MICROWAVE SYSTEM ANALYZER
ME453K/L/M, ME538K/L/M
70 MHz band   **70/140 MHz band**

Custom-made product

The ME453 and ME538 series are used to measure the transmission line characteristics in the BB and IF bands in terrestrial microwave radio relay systems and in satellite communication systems. The above types of transmission distortion can be measured and analyzed with them. They have been designed with special emphasis on measurement items, performance, functions, precision and size so that they can be used for all types of microwave radio relay systems, such as FDM-FM relay systems, high-efficiency large-capacity digital microwave radio relay systems, and INTELSAT and other satellite communications systems. Unique special innovations contribute greatly to improving handling ease. To improve operational ease, a number of internal controls are used and some measurements are automatic.

Furthermore, the measuring parameters and measured values are displayed digitally, so even when one of these analyzers is used for the first time, results can be obtained quickly and accurately.

The IF and BB frequencies must coincide for remote testing with other models or instruments of other manufacturers. This condition can be met quite easily by selecting the appropriate model from this particular series.

Multiplexed telephone, TV, PCM and data communications signals are mostly transmitted through microwave radio relay systems. However, when linear distortion (amplitude distortion, phase distortion) or non-linear distortion (which causes problems, particularly with analog signal transmission) is present in the transmission line, distortion noise is generated in the telephone transmission, clarity and color uniformity are lost with TV transmission and intersymbol interference between codes originating in the waveform distortion results in digital transmission. It is therefore necessary to measure the distortion in these transmission lines and to equalize it sufficiently.

Measurement items
- Group delay characteristics
- Linearity and sensitivity in modulators and demodulators
- Differential gain characteristics
- Differential phase characteristics
- IF and BB band amplitude response
- IF and BB band return loss
- Frequency deviation (or spectrum)
- AM/PM conversion coefficient
- DC characteristics
- IF/BB band power, gam, loss
- IF band frequency

Applications
The ME453 and ME538 can be used in the construction, maintenance, or research and development of digital microwave systems and of satellite and terrestrial radio relay systems with BB and IF capability. The measurement item relating to the various circuit parts are listed below.
- Modulators and demodulators:
  Linearity, sensitivity, group delay characteristics, differential gain, differential phase, IF and BB band amplitude characteristics
- Repeater IF sections and overall links:
  Group delay characteristics, differential gain, differential phase, IF and BB band amplitude characteristics
- Others:
  IF/BB impedance, power, gain, AM/PM conversion coefficient.
  The transmitter and receiver are designed to operate independently so that end-to-end measurement can be conducted with a single analyzer.
  RF band measurements can be conducted by connecting an up/down converter to this analyzer.

Functions
- **LED readout of transmitter settings**
  For IF and BB measurements, the transmitter settings are shown with unmistakable clarity by the front-panel LED display, so you can read deviation, sweep width and center frequency at a glance.

- **Automatic receiver settings and display**
  Deviation, IF level, BB frequency and level—all are automatically selected and displayed by this receiver. Calibration and attenuation are also automatic.

- **Automatic display of units**
  Both sensitivity and units are displayed automatically for all measurements, so readings are fast and unmistakably accurate.

- **All measurements shown on the CRT and large LED displays**
  Measurement parameters and results are displayed on the CRT in alphanumeric form together with the signal trace.
  They are also displayed simultaneously on the large, easy-to-read LED display.

- **Signal averaging for noisy traces**
  Internal normalizing circuitry allows you to average traces for removing the noise component—as in the measurement of a satellite system, for example.

- **BB to BB amplitude measurement (optional)**
  An extremely flat baseband sweep generator and detector give you the end-to-end, BB to BB amplitude response measurements so necessary for maintenance of telephone and TV links. The CRT X-axis is a logarithmic frequency scale. Markers are at 60, 100 and 300 kHz, and 1, 3, 10 and 15 MHz.

• **Receiver GP-IB and direct plotting functions (Option)**
The receiver is computer controllable via the GP-IB which is usable with either plotters or personal computers. This function enables measured data to be sent to a personal computer for data processing.

The direct plotter function allows CRT displayed data (measured parameters and displayed signal) to be directly printed out on either a plotter or a dot matrix printer.

Specifications

• **IF band measurement**

Measurements	Models	ME453K/L/M 70 MHz Band	ME538K/L/M 70 MHz Band	ME538K/L/M 140 MHz Band
Amplitude (IF INPUT terminal)	Inherent slope	±0.05 dB/±25 MHz	±0.05 dB/±25 MHz	±0.05 dB/±25 MHz, ±0.1 dB/±40 MHz, ±0.2 dB/±50 MHz
	Measuring range	0 to 16 dB		
	Max. sensitivity	0.01 dB/div (Y2 display)		
	IF INPUT level	+10 to −20 dBm		
Amplitude (RET. LOSS INPUT terminal)	Inherent slope	±1 dB		
	Measuring range	0 to 40 dB		
	Sensitivity	1 dB/div, 5 dB/div		
	INPUT level	−60 to −20 dBm		
Group delay	Inherent slope	0.3 ns/±15 MHz, 0.5 ns/±25 MHz	0.3 ns/±15 MHz, 0.5 ns/±25 MHz	0.3 ns/±20 MHz, 0.5 ns/±30 MHz, 1 ns/±50 MHz
	Measuring range	0 to 400 ns		
	Max. sensitivity	0.1 ns/div (Y2 display)		
	Noise	0.05 ns/condition: fM = 200 to 278 kHz, deviation: 200 kHz rms, using average function		
Linearity	Inherent slope	0.2%/±25 MHz	0.2%/±25 MHz	0.2%/±50 MHz
	Measuring range	0 to 80%		
	Max. sensitivity	0.05%/div		
	Noise	0.01%/condition: fM < 1 MHz, deviation: 200 kHz rms, using average function		
Differential phase	Inherent slope	0.3°/±15 MHz, 0.5°/±25 MHz	0.3°/±15 MHz, 0.5°/±25 MHz	0.3°/±20 MHz, 0.5°/±30 MHz, 0.8°/±50 MHz
	Measuring range	0° to 40°		
	Max. sensitivity	0.2°/div		
	Noise	0.02°/condition: fM = 5.6 MHz, deviation: 500 kHz rms, using average function		
Differential gain	Inherent slope*	0.2%/±15 MHz, 0.4%/±25 MHz	0.2%/±15 MHz, 0.4%/±25 MHz	0.3%/±20 MHz, 0.4%/±30 MHz, 0.6%/±50 MHz
	Measuring range	0 to 80%		
	Max. sensitivity	0.05%/div		
	Noise	0.01%/condition: fM = 5.6 MHz, deviation: 500 kHz rms, using average function		
IF return loss	Frequency range	70 ± 25 MHz	70 ± 25 MHz	140 ± 50 MHz
	Measuring range	10 to 50 dB: Accuracy depends on the bridge used		
	Sensitivity	1 dB/div, 5 dB/div		
AM to PM conversion	Residual PM	0.3°/dB/±25 MHz	0.3°/dB/±25 MHz	0.3°/dB/±35 MHz
	Measuring range	0.3°/dB to 16°/dB		
Spectrum	Center frequency	70±20 MHz Auto tuning	70±20 MHz Auto tuning	140±30 MHz Auto tuning
	Sweep width	Approx. ±700 kHz		
	Max. sensitivity	Detects 0.1 dB change of modulating signal at carrier zero point		
	Deviation	K: 340 kHz rms at 200 kHz, L: 472 kHz rms at 277.778 kHz, M: 425 kHz rms at 250 kHz		
Deviation	Measuring range	20 to 999 kHz rms at the built-in BB frequencies <8.2 MHz		
	Accuracy	10% at the built-in BB frequencies <8.2 MHz		
	Calibration	Deviation is calibrated by easy pushbutton operation. Accuracy reaches 1% theoretically at the specified modulation frequency and deviation (as measured by the Bessel zero method) shown below.		
Modulator sensitivity	Mod. signal level	−50 to +10 dBm		
	Deviation	Use the DEVIATION meter function or use the carrier zero deviation with the SPECTRUM function		
Demodulator sensitivity	IF signal	Calibrate the deviation with DEVIATION meter function or SPECTRUM function		
	Demo. BB level	−50 to +10 dBm		

Calibration table:

Model	MOD frequency	Key in factor
K	200 kHz	340 kHz rms
L	277.778 kHz	472 kHz rms
M	250 kHz	425 kHz rms

Inherent noise (IF to IF)	Group delay	Linearity	Differential phase	Differential gain	
	66 to 93 kHz: 0.3 ns rms 200 to 278 kHz: 0.1 ns rms 400 to 556 kHz: 0.05 ns rms	0.02% rms	0.05° rms	0.1% rms	Detection band: 3 kHz
	Deviation: 200 kHz rms, fM < 1 MHz		Deviation: 500 kHz rms, fM = 5.6 MHz		

· Specified frequency range = Carrier sweep width + 2 fM

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• **BB (baseband) measurement**

	Item	Inherent slope	Measuring range	Max. sensitivity	Noise
BB to BB measurements	Group delay	0.1 ns	0 to 400 ns	0.1 ns/div (at Y2)	0.2 ns
	Linearity	0.1%	0 to 80%	0.05%/div	0.05%
	Differential phase	0.1%	0° to 40°	0.2°/div	0.05°
	Differential gain	0.1%	0 to 80%	0.05%/div	0.05%
	Measuring condition	BB level: −30 dBm			
BB return loss	Frequency	Built-in BB frequency or BB amplitude option			
	Range	10 to 40 dB, 1 dB/div (BB amplitude option)			
BB amplitude (Option)		Frequency range: 60 kHz to 15 MHz, level: +10 to −50 dBm, inherent slope: ±0.5 dB/100 kHz to 13 MHz Measuring range: 0 to 8 dB, max. sensitivity: 0.1 dB/div			
DC input		Measuring range: 0 to ±400 mV, max. sensitivity: 1 mV/div			

• **Receiver**

IF input	Frequency range	70 MHz band: 45 to 95 MHz 140 MHz band: 90 to 190 MHz When BB frequency is 55.6 kHz (or 27.8 kHz).[1] 70 MHz band: 60 to 80 MHz 140 MHz band: 130 to 150 MHz
	Level range	+10 to −20 dBm
	Level display	3-digit LED display Resolution: 0.1 dB
	Level accuracy	±0.3 dB at +4 dBm
	Impedance	75 0 Return loss: >30 dB at +4 dBm
	Input frequency sweep width	
	Maximum sweep width	±25 MHz/center frequency 70 MHz ±50 MHz/center frequency 140MHz When BB frequency is 55.6 kHz (or 27.8 kHz).[1] ±10 MHz/center frequency 70/140 MHz
	Minimum sweep width	The minimum sweep width is required for reproducing the HOR signal on the CRT, ±0.2 MHz
	Demodulation	66.7, 80 kHz to 8.2 MHz BB frequency 55.6 kHz (or 27.8 kHz) is demodulated when sweep frequency is only 18 Hz.[1]
IF return loss input	The return loss input is used with the same frequency applied to IF INPUT to lock the AFC loop.	
	Input level range	−20 to -60 dBm
	Flatness	±1 dB/45 to 95 MHz ±1 dB/90 to 190 MHz
	Impedance	75 Return loss: >28 dB
BB input (BB + sweep)	BB frequency range	66 kHz to 15 MHz and 55.6 kHz[1] (or 27.8 kHz)
	BB level range	+10 to -50 dBm
	BB level display	3-digit LED display Resolution: 0.1 dB
	BB level accuracy	±0.3 dB at 0 dBm
	Impedance	75 Ω Return loss: >28 dB at 0 dBm frequency 66 kHz to 15 MHz
	Sweep frequency range	18 to 100 Hz
	Sweep voltage range	±50 mV to ±5 V
	X phase setting range	0° to 360°

Phase detector	Input frequency	The BB frequency (66.7 kHz to 12.39 MHz) is selected automatically.

	K	L	M
f_1	66.667 kHz	92.593 kHz	83.333 kHz
f_2	200 kHz	277.778 kHz	250 kHz
f_3	400 kHz	555.556 kHz	500 kHz
f_4	2 MHz	2.4 MHz	
f_5	3.58 MHz		
f_6	4.43MHz		
f_7	5.6 MHz		
f_8	8.2 MHz		
f_9	12.39 MHz (ME538K/L/M)		
f_{10}	55.5556 kHz[2] (option)		

	Capture range	±5 Hz (≤555.556 kHz) $±5 \times 10^{-6}$ (≤12.39 MHz) ±1 Hz (≤55.5556 kHz)
Frequency markers	Slide marker	Variable side markers: 70 ±25 MHz, 140 ±50 MHz
	Frequency display	4-digit LED display Resolution: 10 kHz
	Accuracy	$±1 \times 10^{-4}$ ±1 digit
	2 MHz comb + slide	2 MHz Comb markers + Variable side markers
Center frequency counter	Counts the center frequency of the swept IF signal and CW-IF signal and displays it on the 5-digit LED display. The display to the LED display is made by selecting either the slide marker frequency or center frequency with a key.	
	Frequency range	70 MHz band: 45 to 90 MHz 140 MHz band: 90 to 190 MHz
	Frequency display	4-digit LED display (ME453□) 5-digit LED display (ME538□) Resolution: 10 kHz
	Accuracy	$±1 \times 10^{-3}$ ±1 digit
IF sweep width measurement	Measuring range	70 MHz band: ±0.2 to ±25 MHz 140 MHz band: ±0.2 to ±50 MHz
	Resolution	0.2 to 9.99 MHz: 10 kHz 10 to 50 MHz: 100 kHz
	Accuracy	$±5 \times 10^{-2}$ ±1 digit
BB output (rear panel)	Level	−7 dBm, typical
	Impedance	75 0, nominal
Ext. sweep Input (rear panel)	Frequency	18 to 100 Hz
	Level	1 Vp-p
	Impedance	>5kohm
X-Y recorder output (Option)	Output	X: 0 to 4 V Y: 0 to 4V Pen lift: Open Pen down: Ground
	Sweep speed	20 s, 40 s, nominal

[1] Option 05: 55.6 kHz additional BB frequency
[2] 27.8 kHz can be supplied if specified.

• Transmitter

IF output	Frequency range	70 MHz band: 45 to 95 MHz 140 MHz band: 90 to 190 MHz
	Center frequency Display	4-digit LED display (ME453□) 5-digit LED display (ME538□) Resolution: 10 kHz
	Frequency display Accuracy	$\pm 1 \times 10^{-4}$ ±1 digit/CW
	Stability	±100 kHz at 70 MHz ±200 kHz at 140 MHz 5-hour after 1/2-hour warm-up
	Level range	+ 10 to − 70 dBm (1 dB step attenuator) Continuously variable range: > ±1 dB
	Level accuracy	±0.3 dB at +4 dBm
	Harmonics	< -30 dB
	Impedance	75 fi Return loss: >30 dB at +4 dBm
IF sweep width	Sweep width range	70 MHz band: 0 to ±25 MHz 140 MHz band: 0 to ±50 MHz
	Sweep width display	3-digit LED display Resolution: 0.1 MHz
	Auto sweep reduction	The sweep width is reduced by 2 x BB frequency ±10% when BB frequency >1 MHz. This function can be reset with a switch.
FM deviation	Mod. frequency	Same as BB frequency (item 6)
	Deviation range	5 to 1000 kHz rms
	Deviation display	4-digit LED display Resolution: 1 kHz rms
AUX IF output	Frequency range	Same as IF OUTPUT specification (item 1)
	Output level	-10dBm
	Level accuracy	< ±1 dB
	Impedance	75 fi, nominal
Crystal output	Frequency	70 MHz band: 70 MHz 140 MHz band: 140 MHz
	Output level	+ 5 dBm
	Level accuracy	< ±1 dB
	Impedance	75 fi, nominal

BB + sweep output

BB frequency

	K	L	M
f1	66.667 kHz	92.593 kHz	83.333 kHz
f2	200 kHz	277.778 kHz	250 kHz
f3	400 kHz	555.556 kHz	500 kHz
f4	2 MHz	2.4 MHz	
f5	3.58 MHz		
f6	4.43 MHz		
f7	5.6 MHz		
f8	8.2 MHz		
f9	12.39 MHz (ME538K/L/M)		
f10	55.5556 kHz* (Option)		

* Can be changed to 27.778 kHz if so specified.
Option 05: 55.6 kHz additional BB frequency.

BB frequency Accuracy	± 5 Hz (≤ 555.556 kHz) $\pm 5 \times 10^{-6}$ (≤ 12.39 MHz) ± 1 Hz (≤ 55.5556 kHz)
BB level	+ 10 to − 50 dBm A 10 dB step attenuator and 0 to - 10 dB continuously variable dial are provided for setting the level.
BB level display	3-digit LED display Resolution: 0.1 dB

(Contd.)	BB level accuracy	±0.3 dB at 0 dBm
	BB harmonics	< -38 dB
	BB impedance	75 fi Return loss: >28 dB at - 10 dBm
BB + sweep output	Sweep frequency	Line (50/60 Hz), 70 Hz Option (select one frequency from 18 to 100 Hz) Ext. (18 to 100 Hz)
	Sweep level	0 to 6.5 Vp-p/75 fi
	Sweep level display	3-digit LED display Resolution: 0.01 V
	Sweep level accuracy	±10% at 6 Vp-p
	Sweep harmonics	< − 35 dB
Sweep output	Sweep level	0 to 25 Vp-p/10 kfi
	Sweep level display	3-digit LED display Resolution: 0.01 x 4 V
	Sweep level accuracy	±10% at 24 Vp-p
Ext. sweep input (rear panel)	Frequency	18 to 100 Hz
	Level	2 Vp-p
	Impedance	10 kfi, nominal
Ext. BB input (rear panel)	Frequency	80 kHz to 15 MHz
	Level	− 7dBm
	Impedance	75 fi, nominal
BB sweeper (option)	Frequency range	60 kHz to 15 MHz
	BB output level	+ 10 dBm to − 50 dBm (10 dB step attenuator) Continuously variable range: 0 to - 10 dB
	BB level display	3-digit LED display Resolution: 0.1 dB
	Inherent slope	±0.5 dB/100 kHz to 13 MHz The value of the sum of the receiver and transmitter
	Impedance	75 fi Return loss: >28 dB at - 10dBm

Sweep frequency is automatically set to 18 Hz when f1 is selected.

• Low BB frequency: 55.6 kHz or 27.8 kHz (Option)

Group delay	Inherent slope	70 ±10 MHz: 5 ns 140 ±10 MHz: 5 ns
	Measuring range	0 to 400 ns
	Max. sensitivity	2 ns/div
	Noise	1 ns
Linearity	Inherent slope	70 ±10 MHz: 0.5% 140 ±10 MHz: 0.5%
	Measuring range	0 to 80%
	Max. sensitivity	0.1%/div
	Noise	0.1%

With deviation 100 kHz rms and sweep frequency 18 Hz using average function

• General specifications

Input and output connector	BNC or SP connector Other type of connectors can be installed if requested by the user: e.g., Siemens Small, Weco 560A or equivalent.
Power	260 VA Transmitter: 85 VA Receiver: 175 VA From AC 100 V to AC 250 V, at the request of the user. Tolerance ±10%
Ambient temperature, rated range of use	0° to 50°C
Dimensions and mass	Receiver: 177H x 426W x 450D mm, <18.5 kg Transmitter: 133H x 426W x 450D mm, <13.5 kg

Ordering information

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

Model/Order No.	Name		IF bands	BB	Std. I/O connector
	Main frame				
ME453K	Microwave System Analyzer		70 MHz	200kHz	SP
ME453L	Microwave System Analyzer		70 MHz	278 kHz	BNC
ME453M	Microwave System Analyzer		70 MHz	250 kHz	BNC
ME538K	Microwave System Analyzer		70/140 MHz	200 kHz	SP
ME538L	Microwave System Analyzer		70/140 MHz	278 kHz	BNC
ME538M	Microwave System Analyzer		70/140 MHz	200 kHz	BNC
	Standard accessories				
J0082A	Coaxial Cord, 2 m:	3 pcs	SP-3CP•3C-2WS•SP-3CP for SP connector	(Either one is attached)	
J0092C	Coaxial Cord, 2 m:	3 pcs	BNC-P620•3C-2W•BNC-P620 for BNC connector		
J0134	Power Cord, 2.5 m:	2 pcs	One each for transmitter and receiver		
B0019	Front Cover:	1 pc	For transmitter		
B0020	Front Cover:	1 pc	For receiver		
F0023	Fuse, 3.15 A:	2 pcs	MF51NN250V3.15AAC05		
F0022	Fuse, 2 A:	2 pcs	MF51NN250V2AAC05		
F0045	Fuse, 2 A:	4 pcs	MF51NN250V2ADC01		
W0094CE	ME453K/L/M, ME538K/L/M Operation and Service Manual:	1 copy			
	Options		Processed at factory		
MSA-01	BB Amplitude Measurement				
MSA-02	X-Y Recorder Output				
MSA-03	Sweeper Frequency Added		Specify one frequency from 18 to 100 Hz		
MSA-04	Receiver GP-IB, Direct Plotting of CRT Output				
MSA-05	55.6 kHz BB Frequency Added		Change to 27.8 kHz possible, option 03 (18 Hz) is required.		
	Optional accessories				
MR55A1	IF Return Loss Bridge		Connector: SP or BNC		
MR43A	BB Return Loss Bridge		Connector: SP or BNC		
	Peripherals				
MB23A	Portable Test Rack		Tilt angle		
MB24A	Portable Test Rack		Horizontally fixed		