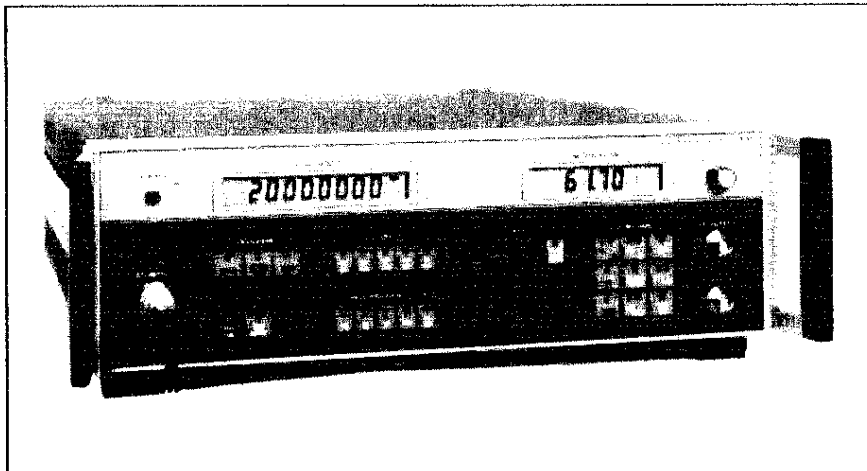




*SINAD and RF power measurements complement the high accuracy measurements of AM, FM and  $\Phi$ M in the versatile product*

## 2305 Modulation Meter



- 0.5% basic accuracy
- 50 kHz to 2.32 GHz frequency range
- Internal calibrator
- Fast automatic tuning
- Low noise
- Non-volatile memory
- GPIB programmable
- AM, FM and  $\Phi$ M 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 FM or  $\Phi$ M deviation and AM depth are made with excellent resolution and high accuracy over a carrier frequency range from 50 kHz to 2.32 GHz. Additional measurements such as frequency, RF 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.

### Wide Ranging Applications

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.

### Automatic and Manual 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 numerical 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 W.

### Modulation Measurement

The 2305 is capable of measuring FM deviations up to 500 kHz, phase deviations to 500 radians and AM depths up to 99.9% with modulating frequencies up to 300 kHz (50 kHz for AM). Ranges are selected automatically by the instrument to give the best possible resolution.

### Four detector modes

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.

### Relative mode

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 calibrate 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 LF filters is offered to cover the widest range of requirements and they allow the user to restrict the LF bandwidth when full coverage is not required. An output giving up to 3 V RMS into 600  $\Omega$  is provided for external monitoring of the demodulated signal.

### Stereo Separation Measurements

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

## Signal-to-Noise Ratio

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 semi-conductor 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

The 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 the 2305 which, with the aid of other diagnostic features, simplify the localizing 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.

# Specification

## GENERAL DESCRIPTION

The 2305 is an automatic tuning modulation meter covering the frequency range 50 kHz to 2.32 GHz, with a basic modulation measurement accuracy of  $\pm 0.5\%$ .

## RF Input

**Carrier Frequency Range**  
50 kHz to 2.32 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 RMS into 50  $\Omega$ ) from 0.5 MHz to 500 MHz  
-23 dBm (16 mV RMS into 50  $\Omega$ ) from 500 to 1000 MHz  
-18 dBm (28 mV RMS into 50  $\Omega$ ) from 1 GHz to 1.5 GHz  
-15 dBm (40 mV RMS into 50  $\Omega$ ) from 1.5 to 2 GHz

## Maximum Input

+30 dBm (1 W or 7 V RMS into 50  $\Omega$ ) from 50 kHz to 2.32 GHz

## Overload Protection

Automatic trip provides protection against overloads up to 25 W

## Input Connector

Type N female

## Input Impedance

50  $\Omega$  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,  $\pm 0.5\%$  of reading  $\pm 1$  least significant changing digit at 1 kHz modulation rate with the 50 Hz to 15 kHz filter selected.  $\pm 1\%$   $\pm 1$  digit for deviations less than 5 kHz.  
Frequency response relative to 1 kHz modulation rate with the 10 Hz to 300 kHz filter selected:  $\pm 0.5\%$  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.

### Notes

- Where necessary, allowance must be made for peak residual noise which will contribute to peak readings.
- Figures apply for carrier frequencies greater than 5.5 MHz.

### AM Rejection

Typically 40 Hz peak deviation for 50% AM at 1 kHz modulation rate with the 300 Hz to 3.4 kHz filter selected

### Notes

- Noise in 50 Hz to 15 kHz band is typically 6 dB higher
- Noise in CCITT psophometric weighting filter is typically 3 dB lower

## Phase Modulation

### Carrier Frequency Range

5.5 MHz to 2.32 GHz, usable down to 50 kHz

### Maximum Deviation

500 radians for modulating frequencies up to 1 kHz. (500/r) 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,  $\pm 2\%$  of reading  $\pm 3$  least significant changing digits for 1 kHz modulation rate.  
Frequency response relative to 1 kHz modulation rate,  $\pm 2\%$  of reading  $\pm 3$  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% AM 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 2.32 GHz.  
30 Hz to 15 kHz for carrier frequencies from 50 kHz 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:  $\pm 1\%$  of reading  $\pm 1$  least significant changing digit at 1 kHz modulation rate for depths up to 95%.  
Frequency response relative to 1 kHz:  $\pm 1.5\%$  of reading for modulation rates from 30 Hz to 50 kHz.

### Notes:

- These accuracy figures apply with 30 Hz to 50 kHz LF filter selected.
- Where necessary, allowance must be made for peak residual noise which will contribute to peak readings.

### FM Rejection

Less than 0.5% AM for 50 kHz peak deviation for carrier frequencies above 5.5 MHz measured with the 50 Hz to 15 kHz filter selected.

### Residual AM Noise

Less than 0.02% RMS AM 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 2.32 GHz.

### Accuracy

$\pm 1$  dB at 800 MHz, from 10 mW to 1 W

### Frequency response

$\pm 1$  dB from 500 kHz to 1.5 GHz usable down to 50 kHz and up to 2.32 GHz

### VSWR

Better than 2:1 from 500 kHz to 1.5 GHz

## Frequency Display

Front panel keys select display of the following on an 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: 50 kHz to 2.32 GHz.  
Resolution: 10 Hz for carrier frequencies up to 1000 MHz, 100 Hz for carrier frequencies up to 2.32 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)

$\pm 1$  count  $\pm$  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-pl)/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 values of the modulation or power.

**Filters**

Five LF (post detection) filters may be selected: 10 Hz to 300 kHz, 30 Hz to 50 kHz flat within 0.1 dB, 65 Hz to 250 Hz, 50 Hz to 15 kHz, 300 Hz to 3.4 kHz nominal 3 dB bandwidth.

**De-emphasis**

Three de-emphasis time constants may be selected: 50  $\mu$ s, 75  $\mu$ s and 750  $\mu$ s. (De-emphasis affects only the LF 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 RMS nominal into 50  $\Omega$  load

**Output impedance**

50  $\Omega$  nominal

**LF Output**

A demodulated, filtered and de-emphasized LF output is available at a front panel socket.

**Level**

Front panel control adjusts level from 0 to at least 3 V RMS into 600  $\Omega$  for FM deviations greater than 500 Hz, AM depth greater than 0.5% or 0 dB greater than 1.5 radians at 1 kHz.

**FM Distortion**

At modulation rates up to 20 kHz: Better than 0.15% THD for deviations up to 100 kHz. Better than 0.5% THD for deviations up to 500 kHz. At modulation rates up to 100 kHz: Better than 1% THD for deviations up to 500 kHz.

**AM Distortion**

At a 1 kHz modulation rate: Better than 0.3% THD for modulation depths up to 95%. At modulation rates up to 50 kHz: Better than 1% THD for modulation depths up to 95%.

**Stereo Separation**

Better than 50 dB at 1 kHz

**General****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  $\pm 0.1$  ppm over temperature range of 0 to 40°C.  
Warm-up time: Within 0.5 ppm of final frequency within 5 min from switch-on at 20°C ambient.  
Ageing rate: better than 3 in  $10^6$  per day, 1 in  $10^7$  per month, 1 in  $10^8$  per year.

**REAR PANEL INPUTS & OUTPUTS****LF Output**

Auxiliary LF 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 k $\Omega$  corresponding to full scale on each range.

**External Filter**

An external LF 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 2.32 GHz.  
Input level: 100 mV to 1 V RMS  
Input impedance: 50  $\Omega$  nominal.

**Internal Standard Output**

10 MHz internal standard output available at a BNC socket. Output level greater than 100 mV RMS into 50  $\Omega$ .

**External Standard Input**

Accepts a 10 MHz signal of at least 1 V RMS  
Maximum input: 2.5 V RMS  
Input impedance: 100  $\Omega$  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 handbooks.

**GPIO INTERFACE**

A GPIO 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 IEC 488-1978, IEC 625-1 1979 and BS6146: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, FP0, DC1, DF1, CO and EL.

**DISTORTION/WEIGHTING FILTER OPTION**

A distortion and SINAD measuring facility (with weighting filters) is available either as a factory fitted option or as 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  $\pm 5\%$ ).  
Fundamental rejection: Greater than 65 dB.  
Distortion range: 0.1 to 100%.  
SINAD range: 0 to 60 dB. Accuracy  $\pm 1$  dB.

**Weighting Filters**

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

**Electromagnetic Compatibility**

Conforms to the requirements of EEC directive 76/889.  
Complies with VDE 0871 (Class B) and VDE 0875.

**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 lb/in<sup>2</sup>).

**POWER REQUIREMENTS****AC Supply**

Switchable voltage ranges 105 to 110 V, 115 to 120 V, 210 to 220 V, 230 to 240 V, all  $\pm 10\%$ . 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 the full order number information

Ordering Numbers	Versions
2305	Modulation Meter 2305
	<b>Supplied with</b>
43123/076	AC Supply lead
46881/431	Operating Manual
23421/620	Stereo Jack Plug
	<b>Accessories</b>
54433/001	GPIO Module
43129/189	GPIO Lead Assembly
46881/365	GPIO Manual
46883/408	IEC I/IEC Connector Adaptor
46883/527	Distortion/Weighting Filter Kit
54711/034	Maintenance Kit
46883/511	Front Handle Kit
46883/506	Rack Mounting Kit
46881/432	Service Manual
54452/011	Signal Sniffer
54431/021	20 W, 50 $\Omega$ , 20 dB Attenuator
54431/022	10 dB, 100 W Attenuator, 50 $\Omega$ , N
54427/011	12 W, 50 $\Omega$ Termination
54311/092	Coaxial Adaptor N Male to BNC Female
54311/095	RF Connector Cable, 1 m, Type N Connectors
43126/012	Cable, 50 $\Omega$ , BNC-BNC, 1.5 m