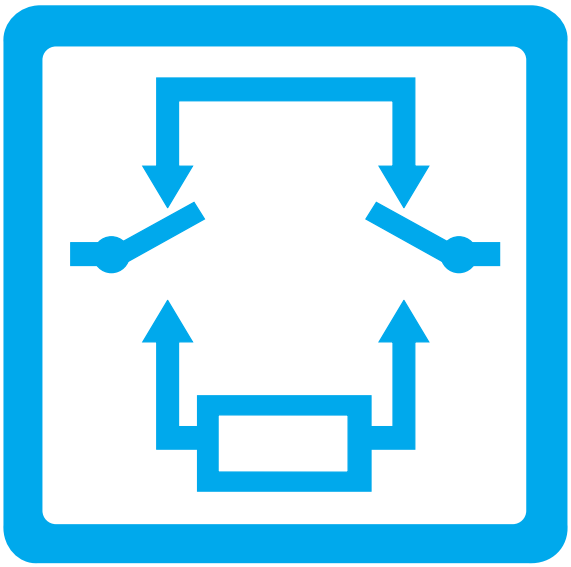


ANALOG TRANSMISSION CHARACTERISTICS MEASURING INSTRUMENTS

CALIBRATION RECEIVER
ML2530A
100 kHz to 3 GHz

Measuring Level while Observing Signals under Test

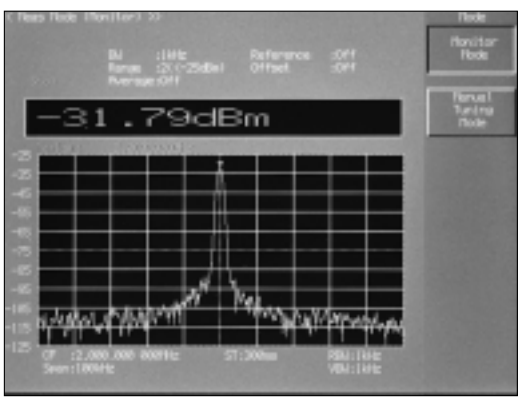
CE GPIB

The ML2530A is a receiver for calibrating the output power level of such devices as signal generators and attenuators, covering the range of 100 kHz to 3 GHz. It is suitable for use as a reference level meter for the RF communications bands used by the world's mobile communications markets. High linearity is achieved by using a level detector that uses DSP technology. The level can be measured while observing the signal waveform to be measured by using the spectrum monitor function.

Features

- Wide dynamic range of –140 to +20 dBm and high linearity
- Provides measurement bandwidth of 1 Hz to 100 kHz, so that even signals with large residual FM can be measured using the 1 Hz bandwidth.
- Supports level units

Manual tuning mode



Monitor mode

For product ordering information, see pages 4 – 10

Specifications

• ML2530A (main frame)

General	Frequency range	0.1 to 3000 MHz
	Level range	–140 to +20 dBm
	RF input connector	Connector: N-J Impedance: 50 Ω VSWR: ≤1.25 (Range 1), ≤1.40 (Range 2), ≤1.50 (Range 3) Max. input level: +20 dBm, 0 Vdc
	CAL output*1	Connector: N-J Impedance: 50 Ω Frequency: 50 MHz ±500 kHz Level: 1.000 mW Level accuracy: ±1.2% (RSS: ±0.9%) Harmonic frequency: ≤–50 dBc
	Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤±5.1 x 10^{-8}/day (10 minutes after power on, with reference to frequency at 24 hours after power on) Aging rate: ≤±2.1 x 10^{-8}/day, ≤±10.1 x 10^{-8}/year (with reference to frequency at 24 hours after power on) Temperature characteristics: ≤±5.1 x 10^{-8} (with reference to frequency at 25˚C in 0˚ to 50˚C temperature range) Accuracy: ≤±15.1 x 10^{-8} (24 hours after power on, within 6 months of calibration)
	External reference input	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz ±10 Hz Level: 0.5 to 5.0 Vp-p
	Internal reference output	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz Frequency accuracy: Same as reference oscillator Level: 2.1 V ±0.6 Vp-p (when 2 m coaxial cable terminated with 50 Ω)
Level measurement	Measurement modes	Manual tuning: Measures level of frequency input directly by ten keys and encoder Monitor: Measures level of frequency specified by marker on spectrum monitor
	Measured frequencies	Range: 100 kHz to 3000 MHz, Resolution: 1 Hz
	Measurement bandwidth	Range: 1 Hz to 100 kHz (1-10 sequence) Filter: Gaussian type Accuracy (3 dB width): ±20% (BW: 1 Hz), ±5% (BW: 10 Hz to 100 kHz)
	Measured level	Range: –140 to +20 dBm Resolution: 0.1, 0.01, 0.001 dB
	Range	Range 1: –35 to +20 dBm, Range 2: –80 to –25 dBm, Range 3: –140 to –70 dBm
	Error*2	Total relative error: In-range linearity + range switching error + noise floor error +1 digit error Total absolute error: Total relative error + CAL output level accuracy + mismatch error at CAL + sensor module calibration factor uncertainty + calibration receiver linearity + sensor module insertion loss reproducibility + mismatch error In-range linearity: ±0.05 dB/55 dB (BW: 1/10/100 Hz, RSS: ±0.03 dB/55 dB) ±0.09 dB/55 dB (BW: 1/10 kHz, RSS: ±0.07 dB/55 dB) ±0.22 dB/55 dB (BW: 100 kHz, RSS: ±0.20 dB/55 dB) *In same range, BW: 100 kHz, frequency: ≥1 MHz Range switching error: ±0.01 dB (at range switch point: –30, –75 dBm) Noise floor (BW: at 100 Hz): ≤–70 dBm (Range 1, ≤11 MHz), ≤–80 dBm (Range 1, >11 MHz), ≤–115 dBm (Range 2, ≤11 MHz), ≤–120 dBm (Range 2, >11 MHz), ≤–125 dBm (Range 3, ≤11 MHz), ≤–135 dBm (Range 3, >11 MHz), Noise floor error: ±0.05 dB (S/N: ≤35 dB), ±0.04 dB (S/N: ≤25 dB), not specified (S/N: ≤10 dB) Frequency drift error: ±0.007 dB (1% of BW frequency drift relative to set signal frequency) BW switching error: ±0.01 dB (BW: 1 Hz to 10 kHz), ±0.05 dB (BW: 1 Hz to 100 kHz, frequency: ≥1 MHz) *Excluding effect of measured signal residual FM
	Average	Measurement times: 1 to 256
	Display units	dBm, dB, dBμ, dBμ (emf) W, mW, μW, pW, fW, aW (automatically chosen best unit for measured value) V, mV, μV, nV, pV (automatically chosen best unit for measured value)
	Display digits	dB units: 0.1, 0.01, 0.001 dB W/V units: 3, 4, 5 digits
	Reference	Set any value: –180 to +60 dBm Meas → Ref: Obtain current measured value
	Offset	Setting range: –100 to +100 dB
	Calibration	Calibration frequency count: 300 Calibration level: 0 dBm +3/–4 dB (relative level calibration at Range 1, using MA2540A) –30 dBm +3/–4 dB (calibration between Range 1 and Range 2) –75 dBm +3/–4 dB (calibration between Range 2 and Range 3)
Spectrum monitor	Center frequency	100 kHz to 3000 MHz, Min. setting resolution: 1 Hz
	Frequency span	10 kHz to 1 MHz, Setting resolution: 1 Hz
	Resolution bandwidth	300 Hz to 100 kHz (1-3 sequence)
	Video bandwidth	10 Hz to 100 kHz (1-3 sequence)
	Sweep time	100 ms to 1000 s
	Reference level	Range 1: +20 dBm, Range 2: –25 dBm, Range 3: –70 dBm

Continued on next page

Spectrum monitor	Markers	Functions MKR → PEAK: Moves marker to max. level in monitored range MKR → CNTR: Sets marker frequency to center frequency of monitored range PEAK → CNTR: Sets max. level frequency to center frequency of monitored range Frequency readout level Range 1: ≥–35 dBm, Range 2: ≥–80 dBm, Range 3: ≥–100 dBm Zone marker width: Spot, 1, 5, 10 div.
	Auto-tune	Signal detection frequency range: 30 to 3000 MHz Signal detection level: ≥–30 dBm
Other	Save/recall	Save count: 100
	Panel lock	Function: Disables all key and encoder functions except power switch and panel lock key
	GPIB	Function: Used to control ML2530A as device from controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
	Power	100 to 120 V/200 to 240 V (auto-switching), 47.5 to 63 Hz, ≤120 VA
	Dimensions and mass	426 (W) x 221.5 (H) x 451 (D) mm, ≤17.9 kg
	Environmental conditions	Operating temperature range: 0˚ to 50˚C Storage temperature range: –20˚ to +60˚C
	EMC	EN61326: 1997/A1, 1998 (Class A) EN61000-3-2: 1995/A2, 1998 (Class A) EN61326: 1997/A1, 1998 (Annex A)
	LVD	EN610101-1: 1993/A2, 1995 (Installation Category Ⅱ, Pollution degree 2)

∗1: At constant temperature in operating range of 15˚ to 35˚C
∗2: At fixed temperature in ambient temperature range of 15˚ to 35˚C, and level calibration after 1 hour warm-up

MA2540A Sensor Module

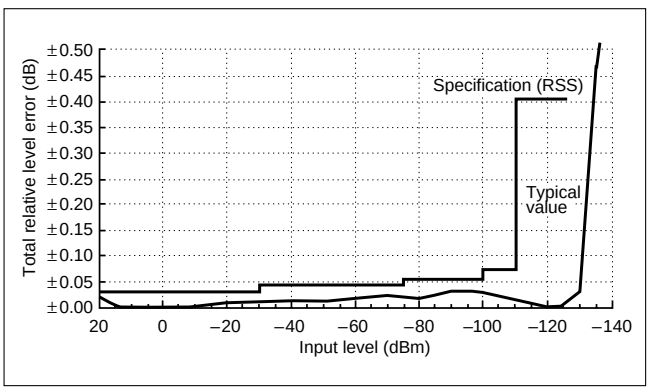
Frequency range	100 kHz to 3000 MHz
Level	Level range: –140 to +20 dBm, Max. input level: +20 dBm
RF input connector	Type: N-J Nominal impedance: 50 Ω VSWR (power sensor side): ≤1.30 (100 to 300 kHz), ≤1.20 (0.3 to 1 MHz), ≤1.36 (1 to 3000 MHz) VSWR (through side): ≤1.12 (0.1 to 100 MHz), ≤1.35 (100 to 3000 MHz)
RF output connector	Type: N-J, Nominal impedance: 50 Ω
RF input/output characteristics	Through side insertion loss: ≤0.7 dB Through side insertion loss reproducibility: ±0.006 dB
Dimensions and mass	63 (W) x 54 (H) x 206 (D) mm, ≤1 kg
Environmental conditions	Same as the ML2530A

Sensor module calibration factor uncertainty

Frequency	Simple total	RSS total
0.1 MHz	±3.0%	±1.4%
10 MHz	±2.4%	±1.1%
100 MHz	±2.4%	±1.1%
1000 MHz	±3.0%	±1.4%
2000 MHz	±3.0%	±1.4%
3000 MHz	±3.2%	±1.5%

Total level error

The total level error is the total of each error source. For example, the total relative level error at a frequency of 1 GHz and a BW of 100 Hz is as shown below.



The absolute level error for a measured signal at a frequency of 1 GHz, measurement bandwidth of 100 Hz, device under test VSWR of 1.5, and signal level of –100 dBm is as follows.

Source of uncertainty	NIST traceable uncertainty
Relative level error at –100 dBm	1.6% (±0.07 dB)
CAL output level error	±0.93%
Mismatch error at calibration	±0.23%
Sensor module calibration factor error at measured frequency	±1.4%
Linearity error of the ML2530A power measurement section	±1.0%
Sensor module relay repeatability	±0.14% (±0.006 dB)
DUT mismatch error sensor module + calibration receiver VSWR: 1.2 (typ.)	±3.7%
Total (RSS)	±4.5 (±0.19 dB)

For product ordering information, see pages 4 – 10

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML2530A	Calibration Receiver	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0012	Fuse, 3.15 A:	2 pcs
W1492AE	ML2530A operation manual:	1 copy
	Optional accessories	
MP721A	Fixed attenuator (3 dB, 2 W)	
MP721B	Fixed attenuator (6 dB, 2 W)	
MP721C	Fixed attenuator (10 dB, 2 W)	
MP721D	Fixed attenuator (20 dB, 2 W)	
MP721E	Fixed attenuator (30 dB, 2 W)	
MP721F	Fixed attenuator (40 dB, 2 W)	
MP721G	Fixed attenuator (50 dB, 2 W)	
MP721H	Fixed attenuator (60 dB, 2 W)	
J0078	High power fixed attenuator (20 dB, 10 W)	
J0063	High power fixed attenuator (30 dB, 10 W)	
J0395	High power fixed attenuator (30 dB, 30 W)	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0431F	Coaxial cable (BNC-P · RG55A/U · BNC-P), 1 m	
J0431G	Coaxial cable (BNC-P · RG55A/U · BNC-P), 2 m	
J0903A	Coaxial cable (NP · RG-142B/U · N-P), 1.5 m	
J0904A	Sensor module cable, 1.5 m (for MA2540A control)	
B0333D	Rack mount kit	
B0329D	Front cover	
B0331D	Front handle (2 pcs/set)	
B0332	Joint plate (4 pcs/set)	
B0334D	Carrying case (hard type, with protective cover and casters)	
	Peripheral instruments	
MS616B	Modulation Analyzer (150 kHz to 3000 MHz)	
MG3633A	Synthesized Signal Generator (10 kHz to 2700 MHz)	
	Sensor module	
MA2540A	Sensor Module	
	Standard accessories	
J0903A	Coaxial cable (N-P · RG-142B/U · N-P), 1.5 m:	1 pc
J0904A	Sensor module cable, 1.5 m (for MA2540A control):	1 pc
W1491AE	MA2540A operation manual:	1 copy

LEVEL METER
ML424A, ML424B
10 Hz to 20 MHz **10 Hz to 30 MHz**

For Constructing and Maintaining FDM Communication Lines

Custom-made product

The ML424A/B is a compactly designed level-meter of high level-measuring accuracy with a calibration signal internally provided. It is also capable of measuring noise levels in conformity with the ITU-T Recommendations with the necessary psophometer option.

Features
- Excellent frequency response of ±0.1 dB over the range from 100 Hz to 13 MHz
- High measuring accuracy of ±0.2 dB including the frequency response, attenuator step accuracy, and temperature stability
- A psophometer option can be incorporated (option 01) for measuring noise levels of telephone and sound program circuits. The characteristics of the weighting filters conform to the ITU-T Recommendations P.53 and J.16.
- The ML424B provides true RMS detection

TRANSMISSION MEASURING SET
ME446A/B, ME447A/B/D/E
10 Hz to 20 MHz

For Measuring Base Band and Frequency Band of FDM Communication Lines

Custom-made product

ME447A

The ME446A/B is a compact test set which consists of the MG442A Synthesized Level Generator and the ML424A/B Level Meter. The MG442A has a superior output level accuracy of within ±0.2 dB including all the frequency characteristics, step accuracy of the attenuator, temperature stability, etc. Output level can be varied in fine steps of 0.1 dB. For this reason, the test set is capable of end-to-end tests of transmission lines by matching the dials of frequency and level without adjustment of the transmitting level.
The ML424A/B is capable of measuring the level of a signal or noise with high accuracy. The frequency range is wide, from 30 Hz to 150 kHz at 600 Ω balanced input impedance, from 4 to 650 kHz at 75 Ω and 150 Ω balanced, and from 10 Hz to 20 MHz at 75 Ω unbalanced, so that apparatus and transmission lines from the voice frequency band to the carrier frequency band up to 3600 channels can be tested. The ME446A/B allows both efficient and economical maintenance of multichannel communication systems.
The ME447A/B is a compact test set composed of the MG442A Synthesized Level Generator, the ML424A/B Level Meter, and the MN415A Level Comparator. This test set can, in addition to the functions possessed by the ME446A Transmission Measuring Set, easily measure gain and loss with high accuracy and digitally display measurement results.

SELECTIVE LEVEL METER
ML422C
50 Hz to 30 MHz

For Measuring FDM Communication Lines with High Level Accuracy

Custom-made product

GPIB

The ML422C is designed for use with and ITU-T system. This instrument covers an extremely wide frequency range, from 50 Hz to 30 MHz. This remarkable instrument offers highly accurate measurement of signal levels, and it has the frequency accuracy and stability needed to manufacture and maintain FDM systems, from voice frequencies up to 3600 channels. The ML422C can also function as a wideband level meter, psophometer, or voice band analyzer.

Features
- Highly accurate level measurement
- Measurement of transmission impairment
- 48 kHz group filter
- Intrinsic distortion below –70 dB
- True RMS value detection and 3.1 kHz bandwidth
- Built-in microprocessor for simple operation

For product ordering information, see pages 4 – 10

RESISTANCE ATTENUATOR

MN510C/D

DC to 500 MHz

Custom-made product

MN510D

These are variable resistance attenuators for measurement of 50 and 75 Ω impedance systems. Each of these attenuators has a wide frequency range and is highly accurate, compact, lightweight with good articulation, and easy to handle. Moreover, comparison measurement can be made far more smoothly when used in conjunction with a key box.