C & U
CREATIVE & UNIQUE

MICROWAVE

Handheld signal analyzer

MSA500 series

REAL TIME system plus SWEEP system

MSA538
MSA558
MSA538TG
MSA538E
MSA558E

MICRONIX

handheld signal analyzer with REAL TIME plus SWEEP system

Signal analyzer MSA500 series offers both the real time system based on Fast Fourier Transform(FFT) and the conventional sweep system. Each strong point of both systems is effectively usable.

Stlong and weak points of real time system and sweep system

Real time system

Strong points

① The spectrum analysis of unsteady signal such as burst signal and noise is available
② The time domain analysis such as power vs. time, frequency vs. time, phase vs. time, IQ vs. time and Q vs. I is available.
③ Since the trigger function is substantial, the spectrum which rarely occurs can be also captured certainly.
④ Compared with OverWrite function in sweep mode, the spectra which are missed are much less.
Especially, any spectrum isn't missed in the span narrower than 200kHz.
⑤ The change of frequency and power over time can be observed m spectrogram analysis.
⑥ Since the measured data is separated into I and Q data, modulation analysis of complicated signals such as phase modulation is possible
⑦ The frequency accuracy is very high as ±0.5ppm ±1 dot at all points of screen.

Weak point

① The maximum frequency span is as narrow as 20MHz.

Sweep system

Strong points

① The wide frequency range can be observed at a glance because the wide frequency span can be set.
② The tracking generator can be equipped.
③ The EMI measurement conforming to the standard is possible.
④ Since the sweep mode is a system of the conventional spectrum analyzer, users are familiar with it and applications are also abundant.

Weak points

① It is difficult to observe an unsteady signal, and even when it can be observed by using a MaxHold, it takes time to measure.
② The analysis in time domain is only at the zero span mode.
③ The modnlation analysis is impossible.
④ The frequency accuracy on the screen is inferior compared to real time mode.

Features of MSA500 series

1 Real time plus Sweep system

In real time system, the spectrum which occurs in an instant won't be missed. It is optimum for analyzing a noise and a transitional phenomenon.
On the other hand, the sweep system is suitable for observing at wide frequency range. Various applications can be covered by making good use of advantage of each system.

2 Sufficient analysis functions

In real time system, Spectrogram analysis and OverWrite analysis can be performed besides Spectrum analysis.
Furthermore, Time domain analysis is also available.

3 Time domain analysis expanding analyzer capability

In real time system, time domain analyses such as power vs. time, frequency vs. time, phase vs. time, IQ vs. time and Q vs. I are possible.

4 Fast Overwrite analysis of 720 frames/sec

Since OverWrite analysis in real time system is processed at high speed as 720 frames/sec, even unnecessary spectrum which appears rarely isn't missed.

5 Powerful trigger functions

In real time system, powerful trigger functions such as channel power trigger, power trigger, IF level trigger and external trigger can be used.

6 Real time operation by 20MHz maximum span

Since a signal can be observed with maximum span of 20MHz in real time system, the modulation signals of almost all of wireless communications can be captured.

7 Large memory of 16K frames and high speed USB communication

In real time system, data can be captured for a long time because the IQ memory is as large as 16K frames (64Mbytes). Moreover, IQ data can be transmitted to PC at speed of 19ms/frame.

8 Average noise level -162d8m/Hz

The average noise level of -162dBm/Hz at [MSA538/538TG/538E] and -157dBm/Hz at [MSA558/558E] is achieved.
At span 20kHz in real time mode, it is -140dBm and -135dBm respectively.

9 Compact and lightweight 1.8kg

The dimensions are as small as 162(W)x71(H)x265(D)mm, and the weight is only 1.8kg including the battery. It is very convenient for outdoor use and on business trip.

10 Four-hour battery operation

Lithium-ion battery MB400 (option) fully charged enables about four-hour battery operation at backlight off.

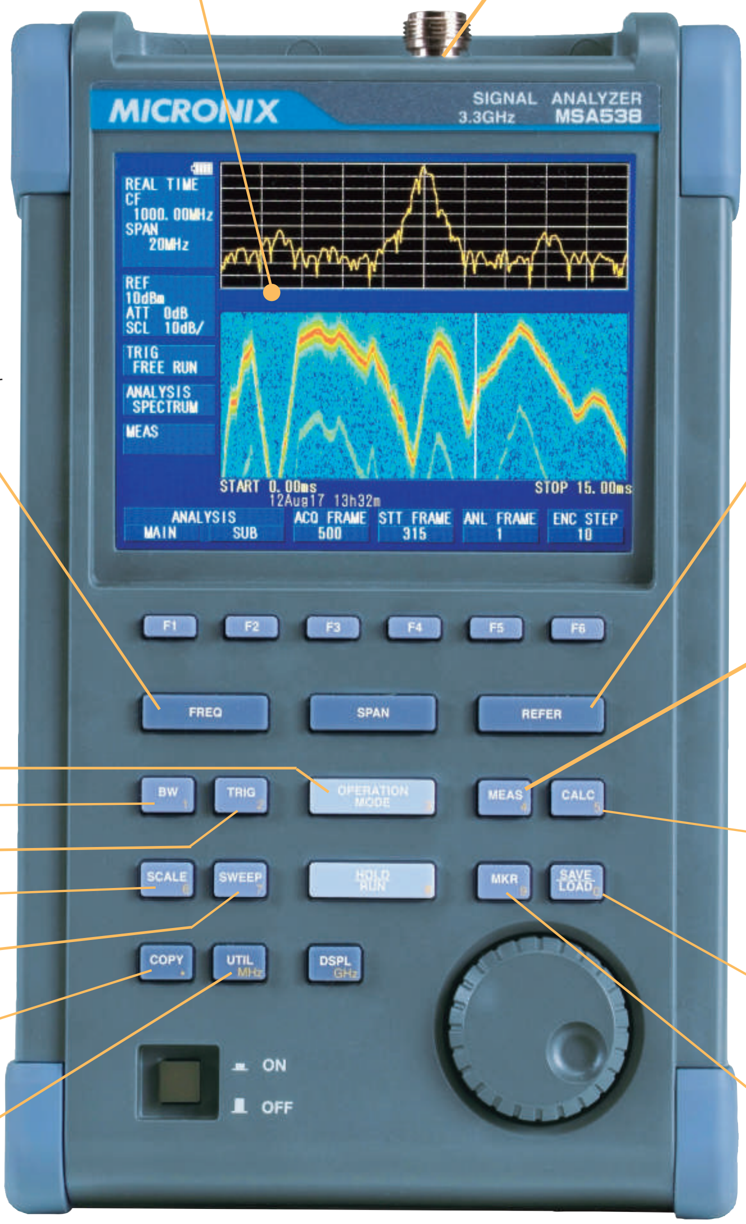
11 Functions comparable to a bench type

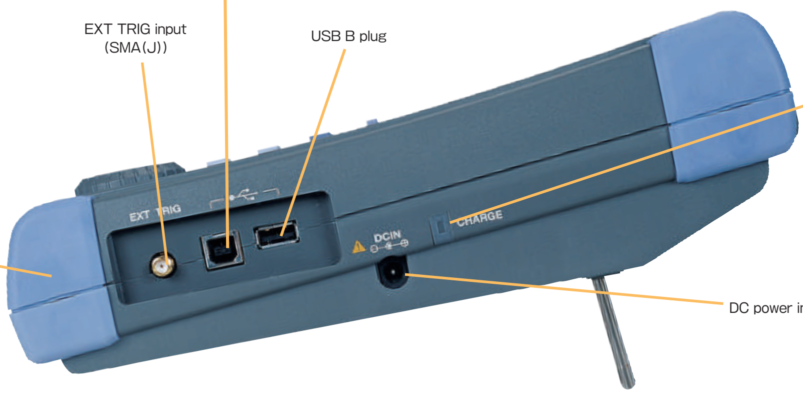
USB memory can be used as an external memory. The screen image is stored by BMP format. And the spectrum waveform, IQ data and setting parameters are stored by CSV format. Moreover, the screen image is copied on the optional USB printer as it is.

12 Functions comparable to a bench type

- Measuring functions : Channel power, Adjacent channel power, Occupied, bandwidth, Electric field strength, Magnetic field, strength and Noise measurement
- Calculation functions: MaxHold, MinHold, Averaging, OverWrite
- Marker measurement and peak search function

Model	Contents
MSA538	20kHz to 3.3GHz The most popular model
MSA558	20kHz to 8.5GHz Covering almost all wireless systems
MSA538TG	20kHz to 3.3GHz With TG from 5MHz to 3.3GHz
MSA538E	20kHz to 3.3GHz With EMI measure-ment
MSA558E	20kHz to 8.5GHz With EMI measure-ment



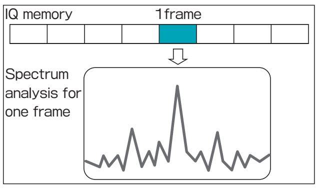


Explanation of real time mode

8 types of analysis functions

Spectrum analysis

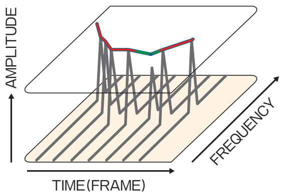
The biggest feature of real time mode is that all the signal spectra acquired in a certain period can be measured without being missed. In sweep mode, unless it is steady signal, some of spectra may be missed. The span from 20kHz to 20MHz (1-2-5 step) and the center frequency with 100Hz resolution can be set.



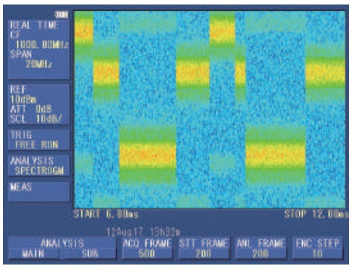
The data of the specified number of 11 acquisition frames (16,383 frames maximum) is stored in IQ memory.
One specified arbitrary frame (analysis start frame, I 024 data) of the stored data is calculated for spectrum.

Spectrogram analysis

The spectrogram is displayed by the three dimensions of time (frame) axis (X), frequency axis (Y) and power axis(Z) (magnitude is expressed by colors). In short, the time response of frequency and power can be observed by X-Y axis and by X-Z axis respectively.



【Setting】
X-axis : Analysis start frame, Number of analysis frames
Y-axis : Center frequency, Span

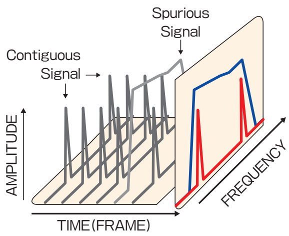


Application

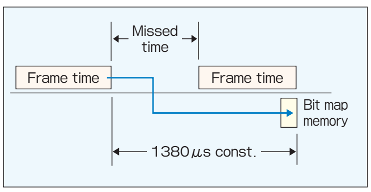
Observation of frequency hopping The time until the frequency and power, which instantaneously change, get stable can be observed.

Spectrogram analysis

OverWrite is a function in which the spectrum waveform of each frame is piled up and then displayed. The spectrum waveform is continuously accumulated at the rate of 720 frames/sec. The occurrence frequency is expressed by colors. The trigger function cannot be used. The spurious response (unnecessary spectrum) which rarely appears can be captured.

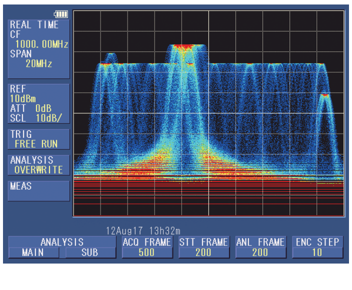


There is no guarantee that all spectra will be completely captured at all spans. As shown in the following table, some spectrum waveforms may be missed due to the span setting. However, any spectrum will not be missed in the span narrower than 200kHz.



SPAN	Flame Time	Frame time
20MHz	30µs	1350µs
10MHz	60µs	1320µs
5MHz	120µs	1260µs
2MHz	300µs	1080µs
1MHz	600µs	780µs
500kHz	1.2ms	180µs
200 to 20kHz	3 to 30ms	0µs (Not missed)

【Setting】
X-axis : Center frequency, Span
Y-axis : Reference level, Scale (2, 5, 10dB/div)
Accumulation frame number: 200, 500, 1000, 2000, 5000, ∞ frame



Application

Observation of unnecessary spectrum which appears rarely
The unnecessary spectrum (spurious) which disturbs a communication system may appear rarely. When span is wide, some spectra may be missed, but the probability of capturing spurious signal increases by setting the large accumulation frame number.

Time domain analysis

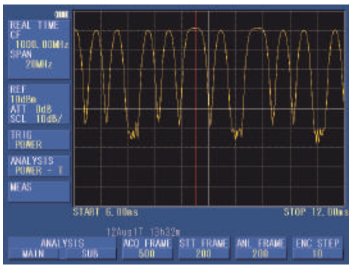
It is the big feature of MSA500 series that time domain analysis is available.
The sampling frequency can be calculated by the following equation.

Sampling frequency=(34MHz*specified span)/20MHz

1 Power vs. time

The power is calculated from IQ data and its time response is displayed.

【Setting】
X-axis : Analysis start frame, Number of analysis frames
Y-axis: Offset, Scale (I, 2, 5, 10dB/div)



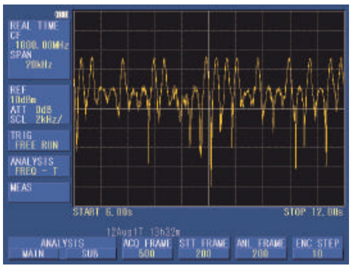
Application

Observation of ASK modulation signal
The ASK signal, which is appeared in burst and whose amplitude is digitally modulated, can be observed .

2 Frequency vs. time

The frequency is calculated based on the phase data and sampling time, and then the time response of the frequency is displayed. The frequency is 0Hz when the frequency doesn't change.
However, when the input frequency isn't coincident with the center frequency,the frequency difference is displayed as an offset.

【Setting】
X-axis : Analysis start frame, Number of analysis frames
Y-axis: Frequency(I,2,5,10%/div of span...actually,displayed by "Hz/div" coupled with span)



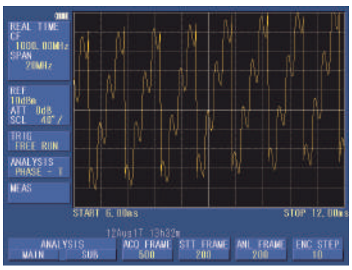
Application

Observation of FM modulation signal
The signal waveform which is modulated by frequency can be observed.

3 Phase vs. time

The phase is calculated based on the IQ data, and the time response of the phase is displayed.

【Setting】
X-axis : Analysis start frame, Number of analysis frames
Y-axis: Offset, Scale (5, 10, 20, 40°/div)



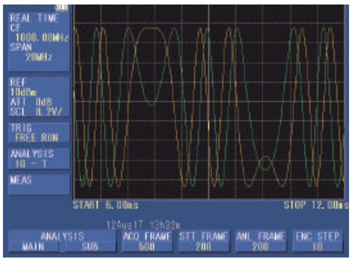
Application

Phase waveform of QPSK modulation
It can be observed how the phase of the QPSK modulation wave changes over time.

4 IQ vs. time

Two waveforms of "I versus time" and "Q versus time" are displayed. The time domain waveforms of I and Q of phase modulation such as QPSK can be observed directly.

【Setting】
X-axis: Analysis start frame, Number of analysis frames
Y-axis: Offset, Scale (0.1, 0.2, 0.4V/div)

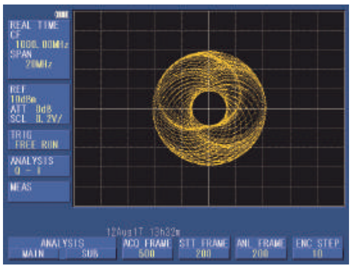


■ Application
I and Q waveforms of QPSK modulation.

5 Q vs. I

I data and Q data are set to X axis and Y axis respectively, and indicated by polar coordinates. The raw constellation waveform can be observed. It does not include the initial phase compensation and the frequency difference compensation of digital phase modulation.

【Setting】
Analysis start frame, Number of analysis frames

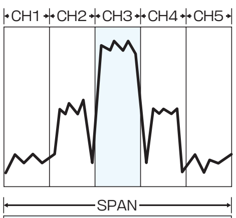


■ Application
Measurement of BPSK modulation
This observation example shows the constellation of digital phase modulation BPSK.

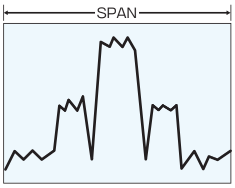
Trigger function

Since MSA500 series is equipped with the powerful trigger function, the desired signal will be able to be captured in every application exactly. In addition to the trigger source and pre trigger described below, trigger mode to select "free run" or "trigger" is available. Also, scan mode to select "single" or "continuous" is available.

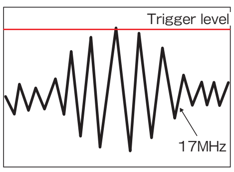
Trigger source



①Channel power trigger
Span is equally divided into five channels (CH1 to CH5). When the instantaneous value of whole power in the specified channel crosses the trigger preset value, the trigger signal is generated. The slope of "rising" or "falling" can be also set. It is convenient when acquiring the hopping signal.



②Power trigger
When the instantaneous value of whole power in the screen crosses the trigger preset value, the trigger signal is generated. The slope of "rising" or "falling" can be also set.

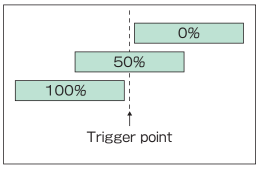


③IF level trigger
When the level of IF signal (modulated with 17MHz) crosses the trigger preset value, the trigger signal is generated. The slope of "rising" and "falling" is not available.

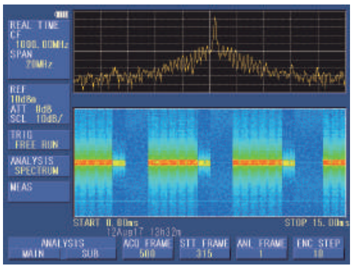
④External trigger
The trigger signal is generated by the signal input to EXT TRIG connector. The input voltage range is from 1 to 10Vp-p, and the frequency range is from DC to 5MHz. The slope of "rising" or "falling" can be also set.

Pre-trigger

By setting Pre-trigger, the signal before a trigger point is analyzable. When Pre-trigger is set to 0%, the signal after trigger point is captured. When being set to 50%, each 50% of signal after and before trigger point is captured.
When being set to 100%, the signal before trigger point is captured. Five positions can be set 0% to 100% in 25% step.



Screen display



There are two ways of screen display. One is Single view displaying one waveform.
Another is Dual view displaying two waveforms.

Single view	Dual view	
	MAIN screen	SUB screen
· Spectrum · Spectrogram · OverWrite · Power vs. time · Frequency vs. time · Phase vs. time · IQ vs. time · Q vs. I	· Spectrum · Spectrogram · Power vs. time · Frequency vs. time · Phase vs time · IQ vs. time · Q vs. I	· Power vs. time · Spectrogram

Large IQ memory of 16K frames

The data after A/D conversion is separated into I and Q. These I and Q data are led to DDC (Digital Down Converter), and then DDC output data is stored in IQ memory of 16K frames (16,383 frames, 64Mbytes). The number of acquisition frames is specified for IQ memory beforehand.
This IQ data besides displayed waveform can be transferred to PC by USB communication.
The longest continuous record time is shown by the below equation.

Longest continuous record time
$= 30.112\mu s * (20MHz/\text{specified span}) * 16{,}383$

For example, when the specified span is 1MHz, the longest continuous record time will be 9.87seconds, so that the analysis for a long time is possible.

USB communication and modulation analysis on PC

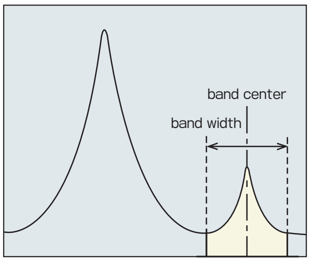
MSA500 series has the large IQ memory of 16K frames (64Mbytes). The data can be transferred as fast as 19ms/frame from IQ memory to PC through USB interface. The modulation analyses such as EVM measurement and constellation display can be accomplished by demodulating the transferred IQ data on PC. The transfer time of 100 frames of IQ data is only 1.9 seconds.
It is very useful for the analysis of the digital phase modulation such as QPSK and QAM. However, it is necessary to design PC software at the user side.
Moreover, the size of the transfer data by USB communication is shown in the following table.

Kind of data	USB transfer data
IQ data	64MByte maximum
Spectrum waveform	Sweep mode : 1001×2Byte Real time mode : 501×2Byte

Measuring functions

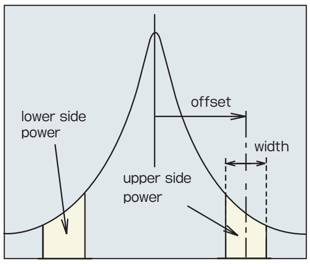
Channel power measurement

The sum of power in the band specified by band center and band width (colored area) is measured. In short, it is possible to measure the total power in the specified frequency band. Of course, this function enables to measure a n01se power.
There is also a function which displays the average power in the specified zone besides the total power.



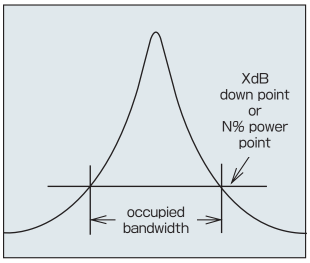
Adjacent channel power measurement

The adjacent channel leakage power is measured as the ratio of power in the range specified by offset frequency and band-width (colored area) to carrier power.
Both of leakage power at the up-per and lower side are measured. Furthermore, the method for measurement is selected out of three methods based on the classification of definition of carrier power; total power method, refer-ence level method and in-band method.



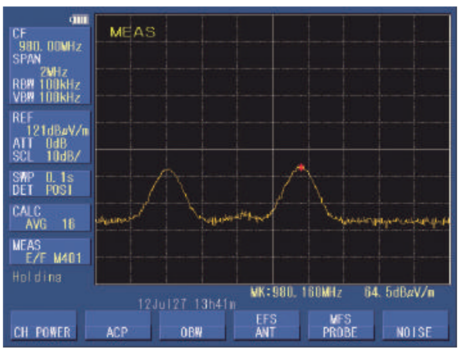
Occupied bandwidth measurement

It is possible to measure the oc-cupied frequency bandwidth de-fined as the width of points that are X(dB) lower than the peak level, or as the width of points at N(%) of the total power.

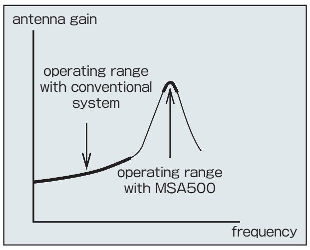


Electric field strength measurement

By connecting the optional portable antenna to the input connector, you can measure the electric field strength. Portable antennas are provided according to the application.



The conventional method covering the wide band with a single antenna re-sults in low antenna gain because of using the range away from an antenna resonance point, and the dynamic range extremely worsens as a result. To use a resonance point where the antenna gain is high, seven kinds of anten-nas are provided according to the frequency bands. Therefore,each antenna secures a wide dynamic range. Antennas of other bands will be also provided if requested. Since the electric field strength is calibrated for each antenna in MSA500 series, it is possible to directly read the measured value.
Moreover, the electric field strength is also measured with an user's antenna besides antennas from M401 to M407 and M308 to M310 if "USER" antenna is selected. Furthermore, the power density (dB μ W/m^2)and magnetic field strength (dB μ A/m) can be measured by calculating based on the electric field strength.



Magnetic field strength measurement

Two types of optional magnetic field probes have been prepared.

①MMP500(Target model : MSA538E, 558E)

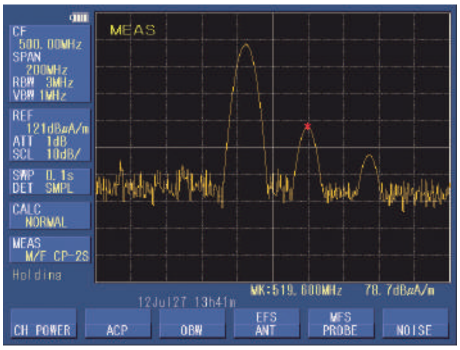
Conducted interference noise on power lines and interference noise on the substrate can be measured non-contactly and electrically. The measured values are calibrated within the device itself. It is ideal for measuring power electronics equipment.

■ Measuring frequency range : 20kHz to 100MHz
(9kHz to 100MHz for MMP500 by itself)

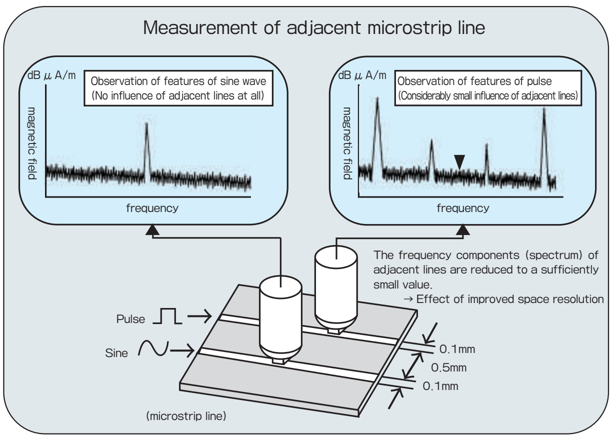
②CP-2SA(Target model : All models)

The magnetic field probes enable precise measurement of magnetic field distribution on LSIs and printed circuit boards. The magnetic field detection unit of CP-2SA em-ploys a shielded loop structure with advanced high-frequency characteristics glass ceramic multilayer substrate technology. This structure allows for detecting only the magnetic field components, ensuring reproducible and accurate measurements.

■ Measuring frequency : 10MHz to 3GHz

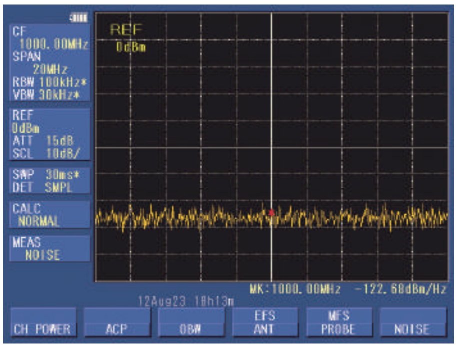


The typical applications of CP-2SA are the evaluation of effectiveness of a bypass capacitor located at a power supply terminal of LSI and the evaluation of wiring rule of PCB. CP-2SA is not affected by adjacent patterns because of high space resolution.



Noise measurement

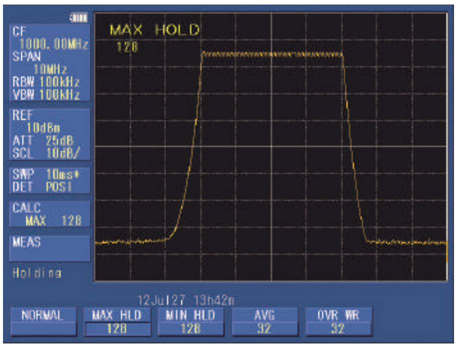
The amount of noise is measured. The unit can be selected from dBm/BW, dB μ V/ √BW, dBmV/ √BW dBV/ √BW. Moreover, the bandwidth BW can be set to a value of !Hz to 3MHz (1-3 step). If BW is set to !Hz, the unit of noise will be expressed as dBm/Hz or dB μ V/v √Hz



Calculation functions

Max hold

The update spectrum data is compared with the data left last time at each point on X axis, and the larger one is retained and displayed. The number of times of the sweep (number of times of the scan in real time mode) can be set in the range from 2 to 1024 times by a power of 2, or by infinite. It is possible to observe a burst signal generated intermittently like a cellular phone and a frequency drift. In addition, this function is effective when the maximum level such as EMI test should be measured.

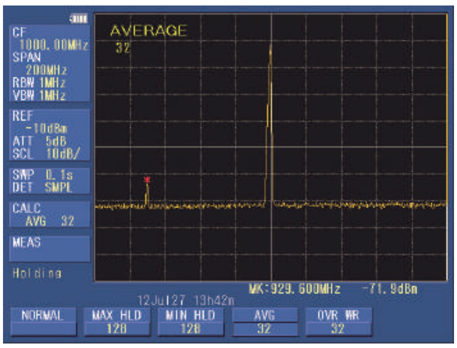


Min hold

The update spectrum data is compared with the data left last time at each point on X axis, and the smaller one is retained and displayed. The number of times of the sweep (number of times of the scan in real time mode) can be set in the range from 2 to 1024 times by a power of 2, or by infinite.

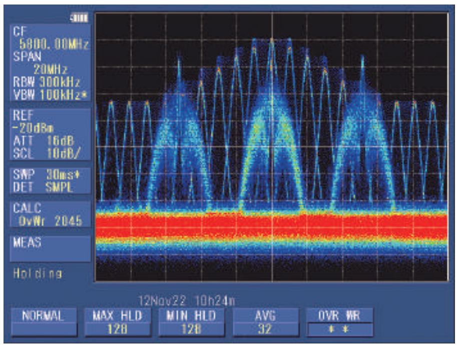
Averaging

The simple averaging processing is executed at each sweep (at each scan in real time mode). The number of times of the averaging can be set in the range from 2 to 1024 times by a power of 2. Even the spectrum buried in noise is observed



OverWrite

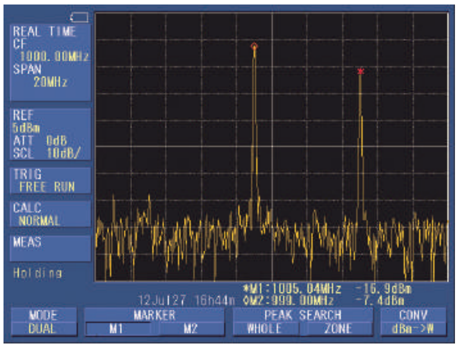
The image on the screen is not cleared at each sweep (at each scan in real time mode), and the OverWrite display is executed. The number of times of overwriting can be set in the range from 2 to 1024 times by a power of 2, or by infinite. This function is, therefore, convenient for observing a process of changes of the signal. Moreover, it is effective for observing a signal occasionally generated. In real time mode, this function should be selected in analysis function.



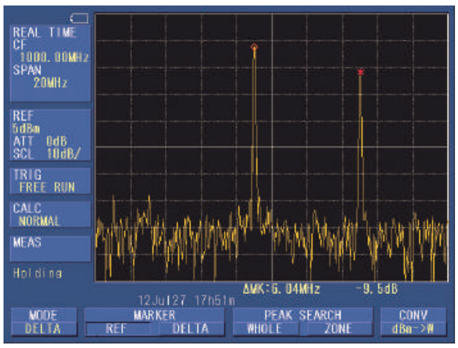
Marker and Peak search

Marker measurement

Two different modes are available for the marker measurement. One is SINGLE or DUAL marker mode to calculate and display the frequency (maximum effective digits : 8) and the level (maximum effective digits : 4) at one or two marker points respectively. And another is DELTA marker mode to calculate and display the frequency difference and the level difference between two markers (one of which is the reference marker). Marker measurement cannot be applied in OverWrite mode.



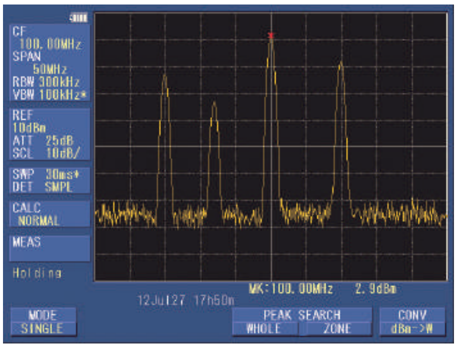
DUAL marker measurement



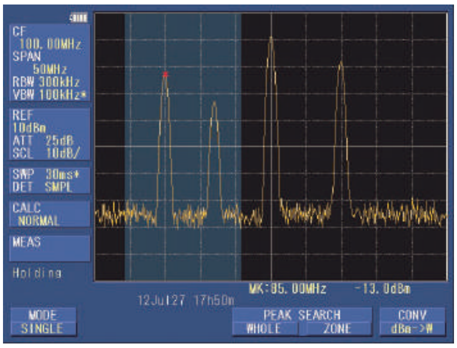
DELTA marker measurement

Peak search

Peak search has two modes: WHOLE peak search mode, which searches for peak levels within the entire 10 divisions of the frequency axis, and ZONE peak search mode, which searches for peak levels within a region specified by center value and width. In WHOLE mode, the marker for peak level moves only when the search key is pressed, whereas in ZONE mode, the marker for peak level follows with each sweep (or scan in real-time mode). Additionally, in WHOLE mode, NEXT peak search (search for the next highest level) is possible. Furthermore, there is a feature to convert units from dB-based (such as dBm) to linear-based (such as W).



WHOLE peak search



ZONE peak search

Storage of measurement data

The following four methods allow you to store the spectrum waveform, IQ data and the setting parameters. The storage data is easily managed because the label or the file name is attached to the collected data.

● Label function

The named label is displayed in the label area on the screen. As for the characters, four kinds of numerals (0 to 9), small letter alphabet (a to z), capital letter alphabet (A to Z) and marks (@, #, ! and etc.) are available. The number of characters is 16 or less.

Label example : BASE352acp8 (refer to screen in next item)

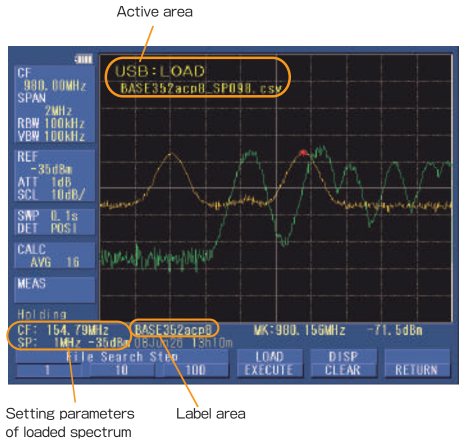
This label is useful as a comment sentence in case of storing the screen image by BMP format in USB memory, or printing on the printer. Furthermore, it is used as a part of the file name at SAVE/LOAD function.

Storage into USB memory

The storage into USB memory is executed with , SAVE/LOAD Key or COPY Key.

● Storage with SAVE/LOAD key

The data is stored in USB memory by CS V format. The data which can be stored are spectrum waveform, IQ data and setting parameters. It is managed by the file name as shown below, and the file name is displayed in the active area on the screen when pushing, SAVE/LOAD key.



File name : BASE352acp8 _ SP 098
① ② ③

① The named label is pasted.
② The type of storage data chosen is attached.
- **S** : Spectrum waveform
- **P** : Setting Parameter
- **I** : IQ data (analysis range)
- **SP** : Spectral waveform + setting parameters
- **IP** : IQ data (analysis range) + setting parameters
- **IF** : IQ Data (Import range) + Setting Parameter

③ The consecutive number is automatically attached only to the same label name.

Only one spectrum is loaded on the screen, and at the same time the setting parameters attached to the spectrum are displayed on the screen.

● Storage with, COPY key

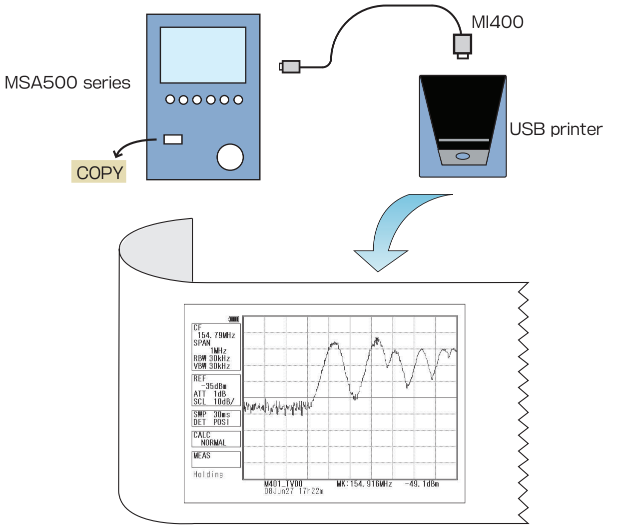
The number of storage data is not limited and depends only on the capacity of USB memory. The whole screen image (excluding function menu) or the waveform area image (excluding active area) can be selected, and it is stored by BMP format. This storage data cannot be loaded on the screen of MSA500 series. Besides, it is possible to transfer the storage data in the internal memory to USB memory in a lump sum.

Storage into internal memory

The operation of SAVE, LOAD or DELETE is achieved in the same way as' 'Storage with SAVE/LOAD key" in the item of USB memory. The data which can be stored is only spectrum waveform and setting parameters.
However, the number of storage data is limited to 200 data or less.

Print on printer

The MSA500 series enables a hard copy of the screen by connecting USB printer (option) to USB A plug with USB cable MI400 (option) Comes into the print mode when pushing COPY key. Since the printer corresponds to two kinds of power supplies of dedicated AC adapter and dry battery, the hard copy of the screen image is easily accomplished even in the open where there is no AC power supply. The dry battery allows the hard copy of almost 140 images.



Save in PC software

Various data can be saved to a PC using optional PC software.

PC software MAS500

Remotely control and set from a PC and display waveforms on the PC screen.
The displayed waveforms can be saved in CSV or BMP format.
(Sweep mode only)

IQ data display and analysis software MAS501

IQ data can be displayed and analyzed.
It is necessary to make measurements with the MSA500 main unit and save the IQ data to USB memory in advance.
(Limited to real-time mode)

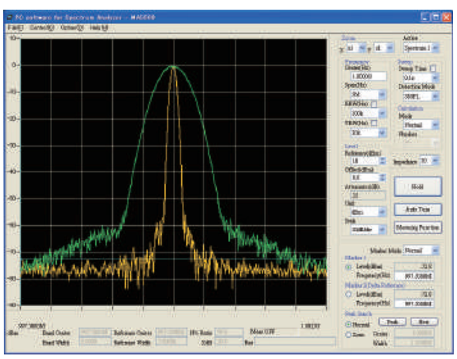
Logging software MAS510

Waveform data can be continuously recorded over a long period of time.
Data is in binary format.
Data can be converted to CSV files using dedicated converter software.
(Sweep mode only)

EMI measurement software MAS530

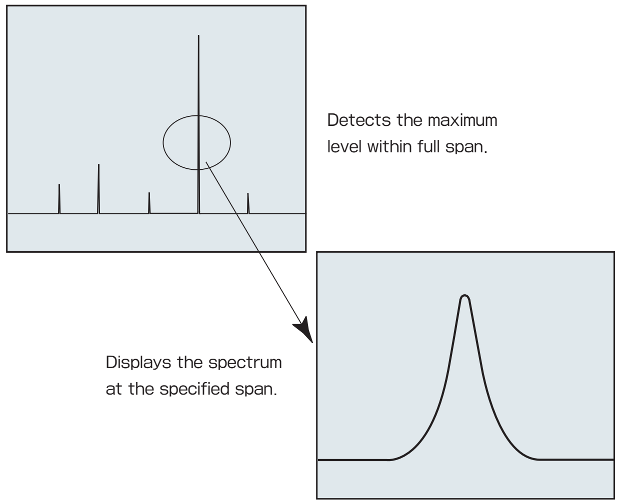
Automatic measurement of radiated and conducted emissions can be performed. Data is in binary format.
Screen capture and text data copy are available as application functions.
(Applicable to MSA538E and 558E only)

See "Options" for more information.



Auto tuning

When pushing AUTO TUNE key which is one of function keys of FREQ key, the spectrum with the maximum level is searched within full span (3.3GHz@MSA538/538TG/538E and 8.5GHz@MSA558/558E), and then it is adjusted to the center of the screen and set to optimum reference level. That spectrum is displayed on the screen at the specified frequency span. Moreover, resolution bandwidth, video bandwidth and sweep time are automatically set to the optimum parameters based on the span.
This function is very convenient when the unknown signal is measured.
Valid only in sweep mode.



Easy operation by AUTO mode

Resolution bandwidth, video bandwidth and sweep time are set automatically based on the specified frequency span. Furthermore, it is also possible to automatically set one or two parameters of either resolution bandwidth, video bandwidth or sweep time.
The operator is released from troublesome operation because these three parameters accompanying the frequency span are set automatically. Auto operation is valid only in sweep mode.
Moreover,the input attenuator and the IF amplifier are automatically set to the optimum values based on the reference level.

Battery operation

Almost four hours battery operation (at backlight off) has been achieved without enlarging the main body by adopting a lithium-ion battery (MB400, option) as a built-in battery. The battery is easily installed or removed because the cover is removed by hand without any tool.
In addition, the battery fuel gauge is displayed on the screen with five levels.

● Battery charge

The time from empty state to full charge is only almost four hours because each model is equipped with the rapid charging circuit.
Under the conditions of power-off and connecting the AC adapter MA400 of a standard accessory, the battery is charged. The charging conditions are indicated by two colors LED on the right side as shown in the table below.

Charging condition	Color of LED
On charge	red
Completion of charge	green
No battery	green
Abnormal	blinking in red

※LED is turned off at power-on.

The abnormal condition means that the charging time is more than the time decided beforehand, or that the battery voltage becomes too high.

with Tracking Generator

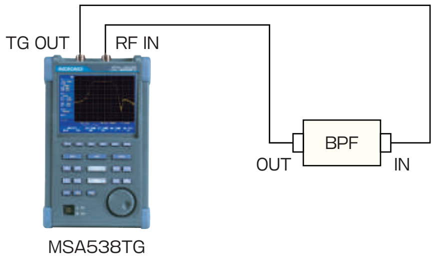
MSA538TG

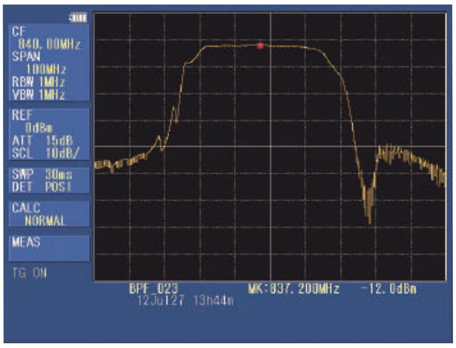
MA430

The tracking generator is a signal source which generates the sine wave synchronizing with the sweep, and is valid only in sweep mode.
For example, the tracking generator outputs 1MHz sine wave when the signal analyzer is at 1MHz sweep point. The 1GHz is output at 1GHz sweep point as well. Therefore, the amplitude frequency characteristics of various electronic components and circuits can be observed on the screen without any troublesome operation.
Moreover, DTF adapter MA430 (option) and VSWR bridge enable the measurements of the distance to discontinuity point of cable and of the return loss respectively.

Frequency response of filter

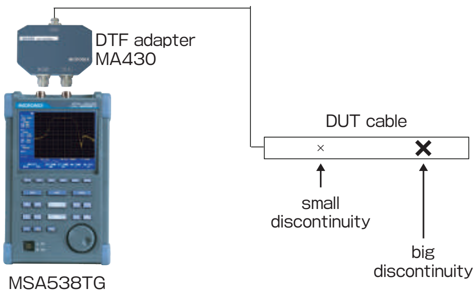
The input and the output of a filter are connected to TG OUT and RF IN respectively. The frequency response of a filter is observed in the range of 5MHz to 3.3GHz.
The frequency response of the coaxial cable and MSA538TG is compensated by using the NORMALIZING function.

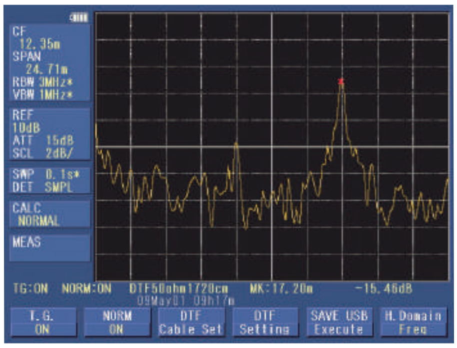




DTF measurement

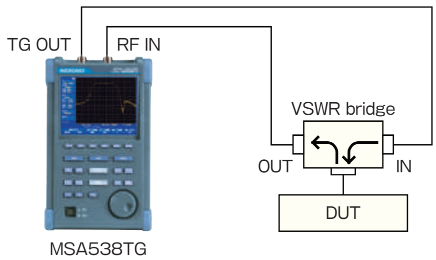
The distance to discontinuity point of cable and the length of normal cable can be measured. The cable length to be measured is 0.3 to 1,000 meters for 50Ω cable and 1 to 400 meters for 75Ω cable. The conventional TDR method has been able to detect only maximum reflection point, but MA430 will not miss even a small discontinuity point.

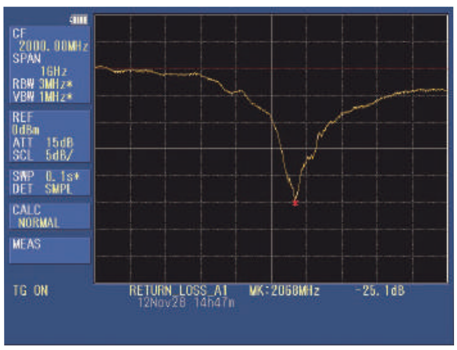




Return loss measurement

VSWR bridge connected to TG OUT and RF IN of MSA538TG enables the return loss measurement. The measured frequency range is from 5MHz to 3GHz.
Additionally, the calibration of the return loss 0dB is done by using the NORMALIZING function.



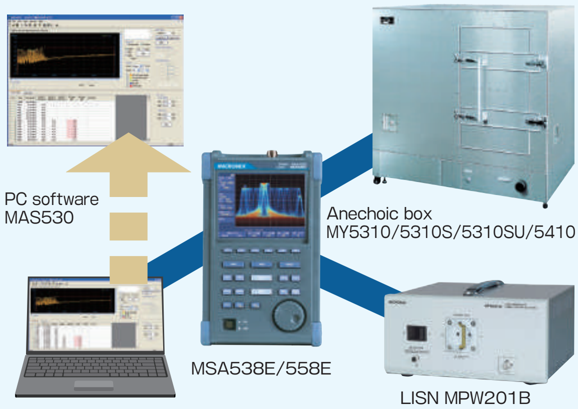


For EMI test

MSA538E/558E

MSA538E/558E is a key instnunent of EMI measurement.
Since it has functions such as PK detection, QP detection, AV detection and RBW 9kHz/120kHz1kHz(6dB), it enables the radiated emission measurement and the conducted emission measurement for precompliance.
Furthermore, the magnetic field probe CP-2SA finds out the source of disturbance noise.

Pre-compliance EMI test system MR2300



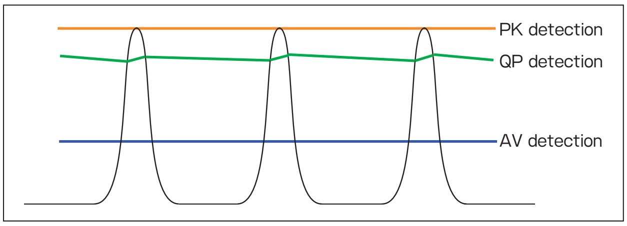
Measurement mode and Preset

Three measurement modes shown below are available. The troublesome setting for EMI test is unnecessary because the parameters corresponding to the measurement mode are automatically preset .

Measurement mode	Function key	Preset
Normal measurement	NORM(F1)	Presets initial parameters of normal mode
Counducted emission measurement	EMI-C(F2)	Presets initial paramenters of conducted emission mode
Radiated emission measurement	EMI-R(F3)	Presets initial paramenters of radiated emission mode

Detection mode

Three detection modes are available: PK (peak value) detection, QP (quasi-peak value) detection, and AV (average value) detection. Only the sweep mode is valid. As shown in the figure below, the measured level depends on the detection mode, and PK≥QP≥AV is valid. For narrow bandwidth signals such as CW waves, PK=QP=AV.



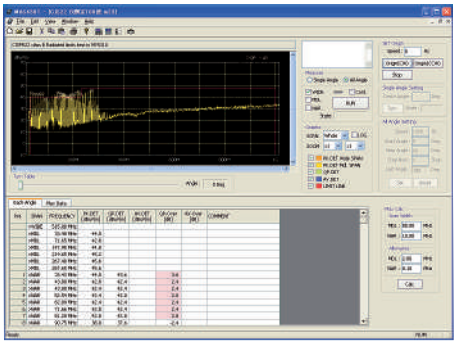
PK detection can be implemented by setting the measurement mode to normal, the detection mode to positive peak, and the calculation function to MaxHold. Therefore, it is useful for narrowing down the number of problematic disturbances, such as out-of-specification, to a small number.
QP detection is used for conducted and radiated disturbance measurements, and AV detection is used for conducted disturbance measurements, and can be used in the final measurement of a spectrum narrowed down by PK detection to shorten the measurement time.

Resolution bandwidth (RBW)

The CISPR standard specifies that conducted disturbance noise be measured at 9kHz, radiated disturbance noise from 30 to 1000MHz at 120kHz, and radiated disturbance noise above 1GHz at 1MHz RBW. The bandwidth is at 6dB.
In addition to these three RBWs, the MSA538E/558E also has an RBW filter with a bandwidth of 300Hz to 3MHz (1-3 steps) at 3dB.

Horizontal axis data of 1001 points

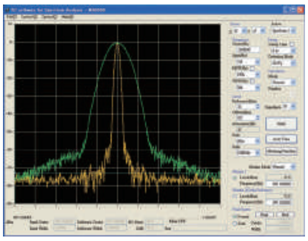
Although the spectrum is displayed by 501 points on the horizontal axis of the screen of MSA538E/558E, it is captured by 1001 points per sweep in the instrument. All of these 1001 point s are transferred to a personal computer and displayed on the PC screen after processed by PC software MAS530. The image, therefore, becomes clearer.



Option

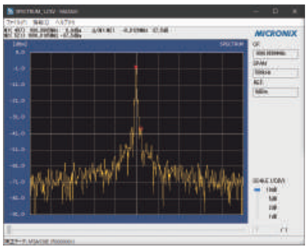
Software

PC software MAS500



MAS500 is software that controls 5 models of signal analyzers from a PC and displays spectral waveforms.
The screen can be saved as it is in BMP format, and the spectral waveforms can be saved in CSV format.

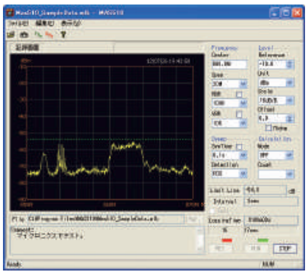
IQ data display and analysis software MAS501



Software for displaying and analyzing IQ data stored on USB memory devices.

- Spectrum
- Power vs.Time
- Frequency vs.
- Phase vs. time
- Spectrogram

Logging software MAS510

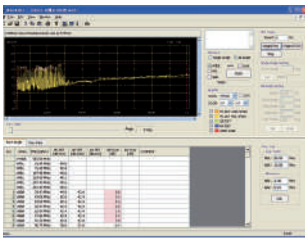


Recording

MAS510 is a logging software that collects the measurement data by uninhabited. It is optimum for watching an abnormal signal at night and recording the data by uninhabited for a long time.

- Logging at specified frequency band, sampling interval and measurement time.
- Makes it possible to fast-forward and fast-rewind the images in the file like a video recorder, and moreover, to jump to the image with spectrum exceeding the limit line.
- ERROR is automatically displayed when the signal exceeding the limit line is input.

EMI measurement software MAS530



This software presets spectrum analyzer settings and typical EMI standard values so that users unfamiliar with spectrum analyzer operation and EMI standards can easily use the software. In addition, an automatic measurement mode is provided to simplify the process of finding out-of-spec spectrum and measuring its QP or AV detection value.
※For MSA538E and 558E only

DTF Adapter MA430

■ Measuring distance range
0.3 to 1,000 meters @50Ω cable
1 to 400 meters @75Ω cable

■ Cable characteristics list
111 kinds @50Ω cable
11 kinds @75Ω cable

Antenna

Portable antenna M400 series, M300 series

Model	Frequency range	Antenna gain(typ)	VSWR	Dimensions	Weight
M401	0.8 to 1GHz	≧+1dBi	<1.5	7.5ϕ×280mm	65g
M402	1.25 to 1.65GHz	≧+1dBi	<1.5	7.5ϕ×280mm	65g
M403	1.7 to 2.2GHz	≧+1dBi	<1.8	7.5ϕ×210mm	65g
M404	2.25 to 2.65GHz	≧+1dBi	<1.8	7.5ϕ×210mm	65g
M405	300 to 500MHz	≧+1dBi	<1.5	8.0ϕ×212mm	62g
M407	470 to 770MHz	≧+1dBi	<1.5	8.0ϕ×138mm	56g
M306	4.8 to 6.2GHz	≧+1dBi	<1.8	16ϕ×100mm	22g
M308	3.6 to 4.2GHz	≧+1dBi	<2.0	16ϕ×100mm	22g
M309	4.4 to 4.9GHz	≧+1dBi	<2.0	16ϕ×100mm	22g
M310	5.9 to 7.2GHz	0.7dBi(typ)	<2.0	16ϕ×100mm	22g

1)The antenna gain and VSWR are the values for the center frequency of the frequency range.
2)Connectors: N(P)@M401-405/M407, SMA(P)@M306/M308-M310.
※Conversion adapter MA306 is required to install M306, M308, M309, and M310.

Loop antenna MAN120

Antenna suitable for detection of low frequency signal and noise.

Frequency range	50kHz to 33MHz
Dimensions	420(ϕ)×13(T)mm
Weight	1.2kg

Biconical antenna MAN150/MAN150B

Suitable for simplified measurement of radiated emissions.

Model	MAN150	MAN150B
Frequency range	20MHz to 3GHz	30MHz to 1GHz
Gain(nominal)	-45dBi to +1dBi	-31dBi to +1dBi
Antenna factor	20 to 51dB/m	17 to 31dB/m
Connector	SMA(J)	
Dimensions(L×W×D)	350×160×140mm	540×225×225mm
Weight	approx.350g	approx.1150g

Log-Periodic antenna MAN160A/160B

■ Components

- Antenna body
- Grip
- Antenna data
- Hard case

Model	MAN160A	MAN160B
Frequency range	700MHz to 4GHz	700MHz to 6GHz
Maximum power	100W(At CW and 400MHz)	
Impedance	50Ω (nominal)	
VSWR	< 2.0(Typical)	
Gain	4dBi(Typical)	5dBi(Typical)
Antenna factor	23 to 38dB/m	26 to 41dB/m
Connector	SMA(J)	
Dimensions	340(L)×200(W)×25(D)mm	
Weight	270g	250g

Low noise amplifier MAP301/302

Can be used as a preamplifier for signal analyzers.

Items	MAP301	MAP302
Frequency range	100kHz to 500MHz	20MHz to 3GHz
Gain	50dB	20dB
Noise figure	3.5dB	3.5dB

Probe

Magnetic field probe MMP500

Conducted disturbance noise measurement up to 9kHz low frequency.

Frequency range	9kHz to 100MHz
Maximum measurement level	119dB μV
Applicable models	MSA538E/558E

USB printer

Printing method	Thermal line dot method
Paper	80mm width thermal paper
Power source	· Internal : AA-sized alkaline battery (4pcs) · External : 7.5VDC/3A (dedicated AC adapter)
Dimensions	134(W)×60(H)×180(D)mm
Weight	Approx. 450g (main unit only)
Data entry	USB 2.0

Lithium-ion battery MB400

7.4V/5000mAh

USB cable MI400

Connector	A plug/B plug
Length	1.5m

Coaxial parts

Coaxial attenuator MG-XXdB

Model	Coaxial Attenuator MG-XXdB		VSWR	Rated power
	DC to 12.4GHz	12.4GHz to 18GHz		
MG-1dB, 2dB, 3dB, 4dB	<±0.5dB	<±1dB	<1.15@DC to 4GHz <1.2@4 to 12.4GHz <1.3@12.4 to 18GHz	1W
MG-5dB, 6dB, 7dB, 8dB	<±0.7dB	<±1.2dB		
MG-9dB, 10dB, 12dB, 13dB	<±1.0dB	<±1.25dB		
MG-14dB, 15dB, 20dB	<±1.2dB	<±1.3dB		
MG-30dB	<±1.2dB@DC to 8GHz		<1.2@DC to 8GHz	

※Connectors, Impedance:SMA(P)/SMA(J), 50Ω

Terminator

Model	Frequency range	VSWR				Rated power	Connector
		DC to 4GHz	4 to 8GHz	8 to 12.4GHz	12.4 to 18GHz		
MG-50S	DC to 18GHz	<1.08	<1.10	<1.15	<1.20	0.25W	SMA(P)
MG-50N	DC to 8GHz	<1.2@DC to 8GHz				2W	N(P)

※Impedance:50Ω

Coaxial cable

Model	Connector	Length	Frequency range
MC102	SMA(P)/BNC(P)	1.5m	DC to 2GHz
MC201	SMA(P)/SMA(P)	0.5m	DC to 18.5GHz
MC202	SMA(P)/SMA(P)	3m	DC to 18.5GHz
MC203	SMA(P)/SMA(P)	4m	DC to 18.5GHz
MC204	SMA(P)/SMA(P)	1.5m	DC to 18.5GHz
MC301	SMA(P)/SMA(P)	0.5m	DC to 10GHz
MC302	SMA(P)/SMA(P)	1m	DC to 10GHz
MC303	SMA(P)/SMA(P)	1.5m	DC to 10GHz
MC304	SMA(P)/N(J)	0.2m	DC to 4GHz
MC305	SMA(P)/N(P)	0.2m	DC to 4GHz
MC306	SMA(P)/BNC(J)	0.2m	DC to 2GHz
MC307	SMA(P)/BNC(P)	0.2m	DC to 2GHz
MC308	N(P)/N(P)	0.5m	DC to 10GHz
MC309	N(P)/N(P)	1m	DC to 10GHz
MC310	N(P)/N(P)	1.5m	DC to 10GHz
MC311	N(P)/SMA(J)	0.2m	DC to 10GHz
MC312	N(P)/BNC(J)	0.2m	DC to 2GHz
MC313	N(P)/BNC(P)	0.2m	DC to 2GHz
MC314	BNC(P)/BNC(P)	1.5m	DC to 2GHz

Adapter

Model	Connector	Impedance	Frequency range
MA301	BNC(P)/BNC(J)	50Ω/75Ω	DC to 2GHz
MA302	BNC(P)/N(J)	75Ω/75Ω	DC to 1.8GHz
MA303	BNC(P)/N(P)	75Ω/75Ω	DC to 1.8GHz
MA304	BNC(P)/F(J)	75Ω/75Ω	DC to 1.8GHz
MA305	BNC(P)/F(P)	75Ω/75Ω	DC to 1.8GHz
MA306	N(P)/SMA(J)	50Ω/50Ω	DC to 12.4GHz
MA307	N(P)/BNC(J)	50Ω/50Ω	DC to 2GHz
MA308	N(P)/BNC(J)	50Ω/75Ω	DC to 2GHz
MA309	N(J)/BNC(P)	50Ω/50Ω	DC to 2GHz

Specifications

Frequency section

Frequency range	20kHz to 3.3GHz < MSA538/538TG/538E > 20kHz to 8.5GHz < MSA558/558E >
Center frequency	
Setting resolution	100Hz Allows rotary encoder, numeric key and function key.
Accuracy	Sweep mode : ± (30 + 20T)kHz ± 1dot @ span ≦ 10MHz, ※1 ± (60 + 300T)kHz ± 1dot @ span ≧ 20MHz, ※1 Real time mode : ± 0.5ppm ± 1dot
Frequency span	
Setting range	Sweep mode : 0Hz(zero span), 100kHz to 2GHz(1-2-5step)and 3.3GHz(full span) < MSA538/538TG/538E > 0Hz(zero span), 100kHz to 5GHz(1-2-5step)and 8.5GHz(full span) < MSA558/558E > Real time mode : 20kHz to 20MHz(1-2-5step)
Accuracy	Sweep mode : ± 3% ± 1dot @ one step slower sweep time than AUTO, ※1 Real time mode : ± 0.1% ± 1dot
Display dots	501dots
Resolution bandwidth	Valid only in sweep mode, 3dB BW
Setting range	300Hz to 3MHz(1-3step)and AUTO < MSA538/538TG/558 > 300Hz to 3MHz(1-3step)and AUTO, in addition 9k(6dB), 120k(6dB), 1MHz(6dB) < MSA538E/558E >
Accuracy	± 10% (@excluding 3MHz), ± 20% (@ 3MHz)
Selectivity	1 : 4.5(typ) @ 3dB : 60dB
Video bandwidth	Valid only in sweep mode, 3dB BW
Setting range	100Hz to 1MHz(1-3step)and AUTO
SSB phase noise	-95dBc/Hz(typ) @ 100kHz offset
Spurious response	Less than -60dBc@Sweep mode, applied to 5dB lower signal from REF level, spurious free mode at MSA558/558E Less than -60dBc@Real time mode, applied to 5dB lower signal from REF level, to be no signal of (REF-30dB) or more outside center frequency ± 200MHz at MSA558/558E
Residual response	-80dBm(typ) @ REF level ≦ -15dBm
Harmonics	-40dBc(typ) @≧ 10MHz
Reference frequency	
Temperature stability	± 0.2ppm @ 0 to 50℃
Aging rate	± 0.5ppm @ 1 year

Amplitude section

Reference level	
Setting range	+10 to -60dBm, 1dB step
Accuracy	± 0.8dB ± 1dot @ CF100MHz, REF -15dBm, ※1
Unit	dBm, dBV, dBmV, dB μ V, dB μ V/m, dB μ A/m
Average noise level	-162dBm/Hz(typ) @ 1GHz < MSA538/538TG/538E > -157dBm/Hz(typ) @ 1GHz < MSA558/558E > 【Ref】 Real time mode, 1GHz and span 20kHz: -140dBm(typ) < MSA538/538TG/538E > -135dBm(typ) < MSA558/558E >
Frequency response	± 2.6dB ± 1dot @< 10MHz ± 1.0dB ± 1dot @≧ 10MHz
Input impedance	50 Ω
Input VSWR	2.0(typ)
Input attenuator	
Attenuation range	0 to 25dB(1dB step), coupled with reference level
Switching error	± 0.6dB @ 100MHz
Display scale	
Display dots	381dots/10div
Scale	Spectrum and OverWrite : 2, 5, 10dB/div Power vs. time : 1, 2, 5, 10dB/div Frequency vs. time : I, 2, 5, I 0%/div of span (actually, displayed by "Hz/div" coupled with span) Phase vs. time : 5, 10, 20, 40° /div IQ vs. time : 0.1, 0.2, 0.4V/div
Accuracy	± (0.1dB + 1dot)/2dB, ± (0.2dB + 1dot)/5dB, ± (0.4dB + 1dot)/10dB, ± (0.9dB + 1dot)/83dB
Offset	Spectrum : ± 200dB, resolution 0.1dB Power vs. time : ± 100dB, resolution 1dB Frequency vs. time : ± (SPAN/2), resolution(SPAN/100) Phase vs. time : ± 200° , resolution 1° IQ vs. time : ± 1V, resolution 10mV
Input damage level	+27dBm(CW average power), 25VDC
RF input connector	N(J)connector

Sweep section

Sweep time	Valid only in sweep mode.
Setting range	10ms to 30s(1-3step, span 0 to 2GHz)and AUTO 30ms to 30s(1-3step, span 5GHz @ only MSA558/ 558E, full span) and AUTO
Accuracy	± 0.1%± 1dot @ excluding full span ± 1.5%± 1dot @ full span < MSA538/538TG/538E > ± 2.5%± 1dot @ full span < MSA558/558E >
Trigger	Valid only in real time mode and zero span of sweep mode.
Trigger mode	Free run, Trigger
Scan mode	Single, Continuous @ Valid only in real time mode
Trigger source	Sweep mode : Internal and External Real time mode : Channel power, Power, IF level and External
Level Setting range	Internal : fixed @sweep mode Channel power : 0dB (REF level) to -40dB, 1dB step Power : 0dB (REF level) to -40dB,1dB step IF level : 1 to 100%(full scale of AID converter), 1% step
Slope	Rising, Falling @valid only in real time mode.
Pre-trigger	Valid only in real time mode.
Setting range	0 to 100%, 25%step
External trigger	
Voltage range	1 to 10Vp-p
Frequency range	DC to 5MHz
Input RC	approx.10k Ω // less than15pF
Input coupling	DC coupling
Trigger level	approx.0.56V(fixed)
Input damage level	± 50V(DC + AC peak)
Input connector	SMA(J) connector
Time resolution	5 samples @channel power 1 sample @power 14.7ns @ IF level
Detection mode	Positive peak, Negative peak and Sample @ Valid only in sweep mode. ※ As for MSA538E/558E, QP and AV are added further.

Real time mode

IQ memory size 64Mbytes

Number of frames 16,383frames max

Frame time 30.1 μs(span 20MHz) to 30.1ms(span 20kHz)

Analysis function

- **Spectrum analysis** Data of one frame is calculated and displayed as spectrum.
  - **Window function** 4-term Blackman-Harris window
  - **Equivalent noise BW** Span/301
- **Spectrogram analysis** Three dimensional display of X axis : time (frame), Y axis : frequency and Z axis: power (magnitude is expressed by colors)
- **Overwrite analysis** Spectrum waveform of each frame is accumulated.
  - **Overwriting frequency** Expressed by colors.
  - **Accumulation rate** 720frames/s
  - **Accumulation frame number** 200, 500, 1000, 2000, 5000, ∞ frames
- **Time domain analysis** Following five types of analyses based on IQ data are displayed.
  - **Power vs. time** Displayed as time on X axis and power on Y axis.
  - **Frequency vs. time** Displayed as time on X axis and frequency on Y axis.
  - **Phase vs. time** Displayed as time on X axis and phase on Y axis.
  - **IQ vs. time** Displayed with two traces as time on X axis and IQ data on Y axis.
  - **Q vs. I** Displayed with polar coordinates as I data on X axis and Q data on Y axis.

Common function

Measuring function Channel power (total power and average power),Adjacent channel power, Occupied bandwidth, Electric field strength (in addition, power density and magnetic field strength measurements, and needs optional dipole antenna), Magnetic field strength (needs optional magnetic field probe) and Noise measurements

Calculation function Norm, MaxHold, MinHold, Averaging, OverWrite
Sweep mode : number of sweeps is 2 to 1024 (power of2) and infinite
Real time mode : number of scans is 2 to 1024 (power of2) and infinite
※ Valid only in spectrum waveform.

Marker measurement Invalid in OverWrite analysis.
SINGLE : displays frequency (8digits max) and level (4digits max) at one marker point.
DUAL : displays each frequency and level at two marker points.
DELTA : displays frequency difference and level difference between two markers.

Peak search function Searches for peak level within all of 10 div (WHOLE) or within specified zone (ZONE) and displays frequency and level at peak level, and moreover NEXT peak search is possible at WHOLE mode. Available for unit conversion from dB to linear system. Invalid in Overwrite analysis.

Auto tuning When pressing AUTO TUNE of function key, the spectrum of maximum level within full span is adjusted to the center, and is set to optimum reference level. Moreover, RBW, VBW and sweep time are also set to optimum parameters.
Valid only in sweep mode.

Save/Load

- **Save** Saves 200 spectrum waveforms and 200 setting parameters.
※ Spectrogram waveform, OverWrite waveform, five kinds of time domain waveforms and IQ data cannot be stored in real time mode.
- **Load** Loads one spectrum waveform and one setting parameter.

Tracking generator (only MSA538TG/Sweep mode)

Frequency range 5MHz to 3.3GHz

Output level -10dBm ± 1dB@1GHz

Output level flatness ± 1.5dB

Normalizing function Compensates input frequency response flat on screen.

Output impedance 50 Ω

Output VSWR Less than 2.0

Output connector N(J) connector

EMI measurement function (only MSA538E/558E)

Detection mode PosPK (positive peak), QP (quasi peak), AV (average) detections
※ Valid only in sweep mode.

Resolution bandwidth 9kHz (6dB), 120kHz (6dB), 1MHz (6dB) and 300Hz to 3MHz (1-3 step)
※ RBW without "(6dB)" is 3dB BW.

Time constant of QP

RBW / Time constant	9kHz	120kHz	1MHz
Charge	1ms	1ms	1ms
Discharge	160ms	550ms	550ms

General

Communication

- **Interface** Corresponds to USB2.0
- **Connector** B plug (device)
- **Transfer rate** Full speed (12Mbps)
- **Transfer data number** 50lpoints (spectrum)/ 64Mbytes max (IQ data) @real time mode
100 l points @sweep mode

Hard copy USB printer (option) connected to A plug (host) enables hard copy of screen image.

USB memory Uses A plug (host), and stores spectrum waveform, IQ data, setting parameters and [(spectrum waveform or IQ data)+ (setting parameters)].
※ Only [IQ data+ setting parameters] is re-analyzable after loading.

Display

- **Display** 5.7inches and color LCD
- **Backlight** LED backlight
- **Number of dots** 640(H)x480(V) dots

Power supply

- **Source of power supply** External DC source (dedicated AC adapter MA400) and Lithium-ion battery (MB400/option)
- **Dedicated AC adapter** Input : 100 to 240VAC
Output : 9VDC/2.6A
- **Lithium-ion battery** 7.4V/5000mAh
  - **Charge function** Capable of charging only during power-off.
Indicates 4 conditions with two colors LED (red and green).
  - **Remainder indication** 5 levels indication

Other

Operating temperature 0 to 50℃
(Guaranteed at 23 ± 10 ℃ but at 23 ± 5 ℃ as to items with ※1, without carrying case)

Operating humidity Less than 40℃ /80%RH
(Guaranteed at less than 33 ℃ /70%RH but at less than 28℃ /70%RH as to items with ※1, without carrying case)

Storage temperature -20 to 60℃ ,less than 60℃ /70%RH

Dimensions 162(W) × 71(H) × 265(D)mm
(Excluding projections, protection bumper and stand)

Weight Approx. l.8kg (including battery)

EMC Complies with EMC Directive 2004/108/EC
・IEC/EN61326-2-1:2012
・CISPR Pub11 Group1, class A

Standard accessories
・AC adapter MA400
・Carrying case
・Accessory pouch
・Operation manual

T: sweep time(s), ※ 1: 23 ± 5℃ ,less than 28℃ /70%RH

※Dimensions exclude protrusions, etc. Weights do not include IF modules. Dimensions and weight are approximate.
※MICRONIX Corporation reserves the right to make changes in design, specifications and other information without prior notice.

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