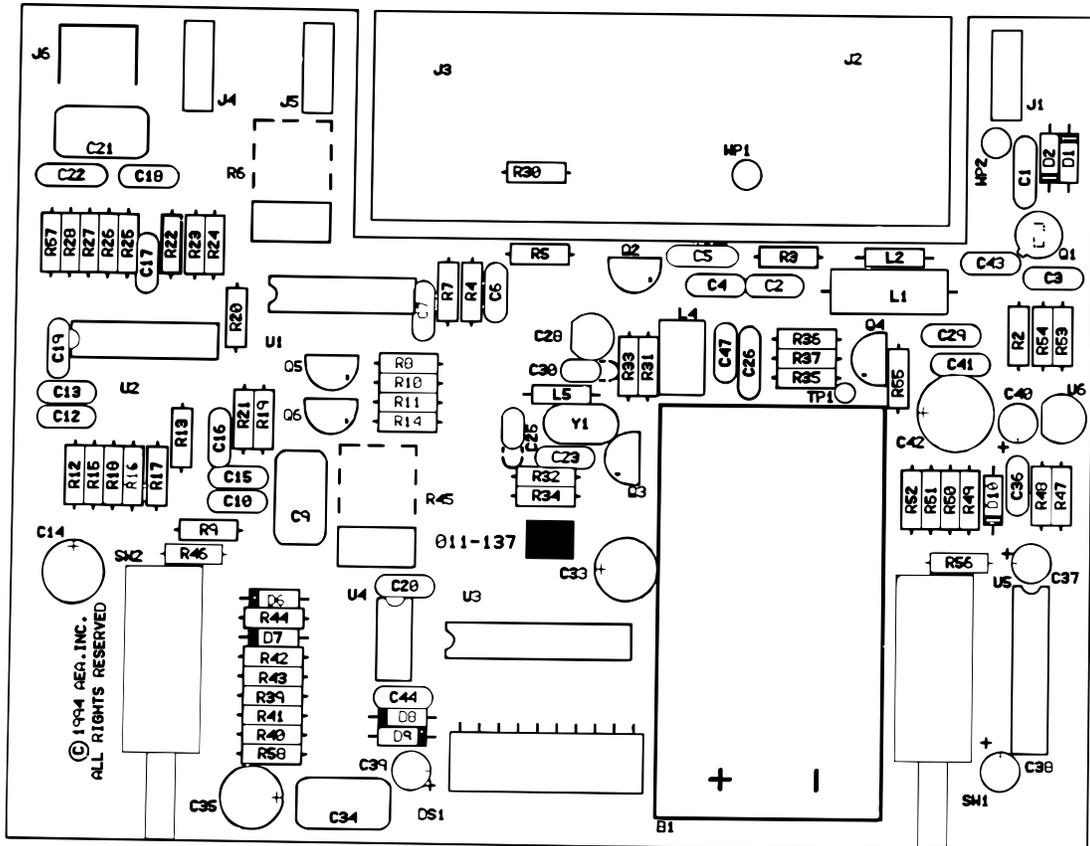
Bargraph driver U3 displays the output voltage of U4B, which is proportional to the peak deviation. To provide double the resolution of the bargraph, the display is dithered by injecting a 60 mV. square-wave derived from U5. The forward voltage drop of D10 provides adequate regulation of this signal. An input of approximately 1.25 Volts at U3 pin 5 provides a full-scale reading. R45 and R46 drop this to 1 Volt full-scale for an external meter.

U6 is a low-dropout regulator which ensures that the output of U1 remains constant throughout the battery life. Q5 and Q6 disable U1 when the battery voltage reaches 5.5 Volts, at which point the battery should be replaced.



Schematic Diagram

Parts Pictorial



If You Need to Call for Help

Call our Customer Service/Technical Support line at (651) 489-5080 between 8:30 a.m. and 5:00 p.m. Central time, weekdays.

Timewave also provides technical assistance by email at techsupport@timewave.com. You may also fax us at (651) 489-5066.

Many of the products that are sent to us for repair are in perfect working order when we receive them. For these units, there is a standard checkout fee that you will be charged. Please perform whatever steps are applicable from the installation sections of this manual before you call or write—you'll only add to the cost of your phone bill if you don't! Please **don't** return your DM-1 to us without contacting us first: we'd like to help you troubleshoot the problem over the phone (or by mail) first, saving you both time and money.

If you're instructed by one of our technicians to return your unit to us, write the RMA number issued to you on the outside of the shipping carton—it will speed the processing of your unit. Inside the carton, enclose a note with your name, address, daytime phone number, RMA number, and a description of your DM-1's problem.

Our street address is:

Timewave Technology Inc.
1025 Selby Ave.
St. Paul, MN 55104 USA

We'll need your street address for UPS return—be sure to include it. UPS Surface (Brown Label) takes 7-10 days to reach us depending on your location, Blue takes 2-3 days. Red is an overnight service and is expensive. Send the DM-1 in a way that it can be traced if we can't verify receipt of shipment. We suggest UPS or insured postal shipment.

When you call for an RMA number, the technician can estimate the repair charges for you over the phone. This is another good reason to call us before sending your unit in for repair.

Typically, we repair equipment in five to ten working days after it arrives at Timewave *if we have all the facts*. If we must call you, it may take longer. Timewave isn't responsible for damage caused by lightning, nonprofessional alterations, "acts of God", shipping damage, poor storage/handling, etc. We'll make note of any shipping damage upon receipt.

Should your warranty card not be on file at Timewave, you'll need to send the proof of purchase date to receive warranty service. Typically, a copy of your invoice from an Timewave dealer will suffice. The warranty is for the original owner only and is not transferable.

Warranty

Timewave Technology Inc. products carry the following warranty:

Timewave hardware products are warranted against defects in materials and workmanship. If Timewave receives notice of such defects during the warranty period, Timewave shall, at its option, either repair or replace hardware products which prove to be defective.

Timewave software and firmware products which are designated by Timewave for use with a hardware product are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If Timewave receives notice of such defects during the warranty period, Timewave shall, at its option, either repair or replace software media or firmware which do not execute their programming instructions due to such defects. Timewave does not warrant that operation of software, firmware, or hardware shall be uninterrupted or error free.

The warranty period for each product is one year from date of shipment.

Limitation of Warranty

The forgoing warranty shall not apply to defects resulting from:

1. Improper or inadequate maintenance by the Buyer;
2. Buyer-supplied software or interfacing;
3. Unauthorized modification or misuse;
4. Operation outside the environmental specifications of the products;
5. Improper site preparation and maintenance.

Exclusive Remedies

The remedies provided herein are the Buyer's sole and exclusive remedies. In no event shall Timewave be liable for direct, indirect, special, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.

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