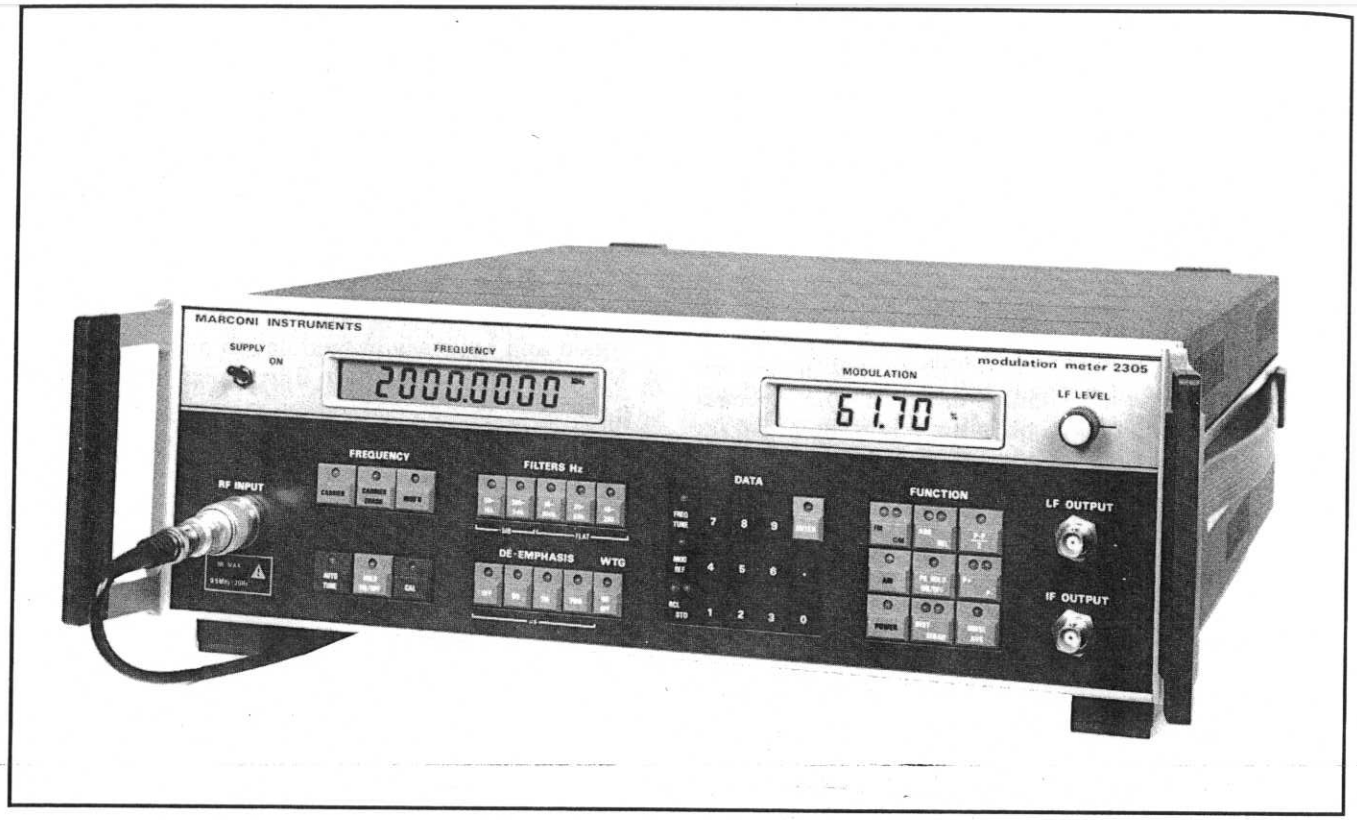
Modulation Meter

2305



- ☐ 0·5% basic accuracy
- ☐ 500 kHz to 2 GHz frequency range
- ☐ Internal calibrator
- ☐ Fast automatic tuning
- ☐ Low noise
- ☐ Non-volatile memory
- ☐ GPIB programmable
- ☐ AM, FM and PM measurements
- ☐ Frequency and power measurements
- ☐ Distortion and weighted measurements (with option)
- ☐ Excellent stereo separation
- ☐ Overload protection

Modulation Meter 2305 is an automatic tuning instrument suitable for a wide range of measurements on signal sources. Conventional measurements such as f.m. or p.m. deviation and a.m. depth are made with excellent resolution and high accuracy over a carrier frequency range from 500 kHz to 2 GHz. Additional measurements such as frequency, r.f. power, frequency response, signal-to-noise ratio, etc. can be made and a high-quality demodulated output is provided for monitoring purposes. An internal calibrator is fitted to ensure optimum accuracy for all modulation measurements.

With its wide range of measurement facilities the 2305 is suitable for development, production and maintenance testing of equipment for fixed and mobile communications, broadcasting, telemetry and multi-channel links. The unit can also be used for measuring and calibrating precision signal sources.

Tuning
In its normal mode the 2305 tunes automatically to the strongest input signal with an acquisition time of typically 500 ms, but a manual facility is provided whereby the instrument can be pre-tuned to a frequency entered via the numeric keypad.

The frequency display is used to indicate the carrier frequency of the input, the error from a previously entered value or the modulation frequency depending on the function selected by the operator.

The 2305 includes input protection against accidentally applied overloads up to 25 watts.

Modulation measurement
The 2305 is capable of measuring f.m. deviations up to 500 kHz, phase deviations to 500 radians and a.m. depths up to 99·9% with modulating frequencies up to 300 kHz (50 kHz for a.m.). Ranges are selected automatically by the instrument to give the best possible resolution.

Four detector responses can be selected: average peak for all routine modulation measurements, positive or negative peak where modulation symmetry needs to be established, and noise averaging for the measurement of residual noise. A peak hold mode is also provided to hold the highest level of modulation which occurs, allowing the limiting performance of transmitters to be correctly measured.

A relative mode allows measurements to be made in dB relative to a reference value, for example when checking frequency response or signal-to-noise ratio.

Power measurement
The 2305 directly indicates power input levels from 10 mW to 1 W and with external attenuator pads this range can be easily extended. The attenuation factor of an external pad or the value of a known power level can be entered into the 2305 and the unit will then automatically correct its reading, to give an indication of the power applied to the input of the attenuator.

Internal calibrator
The internal calibrator checks the 2305 each time the unit is switched on and updates the calibration whenever the operator presses the CAL key. Alternatively a software function allows this facility to be changed to provide a confidence check where this is preferred.

LF processing
A choice of five different l.f. filters is offered to cover the widest range of requirements and they allow the user to restrict the l.f. bandwidth when full coverage is not required. An output giving up to 3 V r.m.s. into 600 Ω is provided for external monitoring of the demodulated signal.

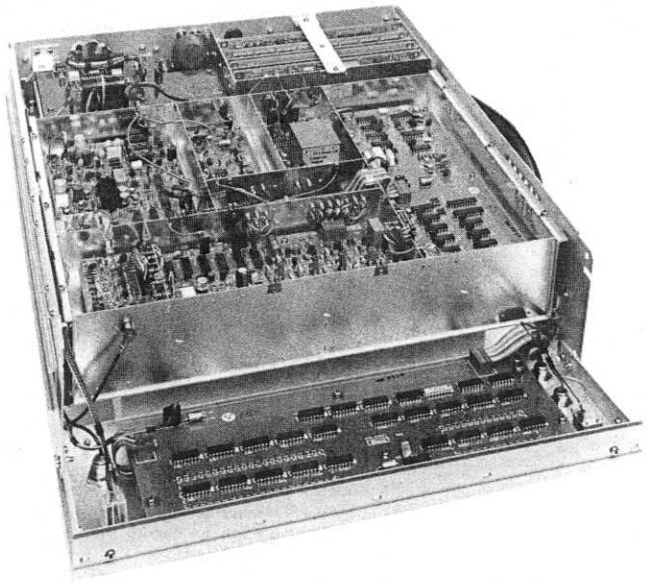
The excellent phase and amplitude linearity of the 2305 allow stereo separation measurements of over 50 dB to be made.

Measurements of residual noise, signal-to-noise ratio and frequency response can be made with 2305 and an option provides for measurement of distortion (at 300 Hz, 500 Hz and 1 kHz) and also includes psophometric weighting filters for weighted noise and distortion measurements.

Non-volatile memory
Information on up to 10 settings may be stored in the instrument for later use and the provision of a non-volatile semiconductor memory allows the data to be stored even after switch-off without relying on a battery. Recalling a complete setting from the memory only requires a simple keyboard action.

Programmability
2305 can be simply fitted with the optional GPIB interface so that all functions can be controlled over the bus. Simple commands set up the required measurement conditions and the unit will then send results to the GPIB controller when requested.

Maintainability
The use of liquid crystal displays reduces power consumption and as a result a cooling fan is not needed, thereby reducing routine maintenance and improving reliability. Self-diagnostic facilities are incorporated within 2305 which, with the aid of other diagnostic features, simplify the localising of faults. Access to the unit is very straightforward and all circuit boards are interconnected by plugs and sockets for ease of removal or replacement. Normal calibration is carried out automatically by the internal calibrator and no adjustable calibration controls are fitted inside the instrument.



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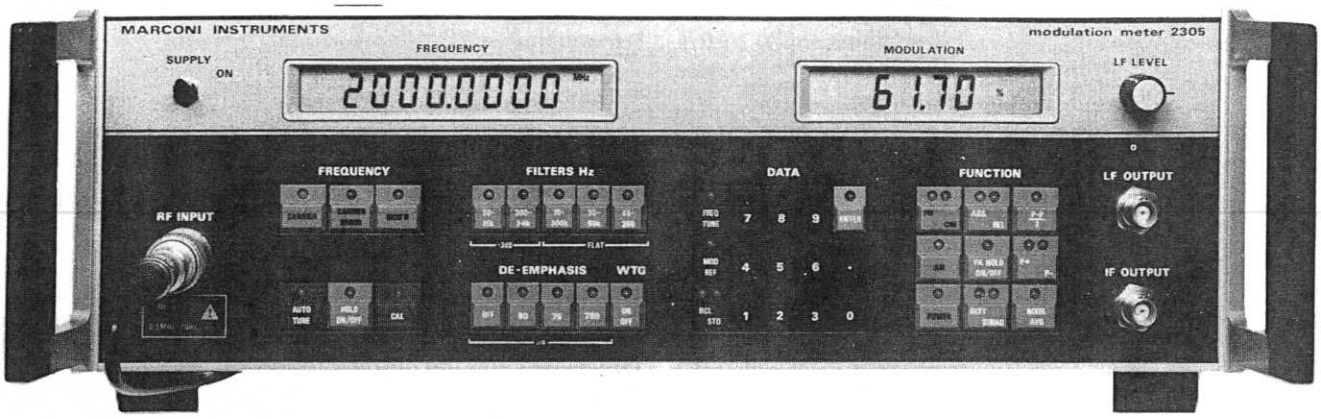


GENERAL DESCRIPTION

The 2305 is an automatic tuning modulation meter covering the frequency range 500 kHz to 2 GHz, with a basic accuracy of ±0·5%.

RF INPUT

Carrier frequency range 500 kHz to 2 GHz.

Automatic tuning Selecting 'Auto Tune' causes the instrument to tune automatically to the strongest signal in the carrier frequency range. Acquisition time is typically 500 ms.

Frequency indication 8 digit LCD—see under FREQUENCY DISPLAY.

Manual tuning By front panel keyboard or GPIB entry.

Sensitivity −25 dBm (13 mV r.m.s.p.d. into 50 Ω) from 0·5 MHz to 500 MHz.
−23 dBm (16 mV r.m.s.p.d. into 50 Ω) from 500 to 1000 MHz.
−18 dBm (28 mV r.m.s.p.d. into 50 Ω) from 1 GHz to 1·5 GHz.
−15 dBm (40 mV r.m.s.p.d. into 50 Ω) from 1·5 to 2 GHz.

Maximum input +30 dBm (1 W or 7 V r.m.s. into 50 Ω) from 500 kHz to 2 GHz.

Overload protection Automatic trip provides protection against overloads up to 25W.

Input connector Type N female.

Input impedance 50 Ω nominal.

FREQUENCY MODULATION

Maximum deviation 500 kHz peak deviation at modulation rates of 30 Hz to 275 kHz at carrier frequencies above 5·5 MHz.
50 kHz peak deviation at modulation rates of 30 Hz to 15 kHz up to 5·5 MHz.

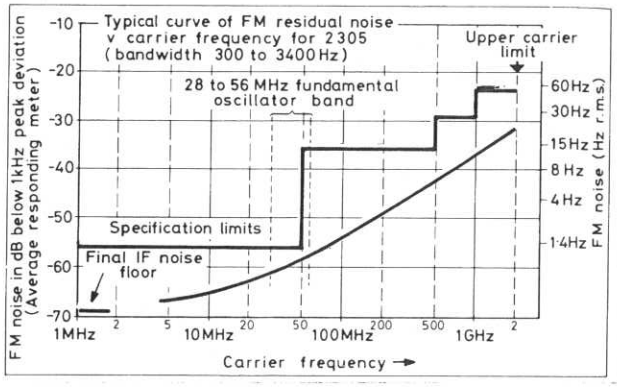
Range selection Ranges automatically selected for best resolution.

Display 4 digit LCD—see under MODULATION DISPLAY.

Accuracy After calibration using internal calibrator, ±0·5% of reading ±1 least significant changing digit at 1 kHz modulation rate with the 50 Hz to 15 kHz filter selected.
±1% ±1 digit for deviations less than 5 kHz. Frequency response relative to 1 kHz modulation rate with the 10 Hz to 300 kHz filter selected:-
±0·5% of reading for modulation rates from 20 Hz to 20 kHz;
+0·5% −1% of reading for modulation rates from 20 Hz to 50 kHz;
+0·5% −5% of reading for modulation rates from 20 Hz to 275 kHz.
Note: 1. Where necessary, allowance must be made for peak residual noise which will contribute to peak readings.
2. Figures apply for carrier frequencies greater than 5·5 MHz.

AM rejection Typically 40 Hz peak deviation for 50% a.m. at 1 khz modulation rate with the 300 Hz to 3·4 kHz filter selected.

Residual f.m. noise



PHASE MODULATION

Carrier frequency range 5·5 MHz to 2 GHz, usable down to 500 kHz.

Maximum deviation 500 radians for modulating frequencies up to 1 kHz.
(500/f) radians for modulating frequencies above 1 kHz, where f is the modulating frequency in kHz.

Range selection Ranges automatically selected for best resolution.

Display 4 digit LCD—see under MODULATION DISPLAY.

Accuracy After calibration using internal calibrator, ±2% of reading ±3 least significant changing digits for 1 kHz modulation rate. Frequency response relative to 1 kHz modulation rate, ±2% of reading ±3 least significant changing digits for modulation rates from 300 Hz to 4 kHz. Usable from 50 Hz to 20 kHz.
Note: Where necessary, allowance must be made for peak residual noise which will contribute to peak readings.

AM rejection Typically 0·04 radian peak deviation for 50% a.m. at 1 kHz modulation rate measured with the 300 Hz to 3·4 kHz filter selected.

AMPLITUDE MODULATION

Maximum modulation depth 99·9%.

Modulation rates 30 Hz to 50 kHz for carrier frequencies from 5·5 MHz to 2 GHz.
30 Hz to 15 kHz for carrier frequencies from 0·5 to 5·5 MHz.

Range selection — Ranges automatically selected for best resolution.

Display — 4 digit LCD—see under MODULATION DISPLAY.

Accuracy — After calibration using internal calibrator, ±1% of reading ±1 least significant changing digit at 1 kHz modulation rate for depths up to 95%.
Frequency response relative to 1 kHz, ±1·5% of reading for modulation rates from 30 Hz to 50 kHz.
Notes:
a) These accuracy figures apply with 30 Hz to 50 kHz l.f. filter selected.
b) Where necessary, allowance must be made for peak residual noise which will contribute to peak readings.

FM rejection — Less than 0·5% a.m. for 50 kHz peak deviation for carrier frequencies above 5·5 MHz measured with the 50 Hz to 15 kHz filter selected.

Residual a.m. noise — Less than 0·02% r.m.s.a.m. measured with the 300 Hz to 3·4 kHz filter selected for input levels above −17 dBm (30 mV).

POWER MEASUREMENT

Range — 10 mW to 1 W (+10 to +30 dBm) from 50 kHz to 1500 MHz. Usable to 2 GHz.

Accuracy — ±1 dB at 800 MHz, from 10 mW to 1 W.

Frequency response — ±1 dB from 500 kHz to 1·5 GHz usable to 2 GHz.

VSWR — Better than 2:1 from 500 kHz to 1·5 GHz.

FREQUENCY DISPLAY

Front panel keys select display of the following on a 8 digit LCD:
Carrier frequency;
Carrier error—the difference between carrier frequency received and carrier frequency set from the front panel or by GPIB control;
Modulation rate.

Carrier frequency mode — *Range:* 0·5 MHz to 2 GHz.
Resolution: 10 Hz for carrier frequencies up to 1000 MHz, 100 Hz for carrier frequencies up to 2 GHz.

Carrier error mode — *Resolution:* 10 Hz for all carrier frequencies.

Modulation rate mode — *Range:* 20 Hz to 275 kHz.
Resolution: 0·1 Hz up to 5 kHz and 10 Hz above 5 kHz.

Accuracy (all modes) — ±1 count ± frequency standard error.

MODULATION DISPLAY

4 digit LCD indicates results in the following units:
AM—% modulation depth
FM—kHz deviation
PM—Radians deviation
Power—dBm or W, as selected
Relative—dB.

Detector modes — The following detector modes may be selected:
Average peak [(pk-pk)/2]
Positive peak
Negative peak
Noise averaging.

Display modes — The following display modes may be selected:
Absolute—displays absolute value of modulation.
Relative—displays modulation in dB relative to a reference level entered from the front panel.
Peak hold—holds and displays the peak value of the modulation.

FILTERS

Five l.f. (post detection) filters may be selected:
10 Hz to 300 kHz } flat within 0·1 dB.
30 Hz to 50 kHz } flat within 0·1 dB.
65 Hz to 250 Hz } flat within 0·1 dB.
50 Hz to 15 kHz } nominal 3 dB bandwidth.
300 Hz to 3·4 kHz } nominal 3 dB bandwidth.

DE-EMPHASIS

Three de-emphasis time constants may be selected: 50 µs, 75 µs and 750 µs. (De-emphasis affects only the l.f. output and relative measurements, not the modulation reading).

IF OUTPUT

IF output is available at a front panel BNC socket.

Frequency — As carrier frequency for inputs up to 1·5 MHz.
250 kHz nominal for inputs from 1·5 to 5·5 MHz.
1·5 MHz nominal for inputs above 5·5 MHz.

Amplitude — Greater than 50 mV r.m.s. nominal into 50 Ω load.

Output impedance — 50 Ω nominal.

LF OUTPUT

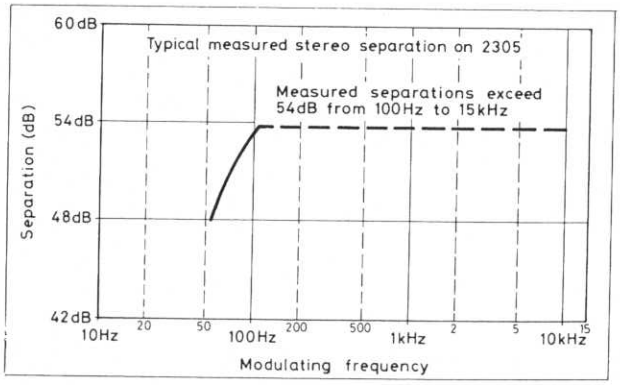
A demodulated, filtered and de-emphasised l.f. output is available at a front panel socket.

Level — Front panel control adjusts level from 0 to at least 3 V r.m.s. into 600 Ω for f.m. deviations greater than 500 Hz, a.m. depth greater than 0·5 or p.m. greater than 0·5 radians.

FM distortion — At modulation rates up to 20 kHz:
Better than 0·15% t.h.d. for deviations up to 100 kHz.
Better than 0·5% t.h.d. for deviations up to 500 kHz.
At modulation rates up to 100 kHz:
Better than 1% t.h.d. for deviations up to 500 kHz.

AM distortion — At a 1 kHz modulation rate:
Better than 0·3% t.h.d. for modulation depths up to 95%.
At modulation rates up to 50 kHz:
Better than 1% t.h.d. for modulation depths up to 95%.

Stereo separation — Better than 50 dB at 1 kHz.



FREQUENCY STANDARD

Internal standard or external input. Front panel indicator shows when external standard is selected.

Internal standard — *Frequency:* 10 MHz.
Temperature stability: better than ±0·1 p.p.m. over temperature range of 0 to 40°C.
Warm-up time: Within 0·5 p.p.m. of final frequency within 5 min from switch-on at 20°C ambient.
Ageing rate: better than 3 in 10^9 per day, 1 in 10^7 per month, 1 in 10^6 per year.

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REAR PANEL INPUTS & OUTPUTS

LF output
Auxiliary l.f. output unaffected by front panel level control is available at a stereo jack socket. Output level is proportional to modulation depth with approximately 5 V peak into greater than 10 kΩ corresponding to full scale on each range.

External filter
An external l.f. filter may be connected via a jack socket.

External local oscillator input
An external local oscillator may be connected to a BNC socket.
Frequency range: 28 to 56 MHz to cover input signals from 26·5 MHz to 2 GHz.
Input level: 100 mV to 1 V r.m.s.
Input impedance: 50 Ω nominal.

Internal standard output
10 MHz internal standard output available at a BNC socket. Output level greater than 100 mV r.m.s. into 50 Ω.

External standard input
Accepts a 10 MHz signal of at least 1 V r.m.s.
Maximum input: 2·5 V r.m.s.
Input impedance: 100 Ω nominal.

SECONDARY FRONT PANEL FACILITIES

Store/Recall
A STORE/RECALL key used with the numeric keypad allows up to 10 instrument settings to be stored in the non-volatile memory for later recall.

Second functions
Numerous second functions are available, selected by pressing the blue ENTER key. Four levels of protection are employed to safeguard calibration data against accidental corruption. Full information is given in the handbook.

GPIB INTERFACE
A GPIB interface is available either factory fitted or as an accessory for the user to fit (see VERSIONS AND ACCESSORIES for ordering information). All controls except the supply switch and LF OUTPUT LEVEL are remotely programmable.

Capabilities
Complies with the following subsets as defined in IEEE 488-1978, IEC 625-1 1979 and BS6146:
SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, and E1.

DISTORTION/ WEIGHTING FILTER OPTION
A distortion and SINAD measuring facility (with weighting filters) is available either as a factory fitted option or an accessory for the user to fit (see VERSIONS AND ACCESSORIES for ordering information).

Distortion/SINAD
Measurement frequencies: 300 Hz, 500 Hz and 1 kHz (all ±5%).
Fundamental rejection: Greater than 65 dB.
Distortion range: 0·1 to 100%.
SINAD range: 0 to 60 dB.
Accuracy: ±1 dB.

Weighting filters
CCITT: Frequency response conforms to CCITT recommendation P53.
CCIR: Frequency response conforms to CCIR recommendation 468-2.

RADIO FREQUENCY INTERFERENCE
Conforms to the requirements of EEC Directive 76/889.

SAFETY
Complies with IEC 348.

RATED RANGE OF USE
(Over which full specification is met)

Temperature
0 to 55°C.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
−40 to +70°C.

Humidity
Up to 90% relative humidity.

Altitude
Up to 2500 m (pressurised freight at 27 kPa differential, i.e. 3·9 lbf/in²).

POWER REQUIREMENTS

AC supply
Switchable voltage ranges 105 to 110 V, 115 to 120 V, 210 to 220 V, 230 to 240 V, all ±10%.
45 to 440 Hz.
Approximately 70 VA maximum.

DIMENSIONS AND WEIGHT (over projections but excluding handles)

Height	Width	Depth	Weight
152 mm	425 mm	535 mm	13·5 kg
6 in	16·7 in	21 in	29·7 lb

VERSIONS AND ACCESSORIES
When ordering please quote eight digit code numbers

Ordering numbers	
	Versions
52305-900K	Modulation Meter 2305. 2305 NATO version, ref. no. 6625-99-746-5601.
	Supplied Accessories
	AC Supply lead 43123-076Y. Operating Manual 46881-431 P (H52305-900K Vol. 1). Stereo Jack Plug 23421-620H.
	Optional Accessories
54433-001U	GPIB Module.
43129-189U	GPIB Lead Assembly.
46881-365R	GPIB Manual.
46883-408K	IEEE/IEC Connector Adapter.
46883-527G	Distortion/Weighting Filter Kit.
54711-034U	Maintenance Kit.
46883-511R	Front Handle Kit.
46883-506M	Rack Mounting Kit.
43126-012S	RF Connecting Cable (TM4969/3) 50 Ω, 1·5 m, BNC.
46881-432X	Service Manual H52305-900K Vol. 2.
54452-011E	Signal Sniffer.
54431-021B	20 W, 50 Ω, 20 dB Attenuator.
54422-011A	12 W, 50 Ω Termination.
54311-092P	Coaxial Adapter N male to BNC female.
54311-095C	RF Connector Cable, 1 m, Type N Connectors.