OPERATING AND SERVICE MANUAL

(HP PART NO. 00427-90002)

MODEL 427A
VOLTMETER

SERIALS PREFIXED: 731-

Appendix C, Manual Backdating Changes,
adapts manual to serials prefixed 550- and 621-

P. O. Box 301, Loveland, Colorado, 80537 U. S. A.

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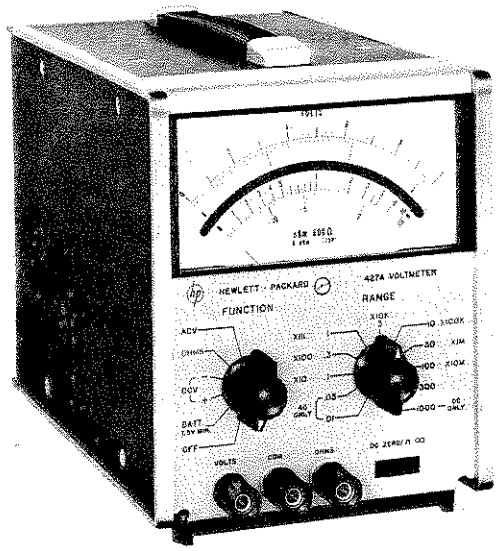


Figure 1-1. Model 427A Voltmeter

Table 1-1. Specifications

DC VOLTMETER

Voltage Ranges: ±100 mV to ±1000 V full scale in a 1, 3, 10 sequence (9 ranges).

Accuracy: ±2% of full scale on any range (0°C to 50°C).

Input Resistance: 10 megohms on all ranges.

AC Rejection: Superimposed peak ac voltages (60 Hz and above) 100 times greater than full scale affects reading less than 1%. Maximum 450 volts peak.

Overload: 1200 Vdc on any range.

AC VOLTMETER

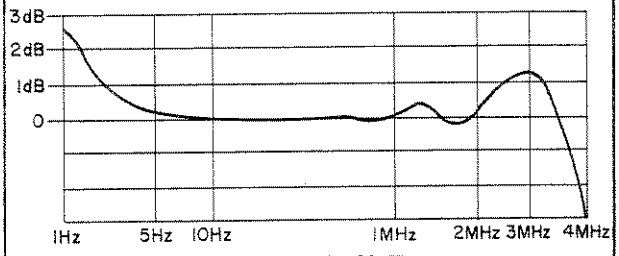
Voltage Ranges: 10 mV to 300 V rms full scale in a 1, 3, 10 sequence (10 ranges).

Frequency Range: 10 Hz to 1 MHz.

Accuracy: (0°C to 50°C).

RANGE	±2% OF FULL SCALE
0.01 V - 30 V	10 Hz - 1 MHz
100 V - 300 V	10 Hz - 100 KHz

Frequency Response:



Frequency response 10 mV to 30 V ranges.

AC VOLTMETER (Cont'd)

Input Impedance: 10 megohms shunted by 40 pF on 10 mV to 1 V ranges; 20 pf on 3 V to 300 V ranges.

Response: Responds to the average value of the input; calibrated in rms volts for a sine wave input.

Overload: 300 V/rms momentarily, 1 V range and below.
425 V/rms maximum above 1 V range.

OHMMETER

Resistance Ranges: 10 ohms center scale to 10 megohms center scale (7 ranges).

Accuracy: ±5% of reading at midscale (0°C to +50°C).

Polarity: Common terminal negative.

Source Current:

RANGE	OPEN CIRCUIT VOLTAGE	SHORT CIRCUIT CURRENT
X10	0.1 V	10 mA
X100	0.1 V	1 mA
X1K	1 V	1 mA
X10K	1 V	100 μA
X100K	1 V	10 μA
X1M	1 V	1 μA
X10M	1 V	0.1 μA

GENERAL

Floating Input: May be operated up to 500 Vdc above ground. (Ohms input open in any function except ohms--volts input open when instrument is in off position.)

Power: 22-1/2 volt dry cell battery. (Eveready No. 763 or RCA VS102.)
Option 01: Battery operation and ac line operation (selectable on rear panel). 115 or 230 V ±20%, 50 Hz to 1000 Hz, 1/2 W.

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 427A is a versatile, compact, self-contained voltmeter. It is capable of making dc measurements from 1 mV to 1000 volts, ac measurements from 0.3 mV to 300 volts at frequencies from 10 Hz to 1 MHz, and resistance measurements from 0.2 ohms to 500 megohms. With the 01 option, the Model 427A may be powered either by a 115 or 230 volt line or by an internal 22-1/2 volt dry cell battery.

1-3. The use of solid state components throughout gives the Model 427A both ruggedness and reliability. Battery operation makes the instrument ideal for field use or isolation from common mode ground loops.

1-4. Figure 1-1 shows the Model 427A, and Table 1-1 contains a list of the Model 427A Specifications.

1-5. BATTERY.

1-6. The battery used in the Model 427A is a 22-1/2 volt dry cell, Eveready No. 763 or an RCA VS102. Typical battery life is more than 300 hours continuous operation or 700 hours intermittent operation.

1-7. INSTRUMENT AND MANUAL IDENTIFICATION.

1-8. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits (prefix) of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 427A described in this manual.

1-9. If a letter prefixes the serial number, the instrument was manufactured outside the United States.

1-10. AVAILABLE ACCESSORIES.

1-11. The following accessories are available to increase the test capabilities of the Model 427A.

1-12. CABLES AND ADAPTERS.

-hp- 11001A 45" test lead, dual banana to BNC male
-hp- 11002A 5' test lead-dual banana to alligator clips
-hp- 11003A 5' test lead-dual banana to pencil probe and alligator clip
-hp- 10111A shielded BNC female to banana plug adapter

1-13. PROBES.

-hp- Model 11074A 10:1 Voltage Divider Probe extends the voltage range of Model 427A by a factor of 10.

-hp- Model 11039A 1000:1 Capacitive Voltage Divider for measuring voltages up to 24 KV.

-hp- Model 11096A High Frequency Probe extends the frequency range of the 427A to 500 MHz. The voltage range is 0.25V to 30V.

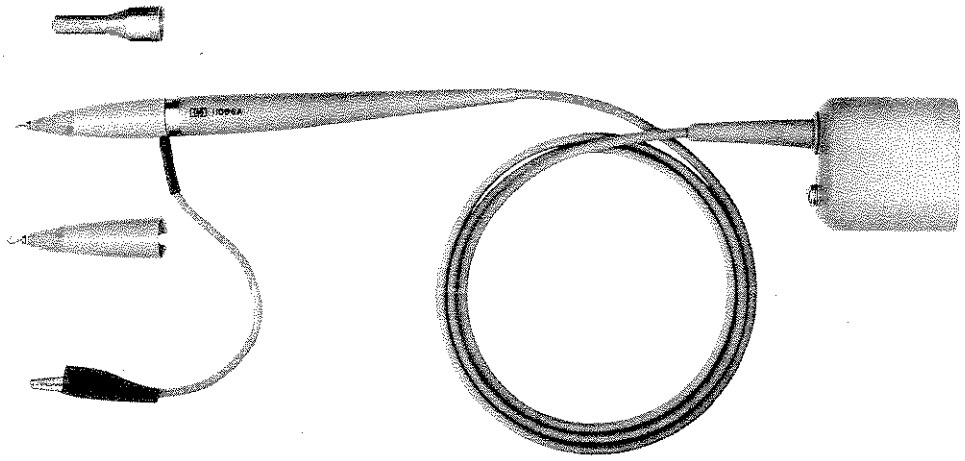


Figure 1-2. 11096A High Frequency Probe

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installation and shipping of Model 427A Voltmeter. Included are initial inspection procedures, power and grounding requirements, installation, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also, test the electrical performance of the instrument using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 427A uses a 22.5 volt dry cell battery for its primary power source. However, if Option 01 is included, the Model 427A can be operated from any source of 115 or 230 volts (±20%) at 50 to 1000 Hz. With the instrument disconnected from the ac power source, move the slide switch (located on the rear panel) until the desired line voltage appears. Power dissipation is less than 1/2 watt maximum.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Option 01 427A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the pigtail on the adapter to ground.

2-10. INSTALLATION.

2-11. The Model 427A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds +55°C (131°F). For additional information, address inquiries to your local -hp- Sales and Service Office. (See Appendix B for office locations.)

2-12. BENCH MOUNTING.

2-13. Model 427A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. Model 427A may be rack mounted by using an Adapter Frame (-hp- Part No. 5060-0797). The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only.

2-16. COMBINATION MOUNTING.

2-17. The Model 427A may be mounted in combination with other submodular units by using a Combining Case (-hp- Model 11051A). If the 427A is equipped with a carrying handle, it will be necessary to remove the top cover on 427A before inserting it into the Combining Case. The Combining Case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit itself, it can be bench or rack mounted and is analogous to any full-module instrument.

2-18. REPACKAGING FOR SHIPMENT.

2-19. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-20 if the original container is to be used; 2-21 if it is not.

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 indicating 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.

2-20. If original container is to be used, proceed as follows:

a. Place instrument in original container. If original container is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

2-21. If original container is not to be used, proceed as follows:

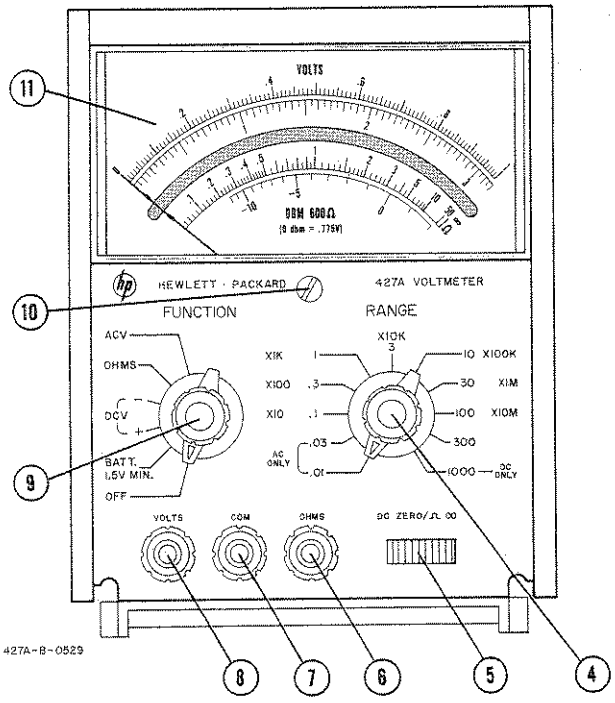
a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

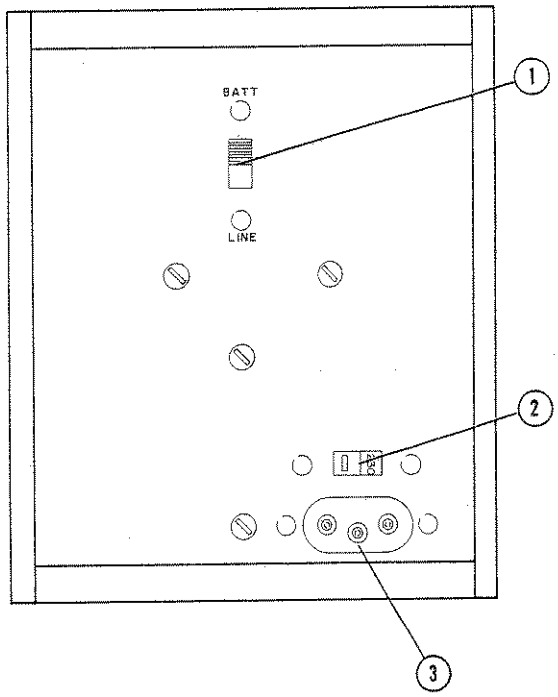
c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE" etc.

MODEL 427A FRONT PANEL



MODEL 427A REAR PANEL (OPTION 01)



(1) BATT/LINE (option 01 only) slide switch: Selects either battery or line operation.

(2) 115/230 slide switch (option 01 only): Selects either 115 Vac or 230 Vac for line operation.

(3) Line input (option 01 only): Connects ac operating power to instrument.

(4) RANGE switch: Selects appropriate range of unknown input.

(5) DC ZERO/Ω ∞ thumbwheel: Used to electrically zero the instrument in DC mode and to infinity-set the instrument in OHMS mode.

(6) OHMS terminal: Connects unknown resistance to instrument.

(7) COM terminal: Connects to instrument common. (Common input for ACV, OHMS and DCV.)

(8) VOLTS terminal: Applies unknown ac or dc voltage to instrument.

(9) FUNCTION switch: Selects mode of operation. Selections are OFF, BATT, +DC, -DC, OHMS and AC.

(10) Mechanical zero: Mechanically zeroes the meter.

(11) Meter face: Displays the magnitude of unknown resistance or voltage in ohms or volts respectively.

Figure 3-1. Location of Front Panel Controls and Indicators

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 427A may be operated as a dc voltmeter, ac voltmeter, ohmmeter or dB meter. This section contains operating instructions for each mode of operation.

3-3. FRONT AND REAR PANEL DESCRIPTION.

3-4. Figure 3-1 shows the location of all the Model 427A controls and indicators and explains the function of each. The Option 01 rear panel is shown. The standard rear panel is blank.

3-5. OPERATING INSTRUCTIONS.

NOTE

To obtain maximum battery life, set the FUNCTION switch of OFF when the instrument is not in use.

3-6. MECHANICAL ZERO ADJUSTMENT.

3-7. Before any measurements are made, complete the Mechanical Zero Adjustment in the following steps.

a. Be sure instrument has been off for at least one minute.

b. Rotate Mechanical Zero Adjustment screw CLOCKWISE until meter pointer is to the left of zero and moving upscale toward zero.

c. Continue to rotate adjustment screw clockwise. STOP when needle is exactly on zero. If needle overshoots, repeat step b.

d. When pointer is exactly over zero, rotate adjustment screw slightly COUNTERCLOCKWISE to relieve tension on suspension. If the pointer moves to the left, repeat whole procedure, but make the counterclockwise rotation less.

3-8. TURN-ON PROCEDURE.

3-9. STANDARD INSTRUMENT.

a. Rotate the FUNCTION Switch to BATT/1.5 MIN position.

b. The meter should read 1.5 or higher on the 0-3 scale on any range, indicating that the battery voltage is 15 volts or higher. If the reading is below 1.5, replace the battery according to the steps in Paragraph 5-54.

3-10. OPTION 01 INSTRUMENT.

a. Select either battery or line operation with the rear panel BATT/LINE slide switch. If battery operation is selected, check the battery according to Paragraph 3-9.

b. If line operation is selected, set the 115/230 slide switch to indicate the proper line voltage.

c. Rotate the FUNCTION switch to the desired function. During line operation, the BATT/1.5 MIN check position displays the output of the Option 01 power supply. The reading should be 1.5 or higher on the 0-3 scale on any range, indicating a power supply output of 15 volts or more. This serves as a convenient check of the Option 01 power supply.

3-11. DC MEASUREMENTS.

a. Rotate the FUNCTION switch to +DCV or -DCV depending on the polarity of the input.

b. Short the VOLTS input to the COM input, rotate RANGE to 0.1, and adjust the DC ZERO/Ω∞ thumbwheel for zero meter deflection.

c. Remove shorting connection. If there is a zero offset with COM and VOLTS open, refer to Paragraph 4-16 and Paragraph 5-30.

d. Select approximate range of input with RANGE switch.

CAUTION

DO NOT APPLY MORE THAN 1200 VDC TO ANY DC RANGE.

e. Connect input across VOLTS and COM terminals and read magnitude of input on meter.

3-12. RESISTANCE MEASUREMENTS.

CAUTION

DAMAGE TO 427A INPUT CIRCUIT MAY RESULT IF DC OR AC VOLTAGE IS APPLIED TO OHMS TERMINAL.

a. Rotate the FUNCTION switch to OHMS.

b. Select the approximate range with the RANGE switch; and with the input terminals open, adjust the DC ZERO/Ω∞ thumbwheel for an ∞ indication on the ohms scale. (Pointer should rest on the mark just to the left of ∞).

c. Connect the unknown resistance across the OHMS and COM terminals. Read the resistance value on the ohms scale.

NOTE

For best accuracy, select an ohms range that will place the meter pointer near the center of the scale.

3-13. AC MEASUREMENTS.

3-14. The Model 427A responds to the average value of the ac input and is calibrated in rms volts for a sine wave input. Since the average value and the rms value of a non-sinusoidal signal are different, any distortion on the input will affect the accuracy of the reading. Table 3-1 shows the effect of harmonic distortion on a reading.

NOTE

The following table is universal in application since these errors are inherent in all average-responding voltmeters. The error shown above may vary with the phase relationship between the harmonic and fundamental.

Table 3-1. Effects of Harmonic Distortion

INPUT VOLTAGE CHARACTERISTICS	TRUE RMS VALUE	METER INDICATION
Fundamental = 100	100	100
Fundamental + 10% second harmonic	100.5	100
Fundamental + 20% second harmonic	102	100 - 102
Fundamental + 50% second harmonic	112	100 - 110
Fundamental + 10% third harmonic	100.5	96 - 104
Fundamental + 20% third harmonic	102	94 - 108
Fundamental + 50% third harmonic	112	90 - 116

3-15. Use the following steps to make an ac measurement.

a. Rotate FUNCTION switch to ACV.

NOTE

With the input shorted, there may be a zero offset of about two minor divisions. This is caused by the bias current through the meter bridge and does not affect the accuracy of ac measurements as the meter moves upscale.

b. Rotate RANGE switch to approximate range of input voltage.

CAUTION

DO NOT APPLY MORE THAN 425V RMS WHEN THE INSTRUMENT IS ON RANGES ABOVE 3, OR MORE THAN 300V RMS ON RANGES BELOW 3.

c. Connect the signal to be measured to the VOLTS and COM terminals and read the magnitude on the voltage scale.

3-16. DB MEASUREMENTS.

a. Making a dB or dBm measurement is essentially the same as making an ac voltage measurement. Follow the steps in Paragraph 3-13, but read the magnitude on the dB scale.

b. The 1 volt position of the RANGE switch is the 0 dBm range. Each position above 1 volt is a 10 dB increase, and each position below 1 volt is a 10 dB decrease. Table 3-2 lists the dB value of each range.

Table 3-2. DB Range Identification

RANGE	DB	RANGE	DB
300	+50	1	0
100	+40	0.3	-10
30	+30	0.1	-20
10	+20	0.03	-30
3	+10	0.01	-40

c. A given dB reading is equal to the algebraic sum of the range and the meter reading. For example, if the meter reading were -6 and the instrument were on the 10 volt (+20 dB) range, the final reading would be 20 dB - 6 dB = 14 dB.

d. The 427A meter is calibrated in dBm. 0 dBm is equivalent to 0.775 volt dropped across a 600Ω load. Consequently, any dBm measurements must be made across a total impedance of 600Ω. Measurements across other impedances will be in dB, not dBm.

e. To convert a dB reading to dBm, use the Impedance Correction Graph (Figure 3-2). For example, to convert a +30 dB reading made across a 50Ω load to dBm, locate the 50Ω load impedance on the bottom of the graph. Follow the impedance line to the heavy black line and read the meter correction at that point. The correction for 50Ω is +10.5 dBm, and the corrected reading is +40.5 dBm.

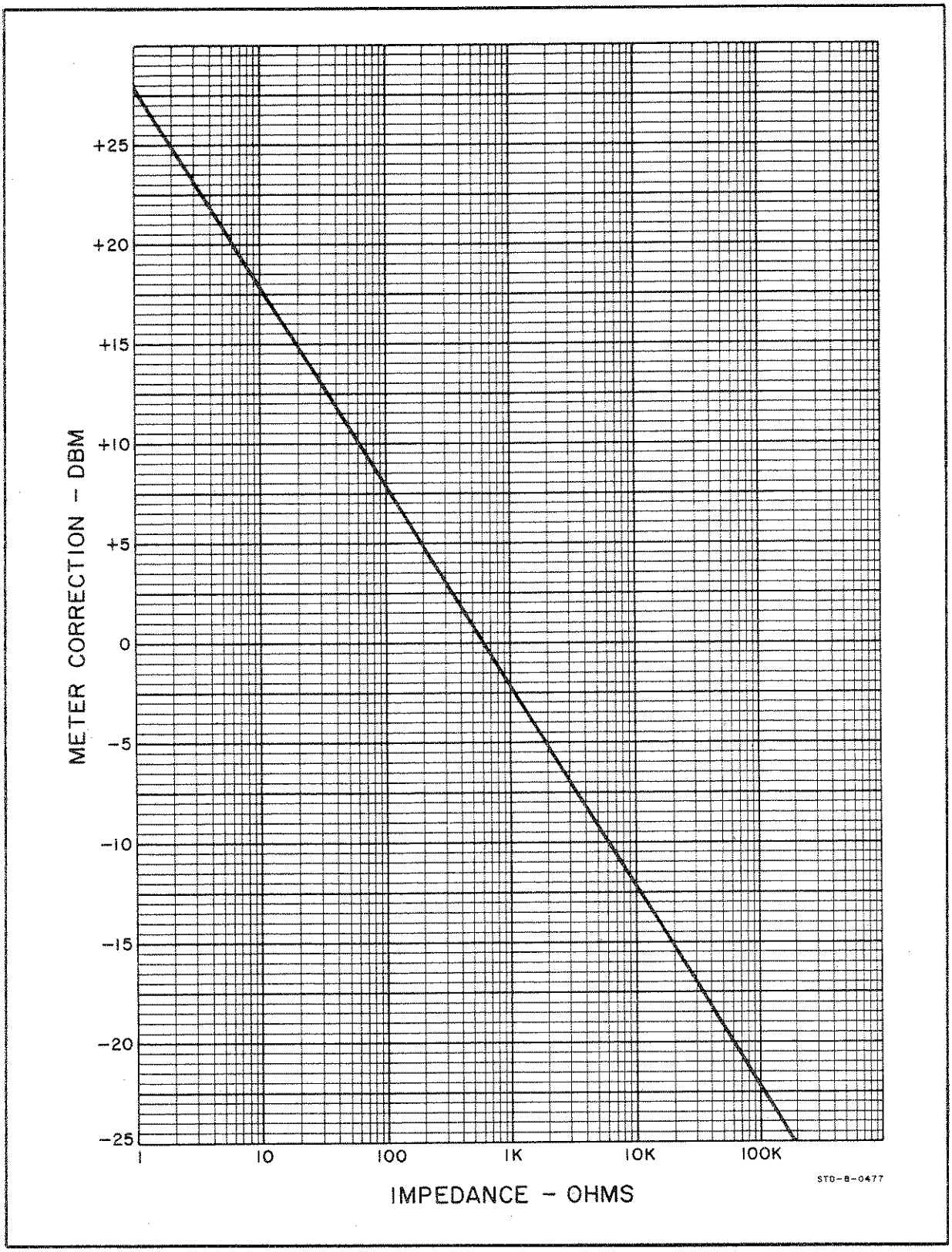


Figure 3-2. Impedance Correction Graph