



OPERATING AND SERVICE MANUAL

(HP PART NO. 03400-90008)

MODEL 3400A RMS VOLTMETER

SERIALS PREFIXED: 1140A*

* Appendix C, Manual Backdating Changes, adapts this manual to instruments with serial numbers 0979A13725 and below, and serials prefixed: 322-, 401-, 528-, and 714--.

CALIBRATION LAB
INSTRUCTION MANUAL FOR

RMS mtr

Model #: *3400A* Date: *6 Feb 98*

Cal Tech: *J. Mckersk*

PROPERTY
OF
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P. O. DRAWER 1343
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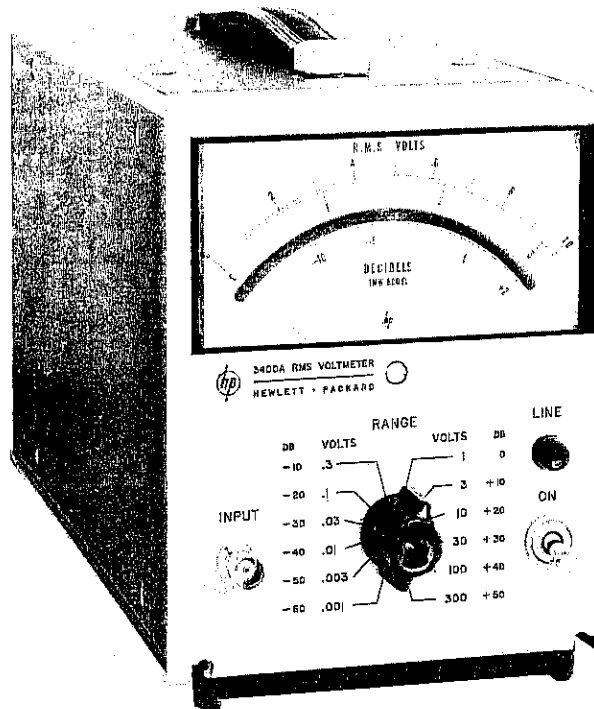


Table 1-1. Model 3400A Specifications

<p>VOLTAGE RANGE: 1 mV to 300 V full scale, 12 ranges.</p> <p>DB RANGE: -72 to +52 dBm (0 dBm = 1 mW in 600Ω).</p> <p>FREQUENCY RANGE: 10 Hz to 10 MHz.</p> <p>RESPONSE: Responds to rms value (heating value) of input signal.</p> <p>METER ACCURACY: % of Full Scale (20°C to 30°C)*</p> <table border="1"> <thead> <tr> <th>10 Hz</th> <th>50 Hz</th> <th>1 MHz</th> <th>2 MHz</th> <th>3 MHz</th> <th>10 MHz</th> </tr> </thead> <tbody> <tr> <td>±5%</td> <td>±1%</td> <td>±2%</td> <td>±3%</td> <td>±3%</td> <td>±5%</td> </tr> </tbody> </table> <p>AC-to-DC CONVERTER ACCURACY: % of Full Scale (20°C to 30°C)*</p> <table border="1"> <thead> <tr> <th>10 Hz</th> <th>50 Hz</th> <th>1 MHz</th> <th>2 MHz</th> <th>3 MHz</th> <th>10 MHz</th> </tr> </thead> <tbody> <tr> <td>±5%</td> <td>±0.75%</td> <td>±2%</td> <td>±3%</td> <td>±3%</td> <td>±5%</td> </tr> </tbody> </table> <p>OUTPUT: Negative 1 V dc into open circuit for full-scale deflection, proportional to meter deflection; 1 mA maximum; nominal source impedance 1000Ω.</p>	10 Hz	50 Hz	1 MHz	2 MHz	3 MHz	10 MHz	±5%	±1%	±2%	±3%	±3%	±5%	10 Hz	50 Hz	1 MHz	2 MHz	3 MHz	10 MHz	±5%	±0.75%	±2%	±3%	±3%	±5%	<p>OUTPUT NOISE: < 1 mV RMS.</p> <p>CREST FACTOR: (ratio of peak-to-rms amplitude of input signal): 10:1 at full scale (except where limited by maximum input), inversely proportional to meter deflection (e.g., 20:1 at half-scale, 100:1 at tenth-scale).</p> <p>INPUT IMPEDANCE: 0.001 V to 0.3 V range; 10 MΩ shunted by <50 pF; 1.0 V to 300 V range; 10 MΩ shunted by <20 pF. AC-coupled input.</p> <p>AC OVERLOAD: 30 dB above full scale or 800 V peak, whichever is less, on each range.</p> <p>MAXIMUM DC INPUT: 600 V on any range.</p> <p>RESPONSE TIME: For a step function, < 5 seconds to respond to final value.</p> <p>POWER: 115 or 230 V ±10%, 48 to 440 Hz. approximately 7 watts.</p> <p>WEIGHT: Net 7 1/4 lbs. (3, 3kg); shipping 10 lbs. (5 kg).</p> <p>OVERALL DIMENSIONS: 6 1/2" high; 5 1/8" wide; 11 11/16" deep.</p>
10 Hz	50 Hz	1 MHz	2 MHz	3 MHz	10 MHz																				
±5%	±1%	±2%	±3%	±3%	±5%																				
10 Hz	50 Hz	1 MHz	2 MHz	3 MHz	10 MHz																				
±5%	±0.75%	±2%	±3%	±3%	±5%																				

*Temperature Coefficient: ±0.1% over range of 0°C to 20°C and 30°C to 55°C.

SCOPE OF MANUAL

This manual contains the information necessary for operating and servicing the standard Model 3400A RMS Voltmeter and the Model 3400A/Option 01 RMS Voltmeter (DB scale uppermost).

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains general information about the Model 3400A RMS Voltmeter (Figure 1-1). Included are: description of instrument, purpose, instrument identification, equipment supplied and accessory equipment available. Also included is a table of instrument specifications.

1-3. DESCRIPTION AND PURPOSE.

1-4. The Model 3400A RMS Voltmeter measures the actual root-means-square (RMS) value of ac voltages between 100 microvolts and 300 volts. Frequency range is from 10 Hz to 10 MHz. Full scale measurements of nonsinusoidal waveforms with crest factors (ratio of peak voltage to rms voltage) of 10 can be made.

1-5. Ac voltages are measured with a specified full-scale accuracy of $\pm 1\%$ from 50 Hz to 1 MHz, $\pm 2\%$ from 1 MHz to 2 MHz, $\pm 3\%$ from 2 MHz to 3 MHz, and $\pm 5\%$ from 10 Hz to 50 Hz and 3 MHz to 10 MHz. A single front panel control selects one of 12 voltage or decibel ranges.

1-6. The Model 3400A crest factor rating is 10:1 which enables full scale readings for pulses which have a 1% duty cycle. At 1/10th of full scale, pulse trains with 0.01% duty cycle (100:1 crest factor) can be accurately measured.

1-7. The Model 3400A provides a dc output which is proportional to the front panel meter reading. By using this voltage to drive auxiliary equipment, the Model 3400A functions as an rms ac-to-dc converter.

1-8. SPECIFICATIONS.

1-9. Table 1-1 contains the specifications for the Model 3400A.

1-10 INSTRUMENT AND MANUAL IDENTIFICATION.

1-11. Hewlett-Packard uses a two-section serial number. If the first section (serial prefix) of the serial

number on your instrument does not agree with those on the title page of this manual, change sheets supplied with the manual will define the differences between your instrument and the Model 3400A described in this manual. Some serial numbers may have a letter separating the two sections of the number. This letter indicates the country in which the instrument was manufactured.

1-12. EQUIPMENT SUPPLIED.

1-13. The equipment supplied with each Model 3400A is listed and described in Table 1-2.

Table 1-2. Equipment Supplied

IDENTIFICATION NUMBER	QUANTITY	DESCRIPTION
10110A	1	Adapter (BNC to dual banana jack)
8120-1348	1	Power Cord
03400-90008	1	Operating and Service Manual

1-14. ACCESSORY EQUIPMENT AVAILABLE.

1-15. The accessory equipment available is listed in Table 1-3. For further information contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

Table 1-3. Accessory Equipment Available

IDENTIFICATION NUMBER	DESCRIPTION
10503A	Cable (Male BNC to male BNC, 48 inches)
11001A	Cable (Male BNC to dual banana plug, 45 inches)
11002A	Test Lead (dual banana plug to alligator clips, 60 inches)
11003A	Test Lead (dual banana plug to probe and alligator clip, 60 in.)
456A	Current Probe

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installation and shipping of the -hp- Model 3400A RMS Voltmeter. Included are initial inspection procedures, power requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. The -hp- Model 3400A RMS Voltmeter received a careful mechanical and electrical inspection before shipment. As soon as the Model 3400A is received, verify that the contents are intact and as ordered. Although the instrument should be free of marks and scratches and in perfect electrical condition, it should be inspected for any physical damage which may have been incurred in transit. Also test the electrical performance of the instrument using the procedures given in paragraph 5-5. If any physical damage or electrical deficiency is found, refer to the warranty on the inside front cover of this manual. Should shipping of the instrument become necessary, refer to paragraph 2-14 for repackaging and shipping instructions.

2-5. POWER REQUIREMENTS.

2-6. The Model 3400A can be operated from any ac source of 115- or 230- volts ($\pm 10\%$), at 48 to 440 cycles. With the instrument disconnected from the ac power source, move the slide switch (located on the rear panel) until the desired line voltage value appears. The ac line fuse is a 0.25 amp, fast blow type for 115- or 230-volt operation. Power dissipation is approximately 7 watts.

2-7. The Model 3400A is equipped with a three-prong power cord. To protect operating personnel, it is necessary to preserve the grounding feature of this plug when using a two contact ac outlet. Use a three-prong to two-prong adapter and connect the green pigtail lead on the adapter to ground.

2-8. INSTALLATION.

2-9. The Model 3400A is a submodular unit suitable for bench top use. However, when used in combination with other submodular units it can be bench and/or rack mounted. The -hp- combining case and adapter frame are designed for this purpose.

2-10. COMBINING CASE (-hp- Models 1051A or 1052A).

2-11. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-12. ADAPTER FRAME (-hp- Part No. 5060-0797).

2-13. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office location.)

2-14. REPACKAGING FOR SHIPMENT.

2-15. The following paragraphs contain a general guide for repackaging for shipment. Refer to paragraph 2-16 if the original container is to be used; 2-17 if it is not. If you have any questions, contact your local -hp- Sales and Service Office.

NOTE

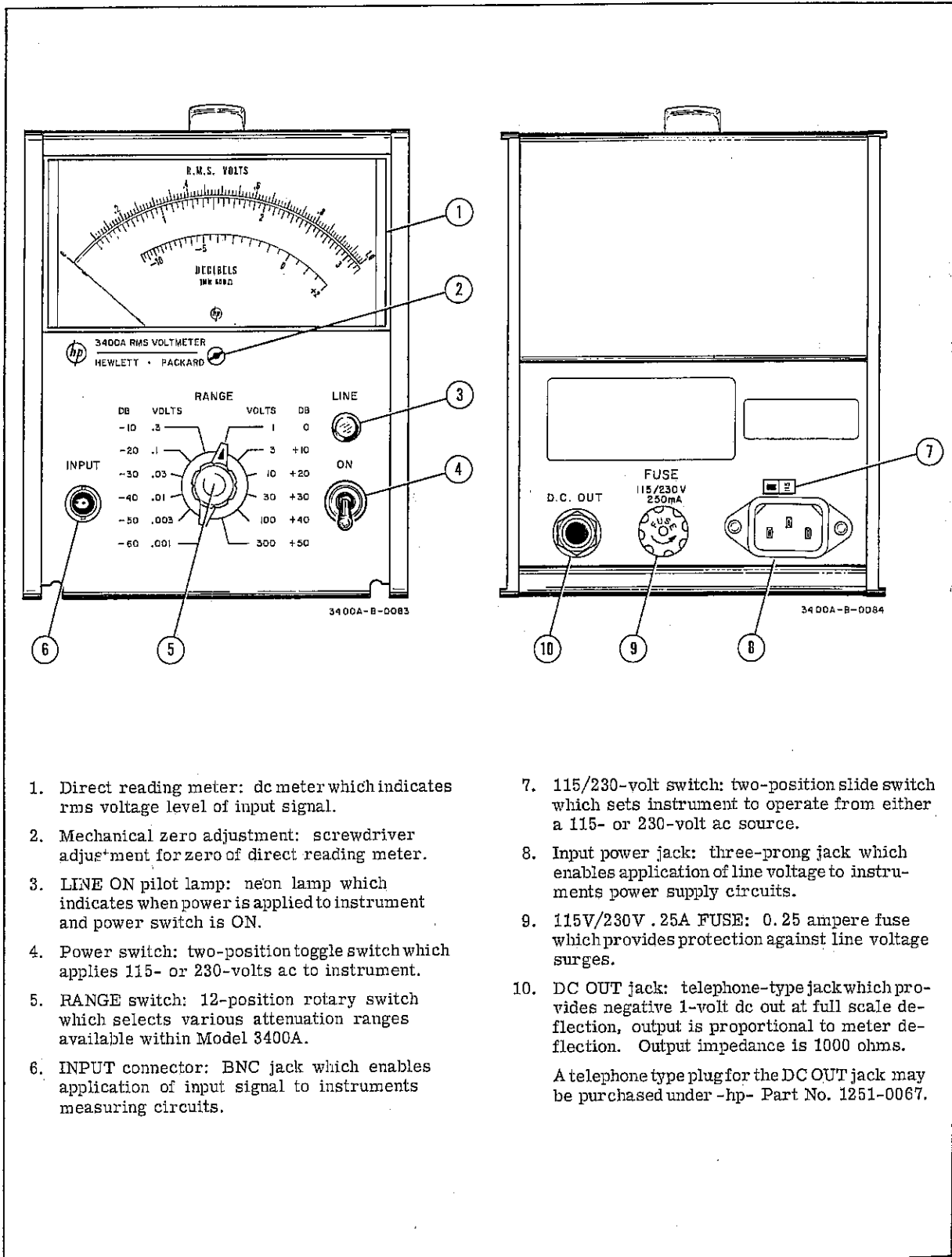
If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-16. If original container is to be used, proceed as follows:

- a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.
- b. Ensure that the container is well sealed with strong tape or metal bands.

2-17. If original container is not to be used, proceed as follows:

- a. Wrap instrument in heavy paper or plastic before placing in an inner container.
- b. Use packing material around all sides of instrument and protect panel face with cardboard strips.
- c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.
- d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.



1. Direct reading meter: dc meter which indicates rms voltage level of input signal.
 2. Mechanical zero adjustment: screwdriver adjustment for zero of direct reading meter.
 3. LINE ON pilot lamp: neon lamp which indicates when power is applied to instrument and power switch is ON.
 4. Power switch: two-position toggle switch which applies 115- or 230-volts ac to instrument.
 5. RANGE switch: 12-position rotary switch which selects various attenuation ranges available within Model 3400A.
 6. INPUT connector: BNC jack which enables application of input signal to instruments measuring circuits.
 7. 115/230-volt switch: two-position slide switch which sets instrument to operate from either a 115- or 230-volt ac source.
 8. Input power jack: three-prong jack which enables application of line voltage to instruments power supply circuits.
 9. 115V/230V .25A FUSE: 0.25 ampere fuse which provides protection against line voltage surges.
 10. DC OUT jack: telephone-type jack which provides negative 1-volt dc out at full scale deflection, output is proportional to meter deflection. Output impedance is 1000 ohms.
- A telephone type plug for the DC OUT jack may be purchased under -hp- Part No. 1251-0067.

Figure 3-1. Model 3400A Controls and Indicators

SECTION III OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section consists of instructions and information necessary for the operation of the -hp- Model 3400A RMS Voltmeter. This section contains identification of controls and indicators, turn-on procedures, and operating instructions. Also included is a discussion of the applications for the Model 3400A.

3-3. CONTROLS AND INDICATORS.

3-4. Each operating control, connector, and indicator located on the Model 3400A is identified and described in Figure 3-1. The description of each component is keyed to an illustration of that component which is included within the figure.

3-5. TURN ON PROCEDURE.

3-6. To turn on the Model 3400A, proceed as follows:

- a. Set 115/230 switch (7, Figure 3-1) to correct position for input line voltage.
- b. Apply ac voltage to Model 3400A by plugging power cord into input power jack (8) ac receptacle.
- c. Operate power switch (4) to ON; ensure that LINE indicator (3) lights.

NOTE

Allow five minutes for the Model 3400A to warm up and stabilize before making a reading.

3-7. OPERATING INSTRUCTIONS.

CAUTION

DO NOT MEASURE SIGNAL ABOVE 80 VOLTS WITH 10 TO 1 CREST FACTOR. OTHERWISE, THE MAXIMUM INPUT RATING (800 VOLTS PEAK) WILL BE EXCEEDED. WHEN MEASURING SIGNALS UP TO 80 VOLTS RMS WITH A 10 TO 1 CREST FACTOR, USE THE BNC TO DUAL BANANA JACK, ACCESSORY 10110A, SUPPLIED WITH THE INSTRUMENT, OR OTHER INPUT TEST LEADS AND CONNECTIONS THAT WILL WITHSTAND THE MAXIMUM INPUT OF 800 VOLTS PEAK.

3-8. To operate the Model 3400A as an rms voltmeter proceed as follows:

- a. Attach test lead to INPUT connector (6, Figure 3-1). (See Table 1-3 for a list of test leads available.)
- b. Set RANGE switch (5) to 300 VOLTS position.

CAUTION

WHEN MEASURING AN AC SIGNAL SUPERIMPOSED ON A DC LEVEL, ALWAYS SET THE RANGE SWITCH TO THE 300 VOLT POSITION. A HIGH VOLTAGE TRANSIENT DUE TO THE APPLICATION OF A DC VOLTAGE WILL DAMAGE THE INPUT CIRCUITRY.

- c. Connect test lead to point to be measured.
- d. Rotate RANGE switch counterclockwise until meter (1) indicates on upper two thirds of scale.

3-9. APPLICATIONS.

3-10. The Model 3400A can be used in conjunction with other test instruments to measure the rms value of ac signal with a dc component, measure rms current and act as an rms ac-to-dc converter. For additional information on special applications, contact your -hp- Sales and Service Office.

3-11. RMS VALUE OF AC SIGNALS WITH DC COMPONENT.

3-12. Since the 3400A is an ac device it will measure only the rms value of the ac component. If it is necessary to include the rms value of the dc component when measuring a signal use a -hp- Model 412A DC Voltmeter to measure the dc component. Substitute the reading from the Model 412A and Model 3400A in the following formula: The ac signal (up to 800V peak) may be superimposed on a dc level of up to 600 V.

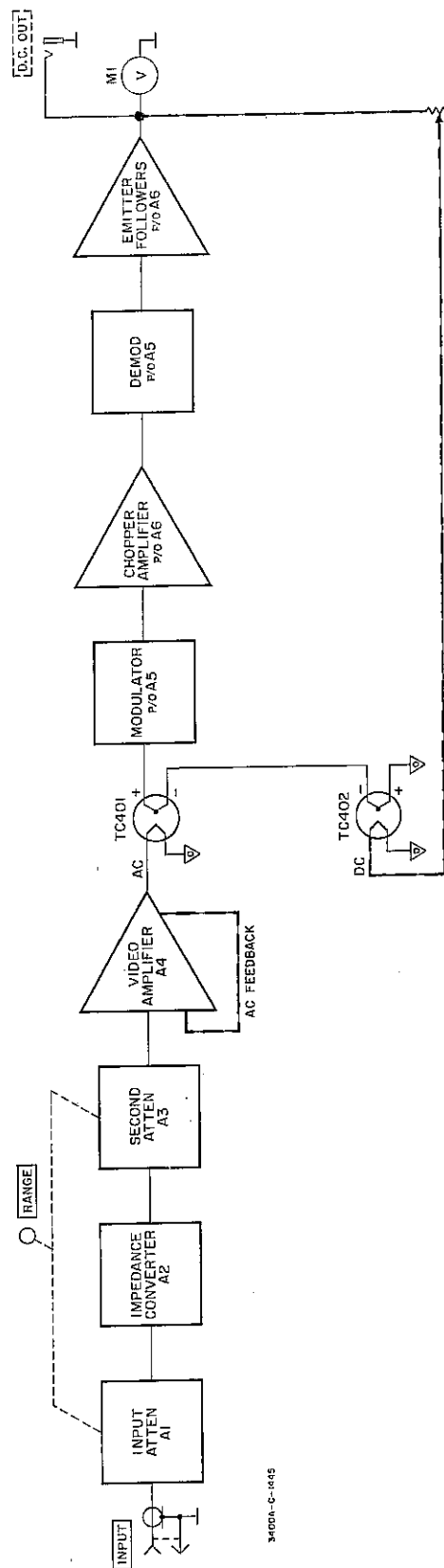
$$e_{\text{rms}} = \sqrt{e_{\text{ac}}^2 + e_{\text{dc}}^2}$$

3-13. RMS CURRENT.

3-14. To measure rms current, use an -hp- Model 456A AC Current Probe. This probe clips around the current conductor and provides an output voltage that is proportional to the current being measured. Using this method, rms currents of one milliampere to one ampere can be measured.

3-15. RMS AC-TO-DC CONVERTER.

3-16. Since the Model 3400A is provided with a dc output (10, Figure 3-1) which is proportional to the meter deflection, it can be used as a linear rms ac to dc converter. The dc output can be used to drive a -hp- Model 3440A Digital Voltmeter for high resolution measurements and/or a Mosely Model 680 Strip Chart Recorder. External loading does not affect the meter accuracy so that both the meter and dc output can be used simultaneously. A plug for DC OUT jack may be purchased under -hp- Part No. 1251-0067.



3400A-C-1045

Figure 4-1. Block Diagram