Operating Manual
DM-1 Deviation Meter

AEA
Connect with us

Proprietary Information

Reproduction, dissemination, or use of information contained in this manual for purposes other than operation and/or maintenance of product is prohibited without written authorization from Advanced Electronic Applications, Inc.

Copyright Notice

Table of Contents

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.

Specifications

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 *(Greater with external meter)*
Accuracy:	± 5% of full scale
Audio Freq. Response:	± 2 dB from 10 Hz to 300 Hz (1 kHz range); ± 3 dB from 10 Hz to 10 kHz (5 kHz range)
Sensitivity (WHIP input):	< 100 mV
Operating power (through):	1 W - 100 W
SWR:	<1.3 : 1
Audio de-emphasis:	750 µs
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.

Insert the battery into the holder noting polarity. 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 CTCSS (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 will not be accurate.

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.

NOTE:

When using the DM-1 to adjust your deviation, please be considerate of your fellow hams and use a dummy load. This prevents you from disturbing communications on the frequency you are transmitting on. If you must test with your antenna, then use low power and use short transmissions.

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.

NOTE:

The transmitter's frequency must be reasonably accurate to be passed by a low Q tank on the output of the mixer, but can be off frequency by a few kilohertz without affecting accuracy.

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.*

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 energy 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 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.
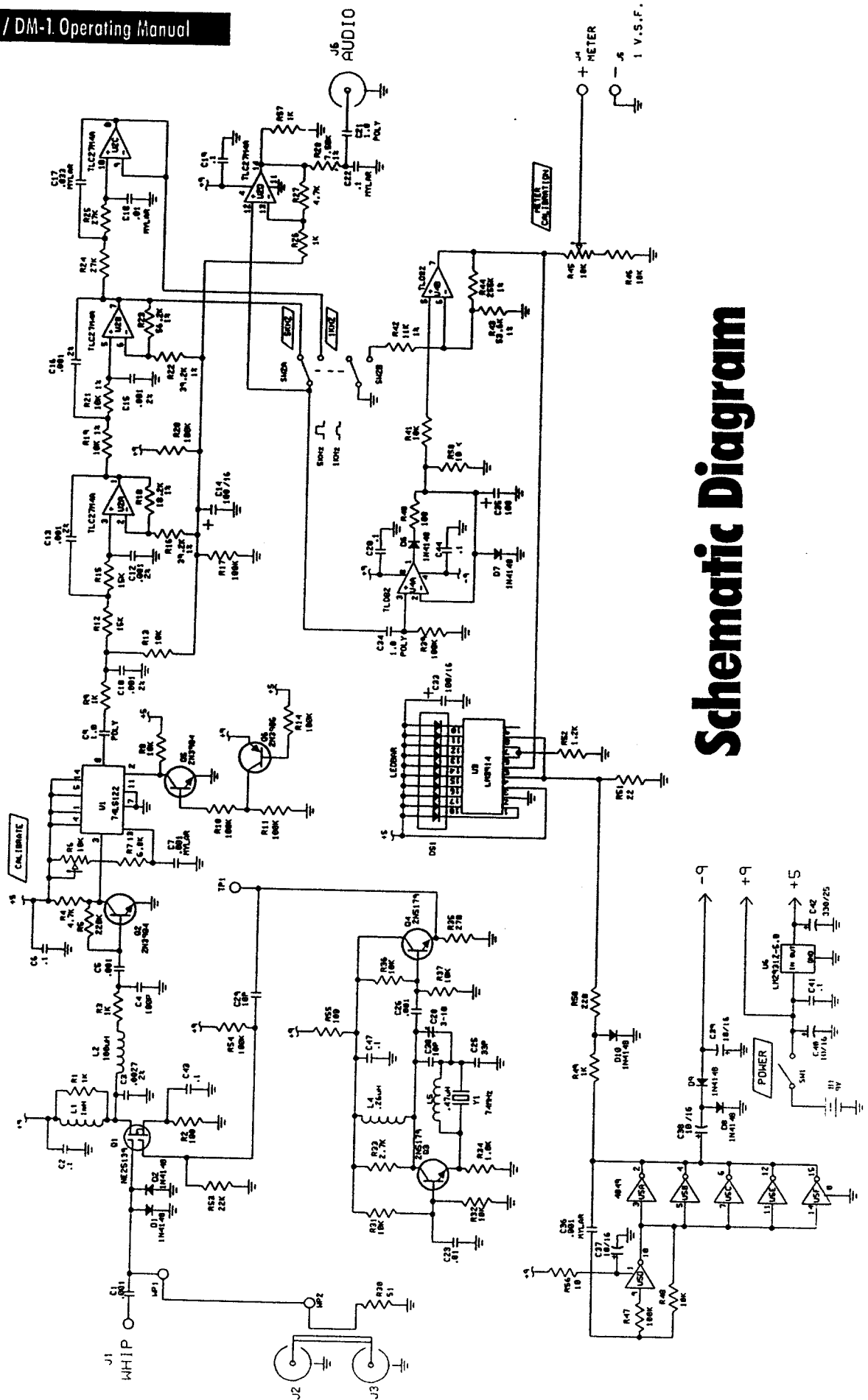
Schematic Diagram

Parts Pictorial
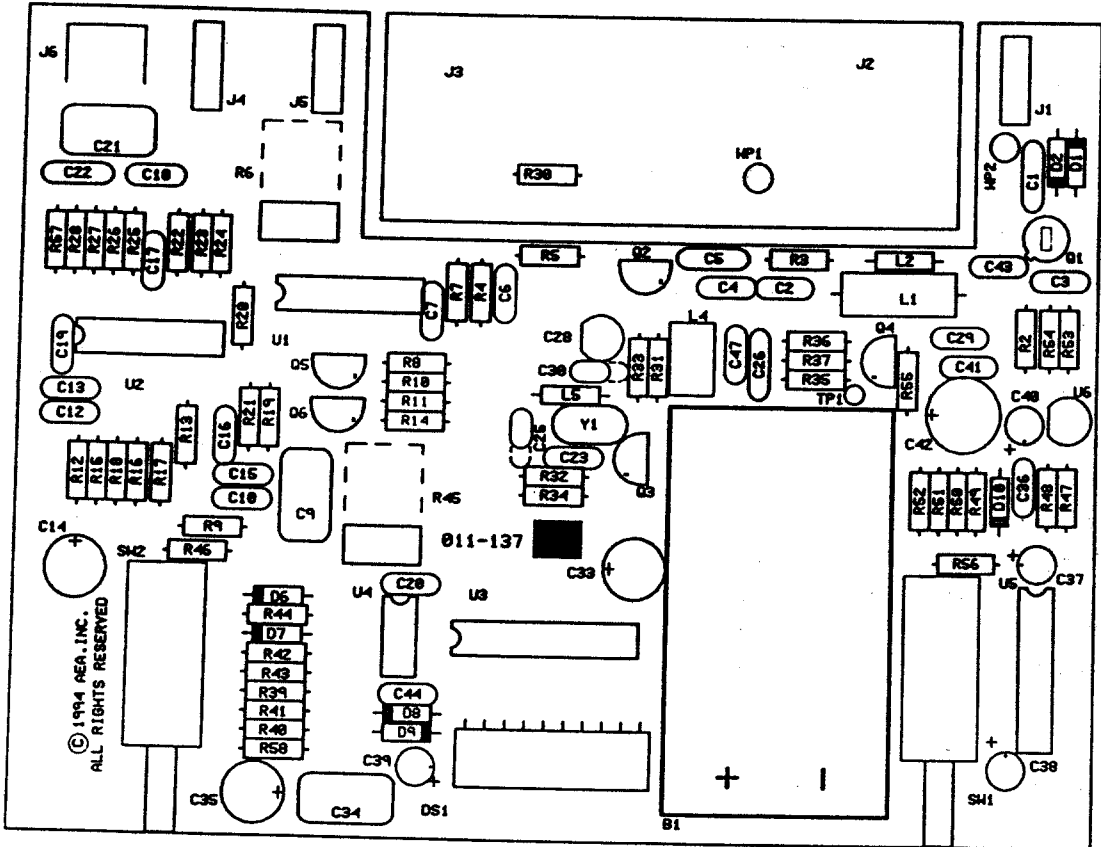
In Case of Trouble

For assistance, please call AEA between 8:00 a.m.–4:00 p.m., Pacific Time. The Customer Service phone number is (206) 775-7373.

You may wish to attempt to solve problems locally using other hams or an AEA dealer. A helpful amateur with equipment similar to your own may be just around the corner.

AEA provides Technical Support for its line of Amateur Radio equipment by way of your personal computer and modem via CompuServe. Leave mail for 76702,1013; we check CompuServe every business day. If you are not a CompuServe user and would like to receive a free introductory CompuServe membership, call 1-800-848-8199 and ask for Representative 48. Tell them you want a starter kit.

Many of the AEA products that are sent to us for repair are in perfectly good order when we receive them. Please read this manual carefully and make sure you have correctly interfaced your unit before you call.

Call our service department for a Return Authorization Number before you return a unit to us for service. This gives our Customer Service personnel a chance to talk with you about the problem. Most problems can be solved over the phone, saving you time and money. When a unit is returned, to us it must be shipped freight prepaid. We will not accept COD shipment on returned units. **Also, please include a complete description of the problem you are having.** This is the most important step in returning a unit. In addition, make sure you have included your return address plus a daytime and evening telephone number where we can reach you if we need to.

Typically, we will service the product in five to ten working days after it has arrived at AEA if we have all the facts about the problem. If we must call you, it may take longer. **Please** include a letter stating the problem and where you can be reached by telephone. If possible, please give us both a work and a home telephone number where we can reach you, plus the times you are available to take calls at both numbers.

Warranty

ADVANCED ELECTRONIC APPLICATIONS, INC. warrants to the original purchaser that this product shall be free from defects in material or workmanship for one year from the date of original purchase. In order to obtain warranty service: 1) Complete and mail the warranty registration card within 10 days to Advanced Electronic Applications, Inc., and 2) Send written notification to the address below or telephone as soon as possible after discovering a possible defect:

Advanced Electronic Applications, Inc.
Attention: Service Department
P.O. Box C2160
2006-196th St. SW
Lynnwood, WA 98036
(206) 775-7373

The written notification must include a copy of the invoice. Include a description of the defective part or condition with details of the electrical connections to associated equipment and list such equipment. Please enclose your name, phone number, and address. Shipping charges for any parts or units submitted for replacement under this warranty must be paid by the purchaser. Correct maintenance, repair and use are important to insure proper performance from this product. Carefully read the Instruction Manual. This warranty does not apply to any defect AEA determines is caused by 1) Improper maintenance or repair, including the installation of parts or accessories that do not conform to the quality and specification of the original parts; 2) Misuse, abuse, neglect, or improper installation; 3) Accidental or intentional damage. The field installation of circuits according to the explicit instructions of AEA will not nullify this warranty. All implied warranties, if any, terminate one year from the date of original purchase. AEA is not responsible for damage to other equipment or property or any other consequential damages. Some states do not allow limitations of how long an implied warranty lasts or do not allow the exclusion of incidental or consequential damages; therefore, the above limitations and exclusions may not apply to you. This warranty gives specific legal rights. You may also have other rights which vary from state to state.