FREQUENCY RESPONSE ANALYZERS

As FRA servo analyzers, they are useful for a wide range of measurement applications.

- SWPS: Loop response for switching power supplies
- DCPS: Ripple rejection ratio for series regulators
- Servo response for magnetic and optical disks
- Resonance response for piezo-electric components
- Impedance of electronic components
- AC impedance of fuel cells
- Internal resistance for electric double layer capacitors
- For other measurement applications

NF Corporation
The high accuracy and functionality unique to frequency response analyzers which allow them to achieve sure measurements are dramatically enhanced to make our FRAs even more convenient and useful!

NF Corporation’s frequency response analyzers utilize the excellent noise eliminating feature of Fourier transformations to accurately measure frequency response characteristics. Equipped with floating input circuitry and auto ranging functions for constantly optimizing input ranges, our FRAs allow dynamically changing frequency responses to be quickly measured with high accuracy, without the need to be concerned with input signal levels or the ground potential of the device being tested; moreover, operation is quite simple. Experience first-hand just how excellent are accuracy, functions, and operability of our FRAs.

### Key Features

- **Frequency range:** 0.1mHz to 10MHz / 15MHz
- **Dynamic range:** 140dB
- **Excellent functions are built-in:**
  - Frequency axis high-density sweep
  - Auto ranging
  - Auto integration
  - Auto-magnification
  - Equalize
  - Equalize
  - Operation
- **Built-in printer:** A printer for outputting hard copies of on-screen images onto thermosensitive paper is built-in, which makes saving measurements and creating reports convenient.
- **Auto ranging:** Input range is switched automatically according to the input signal level, so setup of voltage sensitivity is not necessary for the frequency response analyzer.
- **Date display software:** Data stored in the USB memory can be read out to a personal computer for graphic display and saving in a CSV format.
- **GPIB and USB equipped:** Measuring conditions can be set via an external personal computer and measured data can be read out to it via GPIB and USB.
- **USB memory by the press of a key:** Measured data can be stored and loaded into a USB memory device. Furthermore, the following functions are available.
- **Screen copy:** A screen can be output to the USB memory and printer by the press of a key.
- **Screen copy:** Set conditions can be saved into and loaded from the USB memory by the press of a key.
- **USB memory by the press of a key:** Various graphic outputs
- **Built-in printer:** A printer for outputting hard copies of on-screen images onto thermosensitive paper is built-in, which makes saving measurements and creating reports convenient.
- **Built-in printer:** The contents of the setup and measured data stored in the memory before turning off power are held if power is turned off.
- **Impedance display function:** Impedance can be accurately measured and displayed. Moreover, open-circuit correction, maximum and minimum value displays, and screen image storage can be done.
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- **Isolation:** Oscillator output 2-channel and analysis inputs are isolated from the cabinet by 250Vrms. In this way, the instrument can be protected from damage by an erroneous signal connection.
- **Impedance display function:** Impedance can be accurately measured and displayed. Moreover, open-circuit correction, maximum and minimum value displays, and screen image storage can be done.

**Frequency Response Analyzers**

Frequency response analyzers consist of a sweep oscillator, voltmeter, and phase meter. Digital Fourier transform calculations allow voltage and phase to be obtained simultaneously and with high accuracy, with the oscillator as the reference. When measurement at a frequency ends, the frequency is switched to the next frequency. Thus, an identical measurement is done for each measuring point, a high dynamic range measurement far beyond the limit of bits of the A/D converter can be done.

**FRA5097**

- **15 Mhz**
- **10 Mhz**

**FRA5087**

- **10 Mhz**

**Easy saving and reading by USB memory**

- **USB**
- **Screen copy:**
- **Conditions:**
  - Set conditions can be saved into and loaded from the USB memory by the press of a key.

**Various graphic outputs**

- **Brune, Nyquist, Nichols, and Cole-Cole plots can be displayed. Following measurement, interconversion is also available.**

**Impedance display function** (optional for FRA5087)

- **Impedance can be accurately measured and displayed. Moreover, open-circuit correction, maximum and minimum value displays, and screen image storage can be done.**

**Isolation**

- **Oscillator output 2-channel and analysis inputs are isolated from the cabinet by 250Vrms. In this way, the instrument can be protected from damage by an erroneous signal connection.**

**Color TFT LCD**

- **A frequency response graph and setup menu for measuring conditions can be displayed on a crisp color LCD.**

**Battery backup**

- **The contents of the setup and measured data stored in the memory before turning off power are held if power is turned off.**

**Operation**

- **Auto integra...tion by USB memory can be read out to a personal computer for graphic display and saving in a CSV format.**

**Date display software**

- **Data stored in the USB memory can be read out to a personal computer for graphic display and saving in a CSV format.**

**GPIB and USB equipped**

- **Measuring conditions can be set via an external personal computer and measured data can be read out to it via GPIB and USB.**

**Built-in printer**

- **A printer for outputting hard copies of on-screen images onto thermosensitive paper is built-in, which makes saving measurements and creating reports convenient.**

**Auto ranging**

- **Input range is switched automatically according to the input signal level, so setup of voltage sensitivity is not necessary for the frequency response analyzer.**

**Dynamic range:**

- **140dB**

**Excellent functions are built-in**

- **Auto ranging function which suppresses the effects of external disturbances and variations of measured results by automatically setting an optimum number of integration times is built-in.**

**A basic setup screen can be displayed by one touch.**

- **A special key is provided to facilitate setting procedure.**

**Basic setup**

- **A basic setup screen is displayed simply by pressing the basic setup key.**

**Frequency range**

- **0.1mHz to 10MHz / 15MHz**

(See page 3 for the major ratings of each.)
The FRA5022 is a frequency response analyzer (FRA) for measurement frequencies of 0.1 Hz to 100 kHz. With a slim, space-efficient case design and simple operation for ease of use, it is well suited for integration into production lines and systems.

**Gain accuracy**: ±0.05 dB, **Phase accuracy**: ±0.3°

Digital Fourier transformers and a self-calibration function always achieve highly accurate measurements.

**Frequency range**: 0.1 Hz to 100 kHz

The FRA5022 covers the frequency range best suited for electrochemical measurement and mechanical modal analysis, allowing for support of a wider range of applications.

**Dynamic range**: 120 dB or wider

Auto ranging and a high-resolution A/D converter secure a wider dynamic range. Measurement is secured even if a drastic change occurs during measurement.

### Oscillator section

**Output waveform**: Sinusoidal, square wave, triangular wave, sawtooth wave

- **Frequency range**: 0.1 Hz to 100 kHz
  - Setting resolution: 0.1 Hz
  - Accuracy: ±1.0 ppm
- **AC amplitude**: 0V to 500mV (no load)
  - Setting resolution: 0.1V or 0.01V peak
  - Accuracy: ±1.0V
- **DC bias**: ±10V to 500V (no load)
  - Resolution: 10mV
- **Output control**
  - Quick: Allows setting the output off/on in 3 steps
  - Slow: Allows setting the output off/on in 3 steps

- **Phase control**: Sets the start and stop phases of oscillation in 10° steps

- **AC/DC-simultaneous ON/OFF**: Allows turning of output, even during measurement

### External memory

- **Media**: USB memory (USB 1.1 or USB 2.0)
- **File format**: FAT (compatible with Windows 98SE or later, compatible with MAC/PC/DOS)

### Display section

- **Graph display**: Basic, Nyquist, Nichols, and Bode plots

- **Interconversion**: Also available with use of the cursor

### Interface

- **Software**: Software for loading measurement data onto a PC and displaying graphs is included as standard.
- **Power supply**: 100W maximum
  - Where, 250V or less and 50Hz/60Hz

### Other

- **Auto ranging function**: Searches the maximum and minimum values of vertical axis parameter
- **Orthogonal coordinate display**: Numeric display of the value of a + jb

### Analysis section input

- **Number of input channels**: Two (CH1 and CH2)
- **Isolation**: 500Vrms
- **Maximum input voltage**: ±300Vrms
  - Input impedance: 1 M
- **Minimum range**: 20mVrms
- **Dynamic range**: 120 dB or wider

### Analysis mode

- **Analysis type**: CH1/CH2, CH1/CH2/OSC
  - Level: CH1, CH2

### Harmonic measurement

- **Measurement category**: Voltage (for FRA5022 and 150kHz for FRA5097)
  - Setting resolution: 0.001Vrms
  - Accuracy: ±0.5% (100kHz)

### Power supply

- **AC**: 100V/120V/230V ±10%
- **Voltage**: 2.2V peak
  - Residual noise: ±0.1μV

### Display items

- **Impedance display function**: Measure maximum and minimum values of vertical axis parameter
- **Gain (linear, logarithmic)**, phase enlarged display possible
- **Oscillator output and each input are isolated from the case, allowing for easy
  measurements**.

- **Digital Fourier transforms and a self calibration function always achieve highly
  accurate measurements.**

### Power consumption

- **Input impedance**: 50Ω (AC + DC)
  - Output control: Both AC and DC on, both AC and DC off, only AC off,

### Sensing function

- **Phase**: Any 360° (in horizontal)
  - Orthogonal coordinate display: Numeric display of the value of a + jb

### Analysis input

- **Number of input channels**: Two (CH1 and CH2)
  - Setting resolution: 0.01Vrms
  - Accuracy: ±0.1μV

### Measurement error

- **CH1/CH2 or CH1/CH2/OSC**: ±20kHz = 0kHz = ±22kHz
  - Setting resolution: 0.01Vrms
  - Accuracy: ±0.3μV

### Measuring mode

- **Display**: 4.3 inches, color TFT-LCD

- **Graph display**: Basic, Nyquist, Nichols, and Bode plots

- **Interconversion**: Also available with use of the cursor

### Measurement condition

- **Measurement condition**: All parameters are displayed on the internal linear and logarithmic graph.

### Setting conditions

- **Measurement category**: Voltage (for FRA5022 and 150kHz for FRA5097)
  - Setting resolution: 0.001Vrms
  - Accuracy: ±0.5% (100kHz)
Reliable FRA that offers excellent performance in various situations. Highly accurate measurement meets the greater demands of customers.

Measurement applications

Frequency response analyzers providing consistently high-quality measurements with excellent accuracy and functions are often used for measuring the stability of servo systems, so they are sometimes called "FRA servo analyzers" for many years have lent powerful support to state-of-the-art technology measurements. The range of applications is broad, covering various fields from electronic circuitry, parts, and materials to electrochemistry, machinery, and vibrations.

Loop characteristics of switching power supplies

Evaluate the dynamic stability (gain margin, phase margin) of a switching power supply. Since the signal source and measured terminal are mutually isolated, ground-induced connection is made possible, even with portions having overlapping direct current. The effect of a phase correction circuit can be measured clearly.

Servo response for magnetic and optical disks

Measure transfer functions of servo systems which control the pick-ups of magnetic disk optical disks, and measure open loop response in a normal operating status. It can also measure the phase of a high gain area in a stabilized condition because of its higher noise eliminating capacity, with measurement in a dynamic range of more than 140dB, by using the auto ranging operation at every measuring frequency.

Impedance of electronic components

Measure the impedance of inductors or capacitors. The frequency response analyzer can provide the impedance characteristics of DUT. Since it can perform measurements under a high voltage or large current in combination with a power amplifier, which cannot be done by an LCR meter, impedance can be measured in a condition closer to an actual state of use.

Other applications...

- Characteristics evaluation for vibration-proofing materials
- Frequency response measurement for filters
- Contact resistance measurement for EV connectors
- Testing for hydraulics equipment such as large vibration benches and fatigue testers
- CMRR/PAR measurements for OP amplifiers
- Internal temperature elevation measurements for transformers
- Characteristics measurements for ultrasonic motors
- Chemical impedance measurements

Resonance characteristics of piezo-electric components

Measure the electric resonance of piezo-electric components with an electronic load. Since the frequency response analyzer is not affected by direct current, impedance can be measured accurately with any output current from the fuel cell. Furthermore, measurement at a very low frequency 0-10kHz without DC can be done. Moreover, it can be developed into a system which calculates the parameters (parasitic resistance, reactive resistance, double layer capacity) of an equivalent circuit from the results of measurement.

AC impedance of fuel cells

Measure the AC impedance of fuel cells with an electronic load. Since the frequency response analyzer can provide high frequency resolution of a specified frequency range, which differs from FFTs, and then detailed characteristics near the resonance point can be less because of higher phase accuracy, ±0.3. By combination with the power amplifier, high amplitude response can be measured, not only the small amplitude response.

Internal resistance of electric double-layer capacitors

Measure the internal resistance of an electric double layer capacitor placed intermediately between a capacitor and cell. The frequency response analyzer can perform measurements with a high resolution of up to 0.1kHz. It can also analyze Parkay impedance with Cole-Cole plots (complex impedance display). Moreover, since it is quite resistant to external disturbances, measurement while switching charging and discharging with a large current can be done.

Ripple rejection ratios of series regulators

Measure ripple rejection ratios for series regulators. The ripple rejection ratio characteristics are a major feature of a series regulator. Since the frequency response analyzer automatically removes a DC component of up to 100V, it can measure a high voltage output of the series regulator with a high dynamic range of up to 140dB in combination with a power amplifier (HSA series).

Highly accurate measurement meets the greater demands of customers.
**Peripheral Equipment**

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**Optional accessories**

- High withstand voltage clip set (3 per set) PA-001-0419
- High withstand voltage alligator clip cable set (small) (3 per set) PA-001-0420
- High withstand voltage alligator clip cable set (large) (3 per set) PA-001-0421
- Alligator clip cable set (3 per set) PA-001-0422
- High withstand voltage BNC adapter (T-branch) PC-001-4503
- High withstand voltage BNC cable PC-002-3347
- High withstand voltage extension BNC cable PC-007-0364
- Replacement printer paper (ten rolls) PC-007-0382
- Impedance measuring adapter kelvin clip cable (for replacement) PC-007-1490
- Loop gain measuring adapter clip cable (for replacement) PC-007-1922

**Related Production**

- **High Speed Bipolar Amplifier**
  - **BA series**
  - BA4850: DC to 2MHz 1000Vrms (300vp-p), 0.5Arms
  - Six models line up
  - Four-quadrant output

- **High Speed Bipolar Amplifier**
  - **HSA series**
  - HSA4012 (DC to 1MHz)
  - Six models line up
  - Four-quadrant output

- **Bipolar Power Supply**
  - **BP series**
  - BP4610: +60V, DC to 150kHz, CV/CC mode
  - BP4820: ±20A (60A-p-p)
  - Four-quadrant output

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**Printed in Japan; February 2009**

**http://www.nfcorp.co.jp/english/index.html**