C & U
CREATIVE
& UNIQUE

MICROWAVE

EMI Test System

MR2300

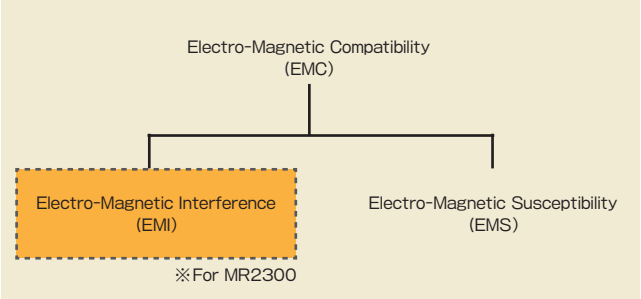
EMI total test system
-Precompliance-

MICRONIX

Outline of MR2300

About the EMI test

EMC test consists of EMS and EMI tests. As for the EMI test, it is evaluated whether the radiated emission or the conducted emission discharged from EUT (Equipment Under Test) exceeds the limit value set beforehand. This limit value is used to guarantee that the EUT operation doesn't give a remarkable disturbance to operation of other equipment and wireless communication. On the other hand, EMS test evaluates whether EUT causes the malfunction by a peripheral electromagnetic radiation.



Generally or from our experience, it is said that the number or the solution time of the problems concerning EMI is 5 to 10 times larger than EMS. In short, passing EMI test means that 80 to 90 percents of EMC test are completed. Therefore, MR 2300 specializes in the EMI test.

What is MR2300 ?

Generally, much waiting time and cost are needed in a formal EMI test using the anechoic chamber. When it is repeated many times to solve the problem and to test formally, longer time and more cost are wasted.
MR2300 focuses on being used to solve the problem in advance <<Precompliance>> and reducing the number of times of formal test to one or two times.
There was a partial EMI test system for precompliance since before.
MR2300 is, however, the first total test system in the world, including even an anechoic box.
Under a recent air environment where the radio waves of TV and wireless communication equipment flit, the EMI test not using an anechoic box is impossible.

What can be done by MR2300 ?

■Two kinds of EMI tests can be carried out.

①Radiated emission test

This test can be performed in the frequency range 30MHz to 1GHz by using an anechoic box and a broadband antenna. It corresponds to 1GHz or more as an option.

②Conducted emission test

This test can be performed in the frequency range 150kHz to 30MHz by using LISN (Line Impedance Stabilization Network).

■The source of noise can be found.

③Conducted disturbance noise measurements.

Using the MMP500 magnetic field probe allows for a straightforward measurement of conducted interference noise on power lines. Additionally, its strong directional capabilities enable the identification of noise sources, akin to typical magnetic field probes.

The features of MR2300

MR2300 is an integration system that concentrates our spectrum analyzer technology, anechoic box technology and antenna technology.

1 Affordable EMI total testing system

We provide a comprehensive solution that includes a radio wave anechoic box, a broadband antenna, an EMI spectrum analyzer, a low-noise amplifier, an LISN, and PC software.
Additionally, we offer the magnetic field probe MMP500 (optional) as a troubleshooting tool.

2 Efficient Measurement of Horizontal and Vertical Polarization

By combining the biconical antenna MAN150B with the low-noise amplifier MAP302, radiation emission measurements can be performed in the 30MHz-1GHz range.
Using a dedicated antenna stand, users can manually switch between horizontal and vertical polarization.

3 Large/medium/small, four types of anechoic boxes

MY5310/S for small EUT, MY5310SU for Medium EUT and MY5410 for large EUT are prepared. MY5310/S is equipped with a turntable of 220mm in diameter/ 10kg in load, MY5310SU is equipped with a turntable of 500mm in diameter/ 50kg in load and MY5410 is equipped with a turntable of 756mm in diameter/ 100kg in load.

4 Calibration of the entire system

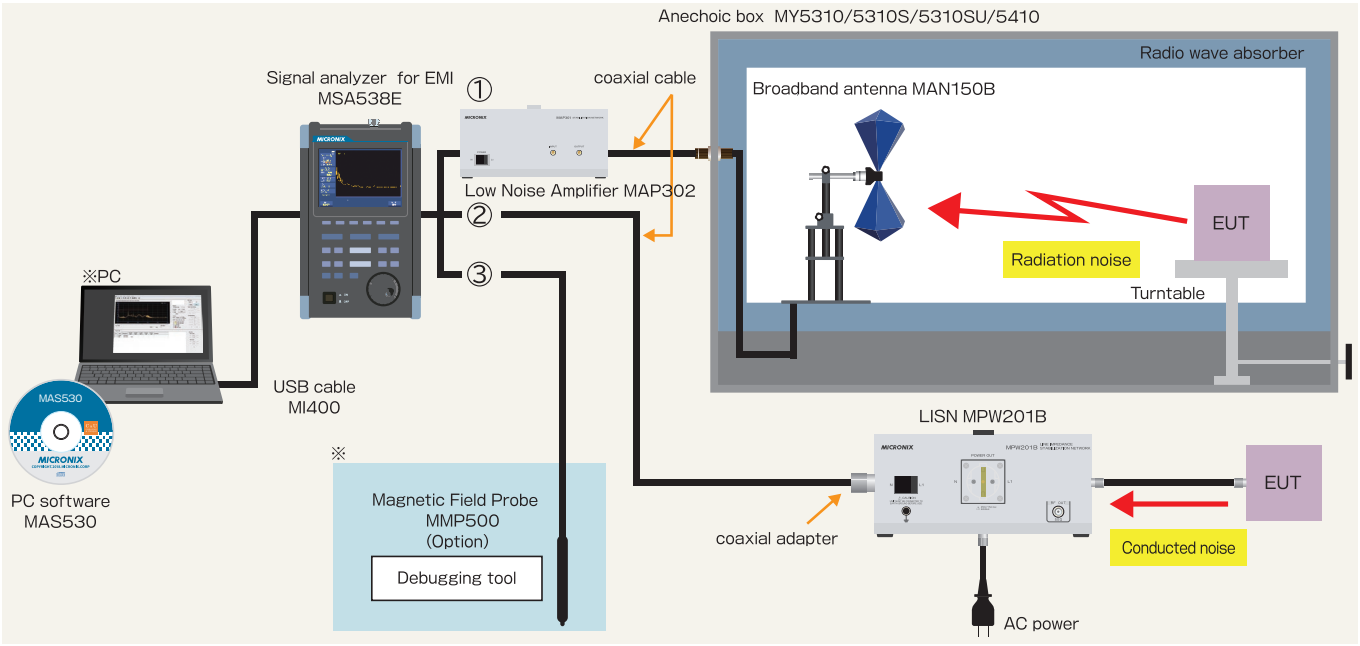
The calibration as the whole system like corrections of the antenna gain, attenuation of LISN and conversion into 3 meters in measurement distance is performed in Spectrum analyzer and PC software. The user only reads the measurement result on the PC screen as it is.

5 Confirmity to regional and international standards

MR2300 is based on CISPR11(classA/B,group1), CISPR22(classA/B), EN55011(classA/B,group1), EN55022(classA/B), VCCI(classA/B) and FCC part15 subpartB(classA/B).
Users can freely set the standard limit line.

Broadband antenna

Explanation of the overall system



When ①, ② or ③ in the whole system chart shown above is connected to [RF INPUT] of Spectrum analyzer MSA438E/538E/558E for EMI, the radiated emission test, the conducted emission test or debugging to remove the source of disturbance noise respectively can be performed.

Connection of ① Radiated emission test

By connecting the radio wave anechoic box MY5310/S/SU or MY5410 to the low-noise amplifier MAP302 using the included coaxial cable, and then connecting the low-noise amplifier MAP302 to the spectrum analyzer MSA438E/538E/558E, radiation interference noise testing in the 30MHz-1GHz range can be conducted.
After receiving the disturbance noise that EUT (Equipment under test) radiates in the air with broadband antenna MAN150B, it is input to MSA438E/538E/558E. The antenna gain of MAN150B is corrected and the electric field strength (dB μ V/m) is calculated in MSA438E/538E/558E. The calculation result is displayed with the limit line by the EMI standard on the screen of a personal computer after forwarded there through the USB cable MI400 communication and converted into 3 meters in measurement distance.

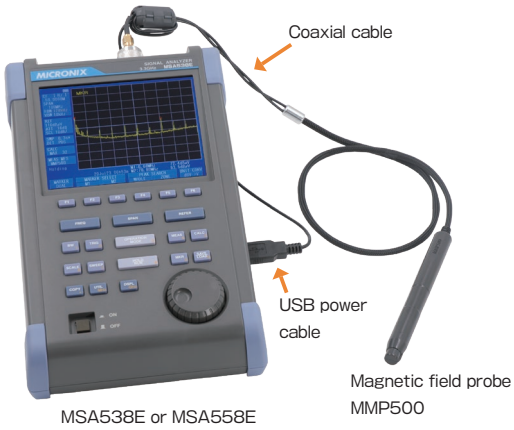
Connection of ② Conducted emission test

By connecting the included high-pass filter to the "RF OUT" terminal of the LISN (MPW201B) and then connecting it to the MSA438E/538E/558E using a coaxial cable, conducted interference noise testing in the 150kHz-30MHz range can be performed.
The disturbance noise that EUT discharges into the power supply line is input to MSA438E/538E/558E through LISN. The attenuation of LISN is corrected and the noise is converted into the unit of dB μ V in MSA438E/538E/558E. The data is displayed with the limit line by the EMI standard on the screen of a personal computer after forwarded there through the USB cable MI400 communication.

Connection of ③ Conducted disturbance noise measurements.

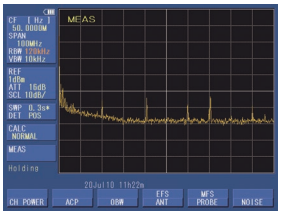
Using the MMP500 magnetic field probe allows for a straightforward measurement of conducted interference noise on power lines. Additionally, its strong directional capabilities enable the identification of noise sources, akin to typical magnetic field probes.

■Magnetic Field Probe MMP500



Conductivity interference noise (noise terminal voltage) measurement up to 9kHz of low frequency is possible. It is ideal for measuring power electronics equipment. This conductivity interference noise can be easily measured with MMP500 and signal analyzers MSA538E/MSA558E.

Measurement mode	standard
frequency range	9kHz to 100MHz
Max. measurement level	119dB μ V
compatible model	MSA538E/558E



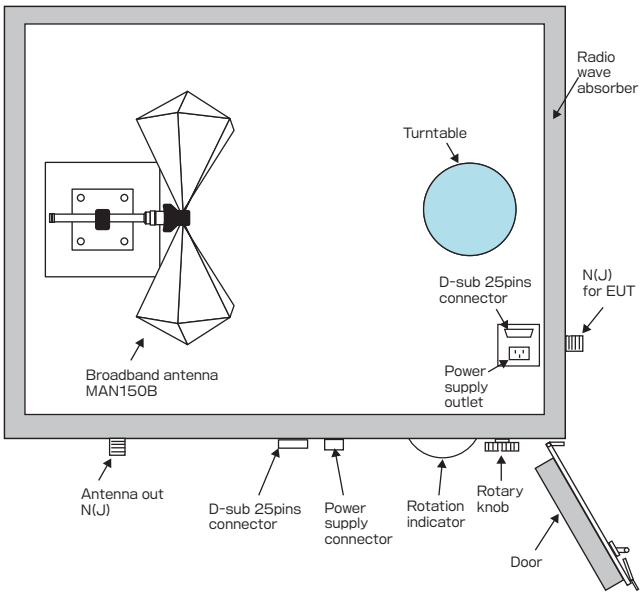
※When combined with MMP500 and MSA538E/558E, the measurement frequency range is from 20kHz to 100MHz.
※MMP500 can be used with spectrum analyzers other than the MSA538E/558E. However, separate measurement value corrections are required.

Anechoic box MY5310/S/SU

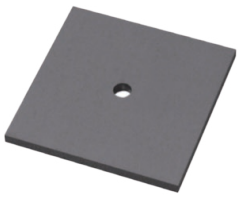
MY5310

MY5310S

The limit value of the radiated emission in CISPR22/classB is as slight as 37 dB μV/m in the frequency range 230 to 1000 MHz. Under the air environment where the radio waves of cellular phone, TV and radio flit, the disturbance noise radiated from EUT is buried in these signals and cannot be measured. Therefore, the measurement in an anechoic box is required.
MY5310/S has the turntable of 220mm in diameter and 10kg in load. This is for such a comparatively small EUT (Equipment under test) as not sticking out from the turntable. The turntable can be turned with the rotary knob installed outside. Moreover, the rotation angle can be accurately set by watching the rotation indicator. MY5310/S is equipped with MAN150B as a broadband antenna. The measured values on the screen of a computer can be directly read because MSA438E/538E/558E and PC software correct the frequency characteristics of antenna gain and the distance between the antenna and EUT. Additionally, a power supply outlet, D-sub connector and N type coaxial connector installed for EUT save the trouble of wiring.



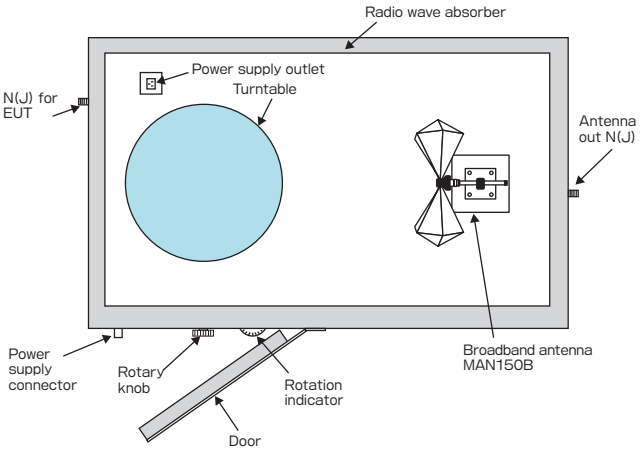
Radio wave absorber



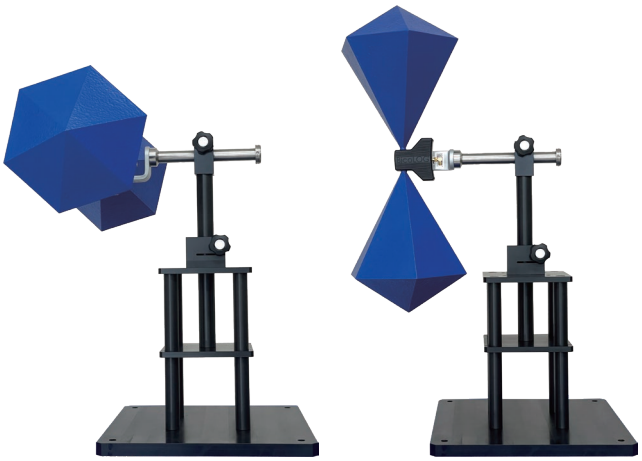
Measuring frequency range	30MHz to 1GHz
Structure	single-layer ferrite tile
Reflection loss	・more than 20dB@30MHz to 400MHz ・more than 12dB@400MHz to 1GHz
Thickness	5.2mm

Anechoic box MY5410

MY5410 is an anechoic box for a large EUT and with the turntable of 756mm in diameter and 100kg in load. As for the broadband antenna, MAN150B is installed.



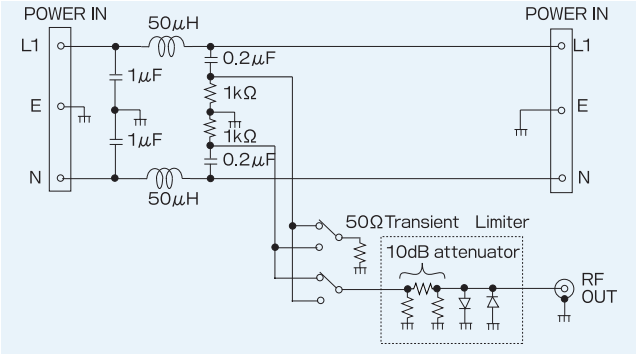
Broadband antenna MAN150B



The MAN150B is a compact biconical antenna that supports frequencies from 30MHz to 1GHz. Using a dedicated antenna stand, users can manually switch between horizontal and vertical polarization. Additionally, the height can be adjusted.

Line impedance stabilization network (LISN) MPW201B

When the conducted emission discharged through the power supply line is measured, the measured value is influenced from the impedance of the power source. The noise level is measured low if the impedance is low, and it is measured high if oppositely high. With this, there are neither universality nor reliability in the measured value. Then, to measure the disturbance noise with stability and reproducibility, the impedance of the power source should be made constant. The impedance of the power source observed from EUT side is made constant by inserting the line impedance stabilization network in the power supply line. However, the impedance of power supply line has the frequency characteristics but the impedance curve is provided by CISPR.



LISN equivalent circuit

The circuit of MPW201B adopts <50Ω/50μH and V type> based on CISPR 16-1. The frequency range is from 150kHz to 30MHz, and the conditions of power supply are single phase, maximum voltage 100 to 250VAC, rated current 15A and 50/60Hz.

As shown in the equivalent circuit, the disturbance noise discharged from EUT is led to a transient limiter with 50 Ω input through a high pass filter composed of a capacitor and resistors, and then input to Spectrum analyzer MSA438E/538E/558E. The disturbance noise can be measured at both terminals of L1 and N, but a high voltage transient pulse may be generated when switching the measurement line. To protect the spectrum analyzer from this pulse, a transient limiter composed of 10dB attenuator and diodes is built in. The gain correction of 10dB attenuator is automatically done in MSA438E/538E/558E.

Spectrum analyzer for MSA438E/538E/558E

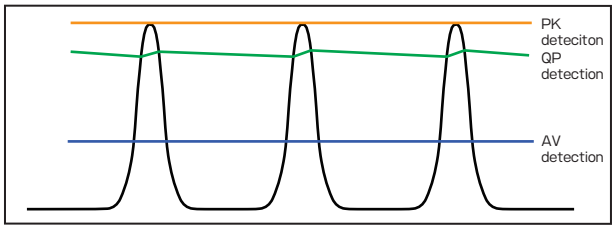
Measurement mode and Preset

It is possible to select from three measurement modes shown below. 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)	Preset initial parameters of normal mode
Conducted emission measurement	EMI-C(F2)	Preset initial parameters of conducted emission mode
Radiated emission measurement	EMI-R(F3)	Preset initial parameters of radiated emission mode

Detection mode

Detection modes has three types, PK(peak), QP(quasi-peak) and AV(average). The expression of PK ≧ QP ≧ AV is approved in the detection level as shown in the figure below. Additionally, PK=QP=AV is right in case of a narrowband signal like the CW wave.



The PK detection is achieved by setting the measurement mode to normal measurement, the detection mode to PosPeak and the calculation function to MaxHold. By the way, a signal of time width 200ns or more can be detected by PosPeak detector because the sampling speed of A/D converter is 5MS/s. The fast sweep time can be used when observing the disturbance noise in the PK detection mode because its time constant is much smaller than QP or AV. Therefore, it is convenient to use the PK detection when narrowing the disturbance noise spectrums out of specification to small number.

The QP detection is usually used in both of the radiated and conducted emissions measurements, and theAV detection is usually used in the conducted emission measurement. The measurement time can be shortened by using them in the final measurement to the spectrums narrowed by the PK detection.

Resolution bandwidth(RBW)

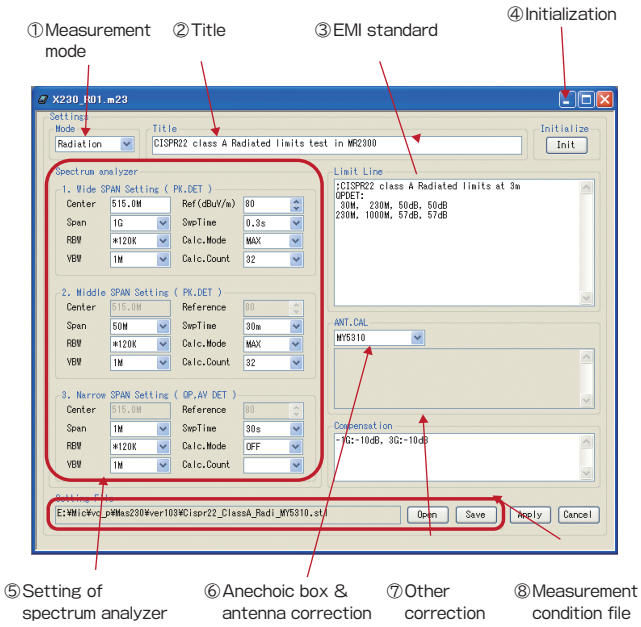
CISPR provides that the radiated and conducted emissions should be measured with RBW filters of 9kHz, 120kHz and 1MHz respectively. The bandwidth is a value at 6dB down. MSA438E/538E/558E also has five RBW filters besides these three filters, whose bandwidths at 3dB are 300Hz to 3MHz. (MSA438E : more than 3kHz)

Horizontal axis data of 1001 points

Although the spectrum is displayed by 501 points on the horizontal axis of the screen of MSA438E/538E/558E, it is fetched by 1001 points per sweep in the instrument. All of these 1001 points are transferred to a personal computer and displayed on the PC screen after processed by PC software MAS430/530. The image, therefore, becomes clearer.

As MR2300 can be easily used even if inexperienced in the operation of a spectrum analyzer and EMI test, the parameters of spectrum analyzer and typical EMI standards are preset. Furthermore, to simplify the procedures from searching out the spectrums out of specification until measuring with QP or AV detection, the automatic measurement mode is prepared. By the way, the measurement value of the radiated emission is converted into 3 meters in measurement distance.

Setting of measurement parameter



①Selection of measurement mode

The radiated or conducted emission measurement is selected.

②Entry of title

The title of the test is entered. The content is arbitrary because this is a comment sentence.

③Setting of EMI standard value

As the main standards are stored in the file explained in item ⑧ , the necessary standard is selected and set from among them after opening it. The standard value not supported or the original value of user is input with the format like the example shown below.

```
;CISPR22 class B Conducted limits for main port
QPDET:
0.15M, 0.50M, 66dB, 56dB, log
0.50M,    5M, 56dB, 56dB
5M,      30M, 60dB, 60dB
AVDET:
0.15M, 0.50M, 56dB, 46dB, log
0.50M,    5M, 46dB
5M,      30M, 50dB
```

④Setting of initialization

The various setting values in the current measurement mode are set to the initial values. They mean the setting parameters of the spectrum analyzer, the setting values of EMI standard, the correction coefficient of the anechoic box & antenna (or LISN) and other correction coefficient.

⑤Setting of Spectrum analyzer

The frequency span is divided into three bands ofWide, Middle and Narrow for the automatic measurement or for shortening the measurement time. The center frequency and the sweep time are set in each span. However, as all of the setting parameters are stored in the file, it is possible to set them easily by opening it.

⑥Setting of correction coefficient of anechoic box & antenna

The corrections of the distance between EUT and antenna in the anechoic box and the frequency characteristics of antenna are performed. Two kinds of correction values are automatically set by designating an anechoic box because the anechoic box and the antenna are a couple, for instance MAN150B is always installed in MY5310/S/SU. However, the attenuation of LISN is corrected in the conducted emission measurement. These correction values are usually set by opening the file but the original correction values by user can be also input.

⑦Setting of other correction coefficient

When the frequency characteristics of a coaxial cable and other should be corrected, this setting is useful. MR2300 has no correction data in this item.

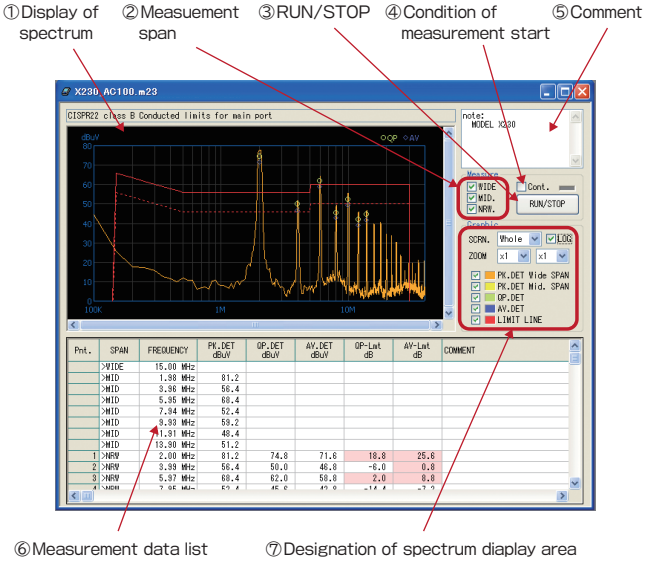
⑧Measurement condition file

The table below shows the files for CISPR22 as an example. All the standards supported (refer to "Standards supported" in Specifications described in the final page) are made to the files.

CISPR 22_ClassA/powerline conducted emission	:Cispr22_ClassA_Cond_MainPort.st1
CISPR 22_ClassB/powerline conducted emission	:Cispr22_ClassB_Cond_MainPort.st1
CISPR 22_ClassA/radiated emission	:Cispr22_ClassA_Radi_MY5310.st1
CISPR 22_ClassB/radiated emission	:Cispr22_ClassB_Radi_MY5310.st1

Automatic measurement

If measured in the wide span with the QP or AV detection all at once, the measurement time becomes very long because the time constant of these detections is very large. Therefore, the measurement is first performed in the wide span with the PK detection, in which the measurement time is short, from the expression of PK ≧ QP ≧ AV, and then only spectrums out of specification are measured with the PK detection as well in the middle span. In addition, only spectrums out of specification even in this middle span are measured with the QP or AV detection in the narrow span. Even if the detection mode is QP or AV, the measurement time is only 30 seconds in the radiated emission measurement or only 10 seconds in the conducted emission measurement because the frequency span is narrow.



①Display of spectrum

The measured spectrum of the disturbance noise and the limit line of the EMI standard are displayed. The solid line shows a limit line of the QP detection and the broken line shows a limit line of theAV detection. Besides, the level measured in the QP or AV detection is displayed on the spectrum with ○ or ◇ mark respectively

②Selection of measurement span

When all of wide span (WIDE), middle span (MID) and narrow span (NRW) are selected, all the procedures until measuring spectrums out of specification with the QP or AV detection are automatically carried out. The measurement in each span can be independently performed, but only spectrums out of specification in the wide span or the middle span are measured by the middle span or the narrow span respectively.

③RUN/STOP

The measurement starts or stops.

④Condition of measurement start

If it is off, the measurement starts newly after deleting the measured data.

If it is on, the unmeasured spectrum is measured by continuing the last measurement.

⑤Comment

The comment sentence is entered.

⑥Measurement data list

[SPAN] shows in which span the measurement is done and ">" is marked after finishing the measurement. [PK.DET], [QP.DET] or [AV.DET] displays the measured value by PK, QP or AV detection respectively. In the wide span and the middle span, only the measured value by the PK detection s displayed. [QP-Lmt] or [AV-Lmt] means the value in which the limit value is subtracted from the measured value by QP or AV detection respectively. Furthermore, when [SPAN] is selected and [DEL] key is pushed, that line and the related data are deleted.

⑦Designation of spectrum display area

■ SCRN:

When "Whole" is selected, the whole of spectrum display area is displayed, and when "Part" is selected, the area of selection cell shown by ▽ marker is displayed.

■ LOG:

The frequency axis is displayed in logarithm.

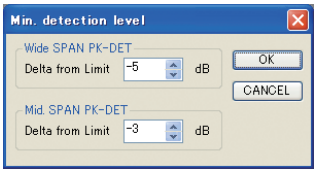
■ ZOOM:

The display magnification is changed.

■ Display / non-display:

On/off of each display item is selected.

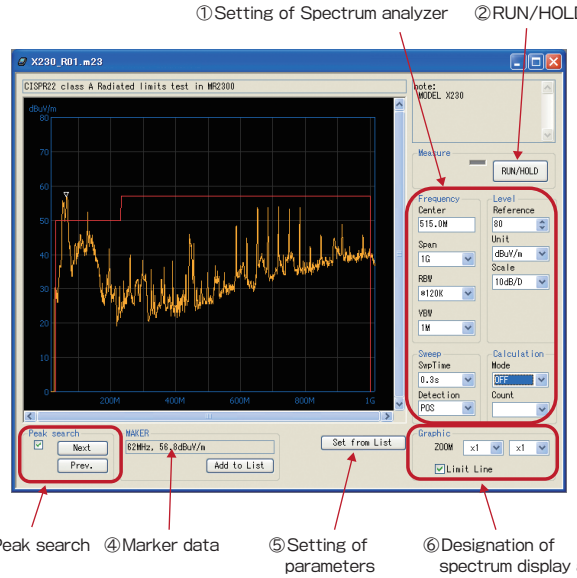
About minimum detection level



In the measurement with the wide span or the middle span, the measurement finishes at this point when there is no noise exceeding the limit line. Therefore, there is no data by the QP or AV detection because the measurement is not continued. Then, the spectrum larger than 5dB low from the limit line is considered as a noise out of specification if −5dB is set in the wide span as shown by the example of picture.

Manual measurement

The manual measurement is very convenient for debugging EUT and removing the disturbance noise. It is possible to measure by freely setting the center frequency, the frequency span and so on.



①Setting of Spectrum analyzer

MSA438E/538E/558E are set. It is recommended to set to PosPeak detection and MaxHold (off) when debugging, and QP/AV detection and MaxHold (on) when confirming finally.

②RUN/HOLD

Capturing the signal is restarted or stopped.

③Peak search

The peak level of spectrum is searched and the marker moves to that point. The next smaller level is searched by Next. Prev is opposite against it.

④Marker data

The data in the marker point is displayed. The marker moves with the peak search or the mouse.

⑤Setting of parameters

When [Set from List] is clicked by a mouse after designating a line of the measurement data list on the automatic measurement screen, the measurement condition of this line is set as parameters of the manual measurement.

⑥Designation of spectrum display area

On/off of the display magnification and the limit line is set.

Reference Standards of the world

①CISPR(Comite International Special des Perturbations Radioelectriques)

Basic standards	
CISPR16-1	Specification for radio disturbance and immunity measuring apparatus and methods Part1: Radio disturbance and immunity measuring apparatus

Product standards	
CISPR11	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment
CISPR12	Limits and methods of measurement of radio disturbance characteristics of vehicles, motor boats and spark-ignited engine driven devices
CISPR13	Limits and methods of measurement of radio disturbance characteristics of sound and television broadcast receivers and associated equipment
CISPR14-1	Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus
CISPR14-2	Requirements for household appliances, tools and similar apparatus. Part2: Immunity
CISPR15	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment
CISPR20	Limits and methods of measurement of immunity characteristics o f sound and television broadcast receivers and associated equipment
CISPR32	Limits and methods of measurement of radio disturbance characteristics of ITE
CISPR24	Limits and methods of measurement of the immunity characteristics of ITE
CISPR25	Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles

②CENELEC(European Committee for Electrotechnical Standardization)

CENELEC and CISPR are almost same. The corresponding table of two standards is shown right.

CENELEC	CISPR
EN55011	CISPR11
EN55012	CISPR12
EN55013	CISPR13
EN55014	CISPR14
EN55015	CISPR15
EN55020	CISPR20
EN55032	CISPR32

③FCC(Federal Communications Commission / USA)

Standards	Contents
Part15	Regulations relating to unnecessary emission of various radiofrequency equipments including broadcast receiver and computer
Part16	Regulations relating to industrial, scientific and medical equipments

④VCCI (Voluntary Control Council for Interference by Information Technology Equipment / Japan)

CISPR16-1 and CISPR32 are quated.

Specifications

System specifications

Measurement Mode Radiated and conducted emissions measurements
※The magnetic field strength measurement with Magnetic field probe MMP500 is performed in Magnetic field strength measurement mode in Measuring functions of MSA538E/558E

Frequency rage 30MHz to 1GHz@Radiated emission measurement
150kHz to 30MHz@Conducted emission measurement

Standards supported CISPR11(class A/B,group1)、CISPR22(class A/B)、EN55011(class A/B,group1)、EN55022(class A/B)、VCCI(class A/B)、FCC part15 subpart B(class A/B)

Anechoic box MY5310/5410

Items	MY5310-F1	MY5410-F1
Outside dimensions	1340(W)×1210(H)×1030(D)mm ※excluding casters and projections	2364(W)×1902(H)×1424(D)mm ※excluding casters and projections
Inside dimensions	1280(W)×960(H)×960(D)mm	2215(W)×1485(H)×1275(D)mm
Door opening dimensions	410(W)×710(H)mm	940(W)×1440(H)mm
Weight	400kg	1020kg
Turntable dimensions	φ220mm	φ756mm
Turntable load	10kg in load	100kg in load
Coaxial Connectors	N(J)×1(Front left bottom for antenna) N(J)×1(Right side bottom)	N(J)×2(Left side bottom) N(J)×1(Front right bottom for antenna)
I/F	D-sub25pins×1(female) LAN×1 AC×1(250Vmax/10A) ※When electric-powered turntable is attached, AC100V	
Shielding Characteristics (typ)	70dB typ@2.2GHz	65dB typ@2.2GHz
Radio wave absorber	single-layer ferrite tile	
Reflection Loss	・ more than 20dB@30MHz to 400MHz ・ more than 12dB@400MHz to 1GHz	

Anechoic box MY5310S/5310SU

Items	MY5310S-F1	MY5310SU-F1
Outside dimensions	1350(W)×1220(H)×1080(D)mm ※excluding casters and projections	1960(W)×1220(H)×1080(D)mm ※excluding casters and projections
Inside dimensions	1280(W)×960(H)×960(D)mm	1895(W)×960(H)×960(D)mm
Door opening dimensions	510(W)×920(H)mm	510(W)×920(H)mm
Weight	400kg	595kg
Turntable dimensions	φ220mm	φ500mm
Turntable load	10kg in load	50kg in load

※It is the same as MY5310 in terms of radio wave absorbers, connectors, I/Fs, shielding and absorption.

Broadband antenna (MAN150B)

Frequency range 30MHz to 1GHz
Polarization Linear
Impedance 50Ω (nominal)
Antenna type Biconical antenna
Gain -31dBi to +1dBi(nominal)
Antenna factor 17 to 31dB/m
Connector SMA(J)
Weight Approx.1150g

Low Noise Amplifier MAP302

Frequency range 20MHz to 3GHz
Noise figure 3.5dB(typical)
Gain 20dB(typical)
Gain flatness ・ 2.5dBp-p(0.02 to 1GHz, typical)
・ 5.5dBp-p(0.02 to 3GHz, typical)
P1dB +12dBm(typical)
Input damage level +13dBm(CW average power)、50VDC
Input/output connector SMA(J)
Dimensions 260(W)×125(H)×220(D) mm
Weight 2.4kg

LISN(MPW201B)

Frequency range 150kHz to 30MHz
Circuit type 50Ω/50μH, V type (based on CISPR16-1)
Impedance accuracy ±20%
Number of phase Single
Max. Power supply voltage 250VAC
Rated current 15A
Power supply Frequency 50/60Hz
RF connector BNC
Transient limiter Built-in
Operating temperature 0 to 40℃(Guaranteed at 23±10℃)
Dimensions 260(W)×125(H)×220(D)mm(excluding casters and projections)
Weight Approx. 2.3kg

Spectrum Analyzer for EMI (MSA438E/538E/558E)

Detection Peak, Quasi-peak and Average detections

Time constant of QP

Time constant \ RBW	9kHz	120kHz
Charge	1ms	1ms
Discharge	160ms	550ms
Mechanical	160ms	100ms

Resolution bandwidth 9kHz, 120kHz, 1MHz･･･6dB
300 to 3MHz(1-3 step)･･･3dB
※MSA438E: more than 3kHz

Other specifications Same as MSA438/538/558

PC software (MAS430/530)

OS Windows 10、11
Communication port USB (1 port)

Others

Operating temperature 0 to 50℃(Guaranteed at 23±10℃)
Operating humidity Less than 40℃/80%RH
(Guaranteed at less than 33℃/70%RH)
Storage temperature and humidity -20 to 60℃, less than 60℃/70%RH
Standard accessories ・ Coaxial cable
・ Communication cable
・ Power cable
・ Handling instructions
Options ・ Magnetic Field Probe MMP500
・ Electric Turntable MT106(all sorts)

※MICRONIX Corporation reserves the right to make change in design, specification and other information without prior notice.

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