



# NF PRODUCTS CATALOG

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**MEASUREMENT  
INSTRUMENTS**

**POWER  
SUPPLIES**

**FUNCTION  
DEVICE**

**CUSTOMIZED  
PRODUCTS**



# FUNCTION GENERATORS

## MULTIFUNCTION GENERATOR

WF1967/WF1968

An function generator equipped with features beyond high-performance and multi-functions **WAVE FACTORY**



1ch, 200 MHz  
WF1967



2ch, 200 MHz  
WF1968

- Frequency range: 0.01  $\mu$ Hz to 200 MHz max.
- Amplitude resolution: approx. 16 bit
- Output voltage: max. 20 V<sub>p-p</sub>/open, resolution: 0.1 mV<sub>p-p</sub>
- Low jitter < 85 ps<sub>rms</sub> ● Low distortion < 0.04%
- Output waveform: Sine, Square, Pulse, Ramp, Noise, DC, Arbitrary waveforms and pre-installed 25 types waveforms
- Arbitrary wave: 420 MS/s, 4 Mi\* words \*Mi: 2<sup>20</sup> = 1048576.
- Oscillation modes: Continuous, sweep, burst, sequence, internal/external modulation
- Functional sub-output works as a four-phase (WF1968) and a two-phase signal generator (WF1967).
- "Synclator" function, automatically synchronize with a signal input from an external source
- 2-channel operation (WF1968 only)

## SPECIFICATIONS

### Frequency and phase

Frequency range  
Sine: 0.01  $\mu$ Hz to 200 MHz, square: 0.01  $\mu$ Hz to 70 MHz, pulse: 0.01  $\mu$ Hz to 70 MHz, ramp: 0.01  $\mu$ Hz to 20 MHz, parameter-variable: 0.01  $\mu$ Hz to 20 MHz, noise: select from 100 M/30 M/10 M/3 M/1 M/300 k/100 kHz (equivalent bandwidth), DC: none, arbitrary: 0.01  $\mu$ Hz to 20 MHz  
Frequency setting resolution: 0.01  $\mu$ Hz (< 50 MHz), 0.1  $\mu$ Hz (50 MHz  $\leq$ )  
Frequency accuracy\*1:  $\pm$  (3 ppm of setting + 6 pHz)  
Phase setting range: -1800.000° to +1800.000° (resolution 0.001°)

### Output characteristics

Amplitude : 0 V<sub>p-p</sub> to 20 V<sub>p-p</sub>/open, 0 V<sub>p-p</sub> to 10 V<sub>p-p</sub>/50  $\Omega$ , resolution 4 digits or 0.1 mV<sub>p-p</sub>  
DC offset :  $\pm$ 10 V/open, resolution 4 digits or 0.1 mV<sub>p-p</sub>  
SYNC/SUB OUT:

Synchronization, sub-waveform (sine, square, ramp (symmetry), rising ramp, falling ramp, noise and arbitrary), internal modulation signal, sweep X drive

### Signal characteristics

Sine Amplitude characteristics\*1:  $\pm$ 0.1 dB (up to 100 kHz)  
Total harmonic distortion\*1: 0.04% or less (20 Hz to 20 kHz)  
Square Duty variable: 0.0000% to 100.0000%  
Pulse Pulse width: 0.0001% to 99.9999% (duty), 6.88 ns to 99.999 Ms (time)  
Ramp Range of symmetry: 0.00% to 100.00%  
Parameter-variable waveform (25)  
Steady sine group, Transient sine group, Pulse waveform group, Transient response group, Surge group, Other group  
Arbitrary waveform  
Waveform length: 4Ki\* to 1Mi words, resolution: 16 bit  
Sampling rate: 420 MS/s, number of waveforms: 128 \*Ki=2<sup>10</sup>

### Modulation

Types : FM, FSK, PM, PSK, AM, DC offset modulation and PWM  
Source : Internal/External modulation (selectable)

### Sweep

Types : frequency, phase, amplitude, DC offset and duty  
Mode : Continuous, Single-shot, Gated single-shot

### Burst/Gate/Trigger

Burst mode : Auto burst, trigger burst, gate and triggered gate  
Trigger : Independent for each channel, manual trigger

\*1: Guaranteed numeric value. Other numeric values are nominal or typical (typ.) values.

### Synclator Function

Frequency range : 20 Hz to 10 MHz  
Target : External trigger input terminal

### Sequences

Control parameters: Step time, hold operation, jump destination, jump count, step stop phase, branch operation, step termination control and step synchronization code output  
Number of waveforms: 128, sequences: 10, steps max.: 255  
Step time: 0.1 ms to 1,000 s (resolution 4 digits or 0.01 ms)

### 2-Channel Ganged Operation (WF1968 only)

Two channels independent, 2-phases (same frequency), constant frequency difference, constant frequency ratio, differential output (reverse phase), differential output 2 (Only DC offset is reversed)

### Other Functions

External frequency reference input/output, External addition input, Multi-I/O, Phase synchronization, Synchronization of multiple units, User defined unit, Setting memory, Control and setting at power-on operation

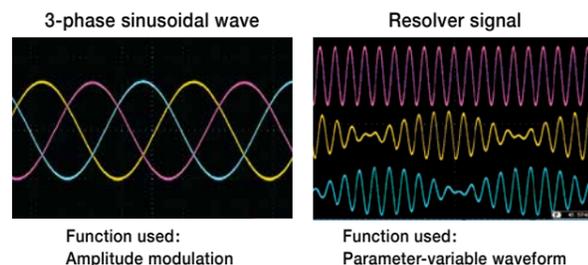
### General

Display : 4.3 inch TFT color LCD  
Interface: GPIB, USB, LAN (option)  
Power supply: AC100 V to 230 V  $\pm$ 10% (250 V or lower.) 50 Hz/60 Hz  $\pm$ 2 Hz  
Power consumption: WF1967: 65 VA or lower. WF1968: 85VA lower.  
Dimensions (mm) 216 (W) $\times$ 132.5 (H) $\times$ 332 (D) (not including protrusions)  
Weight: Approx. 3.0kg (main unit excluding accessories)

### Application software

Sequence editor: Sequence editing, display, transfer, device control  
Arbitrary waveform editor: Arbitrary waveform editing, display, transfer, device control

## WAVE SAMPLE



## MULTIFUNCTION GENERATOR

WF1947/WF1948/WF1973/WF1974

Effortless waveform generation through an intuitive graphical user interface

WAVE FACTORY

- Low noise ● Low Distortion ● 16 bit Resolution



1ch, 30 MHz  
WF1947



2ch, 30 MHz  
WF1948



1ch, 30 MHz  
WF1973



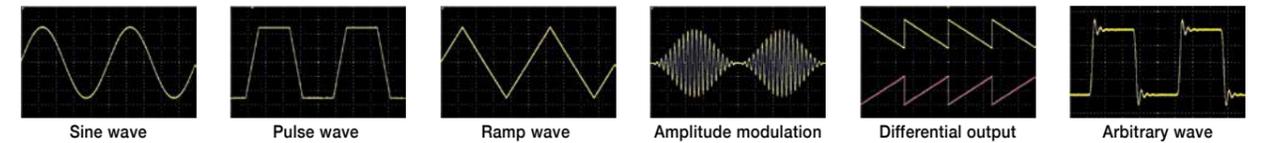
2ch, 30 MHz  
WF1974

- Frequency range: 0.01  $\mu$ Hz to 30 MHz
- Waveform amplitude resolution: WF1947/WF1948: 16 bit WF1973/WF1974: 14 bit
- Various types of output waveform: Sine, Square (duty variable), Pulse, Ramp wave, Noise, DC, Arbitrary waveforms
- Pre-installed 25 types waveforms (WF1973/WF1974)
- Sequence function (WF1973/WF1974)  
Output parameters sequentially such as waveform, frequency, amplitude, DC offset, phase and square wave duty.
- Various oscillation modes: Continuous, sweep, burst (auto burst, trigger burst, gate, triggered gate), internal and external modulation.

- Useful programmable functions

- 2-channel operation (WF1948/WF1974)  
· Independent · 2-phase · Constant frequency difference  
· Constant frequency ratio · Differential output
- Various functions  
External 10 MHz frequency reference input, Synchronous operation of multiple units, External additional input, User-defined units, setting memory
- Other features  
Input/output signal ground insulated, Power input: 90 V AC to 250 V AC, QVGA TFT color LCD, USB/GPIB
- Control software bundled

## SAMPLE WAVEFORMS

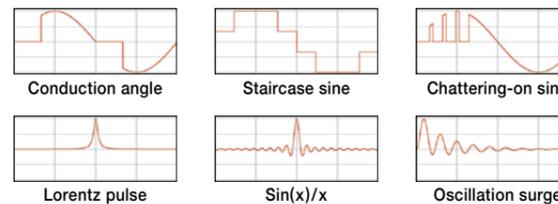


### Parameter Variable Waveforms (WF1973/WF1974)

The parameter-variable waveform offers an easy-order waveform system. The waveform based on your requests can be easily generated : just need to select a preprogrammed waveform and edit it using parameters specifically for your requirements. 25 types of waveforms including circuit-related, communication-related and machine-related waveforms are available.

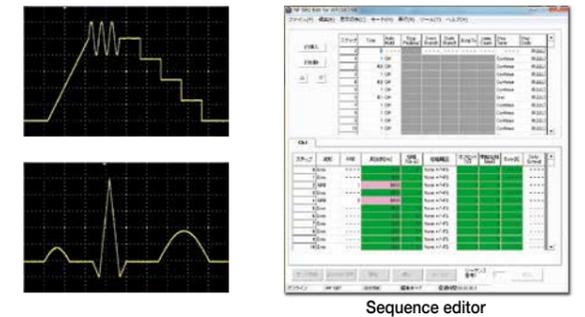
[Ex.]  
CF control sine  
Crest factor (1.41 to 10.00)

### [Examples]



### Sequence Function (WF1973/WF1974)

The sequence function programs and sequentially output parameters such as waveform, frequency and amplitude. Repetition, jump and other such behaviors can also be programmed.



Sequence editor

# IMPEDANCE MEASUREMENTS

## IMPEDANCE ANALYZER

ZA57630

From electronic parts and semi-conductor devices to material and substance characteristics assessments.



- Basic accuracy:  $\pm 0.08\%$
- Measurement frequency: 10  $\mu\text{Hz}$  to 36 MHz
- Measurement impedance range: 10  $\mu\Omega$  to 100 G $\Omega$  (Mode: IMPD-EXT)
- Measurement signal amplitude: 0.01 mVrms to 3 Vrms / 0.1  $\mu\text{Arms}$  to 60 mArms
- Measurement time: 0.5 ms/points
- Measurement parameters: Z, R, X, Y, G, B, Ls, Lp, Cs, Cp, Rs, Rp,  $\theta_z$ ,  $\theta_y$ , D, De, D $\mu$ , Q, V, I,  $\epsilon_s$ ,  $\epsilon_s'$ ,  $\epsilon_s''$ ,  $\mu_s$ ,  $\mu_s'$ ,  $\mu_s''$ , FREQUENCY
- Four measurement modes
  - IMPD-3T (default measurement mode)
  - IMPD-2T (high-frequency measurement mode)
  - IMPD-EXT (expanded measurement mode)
    - Allows external amplifiers, shunt resistors or other devices to be connected.
  - G-PH (gain/phase measurement mode)

## SPECIFICATIONS

### Measurement mode

Mode	IMPD-3T (default measurement mode)	IMPD-2T (high-frequency measurement mode)
Basic accuracy	$\pm 0.08\%$	$\pm 0.32\%$
Measurement frequency	10 $\mu\text{Hz}$ to 10 MHz	10 MHz to 36 MHz
Measurement signal amplitude	Voltage: 0 to 3.00 Vrms, current: 0 to 60 mArms Setting resolution: 3 digits or 10 $\mu\text{Vrms}$ (voltage), 100 nArms (current), whichever is the largest	
DC bias	Voltage: -5.00 V to +5.00 V, current: -100 mA to +100 mA	
HV DC bias	Voltage: -40.00 V to +40.00 V (1 kHz or higher, no load)	
Range ( $\Omega$ )	10, 100, 1k, 10k, 100k, 1M, AUTO	1, 10, 100, 1k, AUTO
Measurement parameters	Z, R, X, Y, G, B, Ls, Lp, Cs, Cp, Rs, Rp, $\theta_z$ , $\theta_y$ , D, De, D $\mu$ , Q, V, I, $\epsilon_s$ , $\epsilon_s'$ , $\epsilon_s''$ , $\mu_s$ , $\mu_s'$ , $\mu_s''$ , FREQUENCY	

Mode	IMPD-EXT (expanded measurement mode)	G-PH (gain/phase measurement mode)
Basic Accuracy	$\pm 0.12\%$	Gain: $\pm 0.01\text{dB}$ , Phase: $\pm 0.06^\circ$
Measurement frequency	10 $\mu\text{Hz}$ to 36 MHz	
OSC	AC signal amplitude setting range (0 to 3.0) $\times$  K  Vrms (K: DUT drive amplifier gain setting) DC bias setting range -5.00 $\times$ K V to +5.00 $\times$ K V (K: DUT drive amplifier gain setting)	
PORT1/ PORT2	Range (Vrms) 10m, 20m, 50m, 100m, 200m, 500m, 1, 2, 5, 7, AUTO Over detection 0 to 7 Vrms	
Measurement parameters	Z, R, X, Y, G, B, Ls, Lp, Cs, Cp, Rs, Rp, $\theta_z$ , $\theta_y$ , D, De, D $\mu$ , Qc, Ql, V1, V2, $\epsilon_s$ , $\epsilon_s'$ , $\epsilon_s''$ , $\mu_s$ , $\mu_s'$ , $\mu_s''$ , FREQUENCY	Gain: dBR (gain dB), R (absolute gain), a (real part of gain), b (imaginary part of gain), $\theta$ , GD (group delay), V1, V2,

### Measured signal control section (Sweep)

Item	Frequency, measurement signal amplitude, DC bias, and time (zero span)
Control	SWEEP UP: Sweeps in the direction of lower limit to upper limit. SWEEP DOWN: Sweeps in the direction of upper limit to lower limit. SPOT: Measures with fixed frequency REPEAT: Repeats SWEEP or SPOT
Density	3 to 2,000 steps/sweep
Time	Frequency: from 0.5 ms/point, Signal amplitude: from 2 ms/point

### Measurement Processing Section

Resonant frequency tracking function	Automatically keeps the measurement frequency tracked to the resonance frequency of the DUT.
Equivalent circuit estimation function*1	Estimate each constant of the equivalent circuits from the frequency sweep measured results.
Piezoelectric constant calculation function*1	Calculates the piezoelectric related constants from the frequency sweep measurement results.
Sequence measurement function	Measurements according to the contents of setting memory (condition file).
Comparator	SPOT : measurement results Max. 14 bins SWEEP: measurement results upper limit and lower limit comparison
Error correction function	Open correction*1, Short correction*1, Load correction*1, Port extension*1, Equalizing*2, Self-calibration*3 and so on.

\*1: excluding G-PH mode \*2: G-PH mode only \*3: IMPD-EXT, G-PH mode only

### Other functions

Display unit	8.4-inch color TFT-LCD (SVGA) with touch panel
Graphs	Bode plot, Nyquist plot, Cole-Cole plot
Graph traces	9 traces of measurement data (MEAS) and reference data
Marker display	Markers are displayed on a graph, and the data at a marker position is displayed as a numerical value.
Memory	Conditions: 32 sets (per measurement mode) Sweep measurement data up to 32 sets can be saved REF data (up to 8 sets) that can be displayed on a graph together with measurement data (MEAS).
External memory	Connector: Front panel, USB-A connector Saved items: Setting conditions, measurement data (MEAS) and reference data (REF 1 to 8) File format: CSV and BMP
Interface	GPIB, USB, LAN, RS-232, External monitor (Analog VGA), (Reference clock input/output, Handler interface)

### Generals

Power input	AC 100 V to 230 V $\pm 10\%$ , however 250 V or less
Power consumption	Max. 100 VA
External dimensions	430 (W) $\times$ 177 (H) $\times$ 350 (D) mm (excluding protruding)
Weight	Approx. 7.0 kg

## LCR METER

ZM2371/ZM2372/ZM2376

### High-speed, high-precision, stable measurement



- Basic accuracy:  $\pm 0.08\%$ , display resolution of 6 digits (max.)
- Measurement speed: max. 2 ms at 1 kHz/1 MHz
- Frequency range: 1 mHz to 100 kHz, 5-digit resolution (ZM2371/ZM2372) 1 mHz to 5.5 MHz, 6-digit resolution (ZM2376)
- Measurement signal level: max. 5 Vrms, 3-digit resolution
- Measurements parameters: Lp, Ls, Cp, Cs, Rp, Rs, |Z|, |Y|, G, Q, D,  $\theta$ , X, B, Rdc
- DC resistance measurement
- 4-terminal contact check function (ZM2372)
- Contact check and low capacitance check (ZM2376)

## SPECIFICATIONS

Frequency range	1 mHz to 100 kHz (5-digit resolution, ZM2371/ZM2372) 1 mHz to 5.5 MHz (6-digit resolution, ZM2376)	Deviation display	Display deviation and deviation % from a preset reference value
Measurement parameters	Primary parameters: Lp, Ls, Cp, Cs, Rp, Rs,  Z ,  Y  and G (Automatically selectable) Secondary parameters: Q, D, $\theta$ , X, B, Rp, Rs, G, Lp and Rdc	Comparator	Primary parameters: 9 bins max. (ZM2371) 14 bins max. (ZM2372/ZM2376) Original measured value / deviation / deviation % can be sorted. Secondary parameter: Upper limit and lower limit comparison Original measured value / deviation / deviation % can be sorted.
Basic accuracy	0.08%	Handler interface (ZM2372/ZM2376)	Signal isolation Input signals: trigger, key lock, setting / correction value memory designation Output signals: comparator results (BIN1 to BIN14)
Measurement signal levels	10 mVrms to 5.00 Vrms (3-digit resolution) 1 $\mu\text{Arms}$ to 200 mArms (3-digit resolution)	Interface	USB, RS-232, GPIB (ZM2372/ZM2376) LAN (Option for ZM2376)
Internal DC bias	0 V to +2.5 V (ZM2371/ZM2372) 0 V to +5 V (ZM2376)	Power	AC100 V to 230V $\pm 10\%$ , 250 V max.
Trigger		Dimensions (mm)	260 (W) $\times$ 88 (H) $\times$ 220 (D) (ZM2371/ZM2372) 260 (W) $\times$ 88 (H) $\times$ 280 (D) (ZM2376)
Signal	INT (automatic continuous trigger), MAN (manual), EXT (handler interface), BUS (remote control)	Weight	ZM2371: approx. 2.0 kg, ZM2372: approx. 2.1 kg, ZM2376: approx. 2.4 kg
Delay time	0.000 s to 999.999 s		
Triggered drive	Drive only at measurement/continuous drive selectable		
Measurement speed	RAP (rapid)/FAST/MED (medium)/SLOW/VLSO (very slow) Switchable between 5 levels from 2 ms to 501 ms		

## TEST FIXTURES & TEST LEADS for LCR METERS

An assortment of test fixtures and test leads are available as jigs and tools for measuring components and materials with the LCR meter. Select the type that suits the target components.

### 2324 Four-terminal alligator-clip test leads

Use these test leads with low-impedance four-terminal components, including those which have separate current supply terminals and voltage test terminals.



### ZM2391

#### Three-terminal alligator-clip test leads

A three-terminal type is also available for simple measurements.



### 2325A (L/M) Kelvin-clip test leads

The two test lead clips enable four-terminal connections. The 2325A can be used to test large or unusually shaped components that cannot be easily inserted into the direct test fixture. Select between two types: the standard L type or the M type with smaller clips.



### ZM2392 Kelvin-clip test leads

The ZM2392 provides test leads for simpler measurements.



### ZM2363 Test fixture

This test fixture is for measuring directly connected lead-ended components. The ZM2363 enables bend free measurement of both parallel-lead type and opposing-lead type components.



### ZM2393/ZM2394/ZM2394H Chip test fixture

This test fixture for SMD and chip elements is directly connected to the panel surface for measuring. Its small floating capacitance makes for easier zero-point correction.



### ZM2366/2326A Test lead for chip components

Features tweezer-type test leads for easy measurement of surface-mounted chip components, etc. The tip's measurement contact is removable.



### ZM2328/ZM2329 DC voltage bias adapter



# FREQUENCY RESPONSE ANALYZERS

## FREQUENCY RESPONSE ANALYZER

FRA51615



FRA51615 is a best fit for measuring frequency response for many industries from electronic circuits, electronic components, and materials for mechatronics and electrochemical applications. Equipped with high performance and high functionalities to support different industries, FRA51615 provides high reproducible measurement data and more efficient testing operations.

- Frequency range: 10  $\mu$ Hz to 15 MHz
- Measurement speed: 0.5 ms/point
- Basic accuracy: gain:  $\pm 0.01$  dB, phase:  $\pm 0.06^\circ$
- Maximum measurement voltage: 600 Vrms
- Maximum input voltage: 600 V CAT II/300 V CAT III
- Isolation: 600 V CAT II/300 V CAT III
- Dynamic range: 140 dB
- Functions to ensure reliable and highly accurate measurements
- Impedance measurement: Z/R/X/Y/L/C/R/V/I/D/Q

### APPLICATIONS

- Measurements of resonance characteristics of piezo element
- Measurements of characteristics of multi-layer ceramic capacitor to which voltage is applied
- Loop gain measurements of DC-DC converters
- Measurements of transmission efficiency on wireless charging
- Measurements of mechanical servo characteristics

### SPECIFICATIONS

#### Oscillator

Waveform	Sinusoidal, square, or triangular
Frequency range	10 $\mu$ Hz to 15 MHz, Res: 10 $\mu$ Hz
AC amplitude	0 to 10 Vpk
DC bias	-10 V to 10 V, Res: 10 mV
Output impedance	50 $\Omega$
Output control	QUICK, SLOW, Function for turning off at 0° phase, Function for changing the frequency at 0°phase
Sweep	Sweep density 3 to 20,000 steps/sweep, linear/log
Isolation	600 V CAT II or 300 V CAT III

#### Inputs

Input channels	2
Input impedance	1 M $\Omega$
Measurement range	30 mV to 600 V (rms), and AUTO. CH1 and CH2 can be set independently.
Isolation	600 V CAT II or 300 V CAT III
Frequency range	10 $\mu$ Hz to 15 MHz
Maximum measurement voltage	600 Vrms
Over-level detection	0 to 600 Vrms
Dynamic range	140 dB (10 Hz to 1 MHz), 80 dB (1 MHz to 15 MHz)

#### Measuring process

Measurement operations	UP SWEEP, DOWN SWEEP, SPOT, REPEAT, SINGLE
Functions	Measurement delay function, Start delay function, Integration function, Automatic integration function, Amplitude compression, Automatic high density sweep (slow sweep), and Sequence measurement function

#### Analyzing process

Display unit	Gain (ratio, unitless number) or impedance
Basic accuracy	(Fixed range) Gain: $\pm 0.01$ dB, Impedance: $\pm 0.12\%$ , Phase: $\pm 0.06^\circ$ (30 mV to 30 V range, 200 kHz or less) (Auto range) Gain: $\pm 0.02$ dB, Impedance: $\pm 0.24\%$ , Phase: $\pm 0.12^\circ$ (200 kHz or less)

#### Gain measurement

Analysis modes	Ratio CH1/CH2, CH2/CH1 Amplitude CH1, CH2
Graph types	Bode plot, Nyquist plot, Nichols plot
Measurement parameters	dBR (Gain dB), $\theta$ (phase), GD (group delay), R (absolute gain), a (real part of gain), b (imaginary part of gain)
Error correction	Equalizing

#### Impedance measurement

(Voltage is measured at CH1 and current is measured at CH2.)	
Analysis modes	Impedance CH1/CH2, Admittance CH2/CH1, Voltage CH1, Current CH2
Graph types	Bode plot, Nyquist plot, Cole-Cole plot
Measurement parameters	Z, R, X, Y, G, B, Ls, Lp, Cs, Cp, Rs, Rp, V(Voltage), I (current), $\theta$ (phase), D (dissipation factor), Q (quality factor)
Error correction	Open / Short / Load correction, Port extension, Slope compensation

#### General

Memory	Measurement data, Reference data, Error correction data
External memory	USB memory device
Display unit	8.4-inch color TFT-LCD (SVGA) with touch screen
Interface	GPIB/USB/LAN/RS-232/VGA
Reference clock	Input/output (10 MHz)
Power	Voltage AC100 V to 230 V, 250 V or less, 50 Hz/60 Hz
Dimensions	430 mm (W) $\times$ 177 mm (H) $\times$ 350 mm (D)
Weight	approx. 8.5 kg

## GAIN-PHASE ANALYZER

FRA51602



FRA51602 measures the loop gain frequency characteristics, such as inverters and switching power supplies by using frequency sweep. The two analysis inputs and oscillator outputs are independently isolated from the instrument enclosure (600 V CAT II/300 V CAT III).

- Frequency range: 10  $\mu$ Hz to 2 MHz
- Measurement speed: 0.5 ms/point
- Basic accuracy: gain:  $\pm 0.01$  dB, phase:  $\pm 0.06^\circ$
- Maximum measurement voltage: 600 Vrms
- Maximum input voltage: 600 V CAT II/300 V CAT III
- Isolation: 600 V CAT II/300 V CAT III
- Dynamic range: 140 dB
- Auto ranging, automatic high density sweep, delay function, group delay, amplitude compression function and so on.

### APPLICATIONS

- Characteristic measurements of inverters and switching power supplies
- Measurements of transmission efficiency on wireless charging
- Measurements of mechanical servo characteristic

### SPECIFICATIONS

#### Oscillator

Waveform	Sinusoidal, square, or triangular
Frequency range	10 $\mu$ Hz to 2 MHz, Res: 10 $\mu$ Hz
AC amplitude	0 to 10 Vpk
Output impedance	50 $\Omega$
Sweep	Sweep density 3 to 20,000 steps/sweep, linear/log
Isolation	600 V CAT II or 300 V CAT III

#### Inputs

Input channels	2
Input impedance	1 M $\Omega$
Measurement range	30 mV to 600 V (rms), and AUTO. CH1 and CH2 can be set independently.
Maximum input voltage	600 V CAT II or 300 V CAT III
Isolation	600 V CAT II or 300 V CAT III
Dynamic range	140 dB (10 Hz to 1 MHz), 80 dB (1 MHz to 15 MHz)

#### Measuring process

Measurement operations	UP SWEEP, DOWN SWEEP, SPOT, REPEAT, SINGLE
Functions	Measurement delay function, Start delay function, Integration function, Automatic integration function, Amplitude compression, Automatic high density sweep (slow sweep), and Sequence measurement function

#### Analyzing process

Basic accuracy (fixed range)	Gain: $\pm 0.01$ dB, Phase: $\pm 0.06^\circ$ (30 mV to 30 V range, 200 kHz or less)
(auto range)	Gain: $\pm 0.02$ dB, Phase: $\pm 0.12^\circ$ (200 kHz or less)
Analysis modes	Ratio CH1/CH2, CH2/CH1 Amplitude CH1, and CH2
Graph types	Bode plot, Nyquist plot, Nichols plot
Measurement parameters	dBR (Gain dB), $\theta$ (phase), GD (group delay), R (absolute gain), a (real part of gain), b (imaginary part of gain)
Error correction	Equalizing

#### General

Display unit	8.4-inch color TFT-LCD (SVGA) with touch screen
Data memory	Measurement data, Reference data, Error correction data
External memory	USB memory device
Interface	GPIB/USB/LAN/RS-232/VGA
Reference clock	Input/output (10 MHz)
Power	AC100 V to 230 V, 250 V or less, 50 Hz/60 Hz
Dimensions	430 mm (W) $\times$ 177 mm (H) $\times$ 350 mm (D)
Weight	approx. 8.5 kg

## FREQUENCY RESPONSE ANALYZER

FRA5022



- Accuracy: gain:  $\pm 0.05$  dB, phase:  $\pm 0.3^\circ$
- Frequency range: 0.1 mHz to 100 kHz
- Dynamic range: 120 dB
- Isolation: 42 Vpk/30 Vrms
- Shortened measurement time for ultra-low frequencies
- Slim chassis (2U) optimal for a rack system
- Color display
- ◆ 4-ch model FRA5014 available

### FRA OPTIONS & PERIPHERALS



PA-001-1840/PA-001-1841



PA-001-0368

- Signal injector probe 5055
- Impedance measuring adapter PA-001-0368
- Loop gain measuring adapter PA-001-0369
- High power measurement adapter PA-001-1840 (1  $\Omega$ )/PA-001-1841 (100  $\Omega$ )
- Test fixture adapter PA-001-1838 (1  $\Omega$ )/PA-001-1839 (100  $\Omega$ )
- Shunt resistor PA-001-0370

# LOCK-IN AMPLIFIERS/PREAMPLIFIERS

## DIGITAL LOCK-IN AMPLIFIER

## LI5660/LI5655/LI5650/LI5645

### High-response, wide-band, high-stability



LI5660

**0.5 Hz to 11 MHz**  
2 phases 2 Frequencies  
HF Input 10V Input



LI5655

**0.5 Hz to 3 MHz**  
2 phases 2 Frequencies



LI5650

**1 mHz to 250 kHz**  
2 phases 2 Frequencies



LI5645

**1 mHz to 250 kHz**  
2 phases 1 Frequencies



### APPLICATIONS

- Scanning probe microscope
- Ultrasonograph
- Light transmission
- Hall coefficient measurements
- Ceramic sensors
- Spintronics
- Terahertz spectroscopy
- Light absorption
- Gyroscope
- Semiconductor lasers

### SPECIFICATIONS

	LI5660	LI5655	LI5650	LI5645
Frequency Range	0.5 Hz to 11 MHz	0.5 Hz to 3 MHz	1 mHz to 250 kHz	
Signal Input	Voltage (A, A-B, C, HF), Current (I)	Voltage (A, A-B), Current (I)		Voltage (A, A-B)
10 Vrms input	○(C input, 0.5 Hz to 3 MHz)	—	—	—
HF input	○(HF input, 10 kHz to 11 MHz)	—	—	—
Sensitivity	A, A-B: 10 nV to 1 V F.S. (0.5 Hz to 3 MHz) C : 1 mV to 10 V F.S. (0.5 Hz to 3 MHz) HF : 1 mV to 1 V F.S. (10 kHz to 11 MHz) I : 10 fA to 1 μA F.S.	A, A-B: 10 nV to 1 V F.S. (0.5 Hz to 3 MHz) I : 10 fA to 1 μA F.S.	A, A-B: 10 nV to 1 V F.S. (1 mHz to 250 kHz) I : 10 fA to 1 μA F.S.	A, A-B: 10 nV to 1 V F.S. (1 mHz to 250 kHz)
Voltage accuracy	A, A-B: ±0.5% (1 kHz, signal level ≥ 1 mV) C : ±0.5% (≤ 20 kHz) HF : ±3% (≤ 1 MHz)	A, A-B: ±0.5% (1 kHz, signal level ≥ 1 mV)		
Current accuracy	±1% (nominal value)			—
Input Referred Noise Voltage	4.5 nV/√Hz (supplement value)			
PSD	2-phase, 2 frequencies			2-phase, 1 frequency
Dynamic Reserve	100 dB			
Time Constant	1 μs to 50 ks		5 μs to 50 ks	
Reference signal	External	0.3 mHz to 3.2 MHz		0.5 mHz to 260 kHz
	Internal	0.3 mHz to 3.2 MHz		0.5 mHz to 260 kHz
Analog Output Max. Update Rate	Approx. 1.5 M samples/s		Approx. 780 k samples/s	
Fractional Harmonic Measurement	(1 to 63)/(1 to 63) of fundamental wave			
Dual Frequency Simultaneous Measurements	○	○	○	—
External 10 MHz Synchronous Input	○	○	○	○
Measurement Parameter	X, Y, R, θ, DC, NOISE			
Automatic setting	Measurement, Time constant, Sensitivity, Phase, Offset			
Remote Control Interface	USB, GPIB, RS-232, LAN			
Display	4.3-inch WQVGA, color LCD			
Power supply	AC 100 V/120 V/230 V			
Dimensions (mm)	430 (W) × 88 (H) × 400 (D)			
Weight	Approx. 7.5 kg			

○ : Equipped — : Not equipped

- Frequency range  
LI5660: 0.5 Hz to 11 MHz\* \* HF input used  
LI5655: 0.5 Hz to 3 MHz, LI5650/LI5645: 1 mHz to 250 kHz
- Voltage measurement  
LI5660: 10 nV to 10 V\* F.S. \* C input used  
LI5655/LI5650/LI5645: 10 nV to 1 V F.S.
- Current measurement  
LI5660/LI5655/LI5650: 10 fA to 1 μA F.S.
- Minimum time constant  
LI5660/LI5655: 1 μs, LI5650/LI5645: 5 μs
- Analog output update rate  
LI5660/LI5655: approx. 1.5 M samples/s  
LI5650/LI5645: approx. 700 k samples/s
- Simultaneous 2-frequency measurements (LI5660/LI5655/LI5650)  
Dual 2-phase sensitive detectors for simultaneous measuring for two frequency components
- Fractional harmonic measurements  
Measurements at fractional times frequencies of the fundamental wave (1 to 63)/(1 to 63)
- External reference 10 MHz synchronous input  
Can be synchronized with the reference frequency of other devices by using an external reference frequency
- Measurement parameters X, Y, R, θ, DC, NOISE
- Thin 2U size (88 mm)

### LIGHT CHOPPER 5584A (optional)

Frequency range: 4 Hz to 400 Hz/40 Hz to 4 kHz  
Aperture: 29 mm×10 mm (4 Hz to 400 Hz)/5 mm×10 mm (40 Hz to 4 kHz)

## LOW NOISE AMPLIFIER

## SA-200/SA-400 SERIES

Extremely, low noise measurements with high accuracy for very small signals



SA-251F6



SA-440F5

SA-200/SA-400 series pre-amplifiers are used for detecting sub micro-Volt signals, and can achieve a ultra low noise level. Eleven models are available for meeting various requirements, such as frequency range, input type, and input impedance. SA-200/SA-400 series pre-amplifiers are best for various types of sensors.

\*CE certified: SA-240F5, SA-250F6, SA-251F6, SA-410F3, SA-440F5

### APPLICATIONS

- Electromagnetic sensor for NMR/MRI systems
- High speed temperature sensor
- High precision strain gauge sensor
- Superconducting SQUID sensor for micro-magnetic detection
- High-temperature superconducting Josephson device for microwave detection
- Superconducting device in quantum computers

### SPECIFICATIONS

Single-end	SA-200F3	SA-220F5	SA-240F5	SA-230F5	SA-250F6	SA-251F6
Bandwidth	DC to 800 kHz	1 kHz to 80 MHz	DC to 20 MHz	1 kHz to 100 MHz	100 Hz to 250 MHz	1 kHz to 500 MHz
Input type	DC coupling	AC coupling	DC coupling	AC coupling	AC coupling	AC coupling
Input impedance	1 k/10 k/100 kΩ ±5% //150 pF or less typ.	1 MΩ ±5% //57 pF typ.	1 MΩ/100 MΩ/open //60 pF typ.	50 Ω ±5%	50 Ω	50 Ω
Equivalent input noise voltage density (Input terminal short circuit)	0.7 nV/√Hz or less (1 kHz) 0.5 nV/√Hz typ. (1 kHz)	0.7 nV/√Hz or less (100 kHz) 0.5 nV/√Hz typ. (10 kHz to 1 MHz)	1.2 nV/√Hz (1 kHz)	0.35 nV/√Hz or less (100 kHz) 0.25 nV/√Hz typ. (10 kHz to 1 MHz)	0.25 nV/√Hz or less (1 MHz)	0.25 nV/√Hz or less (1 MHz)
Equivalent input noise current density	2.2 pA/√Hz typ. (10 kHz)	200 fA/√Hz typ. (100 kHz)	5 fA/√Hz typ. (10 Hz)	5.0 pA/√Hz typ. (100 kHz)	5 pA/√Hz typ. (1 MHz)	8 pA/√Hz typ. (1 MHz)
Noise figure (50 Ω system)	—	—	—	0.6 dB typ. (10 MHz) 0.8 dB typ. (100 MHz)	0.6 dB (10 MHz) 1.0 dB (250 MHz)	0.9 dB (10 MHz) 1.2 dB (250 MHz) 1.8 dB (500 MHz)
Maximum output voltage	±10 V, 1 kΩ	2.0 Vp-p, 50 Ω	±10 V, 1 kΩ	1.8 Vp-p, 50 Ω	2.0 Vp-p	2.0 Vp-p
Output impedance	50 Ω ±5%	50 Ω ±5%	50 Ω	50 Ω ±5%	50 Ω	50 Ω
Voltage gain	40±0.5 dB, 1 MΩ (1 kHz)	46±0.5 dB, 50 Ω (1 MHz)	40 dB ±0.1 dB or less (1 kHz)	46±0.5 dB, 50 Ω (20 MHz)	40±0.5 dB (1 MHz)	40±0.5 dB (1 MHz)
Total harmonic distortion	0.009% typ.	—	0.004% typ.	—	—	—
Power Supply	Through feed-through capacitor	Through feed-through capacitor	HR10-7R-4P (73) connector	Through feed-through capacitor	HR10-7R-4P (73) connector	HR10-7R-4P (73) connector
Operating supply voltage range	±15 V ±5%	±15 V ±5%	±15 V ±1 V	+15 V ±5%	+15 V ±1 V	+15 V ±1 V
Dimensions (W×D×H)	68 × 43 × 17.6 mm	68 × 43 × 28 mm	76 × 50 × 25 mm	68 × 43 × 17.6 mm	76 × 50 × 25 mm	76 × 50 × 25 mm
Weight (approx.)	90 g	130 g	105 g	90 g	140 g	140 g

### Differential

	SA-410F3	SA-420F5	SA-421F5	SA-440F5	SA-430F5
Bandwidth	DC to 1 MHz	1 kHz to 70 MHz	30 Hz to 30 MHz	DC to 20 MHz	1 kHz to 100 MHz
Input type	DC coupling	AC coupling	AC coupling	DC coupling	AC coupling
Input impedance	1 k/10 k/100 kΩ ±5% or less //100 pF typ.	1 MΩ ±5% //15 pF typ.	1 MΩ ±5% //85 pF typ.	1 MΩ/100 MΩ/open //60 pF typ.	50 Ω ±5%
CMRR (Equivalent input)	110 dB or more (55 Hz) 80 dB typ. (100 kHz)	55 dB or more (1 kHz to 10 MHz)	46 dB or more (1 kHz to 10 MHz)	90 dB or more (10 Hz to 10 kHz) 60 dB (1 MHz)	80 dB or more (100 kHz), 90 dB typ. (100 kHz) 80 dB typ. (10 MHz)
Equivalent input noise voltage density (Input terminal short circuit)	0.75 nV/√Hz typ. (1 kHz)	1.2 nV/√Hz or less (100 kHz) 0.9 nV/√Hz typ. (100 kHz to 10 MHz)	0.7 nV/√Hz or less (100 kHz) 0.5 nV/√Hz typ. (100 kHz to 10 MHz)	1.8 nV/√Hz (1 kHz)	0.45 nV/√Hz or less (100 kHz) 0.35 nV/√Hz typ. (10 kHz to 1 MHz)
Equivalent input noise current density	4.5 pA/√Hz typ. (10 kHz)	100 fA/√Hz typ. (1 kHz)	100 fA/√Hz typ. (100 Hz)	25 fA/√Hz typ. (100 Hz)	7.0 pA/√Hz typ. (100 Hz)
Noise figure (50 Ω system)	—	—	—	—	1.25 dB or less, 1.10 dB typ. (10 MHz) 1.75 dB or less, 1.40 dB typ. (100 MHz)
Maximum output voltage	±10 V, 1 kΩ	2.0 Vp-p, 50 Ω	2.0 Vp-p, 50 Ω	±10 V, 1 kΩ	2.0 Vp-p, 50 Ω
Output impedance	50 Ω ±5%	50 Ω ±5%	50 Ω ±5%	50 Ω	50 Ω ±5%
Voltage gain	40±0.2 dB, 1 MΩ (1 kHz)	46±0.5 dB, 50 Ω (1 MHz)	46±0.5 dB, 50 Ω (1 MHz)	40 dB ±0.1 dB (1 kHz)	46±0.5 dB, 50 Ω (100 kHz)
Total harmonic distortion	0.004% typ.	—	—	0.006% typ.	—
Power Supply	HR10-7R-4P (73) connector	Through feed-through capacitor	Through feed-through capacitor	HR10-7R-4P (73) connector	Through feed-through capacitor
Operating supply voltage range	±15 V ±1 V	±15 V ±5%	±15 V ±5%	±15 V ±1 V	±15 V ±5%
Dimensions (W×D×H)	76 × 50 × 21.1 mm	68 × 43 × 28 mm	68 × 43 × 28 mm	76 × 50 × 25 mm	68 × 43 × 28 mm
Weight (approx.)	105 g	100 g	100 g	120 g	130 g

## WIDEBAND CURRENT AMPLIFIER

## SA-600 SERIES

High gain and wide bandwidth



\*All model CE certified

SA-600 series are used for detecting small signals to achieve high gain and wide bandwidth.

### APPLICATIONS

- Photomultiplier tube, photodiode and other photodetectors
- Monitor of particle accelerator beam
- Scanning tunneling microscope ● Ion detector

### SPECIFICATIONS

	SA-604F2	SA-605F2	SA-606F2	SA-607F2	SA-608F2	New SA-609F2
	DC to 500 kHz, 10 M (V/A)	DC to 250 kHz, 100 M (V/A)	DC to 100 kHz, 1 G (V/A)	DC to 20 kHz, 10 G (V/A)	DC to 2 kHz, 100 G (V/A)	DC to 300 Hz, 1 T (V/A)
Maximum input current	±1 μA	±100 nA	±10 nA	±1 nA	±100 pA	±10 pA
Equivalent input current noise density (typ.)	45 fA/√Hz	15 fA/√Hz	6 fA/√Hz	2.5 fA/√Hz	0.6 fA/√Hz	0.4 fA/√Hz
Gain	1×10 <sup>7</sup> (10 M) V/A ±1%	1×10 <sup>8</sup> (100 M) V/A ±1%	1×10 <sup>9</sup> (1 G) V/A ±1%	1×10 <sup>10</sup> (10 G) V/A ±1%	1×10 <sup>11</sup> (100 G) ±3%	1×10 <sup>12</sup> (1 T) ±1%
LPF output (Cut-off frequency setting)	30 kHz/100 kHz/ 300 kHz/ THRU, selectable	10 kHz/30 kHz/ 100 kHz/ THRU, selectable	3 kHz/10 kHz/ 30 kHz/ THRU, selectable	1 kHz/3 kHz/ 10 kHz/ THRU, selectable	100 Hz/300 Hz/ 1 kHz/ THRU, selectable	30 Hz/3 Hz/0.3 Hz/ THRU, selectable
Operating power supply voltage	±15 V ±1 V					
External dimensions /Weight	76 (W) × 50 (D) × 21.1 (H) mm / approx. 135 g					100 (W) × 50 (D) × 25 (H) mm / approx. 140 g

## PROGRAMMABLE CURRENT AMPLIFIER

## CA5351

High sensitive detection of signals from current output sensor such as PD, APD and PMT.



- High gain: 10<sup>3</sup> V/A to 10<sup>10</sup> V/A (8ranges, 10-times step)
- Wide bandwidth: DC to 500kHz (10<sup>9</sup> V/A), DC to 70kHz (10<sup>9</sup> V/A)
- Low noise: 2.5 fA/√Hz (10<sup>10</sup> V/A, 55Hz)
- Fast response: 0.7 μs (10<sup>9</sup> V/A)
- Current suppression: ±8nA to ±8mA (7ranges)
- LAN, USB, GPIB

### APPLICATIONS

- Synchrotron Radiation Facilities: Detection of small current signals generated from ion chamber
- Biochemistry: Measurement of particles suspended in electrolyte by the Coulter method
- Automotive: Light distribution measurement of PWM lighting LED headlight: Amplification of small photo current of photoconductive cells
- Beam position monitoring for synchrotrons and storage rings
- I-V characteristics measurement for organic thin film devices

The CA5351 programmable current amplifier is a variable gain type, current-input, voltage-output amplifier. Various applications from beam position monitoring in synchrotron radiation to quantum electronics, semiconductor, MEMES and Biochemistry research.

## PROGRAMMABLE CURRENT AMPLIFIER

## CA5350

Supports a variety of small current measurements using various optical sensors



- High gain: 10<sup>4</sup> V/A to 10<sup>10</sup> V/A (7ranges), 10<sup>11</sup> V/A max.
- Wide bandwidth: DC to 500kHz (10<sup>9</sup> V/A), DC to 70kHz (10<sup>9</sup> V/A)
- Low noise: 2.5 fA/√Hz (10<sup>10</sup> V/A, 55Hz)
- Fast response: 0.7 μs (10<sup>9</sup> V/A)
- Current suppression: ±8 nA to 800 μA (6ranges)
- USB, GPIB

### APPLICATIONS

- Beam position monitoring for storage rings and synchrotrons
- I-V characteristic measurement of organic thin film device
- Gate leakage current measurement of devices such as FET and IGBT
- Detection of tunneling current of scanning tunneling microscopes (STM)
- Detection of conductive probe current for AFM measurement

The CA5350 programmable current amplifier is a variable gain type, current-input, voltage-output amplifier. With its unique circuitry, high gain and broad bandwidth, as well as stable operation with additional input capacitance.

## LOW NOISE PREAMPLIFIER

## LI-75A



- Input type: Single-Ended/Differential
- Input impedance: 100 MΩ/50 pF
- CMRR: 120 dB (DC to 100 Hz)
- Input referred noise: 2 nV/√Hz (1 kHz)
- Voltage gain: 40 dB
- Frequency response: DC to 1 MHz (DC), 0.2 Hz to 1 MHz (AC)
- Power: Provided by PS-70A (dedicated DC power supply)
- Dimensions (mm): 120 (W)×55 (H)×200 (D)
- Weight: approx. 1.15 kg

## DIFFERENTIAL AMPLIFIER

## 5307



- Frequency response: DC to 10 MHz
- High gain: ×10 to ×1000
- Differential input (single-ended input selectable)
- High CMRR: 120 dB or higher
- Low noise: 4 nV/√Hz typ. (1 kHz)
- Input impedance: 1 MΩ or 100 MΩ selectable

## ISOLATION AMPLIFIER

## 5325



- High withstanding voltage: AC7000 V<sub>peak</sub> (1 min.), 2800 V<sub>peak</sub> (cont.)
- IMRR: 180 dB or greater
- Frequency response: DC to 1 MHz
- High gain: ×0.1 to ×1000
- Low noise: 15 nV/√Hz (typ.)
- Low pass filter: 1 kHz, 10 kHz, 100 kHz

## LOW NOISE PREAMPLIFIER

## CA5360



CA5360 is good solution for improving sensitivity of lock-in amplifiers or removal of noise.

- Voltage gain: ×100 (40 dB) ● DC to 1 MHz
- Input impedance: 100 MΩ
- Input referred noise voltage: 5 nV/√Hz
- CMRR: 100 dB or more (DC to 100 Hz)

## LOW NOISE DC POWER SUPPLY

## LP5394/LP5393

Low noise and low drift



LP5394



LP5393

Ultra low noise DC power supply LP series are the best fit for low noise precision measurement applications, such as sensor pre-amps power supplies and DC bias power supplies that are widely used in advanced devices research, analyzing devices, and medical equipment.

- Output noise: 10 μV<sub>rms</sub> or lower (typ.) (10 Hz to 20 MHz bandwidth)
- Output voltage stability: ±10 ppm/°C (typ.) (LP5394)  
±20 ppm/°C (typ.) (LP5393)
- Output voltage: 0 to ±15 V (LP5394), ±12 V to ±15 V (LP5393)
- Output current: ±0.1 A max.

## LOW NOISE DC VOLTAGE SOURCE

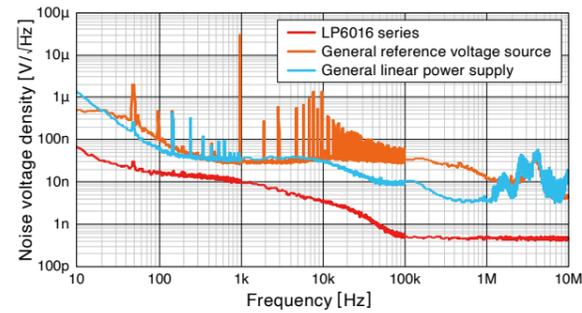
LP6016-01/LP6016-01P

Low noise DC voltage output can be set with a fine resolution of 500  $\mu\text{V}$  steps.

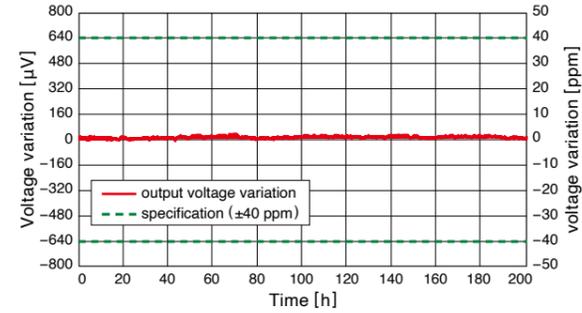


- Output noise: 10  $\mu\text{Vrms}$  or lower (typ.) (10 Hz to 20 MHz bandwidth)
- Output voltage stability :  $\pm 10$  ppm/ $^{\circ}\text{C}$  (typ.)
- Output voltage:  
LP6016-01: 0 to +16.1 V (+) / 0 to -16.1 V (-)  
LP6016-01P: 0 to +16.1 V (Dual outputs, V1, V2)
- Setting resolution: 500  $\mu\text{V}$
- Setting accuracy:  $\pm(0.03\% + 250 \mu\text{V})$
- Output current :  $\pm 100$  mA max. ● USB, RS-232, LAN

### ■ Output Noise Voltage Density ( $\pm 16.1000$ V, 100 mA)



### ■ Long-term Stability ( $\pm 16.1000$ V, 100 mA)



## FILTERS

### DUAL CHANNEL PROGRAMMABLE FILTER

3624/3625/3627/3628



- Dual channels
- 4 models
- Selectable cutoff frequency (3-1/2 digit resolution)
- Power: AC100, 120, 200 or 240 V  $\pm 10\%$ , selectable (max. 250 V)
- Dimensions (mm): 434 (W)  $\times$  132.5 (H)  $\times$  400 (D)

0.01 Hz to 159.9 kHz / 1 Hz to 1.59 MHz

Model	3624	3625	3627	3628
No. of channel	2 (CH-A and CH-B)			
Cutoff frequency	0.01 Hz to 159.9 kHz		1 Hz to 1.59 MHz	
Roll-off	24 dB/oct	48 dB/oct	24 dB/oct	48 dB/oct
Function	THRU, LP-MF (max. flat<Butterworth>), LP-PL (phase linear <Bessel>), HPE, BPF and BEF			
Mode	SEPARATE (independent operating CH-A and CH-B), CASCADE (cassaded CH-A and CH-B)			
Passband gain	$\times 1$ , $\times 2$ , $\times 5$ selectable respectively on input and output amplifiers			
Power supply	AC100, 120, 200 or 240 V $\pm 10\%$ , selectable (Max. 250 V)			
Dimensions	434 (W) $\times$ 132.5 (H) $\times$ 400 (D) mm excluding protusions			
Weight (approx.)	10.0 kg	10.5 kg	10.0 kg	10.5 kg

# AC POWER SOURCES

## PROGRAMMABLE AC POWER SOURCE

## DP SERIES (1.5 kVA to 36 kVA)



### A powerful and reliable AC power source

DP series incorporates new ideas while pursuing the high-quality, stable supply of power that is the fundamental role of any AC power source.

- Highly robustness, low distortion. both capacitive and inductive loads are driven stably.
- Flexible load protection equipped. It protect load and works with stable waveform even using current limiter
- Low noise for both conduction and radiation, which mean best solution for EMC testing.
- Abundant line-up: from 1.5kVA to three-phase 144kVA.

\* DP240S and DP360S are not CE-certified.

## SPECIFICATIONS

		Single-phase (1P2W)						
		DP015S	DP030S	DP045S	DP060S	DP075S	DP090S	DP105S
Output power* <sup>#1</sup>		1.5 kVA	3 kVA	4.5 kVA	6 kVA	7.5 kVA	9 kVA	10.5 kVA
Polyphase system		A polyphase system can be configured by connecting multiple units of the same single-phase model. Single-phase three-wire system: 3 kVA, 6 kVA, 9 kVA, 12 kVA, 15 kVA, 18 kVA, 21kVA, 24 kVA, 48 kVA, 72 kVA Three-phase system: 4.5 kVA, 9 kVA, 13.5 kVA, 18 kVA, 22.5 kVA, 27 kVA, 31.5 kVA, 36 kVA, 72 kVA, 108 kVA						
AC/DC mode		AC, ACDC, DC						
AC output* <sup>#2</sup>	Voltage setting range	0.0 V to 160.0 V/0.0 V to 320.0 V, 0.0 Vp-p to 454.0 Vp-p / 0.0 Vp-p to 908.0 Vp-p (arbitrary waveform)						
	Phase voltage	—						
	Line to line voltage	—						
	resolution	0.1 V						
	Max. current* <sup>#3 #4</sup>	15 A/7.5 A	30 A/15 A	45 A/22.5 A	60 A/30 A	75 A/37.5 A	90 A/45 A	105 A/52.5 A
	Max. peak current* <sup>#3 #5</sup>	4 times value of maximum current.						
Load power factor range	0 to 1 (lead or lag, at 45 Hz to 65 Hz)							
Frequency setting range, output waveform	40.00 Hz to 550.00 Hz (AC mode), 1.00 Hz to 550.00 Hz (ACDC mode), resolution: 0.01 Hz, waveform: sine, arbitrary (16 types),							
Output voltage stability	Line regulation: within ±0.15%, load regulation: within ±0.15 V/±0.3 V (45 Hz to 65 Hz), within ±0.5 V/±1.0 V (40 Hz to 550 Hz)							
Output voltage distortion factor	0.5% or less (40 Hz to 550 Hz, 50% or more of rated output voltage, maximum output current or below, AC mode or ACDC mode)							
DC output	Output power* <sup>#1</sup>	1.5 kW	3 kW	4.5 kW	6 kW	7.5 kW	9 kW	10.5 kW
	Voltage setting range	-227 V to +227 V/-454 V to +454 V, resolution: 0.1 V						
	Max. current* <sup>#4</sup>	15 A/7.5 A	30 A/15 A	45 A/22.5 A	60 A/30 A	75 A/37.5 A	90 A/45 A	105 A/52.5 A
Measurement function	Voltage	RMS value (rms), DC average (avg) (only single-phase models), peak value (pk)						
	Current	RMS value (rms), DC average (avg) (only single-phase models), peak value (pk), peak hold value						
	Power	Effective (W), apparent (VA), reactive (var)						
	Others	Load power factor, load crest factor, synchronization frequency, harmonic current, CO <sub>2</sub> emissions (excluding 24 kVA and 36 kVA)						
Current limiter	Setting: peak limiter (positive current and negative current), RMS limiter, limit operations: automatic recovery or output turn off							
Power unit energization setting	The power section is modularized in 1.5 kVA or 2 kVA units. Power units can be set ON or OFF to suit the load capacity.							
Sequence function	Parameters such as frequency, voltage and time can be programmed and sequentially output. Number of steps: 255 max (for start phase, stop phase, phase angle, step termination, jump count (1 to 9999, or ∞), specification of the jump-to step,							
AC line simulation	Simulates a problem in the power supply line such as power failure, voltage rise, voltage drop, sudden phase changes, or sudden parameters: output range, ACV (phase voltage), frequency, waveform, start phase, stop phase, synchronous step output (2 bit),							
Other functions	Setting limitation: voltage and frequency, remote sensing/AGC/Autocal, memory function, external signal input, interface (RS232C,							
Power input (specified on order)	AC100 V to 230 V ±10% 50 Hz/60 Hz ±2 Hz		AC100 V to 230 V ±10%, 3P3W AC200 V to 220 V ±15% or 3P4W AC380 V ±15% 50 Hz/60 Hz ±2 Hz					
Efficiency	77% or more (typ., at AC200 V input)							
Power consumption (maximum)	2.25 kVA	4.5 kVA	6.75 kVA	9 kVA	11.25 kVA	13.5 kVA	15.8 kVA	
Weight (approx.)	38 kg	50 kg	70 kg	82 kg	110 kg	125 kg	140 kg	
Dimensions (W×H×D)	430 × 398 × 562 mm		430 × 665 × 562 mm		430 × 1021 × 562 mm		430 × 1287 × 562 mm	
Reference	Note: When two values are indicated with a slash [ / ], the value before the slash is specification for 100 V range, the value after the slash is specification for 200 V range. *1: With models of 6 kW or more, output capacity is limited, if input voltage is AC170 V or less. *2: When [V] = Vrms, [A] = Arms, and power input voltage is 200 V, unless otherwise specified. *3: Values for single-phase 3-wire and three-phase are for phase current. *4: If at or above the rated output voltage, this is limited (reduced) to be at or below the power capacity. If there is DC superimposition, the RMS current value of AC+DC *5: For capacitor input type rectifier load (crest factor=4), rated output voltage, 45 Hz to 65 Hz.							

• Single-phase, single-phase three-wire, three-phase and multi-phase models are in one housing. also polyphase systems by combining single-phase models.

• High-performance current limiter (set with peak value and RMS value)

• Measurement functions : voltage, current, power, crest factor, power factor, frequency, harmonic current and so on.

• Sequence and AC line simulation

• Power unit energization settings

• RS-232, USB, GPIB or LAN (specified on order)

• Power input selectable • Simple operation

• Control software bundled



## LINEUP

Output power (kVA)	1.5	3	4.5	6	7.5	9	10.5	12	16	18	24	36	42 <sup>#3</sup>	48 <sup>#3</sup>
Single-phase	●	●	●	●	●	●	●	●	●	—	●	●	●	●
Single-phase 3-wire* <sup>#1</sup>	—	●	—	●	—	●	—	—	—	—	—	—	—	—
Three-phase* <sup>#2</sup>	—	—	●	—	—	●	—	—	—	—	—	—	—	—
Multi-phase* <sup>#3</sup>	—	—	●	●	—	●	—	●	—	●	●	●	—	—

\*1: Single-phase model x2 units

\*2: Single-phase model x3 units, max. 108 kVA

\*3: Multi-phase model (P. 19) and high power model (P. 20) are also available.

### Options

Remote controller DP008

System cable (for single phase 3-wire)

System cable (for 3-phase)

Power input cable / Cable holder



Single-phase (1P2W)			Single-phase three-wire (1P3W)				Three-phase (3P4W)	
DP120S	DP240S*	DP360S*	DP030D	DP060D	DP090D*	DP120D*	DP045T	DP090T
12 kVA	24 kVA	36 kVA	3 kVA	6 kVA	9 kVA	12 kVA	4.5 kVA	9 kVA
clipped Sine (3 types) (phase voltage) (phase voltage)			AC, ACDC 0.0 V to 160.0 V/0.0 V to 320.0 V, 0.0 Vp-p to 454.0 Vp-p / 0.0 Vp-p to 908.0 Vp-p (arbitrary waveform) All-phase common setting for balanced mode. Each phase setting for unbalanced mode. 0.0 V to 320.0 V/0.0 V to 640.0 V 0.0 V to 277.2 V/0.0 V to 554.2 V Only for balanced mode and sine wave. Phase voltage: 0.1 V, line to line: 0.2 V					
120 A/60 A	240 A/120 A	360 A/180 A	15 A/7.5 A	30 A/15 A	45 A/22.5 A	60 A/30 A	15 A/7.5 A	30 A/15 A
12 kW			12 kW					
24 kW			24 kW					
36 kW			36 kW					
120 A/60 A			120 A/60 A					
240 A/120 A			240 A/120 A					
360 A/180 A			360 A/180 A					
model) when the limit state has continued for the designated time.								
1 sequence), step time setting range: 0.0010 s to 999.9999 s, parameters: output range, AC/DC mode, AC phase voltage, frequency, waveform, DC voltage, synchronous step output (2 bit), specification of the branch step, trigger output, number of memories: 5 frequency change. Number of steps: 6 (initial, normal 1, transition 1, abnormal, transition 2, normal 2), step time setting range: 0.0010 s to 999.9999 s, trigger output, repeat count (1-9999 times or ∞) USB, GPIB/LAN [specified on order]), external control I/O, output relay control, output waveform monitor								
3P3W AC200 V to 220 V ±15% or 3P4W AC380 V ±15% 50 Hz/60 Hz ±2 Hz			Same as DP030S		AC100 V to 230 V ±10%, 3P3W AC200 V to 220 V ±15% or 3P4W AC380 V ±15% 50 Hz/60 Hz ±2 Hz			
18 kVA	36 kVA	54 kVA	4.5 kVA	9 kVA	13.5 kVA	18 kVA	6.75 kVA	13.5 kVA
155 kg	345 kg	510 kg	50 kg	82 kg	125 kg	155 kg	70 kg	125 kg
	860 × 1463 × 649 mm	1290 × 1463 × 649 mm	430 × 398 × 562 mm	430 × 665 × 562 mm	430 × 1021 × 562 mm	430 × 1287 × 562 mm	430 × 665 × 562 mm	430 × 1021 × 562 mm

### DP-G Series

This series doesn't have the function of arbitrary waveform and external signal input.

### DP Series Type K

CPCS-CCC outlet. Only Single-phase models are available, not for polyphase system.

**PROGRAMMABLE AC POWER SOURCE**

**DP SERIES MULTI-PHASE MODEL**

Multiple outputs for multiple uses switch between single-phase, single-phase three-wire, and three-phase

**LINEUP**

Model	DP045M	DP090M	DP060LM	DP120LM	DP180LM	DP240LM	DP360LM
1P2W	4.5 kVA	9 kVA	6 kVA	12 kVA	18 kVA	24 kVA	36 kVA
1P3W	3 kVA	6 kVA	4 kVA	8 kVA	12 kVA	16 kVA	24 kVA
3P4W	4.5 kVA	9 kVA	9 kVA	12 kVA	18 kVA	24 kVA	36 kVA

- Highly robust, low distortion
- Low noise
- Short reverse power flow (100%, ≤ 20 ms)
- Load protection: variable current limiter function
- Single space-saving cabinet
- Lineup: 4.5 kVA to 36 kVA
- Single-phase and polyphase output terminal equipped separately

\* DP045M and DP090M are CE certified



DP240LM

**SPECIFICATIONS**

Model	DP045M	DP090M	DP060LM	DP0120LM	DP0180LM	DP0240LM	DP0360LM	
Output power*1	4.5 kVA	9 kVA	6 kVA	12 kVA	18 kVA	24 kVA	36 kVA	
AC output*2	Voltage setting range							
	Phase voltage	0.0 V to 160.0 V / 0.0 V to 320.0 V, arbitrary wave: 0.0 V <sub>p-p</sub> to 454.0 V <sub>p-p</sub> / 0.0 V <sub>p-p</sub> to 908.0 V <sub>p-p</sub> , setting resolution: 0.1 V						
	Line voltage	1P3W: 0.0 V to 320.0 V / 0.0 V to 640.0 V (balanced mode and sine wave only) setting resolution: 0.2 V 3P4W: 0.0 V to 277.2 V / 0.0 V to 554.2 V (balanced mode and sine wave only) setting resolution: 0.2 V						
	Max. current*3	single-phase 45 A / 22.5 A	90 A / 45 A	60 A / 30 A	120 A / 60 A	180 A / 90 A	240 A / 120 A	360 A / 180 A
	polyphase	15 A / 7.5 A	30 A / 15 A	20 A / 10 A	40 A / 20 A	60 A / 30 A	80 A / 40 A	120 A / 60 A
Max. peak current*4	Peak value (Apk) which is four times of the max. current			Peak value (Apk) which is three times of the max. current				
Short reverse power flow	—			100% or less of max. current (RMS) (reverse power flow time ≤ 20 ms, discontinuous, 40°C or lower)				
Load power factor	0 to 1 (phase lead or phase lag, 45 Hz to 65 Hz, external power injection and regeneration are not available.)							
Frequency setting range	40.00 Hz to 550.00 Hz (AC mode), 1.00 Hz to 550.00 Hz (ACDC mode), setting resolution: 0.01 Hz							
Output waveform	Sine wave, arbitrary wave (16 types), clipped sine wave (3 types)							
DC output*5	Output power*1	4.5 kW	9 kW	6 kW	12 kW	18 kW	24 kW	36 kW
	Voltage setting range	-227 V to +227 V / -454 V to +454 V, setting resolution: 0.1 V						
	Max. source current*3	45 A / 22.5 A	90 A / 45 A	60 A / 30 A	120 A / 60 A	180 A / 90 A	240 A / 120 A	360 A / 180 A
	Short sink current	—			100% or less of max. source current (reverse power flow time ≤ 20 ms, discontinuous, 40°C or lower)			
Stability and distortion (phase voltage)	Output voltage stability	Fluctuation with input voltage: within ±0.15% Fluctuation with output current: DC (only single-phase output) within ±0.15 V / ±0.30 V, 45 Hz to 65 Hz within ±0.15 V / ±0.30 V, 40 Hz to 550 Hz within ±0.5 V / ±1.0 V						
	Distortion	0.5% or lower						
Power input	Voltage*1 (specified on order)	Overvoltage category II						
	1P2W input	100 V to 230 V ±10%		200 V to 230 V ±15%		—		
	3P3W input	200 V to 220 V ±15%						
	3P4W input	380 V ±15%						
Frequency, power factor*6, efficiency*6	50 Hz / 60 Hz ±2 Hz, 0.90 or higher (typ., AC200 V input), 77% or higher (typ.)							
Max. power consumption	6.75 kVA or lower	13.5 kVA or lower	9 kVA or lower	18 kVA or lower	27 kVA or lower	36 kVA or lower	54 kVA or lower	
Measurement function	Voltage (RMS value, DC average value, peak value), current (RMS value, DC average value, peak value, peak hold value), power (active, apparent, reactive), load power factor, load crest factor, synchronization frequency, harmonic current, CO <sub>2</sub> emissions							
Current limiter	Setting: peak limiter (positive current and negative current), RMS limiter, Limit operations: automatic recovery or output turn off when the limit state has continued for the designated time.							
Sequence function	Parameters such as frequency, voltage and time can be programmed and sequentially output. Number of steps: max. 255 (in 1 sequence), setting items: step time, output range, AC/DC mode, DC voltage, AC voltage, frequency, waveform, start phase, stop phase, phase angle, step termination, jump count and so on.							
Simulation	Simulates a problem in the power supply line such as power failure, voltage rise, voltage drop, sudden phase changes, or sudden frequency change.							
Control software	Remote control, status monitor, logging, editing the arbitrary waveform data, editing performing sequence/simulation							
Other functions	Voltage/Frequency setting limitation, remote sensing/AGC/Autocal, clipped sine wave, arbitrary wave, external signal input (SYNC, VCA, EXT*5, ADD*5), memory function, protections, external control I/O, interface (USB, RS-232, GPIB/LAN [specified on order]), output relay control, waveform monitor and so on							
Dimensions (W x H x D) (mm)	430 x 665 x 562	430 x 1287 x 562	455 x 887 x 803	455 x 1407 x 803	910 x 1580 x 803	1365 x 1580 x 803		
Weight	approx. 75 kg	approx. 130 kg	approx. 125 kg	approx. 200 kg	approx. 350 kg	approx. 400 kg	approx. 570 kg	

Note: When two values are indicated with a slash [ / ], the value before the slash is specification for 100 V range, the value after the slash is specification for 200 V range.

\*1: Excluding 4.5 kVA models, output power is limited, if input voltage is AC170 V or less. \*2: [V]=Vrms, [A]=Arms, and power input voltage is 200 V, unless otherwise specified.

\*3: If the output voltage is higher than the rated value, this is limited (lowered) to satisfy the output power.

\*4: For the capacitor input type rectified load (crest factor=4 or 3), the rated output voltage, and 45 Hz to 65 Hz. \*5: Single-phase only, [V]=Vdc, [A]=Adc

\*6: In the case of AC-INT, the rated output voltage, the resistance load at the maximum current, 45 Hz to 65 Hz output.

**PROGRAMMABLE AC POWER SOURCE**

**DP SERIES (16 kVA / 42 kVA / 48 kVA)**

High efficiency / Large capacity



DP420LS / DP480LS (single-phase)



Three phase 144 kVA

- Highly robust, low distortion
- Low noise
- High efficiency 77% or more
- Superior transient stability
- Current limiter function
- Reverse power flow (100%, ≤ 20 ms)
- Simple wiring
- Low audible noise

**APPLICATIONS**

- Large scale grid-tied inverter test
- Power solution for EMC chamber and Open-Air test sites
- AC test power for large scale equipment / EMC testing  
Large scale air conditioning systems, chillers, medical system, printing equipment, semiconductor fab equipment, SMT placement equipment, elevator / escalator and industrial robot

**SPECIFICATIONS**

Output power	DP160LS: single-phase 16 kVA DP420LS: single-phase 42 kVA DP480LS: single-phase 48 kVA
AC/DC mode	AC, ACDC, DC (single-phase only)
Output voltage and frequency	AC, ACDC, DC (single-phase only)

	100 V range	200 V range	Resolution
AC Voltage	0 V to 160 V	0 V to 320 V	0.1 V
AC Frequency	AC: 40.00 Hz to 550.00 Hz ACDC: 1.00 Hz to 550.00 Hz		0.01 Hz
DC Voltage	-227 V to +227 V	-454 V to +454 V	0.1 V

Max. current (100 V range/200 V range)	DP160LS: 160 A / 80 A, DP420LS: 420 A / 210 A DP480LS: 480 A / 240 A
Max. peak current	DP160LS: Four times of the max. current DP420LS, DP480LS: Three times of the max. current
Short reverse power flow	Less than 100% of max. current (RMS) (reverse power flow time ≤ 20 ms, discontinuous, less than 40°C)
Fluctuation with output current (100 V range/200 V range)	Within ±0.15 V / ±0.30 V (In the case that the output current is changed from 0% to 100% of the max. current. DC or 45 Hz to 65 Hz.)
Distortion of output voltage waveform	0.5% or lower (40 Hz to 550 Hz)

Power Input (specified on order)	Overvoltage category II 3P3W AC200 V to 220 V ±15% or 3P4W AC380 V ±15%, 50 Hz / 60 Hz ±2 Hz, power factor 0.90 or higher (typ.), efficiency 77% or higher (typ.), max. power consumption DP160LS: 24 kVA or lower, DP420LS: 63 kVA or lower, DP480LS: 72 kVA or lower
Measurement function	RMS / peak / average values of the output voltage / current, current peak-hold values, active / apparent / reactive power, the power factor, the crest factor, and harmonic current (40th max.), synchronization frequency
Variable current limiter	Effective value, positive/negative peak value
Remote sensing, AGC (automatic gain control), Autocal (output voltage compensation)	
Sequence function, voltage fluctuation testing function, clipped sine wave, arbitrary waveform	
Power unit energization setting	
External control I/O	Used to control voltage dip simulator and reference impedance network
Interface	Standard: RS-232, USB Selectable: GPIB or LAN
Control Software	Enables control of basic parameters for output via a PC, including data logging, and creating/editing of sequence, simulation and arbitrary waveforms.
Dimensions (mm)	DP160LS: 455 (W) x 1407 (H) x 803 (D) mm DP420LS / DP480LS: 1365 (W) x 1580 (H) x 803 (D)
Weight (approx.)	DP160LS: 230 kg, DP420LS: 600 kg, DP480LS: 650 kg

**Lineup for High Power Applications**



DP240S



DP360S

DP240S: single-phase 24 kVA  
DP360S: single-phase 36 kVA  
A three-phase model can be configured by connecting 3 units.

\* Contact us for detailed specifications.



3-phase 72 kVA System



**KP3000S**

(Foot type, Optional outlets are equipped.)



For production lines manufacturing household electrical appliances in ever larger sizes, for mixed lines composed of both AC and DC equipment, and for testing of DC-DC converters, this unit provides 3 kVA/3 kW power.

- AC single-phase 3 kVA/DC 3 kW
- KP3000S : configurable of polyphase system
  - single-phase three-wire 6 kVA (2 cabinets)
  - three-phase 9 kVA (3 cabinets)

**KP3000GS: multifunctional single-phase model**  
includes sequence and simulation function,  
and external signal inputs

- Measurement functions  
Voltage (rms value, average DC value, peak value), current (rms value, average DC value, peak value, peak hold value), power (active power, apparent power, reactive power), load power factor, crest factor, sync frequency, harmonic current (up to 40th order), CO<sub>2</sub> emissions
- Current limiter: peak value and RMS value
- Remote sensing, AGC, Auto Cal
- Sequence function and simulation function
- RS-232, USB, GPIB/LAN (specified on order), external control I/O

**SPECIFICATIONS**

**Power Output**

		100 V range	200 V range	Resolution
AC	Output voltage	0 V to 155 V	0 V to 310 V	0.1 V
	Maximum current	30 A	15 A	—
	Frequency	AC: 40 Hz to 550 Hz, AC+DC: 1 Hz to 550 Hz		0.1 Hz
DC	Output voltage	-220 V to +220 V	-440 V to +440 V	0.1 V
	Maximum current	30 A	15 A	—
Output waveform		Sine, arbitrary, clipped sine		

Stable Output in Various Load Conditions

The EC750SA and EC1000SA provide not only a stable power supply, but also the necessary functions for power supply testing, such as measurement, current limiter, and sequence functions.



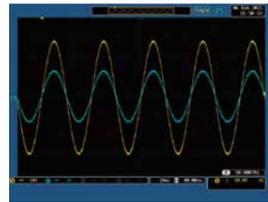
750VA/750W  
EC750SA



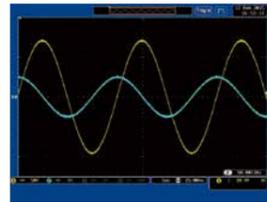
1kVA/1kW  
EC1000SA

- Full power, AC as well as DC (750 VA/750 W, 1 kVA/1 kW)
- Max. output voltage: 310 V
- Peak current output of up to 4 times as large as the max. current (RMS value) at the rated output voltage
- Measurement, sequence, current limiter and protection function
- USB/RS-232, control I/O
- Control software bundled

Output waveform



Resistance Load  
10kΩ, 10mA



Capacitance Load

SPECIFICATIONS

AC/DC mode, signal source

AC/DC mode AC, AC+DC  
Signal source INT (Internal), EXT (External), ADD (Internal and external), SYNC (External synchronization)

AC output

Output power EC750SA: 750 VA  
EC1000SA: 1000VA (when the input is from AC180 V to 250 V, referred to as "AC 200 V input system")  
When the input is from AC 100 V to 180 V (referred to as "AC 100 V input system"), output power is limited to 750 VA.  
Rated output voltage 100 Vrms/200 Vrms  
Output range 100 V range/200 V range  
Voltage setting range\*1 0.0 to 155.0 Vrms/0.0 to 310.0 Vrms (resolution 0.1 Vrms)  
Max. current\*2 \*3 \*4 10 Arms/5 Arms  
Max. peak current\*3 \*5 EC750SA: 30 Apk/15 Apk, EC1000SA: 40 Apk/20 Apk  
Frequency setting range\*6 1.0 Hz to 550.0 Hz (resolution 0.1 Hz)  
Output waveform\*6 Sine wave, square wave, arbitrary wave (16 types)

DC output

Output power EC750SA: 750 W  
EC1000SA: 1000W (AC 200V input system) (for the AC 100 V input, output power is limited to 750 W)  
Rated output voltage 100 V/200 V  
Voltage setting range\*1 -220.0 V to +220.0 V / -440.0 V to +440.0 V (resolution 0.1 Vrms)  
Max. current\*2 \*3 10 A/5 A  
Max. peak current\*2 EC750SA: 30 Apk/15 Apk, EC1000SA: 40 Apk/20 Apk

Output voltage stability

Fluctuation with output current 45 Hz to 65 Hz: Within ±0.15%,  
DC and 40 Hz to 550 Hz: Within ±0.5%  
Fluctuation with input voltage Within 0.2% (power input voltage: 100 V/120 V /230 V, no load, rated output)

Output voltage distortion factor

0.5% or lower (50 Hz/60 Hz, 50% or higher of rated output voltage)

Power input

Voltage AC100 V to 230 V ±10% (max. voltage 250 V), overvoltage category II  
Frequency 50 Hz/60 Hz ±2 Hz (single-phase)  
Power factor (typ.) 0.95 or higher (at AC100 V input), 0.90 or higher (at AC200 V input)  
Max. power consumption EC750SA: 1.2 kVA or lower  
EC1000SA: 1.4 kVA or lower

Measurement functions

Output voltage, output current, output power, load power factor, load crest factor, output harmonic current, external synchronization frequency

Sequence functions (internal signal source only.)

Number of sequences One sequence per AC/DC mode at both 100 V and 200 V range.  
Number of steps Up to 255 (within one sequence)  
Step time 0.1 ms to 999.9999 s (resolution:0.1 ms)  
Operation within step Constant, keep or linear sweep  
Parameters DC voltage, AC voltage, frequency, waveform, step synchronization output of 2 bits  
Number of jumps 1 to 999 or continuous  
Sequence control Start, stop, hold and branch

Control software

Remote control, logging, arbitrary waveform, sequence

Other functions

Setting range limit function\*6, arbitrary wave, external signal input, memory function, protections, external control I/O, USB Interface, LCD display

Generals

Dimensions (mm) 258 (W)×176(H)×440(D) (not including protrusions)  
Weight approx. 9.7 kg

- \*1: Signal source: INT, SYNC or ADD, no load
- \*2: The limit on max. output power may cause a reduction in max. output current and max. peak current (EC1000SA for power input AC100 V)
- \*3: For at or above the rated output voltage, the limit on max. output power reduces max. output current. (EC1000SA only).
- \*4: The RMS current of AC+DC is max. output current
- \*5: For a capacitor input type rectifier circuit (crest factor = 4)
- \*6: Signal source: INT, SYNC or ADD

BIPOLAR AMPLIFIERS

HIGH SPEED BIPOLAR AMPLIFIER

HSA SERIES

High Speed, Broad Bandwidth, High Voltage Output

In the test of electronic components and devices such as capacitors and coils, it can stably drives the DUT that cannot be driven by other amplifiers. Used in advanced research fields such as medicine and biotechnology.



1MHz, 3Ap-p



1MHz, 6Ap-p



1MHz, 12Ap-p



500kHz, 5.66Ap-p

NEW

LINE UP

	Frequency	Voltage	Current	Slew Rate
HSA42011	DC to 1 MHz	150 Vp-p	3 Ap-p	475 V/μs
HSA42012	DC to 1 MHz	150 Vp-p	6 Ap-p	475 V/μs
HSA42014	DC to 1 MHz	150 Vp-p	12 Ap-p	475 V/μs
HSA42052	DC to 500 kHz	300 Vp-p	5.66 Ap-p	450 V/μs

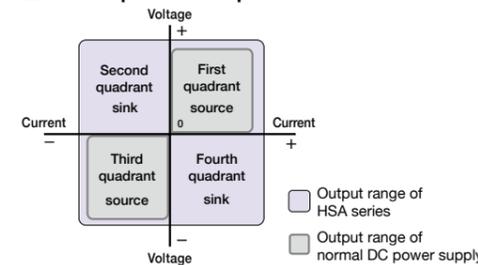
APPLICATIONS

- Driving multilayer ceramic capacitors (MLCC)
- Drive test of ultrasonic motor in combination with signal generator
- B-H curve measurement of magnetic materials such as magnetic powder core and ferrite
- Drive of piezoelectric element and measurement of resonance characteristics
- Reproduction of malfunction due to power supply noise of smartphone / touch panel
- Power fluctuation test of in-vehicle electrical components

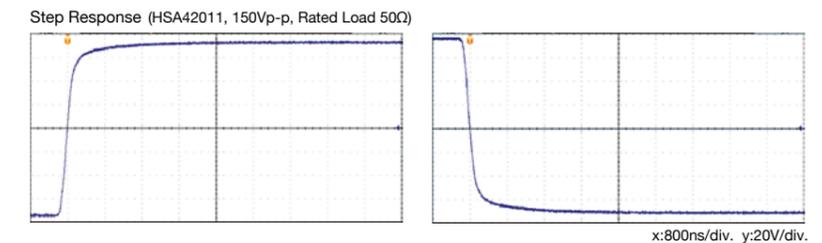
SPECIFICATIONS

Model	HSA42011	HSA42012	HSA42014	New HSA42052
Maximum Output Voltage	RL: 50 Ω 53 Vrms (40 Hz to 1 MHz) 45 Vrms (20 Hz to 40 Hz) RL: 75 Ω ±75 V (DC to 1 MHz)	RL: 25 Ω 53 Vrms (40 Hz to 1 MHz) 45 Vrms (20 Hz to 40 Hz) RL: 37.5 Ω ±75 V (DC to 1 MHz)	RL: 12.5 Ω 53 Vrms (40 Hz to 1 MHz) 45 Vrms (20 Hz to 40 Hz) RL: 18.8 Ω ±75 V (DC to 1 MHz)	DC mode RL: 50 Ω 100 Vrms (40 Hz to 200 kHz) 40 Vrms (20 Hz to 500 kHz) RL: 75 Ω ±150 V (DC to 50 kHz) ±140 V (50 kHz to 200 kHz) ±55 V (200 kHz to 500 kHz) AC mode RL: 50 Ω 100 Vrms (40 Hz to 200 kHz) 40 Vrms (20 Hz to 500 kHz) RL: 75 Ω ±150 V (10 Hz to 50 kHz) ±140 V (50 kHz to 200 kHz) ±55 V (200 kHz to 500 kHz)
Maximum Output Current (AC)	1.06 Arms, 3 Ap-p (40 Hz to 1 MHz)	2.12 Arms, 6 Ap-p (40 Hz to 1 MHz)	4.24 Arms, 12 Ap-p (40 Hz to 1 MHz)	2 Arms, 5.66 Ap-p (40 Hz to 200 kHz)
Maximum Output Current (DC)	±1 A	±2 A	±4 A	±2 A
Low Amplitude Frequency response	DC to 100 kHz -1 dB to +1 dB 100 kHz to 1 MHz -3 dB to +1 dB			DC mode DC to 100 kHz: -0.3 dB to +0.3 dB 100 kHz to 300 kHz: -1 dB to +0.5 dB 300 kHz to 500 kHz: -3 dB to +0.5 dB AC mode 10 Hz to 100 kHz: -0.3 dB to +0.3 dB 100 kHz to 300 kHz: -1 dB to +0.5 dB 300 kHz to 500 kHz: -3 dB to +0.5 dB
Gain Accuracy	±5% (Fixed Gain: ×1, ×10, ×20, and ×50, Variable Gain: CAL, at 400 Hz)			±5% (Fixed Gain: ×1, ×20, ×40, and ×100, Variable Gain: CAL, at 400 Hz)
Slew Rate	475 V/μs or above			450 V/μs or above
Output DC Offset	±0.5 V or above			DC: ±1 V or above, AC: ±1 mV
Output DC Bias	±75 V or above			±150 V or above
Harmonic Distortion Rate	0.1% or less (40 Hz to 1 kHz, output 40 Vrms)			0.1% or less (40 Hz to 1 kHz, output 80 Vrms)
Output Impedance	[0.19+0.0155√f×(1+j)] Ω or less (typ.) [0.19+0.00803√f×(1+j)] Ω or less (typ.) [0.19+0.00460√f×(1+j)] Ω or less (typ.) [0.19+0.0084√f×(1+j)] Ω or less (typ.)			
Input Format	Input A, Input B or addition of input A and input B (When two inputs are on, the maximum input voltage is within ±10 V in total)			
Input Impedance	50 Ω±5%/10 kΩ±5% switchable (Unbalanced, switch between two inputs A and B at once)			
Power Input	AC100 V to 230 V±10% (Maximum voltage 250 V), Overvoltage category II 50 Hz ±2 Hz or 60 Hz ±2 Hz (Single-phase), Power factor 0.95 or more			
Power Consumption	290 VA or less	580 VA or less	1050 VA or less	1050 VA or less
Dimensions	220(W)×132.5(H)×450(D)mm	290(W)×132.5(H)×450(D)mm	350(W)×177(H)×450(D)mm	350(W)×177(H)×450(D)mm
Weigh	approx. 9kg	approx. 11kg	approx. 16kg	approx. 16kg

Four-quadrant operation



Fast response, wide frequency bandwidth, DC to 1MHz





BA4825

- **Broadband:** DC to 2 MHz
- **High-power output:** 100 Vrms (300 Vp-p), 0.5 Arms
- **High slew rate:** 500 V/μs
- **Low output impedance**
- **Bipolar output**  
Four-quadrant operation that enables positive and negative voltage and current to be supplied (source) and absorbed (sink).
- **Multiple functions**  
Output polarity switching, output range shift, output monitoring, external output on/off control, DC bias addition, and DC offset adjustment

**APPLICATIONS**

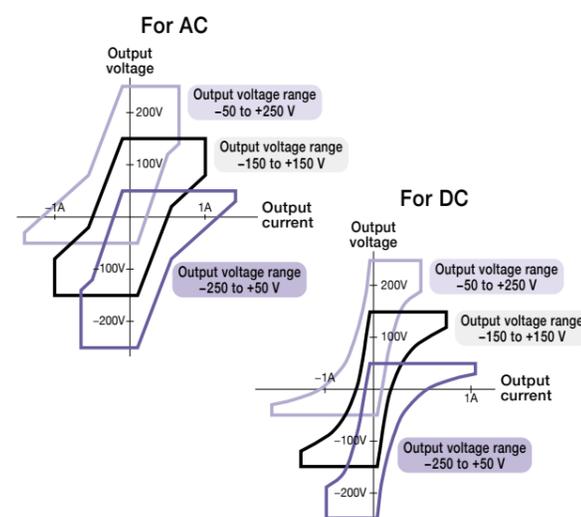
- Driving and evaluation of piezoelectric elements
- Test and evaluation of display devices
- Power amplifier for signal or pulse generators
- Measurement of magnetizing characteristics (B-H curves)
- Driving of elastic surface wave ultrasonic motors and comb tooth-shaped electrodes in the field of nanotechnology and MEMS
- High-frequency ripple tests of capacitors

**SPECIFICATIONS**

<b>Frequency</b>	
Frequency band	DC to 2 MHz
<b>Output</b>	
Maximum output voltage	<ul style="list-style-type: none"> <li>● ±150 V range (rated resistance load 200 Ω) 100 Vrms or greater (40 Hz to 500 kHz) 70 Vrms or greater (500 kHz to 1 MHz) 40 Vrms or greater (1 MHz to 2 MHz)</li> <li>● ±150 V range (rated resistance load 450 Ω) ±150 V (300 Vp-p) (DC to 500 kHz) ±100 V (200 Vp-p) (500 kHz to 1 MHz) ±56 V (112 Vp-p) (1 MHz to 2 MHz)</li> <li>● +250 V range (rated resistance load 1,250 Ω) -50 V to +250 V (DC to 500 kHz) +40 V to +240 V (500 kHz to 1 MHz) +80 V to +200 V (1 MHz to 2 MHz)</li> <li>● -250 V range (rated resistance load 1,250 Ω) -250 V to +50 V (DC to 500 kHz) -240 V to -40 V (500 kHz to 1 MHz) -200 V to -80 V (1 MHz to 2 MHz)</li> </ul>
Rated output current	0.5 Arms (±150 V range, rated resistance load 200 Ω)
Output power	50 W (rated condition), 150 W max.
Operation mode	Constant voltage (CV)
Output polarity	In-phase or reversed phase (toggled with the panel switch)
Characteristics of small amplitude frequency	DC to 100 kHz, ±0.5 dB 100 kHz to 2 MHz, +1, -3 dB Conditions: Output amplitude 20 Vrms, reference 1 kHz
Gain setting	Fixed: ×1, ×10, ×20, ×50 Variable: ×1 (CAL) to ×3, consecutive The set gain equals to (Fixed × Variable).
Slew rate	500 V/μs
Output DC offset	Adjustment range: ±0.5 V or more (input terminal short circuit)
Output DC bias	±200 V or more Allows turning on/off by the front panel switch.
Output impedance	0.5 Ω+1.5 μH or less (typ.)
Output terminal	BNC connector (front panel), Lo side grounded to the cabinet
Monitor output	1/100 of output voltage, in-phase
Output on/off	Front panel switch or external control input

<b>Input</b>	
Maximum input voltage	±10 V
Number of terminals	2 (A input: Front panel, B input: Rear panel) (Input type may be A input, B input, or both A input and B input.)
Input terminals	BNC connector, Lo side grounded to the cabinet
Input impedance	50 Ω and 10 kΩ, switchable
<b>Miscellaneous</b>	
Protection function	Output overcurrent, output overvoltage, power section failure, abnormal internal temperature
External control input/output	Output on/off and other uses
Settings at power-on	Settings power-on made by dip switches on the rear panel (10 settings for BA4825)
Power input	AC100 V to 230 V ±10% (at 250 V or less), 50 Hz/60 Hz ±2 Hz
Power consumption	350 VA or less
Dimensions (mm)/Weight	258 (W) × 132.5 (H) × 390 (D) (not including protrusions)/approx. 7kg

**Output voltage and current range**



# BIPOLAR DC POWER SUPPLY

# BP SERIES

Voltage  $\pm 60$  V, Current  $\pm 100$  A max., Constant voltage and Constant current  
Wide output range, Variety of Application



\*BP4610 and BP4620 are CE certified

## SPECIFICATIONS

Model		BP4610	BP4620	BP4630	BP4640			
Output	Maximum output voltage*1 CV mode	DC	-115 V to +115 V					
		DC to 0.5 kHz	RL = 23 $\Omega$	RL = 12 $\Omega$	RL = 7.7 $\Omega$	RL = 5.8 $\Omega$		
		0.5 kHz to 40 kHz	$\pm 60$ V	RL = 6 $\Omega$	RL = 3 $\Omega$	RL = 2 $\Omega$	RL = 1.5 $\Omega$	
		40 kHz to 150 kHz	$\pm 60$ V	RL = 4 $\Omega$	RL = 2 $\Omega$	RL = 1.3 $\Omega$	RL = 1 $\Omega$	
	Maximum output current*1 CC mode	DC to 0.5 kHz	$\pm 10$ A/RL = 6 $\Omega$	$\pm 20$ A/RL = 3 $\Omega$	$\pm 30$ A/RL = 2 $\Omega$	$\pm 40$ A/RL = 1.5 $\Omega$		
		0.5 kHz to 30 kHz	$\pm 15$ A/RL = 4 $\Omega$	$\pm 30$ A/RL = 2 $\Omega$	$\pm 45$ A/RL = 1.3 $\Omega$	$\pm 60$ A/RL = 1 $\Omega$		
		30 kHz to 70 kHz	$\pm 8.3$ A/RL = 6 $\Omega$	$\pm 16.6$ A/RL = 3 $\Omega$	$\pm 24.9$ A/RL = 2 $\Omega$	$\pm 33.2$ A/RL = 1.5 $\Omega$		
	Small amplitude frequency characteristics*1		CV mode: DC to 200 kHz (amplitude 12 V <sub>p-p</sub> , 500 Hz reference), CC mode: DC to 70 kHz (amplitude 12 V <sub>p-p</sub> , 500 Hz reference)					
	Response calibration function		Response characteristic can be adjusted with knobs on the front panel (Time constant: T, Voltage: V, and CV: 2.5 $\mu$ s*1 (square $\pm 60$ V), CC: 4 $\mu$ s*1 (square, for the following current))					
	Rise / Fall time		$\pm 10$ A					
Output Impedance*1	CV mode	7 m $\Omega$ + 1.3 $\mu$ H	3.5 m $\Omega$ + 0.65 $\mu$ H	2.3 m $\Omega$ + 0.43 $\mu$ H	1.8 m $\Omega$ + 0.33 $\mu$ H			
	CC mode	10 k $\Omega$ // 0.45 $\mu$ F	5 k $\Omega$ // 0.90 $\mu$ F	3.3 k $\Omega$ // 1.35 $\mu$ F	2.5 k $\Omega$ // 1.8 $\mu$ F			
Signal sources*2	Internal signal source	CV mode	DC voltage setting range	-115 to +115 V (resolution 0.01 V)				
			AC voltage	Amplitude range	0 V <sub>p-p</sub> to 120 V <sub>p-p</sub> (resolution 0.1 V <sub>p-p</sub> )			
			Waveform	Sine, square, arbitrary (16 types)				
	CC mode	DC current	Setting range	-10A to +10A	-20A to +20A	-30A to +30A	-40A to +40A	
			Resolution	0.01 A				
			Amplitude range	0 to 30 A <sub>p-p</sub>	0 to 60 A <sub>p-p</sub>	0 to 90 A <sub>p-p</sub>	0 to 120 A <sub>p-p</sub>	
AC current	Resolution	0.001 A <sub>p-p</sub>						
	Waveform	Sine, Square, Arbitrary (16 types)						
	Frequency range	1 Hz to 100 kHz (resolution 0.1 Hz)						
External signal input		Phase: In phase, Input impedance: 10 k $\Omega$ , Non-destructive max. input voltage: $\pm 5$ V, Frequency range: DC to 200 kHz						
Functions	Sequence functions		Number of sequences: 1 sequence for each of the CV and CC, number of steps: 1 to 255 (within 1 sequence), frequency, waveform, step sync output 2 bits, jump count: 1 to 999, or continuous, sequence control: start / stop / hold / branch					
	Monitor output		Output voltage, output current					
	Measurement functions		DC output voltage, DC output current, AC output voltage, AC output current					
	Arbitrary waveform memory		16 (1024 words, 16 bit.) write is performed via the USB interface.					
	Store / Recall memory		The basic settings can be saved to memories No.1 to No.30					
Other functions		Protection functions, external control input / output, key lock, beep, reset, self-diagnosis function						
Generals	Interface		USB Interface (USBTMC / USB1.1)					
	Power Input	Voltage	90 V to 250 V	180 V to 250 V	180 V to 250 V, three-phase,			
		Frequency	50 Hz / 60 Hz $\pm 2$ Hz					
		Power consumption	1.2 kVA max.	2.4 kVA max.	3.6 kVA max.	4.8 kVA max.		
Dimensions (W x H x D) (mm)	430 x 176 x 551		430 x 354 x 551		430 x 710 x 686	505 x 1150 x 700		
Weight (approx.)	26 kg		53 kg		97 kg	165 kg		
Remarks		*1: Adjusted characteristics *2: Selectable from among internal source, external signal, and internal source + external signal.						

- Wide range voltage output  $\pm 60$  V (possible to shift the range)
- 10 Models,  $\pm 10$  A to  $\pm 100$  A
- Two mode selectable, constant voltage / constant current
- High speed, DC to 150 kHz (CV, Adjusted)
- Up to 255 Steps sequence function
- DC, sine wave, square wave, and arbitrary wave
- Response calibration function
- USB / External control IO
- Analog input as power amplifier
- Control software bundled

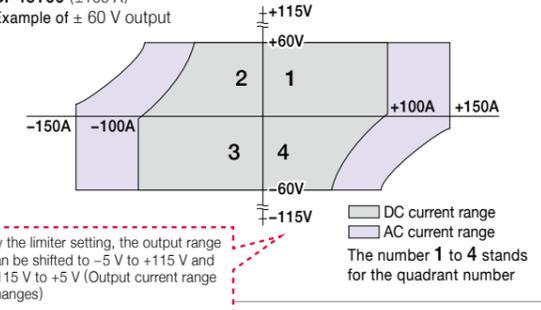
### Remote control



▲ Sequence edit

### Wide operation area

BP46100 ( $\pm 100$  A)  
Example of  $\pm 60$  V output



## APPLICATIONS

- Power supply for voltage fluctuation test on 12 V / 24 V / 48 V vehicle electrical and electronic components
- Constant current power supply for generating magnetic field
- Constant current power supply for capacitor ripple test
- Constant current power supply for plating

BP4650	BP4660	BP4670	BP4680	BP4690	BP46100
RL = 4.6 $\Omega$	RL = 3.8 $\Omega$	RL = 3.3 $\Omega$	RL = 2.9 $\Omega$	RL = 2.6 $\Omega$	RL = 2.3 $\Omega$
RL = 1.2 $\Omega$	RL = 1 $\Omega$	RL = 0.86 $\Omega$	RL = 0.75 $\Omega$	RL = 0.67 $\Omega$	RL = 0.6 $\Omega$
RL = 0.8 $\Omega$	RL = 0.67 $\Omega$	RL = 0.57 $\Omega$	RL = 0.50 $\Omega$	RL = 0.44 $\Omega$	RL = 0.4 $\Omega$
RL = 1.2 $\Omega$	RL = 1 $\Omega$	RL = 0.86 $\Omega$	RL = 0.75 $\Omega$	RL = 0.67 $\Omega$	RL = 0.6 $\Omega$
$\pm 50$ A/RL = 1.2 $\Omega$	$\pm 60$ A/RL = 1 $\Omega$	$\pm 70$ A/RL = 0.86 $\Omega$	$\pm 80$ A/RL = 0.75 $\Omega$	$\pm 90$ A/RL = 0.67 $\Omega$	$\pm 100$ A/RL = 0.6 $\Omega$
$\pm 75$ A/RL = 0.8 $\Omega$	$\pm 90$ A/RL = 0.67 $\Omega$	$\pm 105$ A/RL = 0.57 $\Omega$	$\pm 120$ A/RL = 0.5 $\Omega$	$\pm 135$ A/RL = 0.44 $\Omega$	$\pm 150$ A/RL = 0.4 $\Omega$
$\pm 41.5$ A/RL = 1.2 $\Omega$	$\pm 49.8$ A/RL = 1 $\Omega$	$\pm 58.1$ A/RL = 0.86 $\Omega$	$\pm 66.4$ A/RL = 0.75 $\Omega$	$\pm 74.7$ A/RL = 0.67 $\Omega$	$\pm 83$ A/RL = 0.6 $\Omega$
500 Hz reference)		CV mode: DC to 170 kHz (amplitude 12 V <sub>p-p</sub> , 500 Hz reference), CC mode: DC to 70 kHz (amplitude 12 V <sub>p-p</sub> , 500 Hz reference)			
		CV: 2.7 $\mu$ s*1 (square $\pm 60$ V), CC: 4.2 $\mu$ s*1 (square, for the following current)			
$\pm 50$ A	$\pm 60$ A	$\pm 70$ A	$\pm 80$ A	$\pm 90$ A	$\pm 100$ A
1.4 m $\Omega$ + 0.31 $\mu$ H	1.2 m $\Omega$ + 0.3 $\mu$ H	1 m $\Omega$ + 0.29 $\mu$ H	0.9 m $\Omega$ + 0.27 $\mu$ H	0.8 m $\Omega$ + 0.26 $\mu$ H	0.7 m $\Omega$ + 0.24 $\mu$ H
2 k $\Omega$ // 2.25 $\mu$ F	1.7 k $\Omega$ // 2.7 $\mu$ F	1.4 k $\Omega$ // 3.15 $\mu$ F	1.3 k $\Omega$ // 3.6 $\mu$ F	1.1 k $\Omega$ // 4.05 $\mu$ F	1 k $\Omega$ // 4.5 $\mu$ F
		-50A to +50A			
		-60A to +60A			
		-70A to +70A			
		-80A to +80A			
		-90A to +90A			
		-100A to +100A			
		0 to 150 A <sub>p-p</sub>			
		0 to 180 A <sub>p-p</sub>			
		0 to 210 A <sub>p-p</sub>			
		0 to 240 A <sub>p-p</sub>			
		0 to 270 A <sub>p-p</sub>			
		0 to 300 A <sub>p-p</sub>			
200 kHz					
step time: 0.1 ms to 999.9999 s (res 0.1 ms), parameters: DC voltage (CV), DC current (CC), superimposed AC voltage (CV), superimposed AC current (CC), stop / hold / branch					
three-wire or 323 V to 433 V, three-phase, four-wire (specified on order)					
6 kVA max.		7.2 kVA max.		8.4 kVA max.	
				9.6 kVA max.	
				10.8 kVA max.	
				12 kVA max.	
180 kg		260 kg		280 kg	
				300 kg	
				320 kg	
				340 kg	

# FUNCTION MODULES

Advanced circuit and various types of electronic equipment combined with advanced technology and reliable mounting technology.

## FILTER

Filters for noise removal and anti-aliasing are modularized. The characteristics you need are available from a wide range selection of models.

- **Resistor tunable filter**

Filter module that sets the cutoff (center) frequency with external resistors.

- **Programmable filter**

Filter module that sets the cutoff (center) frequency with logic signals.

- **Voltage tunable filter**

Filter module that sets the cutoff (center) frequency with external DC voltages.

- **Fixed frequency filter**

A semi-custom-made filter module that the customers can select the filter characteristics and designate necessary items, such as cutoff frequency, and create it.



## AMPLIFIER

Amplifier modules having low noise and excellent frequency characteristics. A highly accurate amplifier circuit can be realized with a few external components.

- **Low noise amplifier**

It is an amplifier module with extremely low internal noise. While achieving low noise, it has excellent DC and frequency characteristics. Thus, it is possible to achieve both high-precision signal processing and high-density mounting.

- **Transconductance amplifier**

It outputs and applies a weak current of  $\mu\text{A}$  level. It is a voltage to current conversion module that can supply bipolar output current.

- **Transimpedance amplifier**

High gain, broadband, low noise. Current amplifiers that realize the world's highest performance with original circuit design technology.

- **Piezo driver**

It is a linear amplifier that outputs 150 Vpp. This amplifier is optimum for driving various piezoelectric actuator.



## OSCILLATOR

Lineup for low distortion sine-wave oscillator modules that can set the oscillation frequencies with external resistors.

- **Resistor tunable oscillator**

Oscillator module that sets the frequency with external resistor.

- **Random binary generator**

Oscillator which can be output binary signals from a random timing. It is possible to make white noise combination with lowpass filter.



## PHASE DETECTOR

A phase detector module is used to detect signals that are buried in noise as well as signals extremely minor levels.

- **Phase detector**

A phase detector module can detect small level signals and signals that are buried in noise.

- **Vector detector**

It detects the quadrature phase using phase detector module. The amplitude and the phase of the input signal synchronous with a reference signal are calculated by a DSP.



## CUSTOM DEVICE

Based on customer's requests, we can do circuits design, sample prototypings, and mass productions. Designing and manufacturing include small quantity lot and board mounting, also support highly reliable products, such as hermetic seals.



# CUSTOMIZED PRODUCTS

## RIPPLE CURRENT TESTER



A device that tests the reliability of a capacitor and coil by applying a DC bias and superimposing a sinusoidal ripple current. Meets the needs of reliability tests, deterioration tests, and noise tests of capacitors and coils.

- **For electrolytic capacitors**

- Frequency range: 120 Hz to 100 kHz
- Ripple current: 100 A
- Waveform: sine wave
- Multi channels

- **For power inductor**

- Frequency range: 10 kHz to 150 kHz
- Ripple current:  $\pm 30\text{ A}$
- Inductance: 10  $\mu\text{H}$  to 500  $\mu\text{H}$

## BIDIRECTIONAL DC POWER SUPPLY / BATTERY SIMULATION POWER SUPPLY



For evaluation of secondary batteries and various simulated power supplies

- Output range: 0 to 400 V /  $\pm 50\text{ A}$  /  $\pm 20\text{ kW}$
- 800 V in 2 series,  $\pm 500\text{ A}$  in 10 parallel
- Constant voltage / constant current / constant power output, switchable
- Limiter function, load protection function, measurement function, remote sensing
- A maximum of 10 units lithium ion battery simulated power sources can be combined and controlled together with the controller
- Supports solar cell simulation

## MULTICHANNEL LOW NOISE AMPLIFICATION SYSTEM

Sensors, from low resistance to high resistance  
Highly accurate signal processing



- Low Noise
  - Bipolar Input: 1.3  $\text{nV}/\sqrt{\text{Hz}}$
  - FET Input: 2.5  $\text{nV}/\sqrt{\text{Hz}}$
- Multifunction
  - Input-coupling: DC / AC
  - Input-mode: differential / single-ended / GND
  - LPF: THRU (OFF) / LPF (ON,  $f_c = 1\text{ MHz}$ )
  - Equivalent input offset voltage adjustment range:  $\pm 100\ \mu\text{V}$
  - Amplifier GND: FLOAT / EXTERNAL

## NF Corporation

- **Head Office: Yokohama, Japan**
- **Establishment: April 1959**
- **Business Description:**  
Development, Manufacture and Sales of Measurement Instruments, Power Supplies, Device Modules and Customized Products
- **Production Sites: Yokohama and Yamaguchi (2 sites)**
- **Overseas Office: Ohio, USA and Shanghai, CHINA**



Head Office