## Audio Analyzer
# VA-2230

### OUTLINE

The VA-2230 is a high-performance, multifunction audio analyzer featuring a measuring signal generator with fast response and high stability and 10 measuring functions. It consists of a measuring signal generation block incorporating a programmable (DDS) oscillator and high-speed measurement block which processes signals using a notch filter, HPF and LPF and applies DSP computations. The 10 measuring functions include the frequency measurement, AC level measurement with a wide bandwidth up to 210 kHz, wattage measurement, total distortion measurement, total harmonic distortion measurement, high-order harmonic analysis, S/N ratio measurement, L/R ratio measurement, SINAD measurement and DC level measurement. These functions can be used independently or can also be combined with the signal generation block to build audio measuring systems with low noise, high accuracy and high speed. With digital technology invested everywhere, the VA-2230 makes possible fully automated measurements including automatic range switching and automatically synchronized measurement data output. In addition, it is also packed with a multiplicity of versatile functions including a preset memory for storing and recalling up to 100 measurement condition settings, a limiting function using zone display with GO/NO-GO judgment of the measurement results, an auto sequencing function which recalls the preset memory settings in sequence, a printer output for printing the measurement results, an EXT I/O for remote control and a GP-IB as standard.

GP-IB

## FEATURES

### DSP for Measurements Based on FFT Computations

True rms measurements based on FFT are made possible by the DSP. The distortion measurements include the total distortion measurement (THD+N) as well as the total harmonic distortion measurement (THD) and the harmonic analysis (HD) which have previously been available only with high-grade tools.

### DDS Signal Generator with Low Distortion

The signal generator is capable of low-distortion signal oscillation based on the DDS (Direct Digital Synthesizer) method with a high 50 ppm frequency stability.
The setting can be made at a high speed.

### Large LCD for Versatile Display

Three display modes include a numeric display mode (PAGE 1), an analog meter mode (PAGE 2) and a limit mode for use in GO/NO-GO judgments (PAGE 3).

### Excellent Operability

Menu operations are performed based on selections using function keys, while direct keys are used to switch the output channels and measuring items. The output value settings can be modified using the numeric keys or the jog /shuttle keys.

### GP-IB Provided as Standard

The GP-IB is now standard production line item. It also makes system expansion easy by enabling the transfer of memory contents between tools of the same model (memory copy), and the synchronized recalling of preset memory, etc.

### Floating Switching

The GND circuits of the signal generation block, AC measurement block and DC measurement block are separate and each can be floated from the cabinet independently of the others.

### SINAD Measurement

The SINAD measurement makes the analyzer usable in the field of communications equipment as well as in the field of audio equipment.

### Two Input/Output Channels

While the signal generation and measurement blocks are composed of single-channel circuitry, signal switchers are built in to allow the input and output of 2 channels of signals. This makes possible the measurements of crosstalk, signal separation and L/R ratios.

### Other Major Features

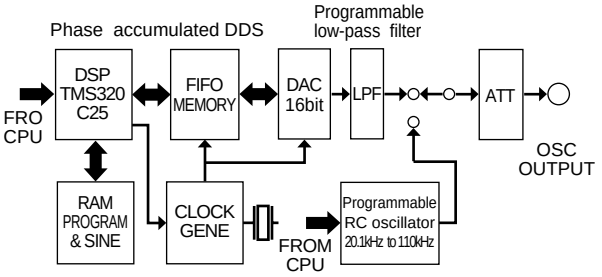
●The frequency range of the frequency counter and AC level measurement functions is expanded up to 210 kHz to enable the head bias adjustment of the tape decks.
●Relative measurement is possible in AC level measurement while wattage display (virtual load) is possible when simulating a loudspeaker, etc.
●The BAL/UNBAL input capabilities make possible the non-grounded measurement of high-power amplifiers, etc.
●100-step sequence memory, which can be divided into 10 groups.
●I/O ports for external control and printing out.

## APPLICATIONS

●Production lines, PC board checking, engineering and design of audio/video manufacturers. ●Production lines, PC board checking, engineering and design of communications and telephone equipment manufacturers. ●Production line, engineering and design of manufacturers who require automated measurements. ●Production line, engineering and design of parts manufacturers.

## Signal Generator Block with Fast Response & High Stability

Signals in the range from 5 Hz to 20 kHz are generated using the DDS signal generator together with high-order analog filters that are effective for eliminating noise and improving the distortion factor of the output signals; this makes it possible to generate signals with a fast response and a high stability with an ultralow distortion of below 0.005% (−86dB). The distortion of the sine waves is also reduced by using a D/A converter with 16-bit operation. Signals in the range of 20.1 kHz or higher are generated by the programmable RC signal generator using a state-variable filter. This makes it possible to produce high-power output of 5Vrms at the 600Ω load end (10Vrms at the open end) with fast response and high stability at a low distortion of below 0.01% (−80dB).




DDS signal oscillator

## Measurement Block with High Performance & Multiple Functions

### 10 Measurement Functions in Total

Ten measurement functions are condensed in a single unit. In addition, accurate measurements are achieved thanks to the state-variable filter for fast presetting of frequencies and the DSP which performs high-speed FFT analysis of multi-point sampling results, eliminates carrier wave analysis and calculates the noise distortion component.

| | |
|---|---|
| **Frequency measurement** | Measuring range : 5Hz - 210kHz<br>Accuracy : ± $5\times10^{-4}$ ± 1dgt |
| **AC level measurement** | Measuring range: 0.3mV - 100V<br>Accuracy : ± 2% of F.S. (1kHz)<br>Frequency range : 20Hz - 20kHz (±5%)<br>5Hz - 210kHz (±20%)<br>Residual noise :≦10μV<br>Response characteristics : actual value |
| **Watt measurement** | Calculation by AC level measured value and virtual load resistance/<br>RL set range : 2 −5000Ω |
| **Distortion measurement** | Frequency range : 10Hz - 110kHz<br>Measuring range : 0.01% - 100%<br>Residual distortion:≦−94dB (10Hz - 20kHz,80kBW)<br>Fundamental wave removal ratio: notch −60dB +FFT −50dB = −110dB |
| **Harmonic distortion measurement** | Nos. 2 - 10 harmonic waves are detected and measured<br>Residual distortion: ≦ -100dB (10Hz - 20kHz, 80kBW) |
| **Harmonic analysis measurement** | Nos. 2 - 10 harmonic waves are set to any value and measured Residual distortion: ≦ -100dB (10Hz - 20kHz, 80kBW) |
| **S/N measurement** | Measuring range : 0 −130dB<br>Measuring level range : 30μV - 100V<br>Accuracy: ±1.2dB (20Hz - 20kHz) |
| **Ratio measurement** | Measuring range: 0 - 130dB<br>Accuracy : ±1.2dB (1kHz, full input range) |
| **SINAD measurement** | Measuring range : 0 - 40dB<br>Accuracy : ±1dB |
| **DC level measurement** | Measuring range : 30mV - 100V<br>Accuracy : ±(0.3% of F.S. + 0.75% of measured value) |

(1) Frequency measurement function


To measure a low frequency at high speed and high resolution, this function samples a signal with an accuracy of 5 x $10^{-5}$ and a timebase of 500 kHz (2μs), processed it by FFT analysis and displays the carrier wave frequency . In the AC level measurement mode, frequencies in the range from 5 Hz to 210 kHz can be measured at input signal levels between 1 mV and 100 Vrms.

(2) AC level measurement function


The high-sensitivity AC voltage level measurement features rms value response as the indication response characteristic. The measurement range is divided into 12 ranges with full scales from 300μV to 100 V, and each range except the 100 V range allows an excessive input range of about 10%. The range can be switched either automatically or manually and the units used in display can be selected from V (mV), dBV and dBm. Additional functions include the ratio display between the L and R inputs and the wattage display, and relative level measurement is also possible. This is useful in the measurements of the frequency response, level ratio, S/N, etc.

(3) Wattage measurement function


The wattage is calculated from the AC level measurement value and a virtual load resistance RL (Wattage = (AC level measurement)2/RL) and is displayed.

(4) Distortion measurement function


Total distortion measurement is possible with carrier wave frequencies ranging from 10 Hz to 110 kHz. The measuring range is divided into 9 ranges with full scales from 0.01% to 100% and these ranges are switched automatically. The input range is from 0.1 to 100 Vrms but a high-sensitivity input range with a 3 mV full scale is also provided for use in measuring the dynamic range of digital audio equipment. When measuring signals with high noise levels, it is also possible to measure them by fixing the tuning frequency of the carrier wave elimination filter, the input range or the measuring range independently.

(5) Total harmonic distortion (THD) measurement function


The distortion of the 2nd to 10th harmonics except for noise is measured and displayed..

THD = $\sqrt{e2^2+e3^2+\cdots e10^2}/ein\times100\%$ or
THD = 20log ($\sqrt{e2^2+e3^2+\cdots e10^2}/ein$)dB
where ein : input signal level
eN : Signal level of Nth harmonic (N = 2, 3,...10)

(6) Total harmonic analysis (HD measurement) function


The distortion of a harmonic or a combination of harmonics selected from higher harmonics up to the 10th is measured and displayed.

HD = $\sqrt{e2^2+e3^2+\cdots eN^2}/ein\times100\%$ or
HD = 20log ($\sqrt{e2^2+e3^2+\cdots eN^2}/ein$)dB
where ein : input signal level
eN : Signal level of Nth harmonic (N can be selected from 2, 3,...10 to combine the desired number of harmonics.)

(7) S/N measurement function


By automatical synchronize of the signal generator output on-off and the S component-N component level measurements, **a** simple press of the S/N key allows measurement of the S/N ratio up to 130 dB.
The S component and N component level measuring ranges can be switched either automatically or manually.

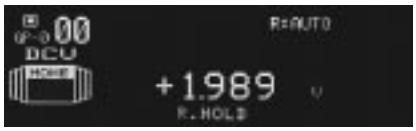
(8) Ratio (L/R, R/L) measurement function


This function measures the ratio of the R level with respect to the L input level or that of the L level with respect to the R input level. The measuring range is between about 30 μV and 100 V and either automatic or manual measurement can be selected.

(9) SINAD measurement function


This function measures the AC levels of the S component (including noise and distortion) and N component (including distortion) and calculates the SINAD. The range of the S component can be switched either automatically or manually while that of the N component is fixed to allow measurement from 0 dB up to 40 dB.

(10) DC level measurement function



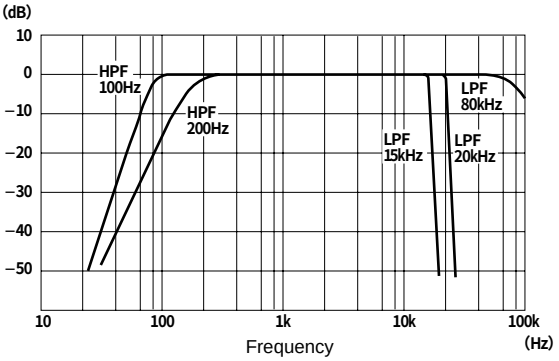

This function has 5 measuring ranges with full scales of 30 mV, 300 mV, 3 V, 30 V and 100 V. Each of these ranges except the 100 V range allows an excessive input range of about 10%. The measuring range can be switched either automatically or manually.

## Valuable Additional Functions to Respond to Various Needs

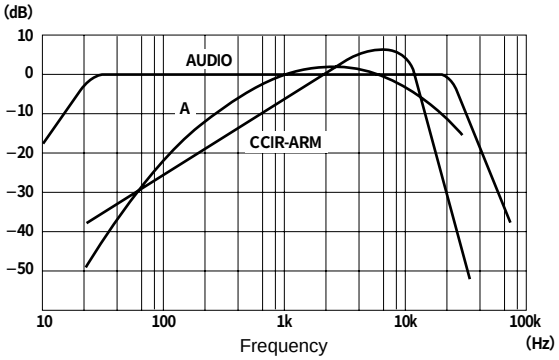
### Eight filters built in

Filtering can be inserted in the AC level, distortion, total harmonic distortion, harmonic analysis, S/N ratio and SINAD measurement circuits. A total of 8 filter circuits are available, including 2 HPF, 3 LPFs and 3 weighting filters.

HPF: 100Hz, 200Hz
LPF: 15kHa, 20kHz, 80kHz
PSO: IEC-A, DIN-AUDIO, CCIR-ARM




(a) Low-pass filter, bypass filter




(b) Filter for noise evaluation

### Programmability

The 100-step preset memory can store all of the panel conditions as well as the external control I/O setting, etc., and the analyzer tool can be controlled according to a program through the external control signal input. Auto sequencing allows recall automatically of the desired addresses without using a special external controller, and the memory type function makes it possible to copy the memory contents to an analyzer of the same model.

### Limit judgment

Production processes often perform GO/NO-GO judgments by setting the control limit values for measurements, then the limit judgment function has been provided to respond to this need. The GO/NO-GO judgment by setting the upper and lower limit values for each measurement so as to facilitate judgment operations in automated measuring systems.

### GP-IB control provided as standard

The GP-IB commands make possible the remote control, output of measurement data, synchronized control of preset memory, transfer of memory contents and so on.

External control I/O

External control I/O is provided apart from the GP-IB interface to allow programmable control in interlocking with external equipment. This facilitates the extension toward systematized measurements.

●Remote sequential recall: Remote sequential recall can be remote controlled externally.

●Remote modification: The frequency and output level of the signal generator can be modified by remote control from an external rotary encoder.

●Remote direct recall: Direct memory recall can be remotely controlled externally.

●Limit judgment output: The signal for lighting an external LED to indicate the limit judgment results is available.

●Control output: Eight-bit x 2-port TTL output signals for use in controlling external equipment are available.

●Memory print-out (memory listing output): The contents of a preset memory can be printed .

●Data read: An external 8-bit data signal at the TTL level can be read through a GP-IB controller.

●Data print: Measurement values may be printed .

Averaging capability

To reduce variance in the measurement data, averaging of measured data is
available in the AC level, DC level, distortion, total harmonic distortion,
harmonic analysis, S/N ratio and SINAD measurement functions. The averaging count can be selected from OFF, 2, 4, 8 and 16.

Memory sync. and memory copy capabilities

The GP-IB interface enables the memory synchronization which recalls preset memories simultaneously and the memory copy which transfers memory contents between analyzers of the same model.

Floating, input impedance switching and balanced input capabilities

The common terminals for the signal generation, AC measurement and DC measurement blocks can be independently be floated from the chassis. The input impedance of the AC measurement block is switchable. In addition, when the output of the measurement object is floated, for example with a BTL amplifier, the input format can be switched to balanced input.

6 optional filters

In addition to the 8 kinds of filters provided as standard, up to two sets of 6 kinds of optional filters can be additionally inserted .
OF-1 (3kHz BPF)
OF-2 (1kHz BPF)
OF-3 (315Hz BPF)
OF-4 (CCITT P53TEL)
OF-5 (C-MESSAGE)
OF-6 (IEC-C)

## SPECIFICATIONS

Signal Generator for Measurement

**〈Oscillator〉**

| | |
|---|---|
| Frequency range | 5Hz to 20.09kHz (DDS system) |
| | 20.1kHz to 110.0kHz (CR oscillator) |
| Frequency setting resolution | 1Hz (5Hz to 2.009kHz) |
| | 10Hz (2.01kHz to 20.09kHz) |
| | 100Hz (20.1kHz to 110.0kHz) |
| Frequency accuracy | ±0.005% (5Hz to 20.09kHz) |
| | ±3% (20.1kHz to 110.0kHz) |
| Display digits | 4-digit max. |
| Spot oscillator • 1 | 20Hz (±0.005%) |
| Spot oscillator • 2 | 1kHz (±0.005%) |
| Spot oscillator • 3 | 20kHz (±0.005%) |
| Output channels | 2CH (L,R :Only common output) |
| Output impedance | 600Ω±2% (unbalanced) |
| Output level range | 14.0 to −85.9dBV/16.2 to −83.7dBm |
| Output level resolution | 0.1dB |
| Output level accuracy | ±0.5dB of set value (＞−40dBV) |
| | ±0.8dB of set value (≦−40dBV) |
| | 1kHz、600Ω load |
| Spot oscillator • 1 | 20Hz (±0.5dB) |
| Spot oscillator • 2 | 1kHz (±0.5dB) |
| Spot oscillator • 3 | 20kHz (±0.5dB) |
| Frequency response | ±0.05dB (20Hz to 20kHz)/±0.5dB |
| | (All ranges) |
| Noise at OFF state | ≦10μVrms |
| Distortion (THD+N) | ≦0.005% (20Hz to 20kHz, 80kBW) |
| | ≦0.01% (All ranges) |
| Spot oscillator • 1 | 20Hz (0.001%THD+N, 80kBW) |
| Spot oscillator • 2 | 1kHz (0.001%THD+N, 80kBW) |
| Spot oscillator • 3 | 20kHz (0.001%THD, 80kBW) |

Measurement function block

<Measuring items>

Frequency measurement, AC level measurement (relative display/wattage display), DC level measurement, total distortion measurement (THD+N), harmonic distortion measurement (THD), harmonic analysis measurement (HD), SINAD measurement, S/N measurement, ratio measurement (R/L, L/R).

<Frequency measurement>

| | |
|---|---|
| Measuring range | 5Hz to 210kHz |
| Measurement resolution | 5-digit (≧100Hz)/0.01Hz (＜100Hz) |
| Measuring accuracy | $\pm 5\times10^{-4}\pm$1digit |
| Input level range | 1mV to 100Vrms |

<AC level measurement>

| Measuring range | V (mV) | dBV | dBm |
|---|---|---|---|
| | 100V | 40.0dBV | 42.2dBm |
| | 30V | 29.5dBV | 31.7dVm |
| | 10V | 20.0dBV | 22.2dBm |
| | 3V | 9.5dBV | 11.7dBm |
| | 1V | 0.0dBV | 2.2dBm |
| | 300 mV | −10.5dBV | −7.8dBm |
| | 100mV | −20.0dBV | −17.8dBm |
| | 30mV | −30.5dBV | −27.8dBm |
| | 10mV | −40.0dBV | −37.8dBm |
| | 3mV | −50.5dBV | −47.8dBm |
| | 1mV | −60.0dBV | −57.8dBm |
| | 0.3mV | −70.5dBV | −67.8dBm |

Measuring accuracy ····· ±2% of full-scale indication (1kHz)
Frequency response ····· ±5% (20Hz to 20kHz) reference : 1kHz
±10% (5Hz to 110kHz) reference : 1kHz
±20% (5Hz to 210kHz) reference : 1kHz
Vestigial noise ····· ≦4μV (80kBW)
Response characteristics ···· actual value
Relative measurement range ···· 0 to ±130dB
Wattage display ····· Power calculation based on AC level measurement and virtual load (RL)
Resolution of watt display ···· 5 digits max.
Setting range of RL ····· 2 to 5000 Ω

<DC level setting>

Input channel ····· 1CH: for DC input
Input impedance ····· 1M Ω
DC level measuring ranges ····· 5 ranges (100V/30V/3V/300mV/30mV)
DC level measuring accuracy ···· ±(0.3%fs+0.75% of measuring value)

<Distortion measurement common specifications>

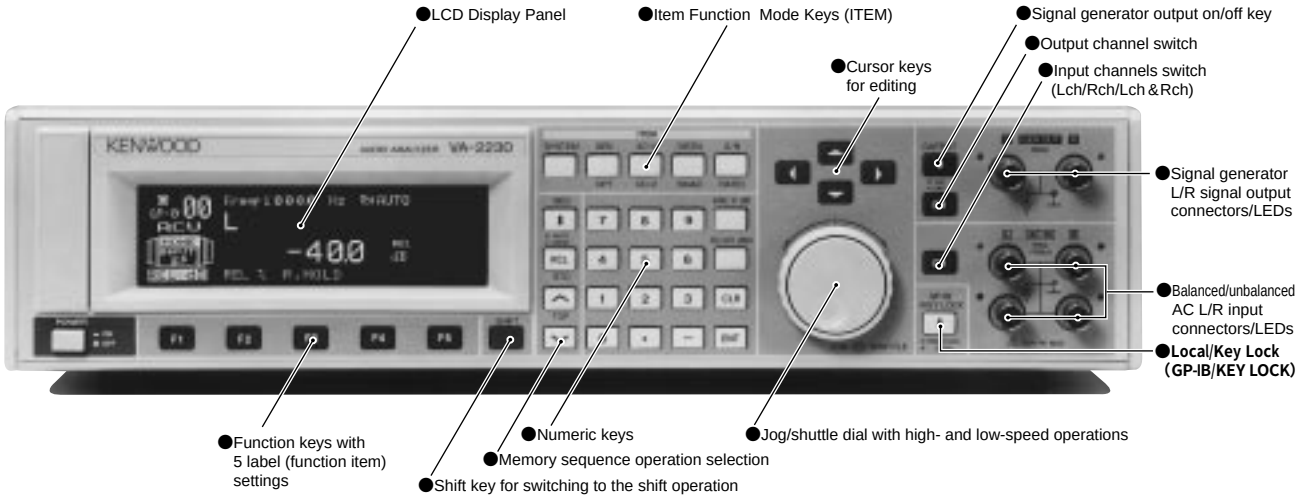
Fundamental frequency range ···· 10Hz to 110kHz

| Distortion measurement range | 100% | 0.0dB |
|---|---|---|
| | 30% | −10.5dB |
| | 10% | −20.0dB |
| | 3% | −30.5dB |
| | 1% | −40.0dB |
| | 0.3% | −50.5dB |
| | 0.1% | −60.0dB |
| | 0.03% | −70.5dB |
| | 0.01% | −80.0dB |

Secondary harmonic deviation ···· ±1dB (20Hz to 20kHz)
±3dB (all range)
Fundamental wave removal ratio ···· 110dB or more
60dB (NOTCH)+−50dB(FFT)
Response characteristics (input) ····· actual value
Response characteristics (distortion) ····· actual value
Input level range ····· 1mV to 100V

| Input ranges | V (mV) | dBV | dBm |
|---|---|---|---|
| | 100V | 40.0dBV | 42.2dBm |
| | 30V | 29.5dBV | 31.7dVm |
| | 10V | 20.0dBV | 22.2dBm |
| | 3V | 9.5dBV | 11.7dBm |
| | 1V | 0.0dBV | 2.2dBm |
| | 300mV | −10.5dBV | −7.8dBm |
| | 100mV | −20.0dBV | −17.8dBm |
| | 30mV | −30.5dBV | −27.8dBm |
| | 10mV | −40.0dBV | −37.8dBm |
| | 3mV | −50.5dBV | −47.8dBm |

(30mV to 3mV ranges: manual only)
Display units ····· Input level: V, dBV, dBm
Distortion: %, dB



<Total distortion measurement>

Measuring mode ····· harmonic distortion+noise(THD+N)
Residual noise/distortion
(100V, 30V, 10V, 3V & 1V ranges) ···· ≦−94dB (10Hz to 20kHz, 80kBW)
≦−80dB (all limits, 500kBW)
input≧1/3 of full scale
(300mV range) ····· ≦−86dB (10Hz to 20kHz, 80kBW)
≦−66dB (all limits, 500kBW)
input≧1/3 of full scale
(100mV range) ····· ≦−74dB (10Hz to 20kHz, 80kBW)
≦−60dB (all limits, 500kBW)
input≧1/3 of full scale
(3mV range) ····· ≦−45dB (10Hz to 10kHz, 20kBW)
input=2mVrms

〈Harmonic distortion measurement〉

Measuring mode ····· Nos. 2 - 10 harmonic waves are detected and measured
Residual noise/distortion
(100V, 30V, 10V, 3V & 1V range) ···· ≦−100dB (10Hz to 20kHz, 80kBW)
≦−80dB (all limits, 500kBW)
input≧1/3 of full scale
(300mV range) ····· ≦−94dB (10Hz to 20kHz, 80kBW)
≦−74dB (all limits, 500kBW)
input≧1/3 of full scale
(100mV range) ····· ≦−86dB (10Hz to 20kHz, 80kBW)
≦−74dB (all limits, 500kBW)
input≧1/3 of full scale

<Harmonic analysis measurement>

Measuring mode ····· Nos. 2 - 10 harmonic waves are set to any value and measured Residual

<SINAD measurement>

SINAD measuring range ····· 0 to 40dB (1 range)
Residual SINAD ····· Same as <Total distortion measurement>

<S/N measurement>

Input level ····· 30μV to 100Vrms
(both S component & N component)
Measuring range ····· 0 to 130dB (80kHzBW)
S/N accuracy ····· ±1.2dB
Response characteristics ····· actual value

<Ratio measurement>

Input level range ····· 30μV to 100Vrms (both numerator and denominator)
Ratio range ····· 0 to ±130dB (80kHzBW)
Ratio accuracy ····· ±1.2dB (1kHz, full scale input)
Frequency response ····· ±2dB (standard: 1kHz)
Display unit ····· dB, %
Response characteristics ····· actual value

<Measurement block common specifications>

Input channels ····· AC input: 2 CHs, alternate (Balanced and unbalanced switchable)
Input impedance ····· AC input: 10 kΩ, 100 kΩ ≦ 200 pF
Maximum allowable input ···· 150 V (DC + AC peak)
Grounding ····· Floating and non-floating switchable (independently for DC, AC and signal generator)
Averaging count ····· 2, 4, 8, 16, OFF
Built-in filters ····· HPF (100 Hz/200 Hz/Optional), LPF (15 kHz/20 kHz/80 kHz /Optional), PSOPHO (IHF-A/CCIR-ARM/DIN-AUDIO/Optional)
Optional filters ····· 3kHz BPF/1kHz BPF/315Hz BPF/CCITT P53TEL/C-MESSAGE/IEC-C

**<Other functions>**

<Sequence function>

Operation specifications ····· 1) Single Up; 2) Single Down; 3) Repeat Up; 4) Repeat Down
<GP-IB function> ····· SH1, AH1, T8, L4, SR0, RL1, PP0, DC1, DT1, C1, C2, C3, C27
1) Panel status; 2) Measurement value output; 3) Memory copy (between same models); 4) Memory synchronization (between same models, same versions)
<EXT I/O function> ····· 1) Level or frequency setting from an external rotary encoder; 2) Direct memory call; 3) Control output; 4) Limit judgment output; 5) Memory listing; 6) 8-bit data read;7) Measurement data print-out.

<Memory function>

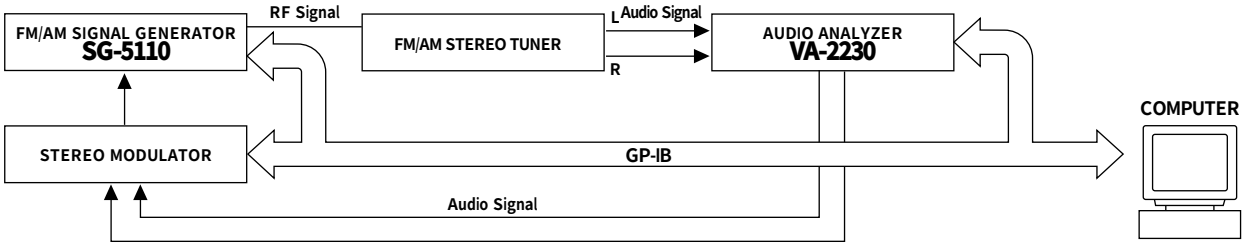
Memory point count ····· 100 steps (Can be divided into 10 groups.)
Setting contents ····· 1) Panel setting; 2) EXT CONTROL I/O; 3) Limit data batch memory.

**〈General specifications〉**

Temperature/humidity
for operation ····· 0 to 40℃, RC 90% max.
Temperature/humidity
for characteristics in spec. ···· 5 to 35℃, RC 85% max.
LCD Temperature/humidity
for operation ····· 0 to 30℃, RC 90% max.
0 to 40℃, RH60% max.
Power source ····· 100/120/220/240V AC, ± 10% (max. 250V)/Approx. 48W
Dimensions ····· 426 (W)×99 (H)×400 (D) mm
Weight ····· Approx. 10kg
Accessories ····· Instruction manual (1), cable (1), power cord (1)

## EASY EXPANSION TO AUTO MEASURING SYSTEM

■With a FM/AM stereo tuner




■With a Laserdisc player