OPERATING AND SERVICE MANUAL

4935A
Transmission Impairment Measuring Set

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2314A**.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

WARNING

Power switch does not turn off AC power and some DC power circuits.

MANUAL PART NO. 04935-90013
MICROFICHE PART NO. 04935-90014

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WARNING

SAFETY

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THIS INSTRUMENT, the protective earth terminals of this instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

GROUNDING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal can make this instrument dangerous. Intentional interruption is prohibited.

HIGH VOLTAGE

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

Adjustments and service described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points, if contacted, result in personal injury.

CAUTION

LINE VOLTAGE

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument requirements match the voltage of the power source.

GROUNDING

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that all devices connected to this instrument are connected to the protective (earth) ground.

BEFORE SWITCHING ON THIS INSTRUMENT, ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.)

IEC SYMBOLS

The following is a list of key IEC symbols used by Hewlett-Packard. All symbols are normally applied adjacent to the device requiring the symbol. They shall not be placed on removable parts likely to be detached or lost.

Instruction Manual symbol: If necessary, to preserve the apparatus from damage it is necessary for the user to refer to the instruction manual, then shall the apparatus be marked with this symbol (IEC 348;16a).

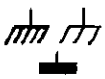
Terminal devices fed from the interior by live voltages that may be dangerous when connecting to or disconnecting from those devices shall be marked with the flash shown when the voltage exceeds 1 KV: The flash shall be red (IEC 348;18c).

Earth Terminals. If the use of this symbol for the protective earth terminal is not permitted by National Standards, it may be modified, for example, by being placed inside a circle (IEC 348;18a).

AC current (IEC 117-1, symbol No. 3).

DC current (IEC 117-1, symbol No. 2).

AC or DC current (IEC 117-1, symbol No. 8).



Frame or chassis connection. The hatching may be completely or partly omitted if there is no ambiguity. If the hatching is omitted, the line representing the frame or chassis shall be thicker (IEC 117-1, symbol No. 87).

A — Ampere (IEC 117-4, symbol No. 356).

V — Volt (IEC 117-4, symbol No. 357).

VA — Voltampere (IEC 117-4, symbol No. 358).

W — Watt (IEC 117-4, symbol No. 360).

Wh — Watthour (IEC 117-4, symbol No. 361).

VAh — Voltamperehour (IEC 117-4, symbol No. 362).

Hz — Hertz (IEC 117-4, symbol No. 365).

Contactor, normally closed. In order to avoid confusion with the symbol for a capacitor, the distance between the horizontal (as drawn here) lines should be at least equal to the length of those lines (IEC 117-3, symbol No. 215.2).

In addition the following describes the use of Warnings, Cautions and Notes used in HP Automatic Test System Manuals.

Warnings, cautions and notes. (All) Warnings and cautions shall precede the text to which each applies but notes may precede or follow applicable text depending on the material to be highlighted. Warnings, cautions, and notes shall not contain procedural steps nor shall they be numbered. When a warning, caution, or note consists of two or more paragraphs, the heading WARNING, CAUTION, NOTE, shall not be repeated above each paragraph. If it is ever necessary to precede a paragraph by both a warning and a note, or a caution and a note, etc, they shall appear in the sequence as noted, namely, warnings, cautions, notes. Such inserts in the text shall be short and concise and be used to emphasize important and critical instructions.

WARNING

An operating procedure, practice, etc, which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc. which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE: An operating procedure, condition, etc. which it is essential to highlight.

Health hazards precaution data. (All) When hazardous chemicals or adverse health factors, in the environment or use of the equipment cannot be eliminated, appropriate precautionary requirements shall be included.

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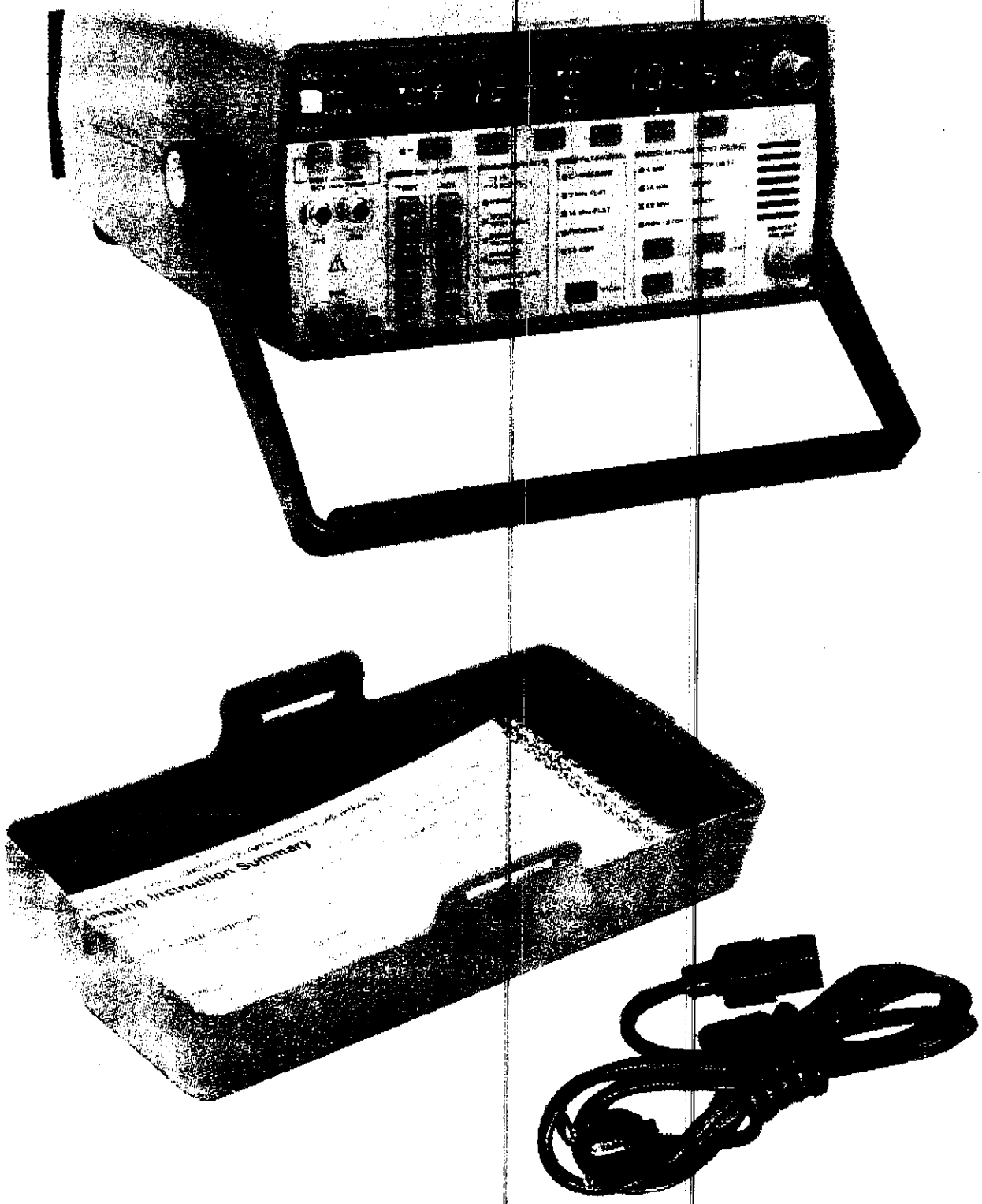

Figure 1-1. Model 4935A Transmission Impairment Measuring Set

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This Operating and Service manual contains information to install, operate, maintain, and service the HP Model 4935A Transmission Impairment Measuring Set (TIMS). Figure 1-1 shows the HP Model 4935A with cover and power cord. The manual is divided into eight major sections which provide the following information:

SECTION I. GENERAL INFORMATION. Provides identification, specifications, related manuals, and user-repair information.

SECTION II. INSTALLATION. Contains unpacking and inspection information, power requirements, packaging, and storage instructions.

SECTION III. OPERATION. Includes an explanation of controls, connectors, indicators, and an automatic self check procedure. Describes measurement principles and front panel instructions for making each measurement.

SECTION IV. PERFORMANCE TESTS. Gives test procedures required to verify that the instrument's performance is in accordance with the specifications.

SECTION V. ADJUSTMENTS. Provides adjustment and calibration procedures.

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SECTION VIII. SERVICE. Includes theory of operation, troubleshooting procedures, flowcharts, component locators, and schematic diagrams.

1-3. GENERAL DESCRIPTION

1-4. HP Model 4935A is a Transmission Impairment Measuring Set (TIMS) which measures wideband data and voice impairments. The frequency range over which measurements are made is 20 Hz to 110 kHz, in steps of 1, 10, 100, 1000, or 10,000 Hz. There are four permanently stored, fixed frequencies –404, 1004, 2804, and 2713 Hz. Any other four frequencies may be temporarily assigned and stored by the user.

1-5. INSTRUMENT IDENTIFICATION

1-6. A 10 character serial number (0000A00000) is inscribed on the rear panel. The first four digits and the letter are the serial prefix. The serial prefix will change only if changes are made to the instrument; a Manual Change Sheet will be included with the manuals of any instruments affected. The last five numbers form the serial suffix which is unique to each instrument.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1.

Table 1-1. Specifications

TRANSMITTER

Frequency

Frequency Range . . . . . .20 Hz to 110 kHz

	Resolution	Accuracy
20–99,999 Hz	1 Hz	± .005% of output frequency
100–110 kHz	10 Hz	± .012% of output frequency

Store and Recall Functions

SK Skip . . . At power up skips a band from 2450–2750 Hz

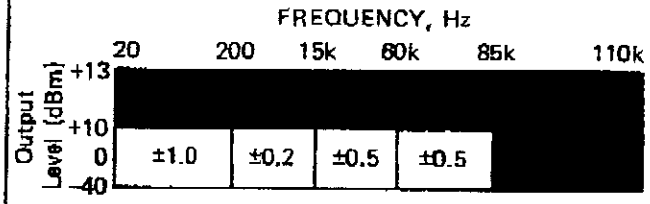
Frequencies . . . . . At power up F1 is 404 Hz
F2 is 1004 Hz
F3 is 2804 Hz
F4 is 2713 Hz

Level

Range . . . . . .–40 to +13 dBm

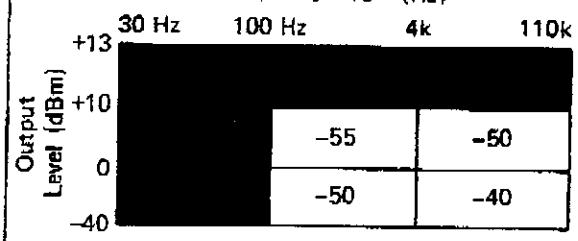
Resolution . . . . . 0.1 dB

Flatness . . . . . (in dB)



Distortion: (in dB from fundamental)

(Includes harmonics, spurious and background noise within a filter with a 3 dB bandwidth of 4 kHz or 4 f_0, whichever is greater.)



At 1004 Hz, 0 dBm, THD using a 4 kHz filter is more than 65 dB down from the fundamental.

Message Circuit Noise

Transmitter is quiet terminated

RECEIVER

Frequency

Frequency Range . . . . . .20 Hz to 110 kHz

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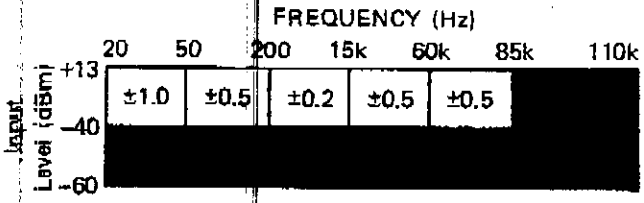
Level

Range . . . . . .–60 to +13 dBm

Resolution . . . . . 0.1 dB

Accuracy . . . . . (in dB)



Receiver accuracy not specified below 500 Hz when using 135Ω termination.

At 1004 kHz accuracy is ±0.1 dB from –20 to +13 dBm.

Cross talk: >78 dB isolation @ 4 kHz, decreasing 6 dB per octave above 4 kHz.

Message Circuit Noise

Range (@ 600Ω and 900Ω) . . . . . .0 to 100 dBrn

@ 135Ω lower limit is 7 dB higher

Resolution . . . . . 1 dB

Accuracy . . . . . .± 1 dB from 10 to 100 dBrn
±2 dB from 0 to 10 dBrn

Filters . . . . . C-Message, 3 kHz Flat, 15 kHz Flat, Program, 50 kBit

Specifications describe the instrument's warranted performance. Supplemental characteristics shown in shaded areas or in italics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.

WARNING

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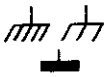

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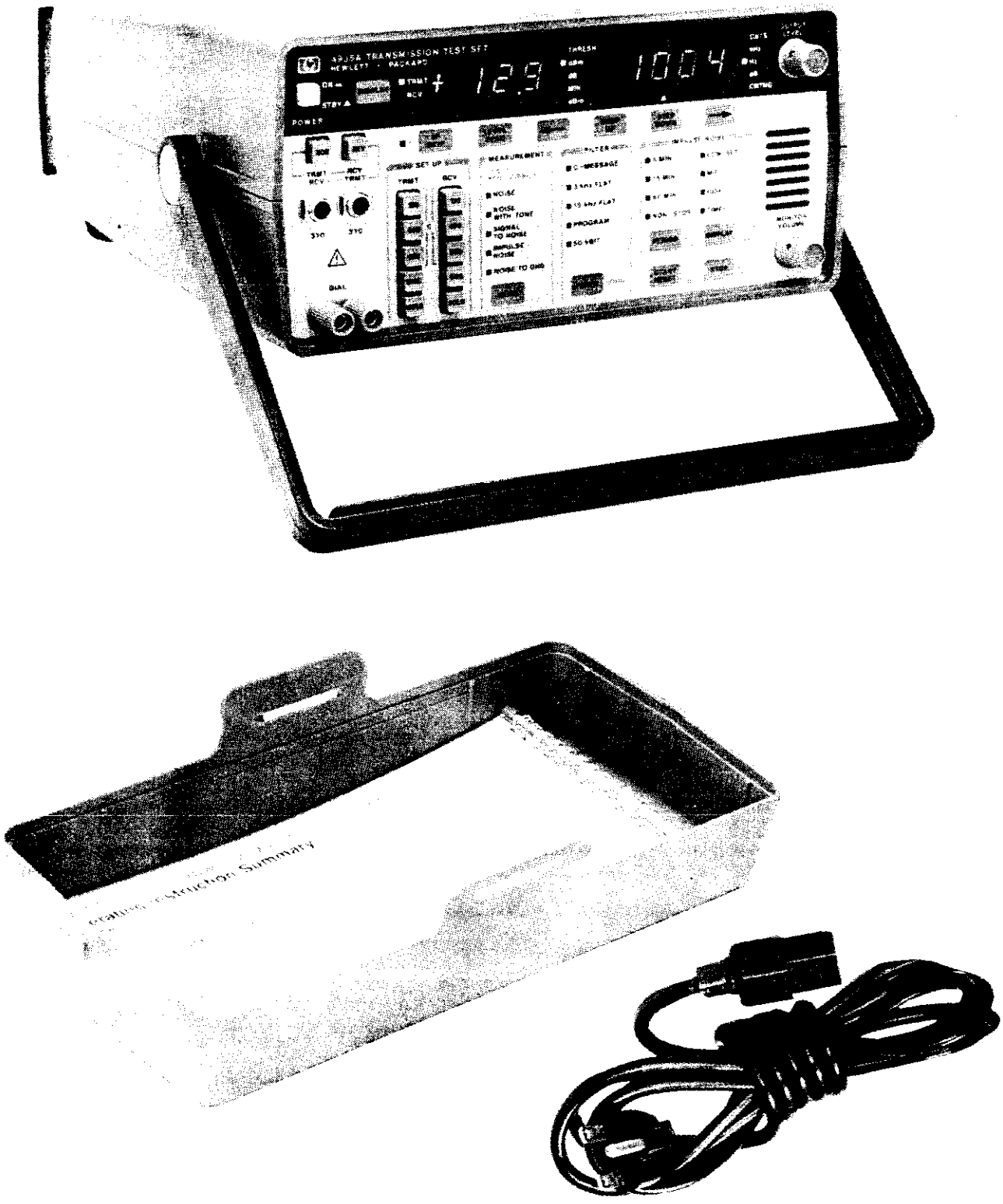

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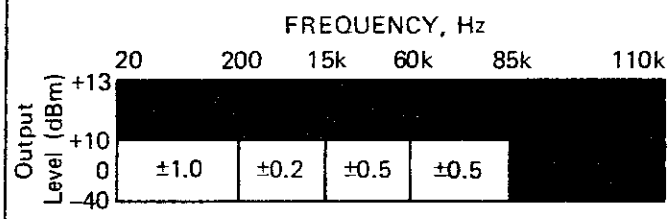
Frequencies . . . . . At power up F1 is 404 Hz
F2 is 1004 Hz
F3 is 2804 Hz
F4 is 2713 Hz

Level

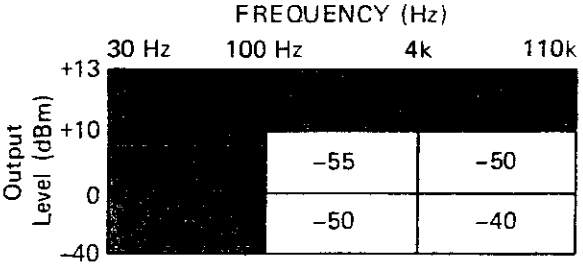
Range . . . . . .–40 to +13 dBm

Resolution . . . . . 0.1 dB

Flatness . . . . . (in dB)



Distortion: (in dB from fundamental)
(Includes harmonics, spurious and background noise within a filter with a 3 dB bandwidth of 4 kHz or 4 f_0, whichever is greater.)



At 1004 Hz, 0 dBm, THD using a 4 kHz filter is more than 65 dB down from the fundamental.

Message Circuit Noise

Transmitter is quiet terminated

RECEIVER

Frequency

Frequency Range . . . . . .20 Hz to 110 kHz

	Resolution	Accuracy
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Level

Range . . . . . .–60 to +13 dBm

Resolution . . . . . 0.1 dB

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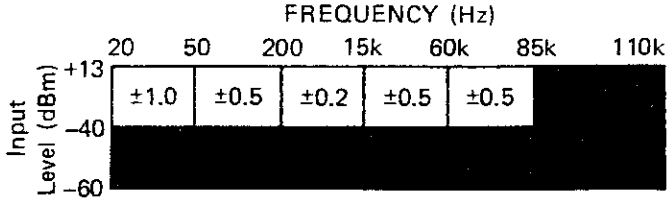


Receiver accuracy not specified below 500 Hz when using 135Ω termination.

At 1004 kHz accuracy is ±0.1 dB from –20 to +13 dBm.

Cross talk: >78 dB isolation @ 4 kHz, decreasing 6 dB per octave above 4 kHz.

Message Circuit Noise

Range (@ 600Ω and 900Ω) . . . . . .0 to 100 dBrn

@ 135Ω lower limit is 7 dB higher

Resolution . . . . . 1 dB

Accuracy . . . . . .± 1 dB from 10 to 100 dBrn
±2 dB from 0 to 10 dBrn

Filters . . . . . .C-Message, 3 kHz Flat, 15 kHz Flat, Program, 50 kBit

Specifications describe the instrument's warranted performance. Supplemental characteristics shown in shaded areas or in italics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.

Table 1-1. Specifications (Continued)

TRANSMITTER

Noise with Tone
Frequency ..... 1004 Hz fixed tone
(For other specifications, see Level and Frequency)

Signal-to-Noise Ratio
Frequency ..... 1004 Hz fixed tone
(For other specifications, see Level and Frequency)

3-Level Impulse Noise
Frequency .....1004 Hz fixed tone or quiet terminated depending on filter selection
(For other specifications, see Level and Frequency)

Noise-to-Ground
Transmitter is quiet terminated

P/AR (Optional)
Frequency .... Signal spectrum is a complex pulse train of 16 frequencies between 140 Hz and 3890 Hz.
Level Range .....-40 to 0 dBm
Resolution ..... 1 dB

RECEIVER

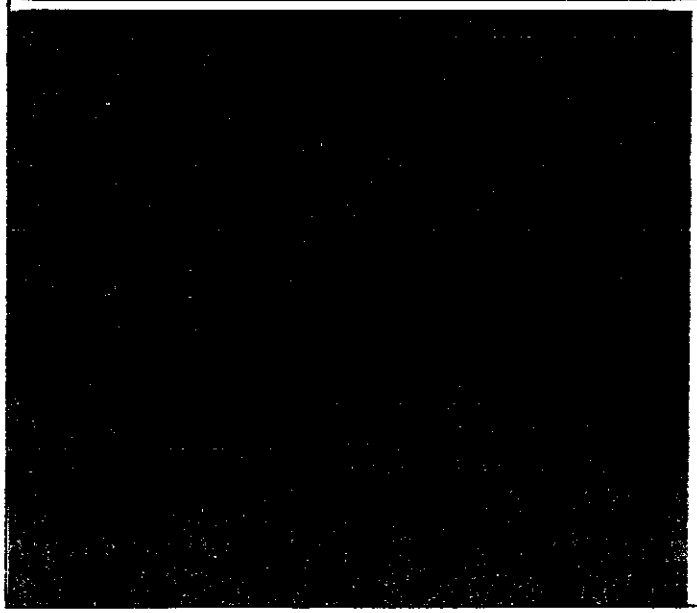
Noise with Tone
Notch Filter ..... >50 dB rejection from 995 to 1025 Hz
Range (@ 600Ω and 900Ω) ..... 10–100 dBrn
Accuracy ..... ±1 dB from 20 to 100 dBrn
±2 dB from 10 to 20 dBrn
(For other specifications, refer to Message Circuit Noise)

Signal-to-Noise Ratio
Signal Level Range .....-40 to +13 dBm
Ratio Range ..... 10 to 45 dB
Resolution ..... 1 dB

3-Level Impulse Noise
Level Range .....-40 to +13 dBm
Notch Filter .....See Noise with Tone
Threshold Ranges (@ 600Ω)
Low .....30 to 109 dBrn
Mid ..... 4 dB above Low to a maximum of 109 dBrn
High ..... 8 dB above Low to a maximum of 109 dBrn
Loss of Holding Tone Indication ..... Minus sign
Threshold Accuracy (above 40 dBrn) ..... ±1 dB
Count Timer ..... 5, 15, 60 min. or non-stop
Count Range ..... 0–9999 for each threshold
Count Rate ..... 8 per sec.

Noise-to-Ground
Range (@ 600Ω and 900Ω) .....50 to 130 dBrn
Resolution ..... 1 dB
Accuracy ..... ±1.5 dB

P/AR (Optional)
P/AR Range .....0 to 120 P/AR units
Resolution ..... 1 P/AR unit
Accuracy (from 30 to 110 P/AR units) ... ±2 P/AR units
Level Range .....-40 to +3 dBm
Resolution ..... 1 dB



Temperature Range:
Operating ..... 0°C to 50°C (32°F to 122°F)
with batteries 0°C to 40°C (32°F to 104°F)
Storage ..... -20°C to 75°C (-4°F to 167°F)
with batteries -20°C to 45°C (-4°F to 113°F)
Warm up time @ 20°C for stated accuracy .....5 min.

Dimensions .11.2 x 25.9 x 28.6 cm (4.4 x 10.2 x 11.25 in.)
Weight .....5.0 kg (11 lbs.), 6.5 kg (14 lbs.) with battery

OPTIONS
001 ..... Adds rechargeable battery pack
002 Adds P/AR measurement in place of Noise-to-Ground
003 ..... Adds both battery pack and P/AR
Deletes Noise-to-Ground

ACCESSORIES:
15513A ..... Test cord w/31Q male at both ends
18132A ..... 19" rack mount adapter
18134A ..... Soft pack carrying case
18161A ..... Ladder bracket

1-9. SAFETY CONSIDERATIONS

CAUTION

Before applying power, make sure that the rear power input module is set to the line voltage in use and that the correct fuse is installed.

1-10. Whenever internal circuits are exposed, caution must be used. Observe all warnings and cautions marked on the instrument or listed in the procedures.

1-11. When using AC power for test equipment, the chassis must be connected to earth ground. When the power button is on STBY (standby), AC and DC voltages are present in the instrument. To completely power down, disconnect the AC power cord from the 4935A. The batteries in options 001 and 003 provide continuous power to 4935A circuits; follow the disassembly procedures in Section VIII, Service to access the instrument.

WARNING

Power switch does not turn off AC power and some DC circuits.

1-12. RELATED MANUALS

1-13. Operating information is summarized on a card in the instrument cover.

1-14. USER REPAIR

1-15. Internal repairs to the instrument should be done by authorized repair shops only. For assistance, contact the nearest Hewlett-Packard Sales and Service Office listed at the rear of this manual.

1-16. OPTIONS AND ACCESSORIES

1-17. Options available are:

Option 001: Adds a rechargeable battery pack.

Option 002: Adds P/AR (Peak/Average Ratio) measurement in place of Noise-to-Ground.

Option 003: Adds P/AR (Peak/Average Ratio) measurement in place of Noise-to-Ground and a rechargeable battery pack.

1-18. Accessories available are:

15513A	Test cord w/310 male at both ends
18132A	19" Rack Mount Adapter
18134A	Soft-pack Carrying case
18161A	Ladder Bracket
04935-60014	Diagnostic Service Kit

1-19. WARRANTY

1-20. Instrument warranty is as listed on the inside of the front cover.

Battery warranty is 1 year.

1-21. RECOMMENDED TEST EQUIPMENT

1-22. Recommended test equipment is listed in Table 1-2. Equipment with equivalent characteristics may be used.

Table 1-2. Recommended Test Equipment

INSTRUMENT	CRITICAL SPECIFICATIONS	RECOMMENDED MODEL	USE*
AC CALIBRATOR	OUTPUT LEVEL 1mV TO 10V FREQUENCY: 20 Hz TO 110 kHz ACCURACY 0.1% @ ≥7mV	FLUKE 5200A OR EQUIVALENT	P,T
OSCILLOSCOPE	>15 MHz BANDWIDTH A VS B CAPABILITY	HP 1741A	P,A
MULTIMETER	AC AND DC FUNCTIONS AC VOLTS: 1mV RMS TO 1000V DC VOLTS: .1 TO 1000V BALANCED INPUT	HP 3455A	P,A,T
DIGITAL MULTIMETER	DC CURRENT: 1AMP MAX	HP 3468A	P,A,T
DUAL OUTPUT POWER SUPPLY	+12 AND -12V @ 0 TO 0.2A	HP 6234A	P
DUAL RANGE DC POWER SUPPLY	0-50 Vdc @ 0 TO 2A	HP 6218A	P,T
AUDIO ANALYZER	INPUT VOLTAGE RANGE 50mV-300V BANDWIDTH 500 kHz FILTER 30 kHz	HP 8903A	P
COUNTER	RANGE: AC COUPLED 30 Hz TO 100 MHz SENSITIVITY: 10 mV TO 100 MHz	HP 5315A	P

*P = PERFORMANCE TESTS A = ADJUSTMENTS T = TROUBLESHOOTING

Table 1-3. List of Parts Used for Performance Tests

PART NUMBER (IF APPLICABLE)	DESCRIPTION
1698-3447	135Ω 1% RESISTOR
0698-8240	398Ω 1% RESISTOR
0698-7408	600Ω .1% RESISTOR
0698-6344	900Ω .1% RESISTOR
HP 11095A	TERMINATION, 600Ω BNC-TO-BNC
1250-0781	BNC-TEE FEMALE
1251-3757	BNC TO TYPE 310 POMONA NO. 2798 OR EQUIVALENT BNC TO DUAL BANANA JACK POMONA NO. 1296 DUAL BANANA COMPONENT CARRIER POMONA NO. 1330-ST
04935-60014	DIAGNOSTIC SERVICE KIT

1-23. BATTERY OPERATION (Options 001 and 003)

1-24. Nickel-Cadmium batteries enable the 4935A to be used in areas removed from AC power. Typical operating time is 3 hrs when fully charged. The batteries are trickle-charged whenever the instrument is connected to an AC source and the POWER switch is in STBY.

1-25. Regular discharge-charge cycles are recommended to maintain battery capacity. The instrument should be operated until batteries are discharged (instrument stops working) then recharged, at least every 30 days. Normal recharge time is about 14 hours. Typical battery life under normal operating conditions should be at least 100 charge-discharge cycles.

NOTE

Batteries do not charge when 4935A is operating from an AC source.

1-26. Charging the Batteries

1-27. The internal battery pack consists of three rechargeable battery packs (+6V, +15.6V and -15.6V). These provide typically three hours of continuous use without recharging. To recharge the battery packs, connect the 4935A to an AC power source and press power switch to STBY (the batteries will not charge with the POWER switch in ON). Normal recharge time is about 14 hours.

1-28. The batteries may be charged at temperatures between 5°C and 40°C (41°F and 104°F), but have greater charge capacity if charged between 5°C and 25°C (41°F and 77°F). At temperatures above 25°C the charge acceptance falls off as shown in Figure 1-2. For example, a cell charged at 45°C accepts about 60-70% of its rated capacity. Temperatures below 5°C cause pressure to build up within the cell as it is charged, which could result in venting of the cell. This results in a permanent degradation of the battery capacity due to loss of electrolyte.

1-29. Operating Temperature

1-30. Normal operating temperature of the 4935A with batteries (options 001 and 003) should be between -20°C and +40°C. However, there will be a loss of capacity when operating at the extremes. At low temperatures, the batteries cannot fully discharge even if they were fully charged at room temperature. At high temperatures, this same effect takes place to a lesser degree, in addition to the problem of charge acceptance previously mentioned. Figure 1-3 illustrates this effect.

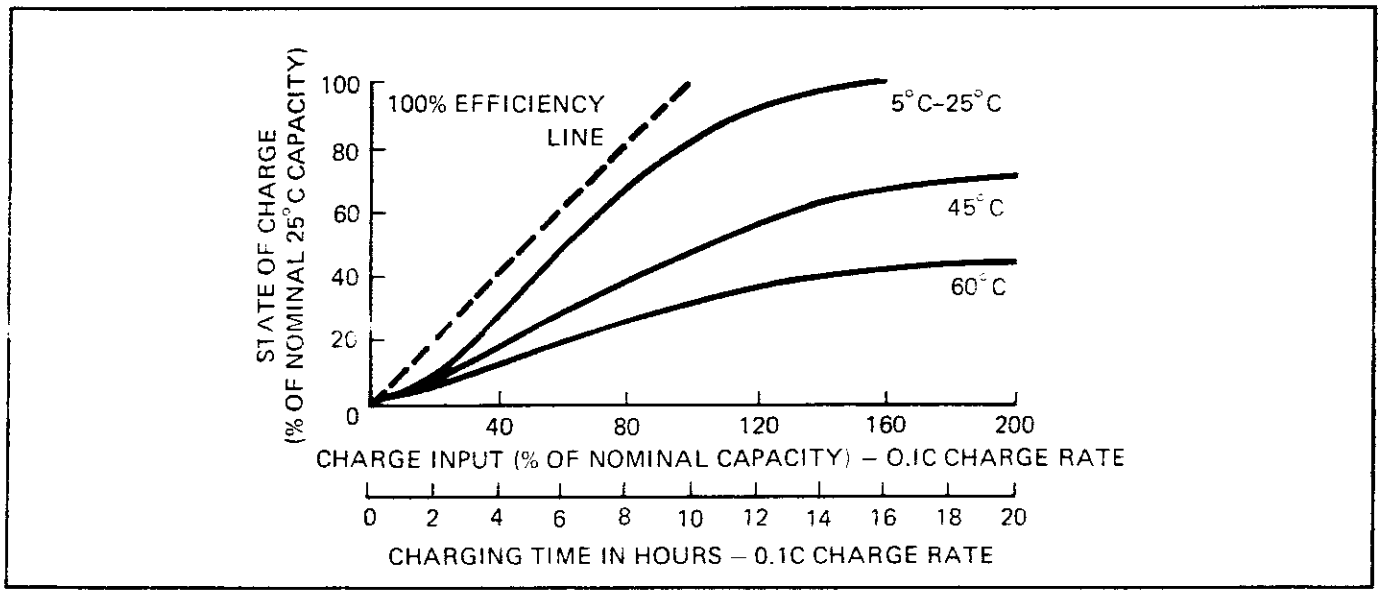


Figure 1-2. Charge Acceptance at Various Temperatures