COSINUS MESSTECHNIK GMBH

Datenblatt

NF-WF-Serie

Inhalt:

COSINUS MESSTECHNIK GMBH

200MHz

MULTIFUNCTION GENERATOR

WF1967/WF1968

An original function generator with features beyond high-performance and multi-functions

WAVE FACTORY

NF's concept of a function generator that covers all the basics and fully responds to the demand for high quality signals.
And equipped with NF-only features that are not available in other products.

NF's concept of basic performance and functions, based on our continuous development of function generators

Maximum frequency 200MHz with high-accuracy and high-resolution

This generator supports a wide band range with sine wave output from 0.01 μHz to a maximum of 200 MHz, and square wave and pulse wave output from 0.01 μHz to 70 MHz.
The frequnecy output accuracy is ± (3 ppm of setting + 6 pHz) and 0.01 μHz(less than 50 MHz) of high resolution frequency settings are available.

Waveform amplitude resolution: 16-bit

With its original circuit configuration, this model achieves 16 bit amplitude resolution that is typically not available in 100 MHz class function generators. Waveforms of every type — sine wave, square wave, arbitrary wave, etc. — can be obtained with low spurious signal levels.

Amplitude setting: maximum 20 Vp-p / open

The maximum output voltage is 20 Vp-p below 110 MHz. The minimum setting resolution is 0.1 mVp-p, and a setting of 0 V p-p is also possible.
The auto range function enables the optimal output voltage range to always be selected from the full output voltage range. By setting the level to reduce the degradation of the amplitude setting accuracy, very high amplitude setting accuracy can be achieved. In addition, when amplitude discontinuity due to range switching becomes a problem, it is also possible to select range hold.

Wide array of output waveform

The basic waveforms as sine wave, square wave (duty variable), pulse waves (pulse width, duty, rising/falling time variables), ramp wave (symmetry variable), noise (Gaussian distribution), and DC can be generated, and preinstalled 25 types of waveforms (parameter-variable waveform) that commonly used in various fields are supported also.
In addition, the user can define arbitrary waveforms up to 1Mi* words in maximum, and these can be easily set on the control panel or created using the included arbitrary waveform editor.

* Mi represents 2^{20} = 1048576. (IEC 60027-2, IEEE 1541-2002)

Parameter-variable waveform, arbitrary waveforms P.5

Various oscillation modes

Equipped with various oscillation modes: continuous, sweep (frequency, phase, amplitude, DC offset, duty), burst (auto burst, trigger burst, gate, triggered gate), sequence, internal modulation and external modulation (FM, FSK, PM, PSK, AM, DC offset modulation and PWM).
The variety of settings available in each mode supports the output of various test signals and complex testing efficient.

Sequence function

The sequence function, can output parameters sequentially such as waveform, frequency, amplitude, DC offset, phase, and square wave duty, has equipped. The sequence function can be programmed on the unit itself or using the included software.

Sequence function P.6

2-channel ganged operation (WF1968 only)

In addition to two independent channel settings, 2-phase and constant frequency difference setting is possible. While the 2-channels are ganged, each sweep oscillation modes can be operated. The output of each channel is isolated from the chassis.

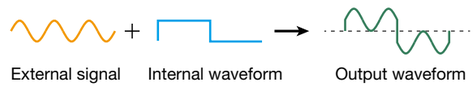
- Independent ● 2-phase (same frequency)
- Constant frequency difference ● Constant frequency ratio
- Differential output (same frequency, amplitude, and DC offset, reverse phase waveforms)
- Differential output 2 (same frequency and amplitude, reverse phase waveforms of DC offset are reverse polarity)

Floating

The signal ground of waveform output is isolated from the chassis and can be connected to different potential devices.
Based on this, the noise caused by ground loop, can reduced also. Channels are also isolated from each other in the 2-channle model.

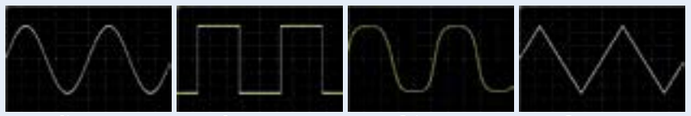
External addition input

An external signal can be added to the waveform generated internally when output.
Input frequency is from DC to 100 MHz.

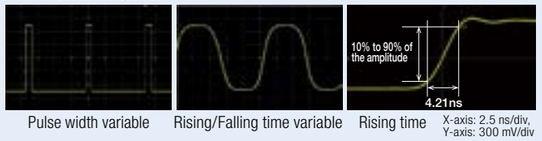


Waveform

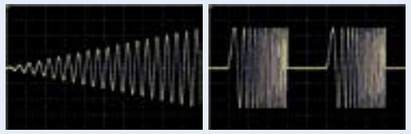
Wide array of output waveform and various oscillation modes



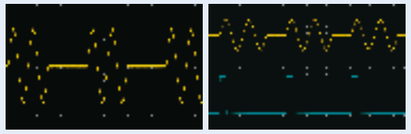
As a pulse generator



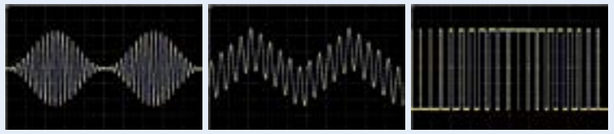
Sweep

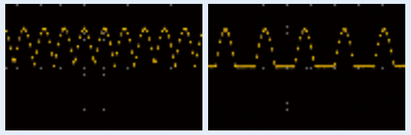


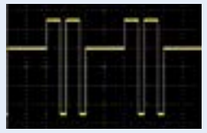
Burst, trigger, gate



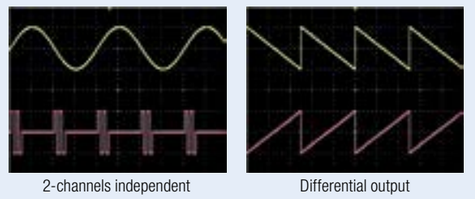
Modulation



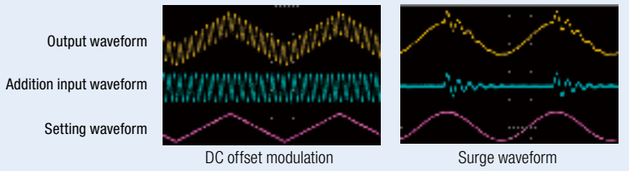




2-channel ganged operation



External addition Input

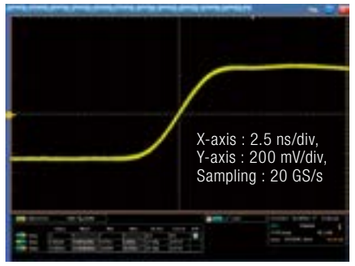


Generates high-quality signals to meet advanced testing needs

Low jitter < 85 ps rms

Compared with previous models, jitter is significantly reduced to 85 ps rms or less(typ. 100 Hz or more), achieves stable square wave output.
In addition, trigger jitter is also reduced to 0.2 ns rms or less (typ.)

Rise of waveform observed on an oscilloscope
Square wave 5 MHz, 1 Vp-p, offset 0 V



Low distortion < 0.04 %

This function generator achieves sine wave output with total harmonic distortion (THD) of 0.04 % or less (guaranteed value) and low distortion.

High-speed, large-capacity arbitrary wave form: 420 MS/s, 4 Mi* words

Achieves a high-speed sampling rate of 420 MS/sec for arbitrary waveforms, which is faster compared with the previous models. Equipped with large capacity total memory of 4 Mi words and supports a maximum of 1 Mi words per waveform. Arbitrary waveforms can also be saved to external USB memory and used. In addition, the amplitude resolution of 16 bits enables the accurate output of complex signals defined by the user.

* Mi represents 2^{20} = 1048576.

High-resolution setting

From ultra-low frequency to high frequency, we have maintained a high setting resolution for the frequency setting resolution: 0.01 µHz at less than 50 MHz and 0.1 µHz at 50 MHz or more.
In addition, high-precision signals can be output since the various parameters are possible to set at a high resolution, such as the amplitude setting resolution: 0.1 mVp-p, the phase setting resolution: 0.001°, and the square wave and pulse wave duty setting resolution: 0.0001%.

Real-time frequency response correction

Automatically corrects the amplitude in real time depending on the oscillation frequency.
This reduces amplitude fluctuations in frequency modulation and frequency sweep.

Original functions available only in NF's function generators

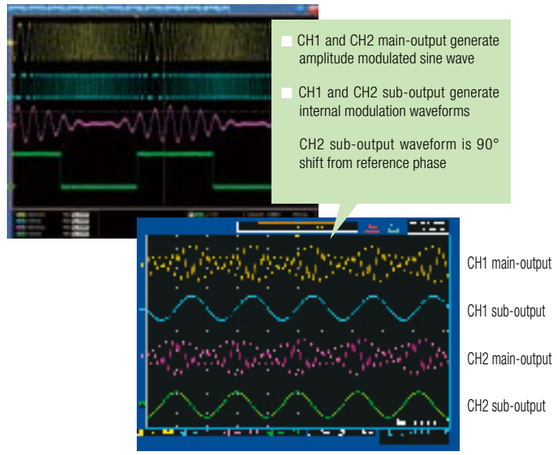
Equipped with Plus One Channel sub-output

A four-phase signal generator in WF1968, a two-phase signal generator in WF1967.

The sub-output can be used to output a continuous signal independent from the main output. It is possible to set waveform, phase, amplitude, DC offset and a phase difference between the sub-output and main-output. In addition, when using the internal modulation function in the main output, the modulation waveform can be output from the sub-output. With freely settable sub-output, one function generator can be used as a multi-phase signal generator.

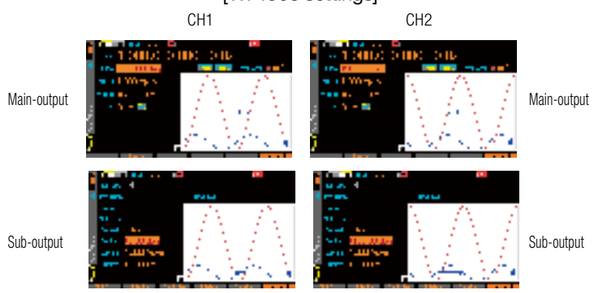
■ Output waveforms

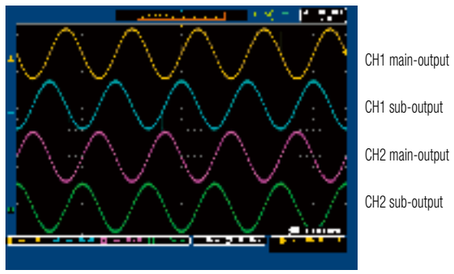
Sine wave, square wave (50% duty cycle), ramp wave (50% symmetry), rising ramp wave, falling ramp wave, noise, arbitrary wave.



Outputs 90° phase shift waveforms per channel with WF1968.

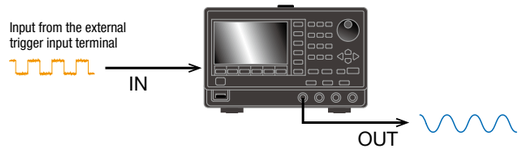
[WF1968 settings]

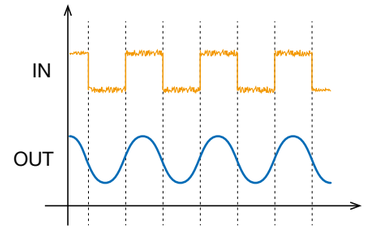




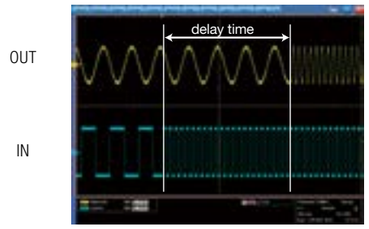
Synclator function (synchronized with external signal)

This function automatically synchronizes with a signal input from an external source and the main-output signal. It is also possible to adjust the phase difference between the external input signal and the main-output.
This is useful function for waveform conversion or shaping for fluctuating signals and rotating equipment applications.

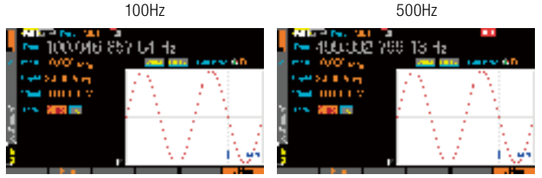




Input of 100 Hz and 500 Hz external signals



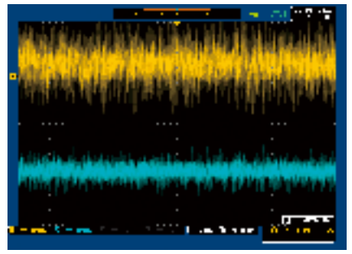
[Synchronizing frequency display]



■ Can be used as a simple frequency counter

Noise equivalent bandwidth setting

The noise waveform can be set to the equivalent bandwidth in seven steps of 100 M, 30 M, 10 M, 3 M, 1 M, 300 k and 100 kHz. By limiting the bandwidth using an external filter, the amplitude will also be small. However, by using the noise equivalent bandwidth setting function, an external filter will not be required, and the noise bandwidth can be limited while the amplitude (noise rms) is in a constant state.

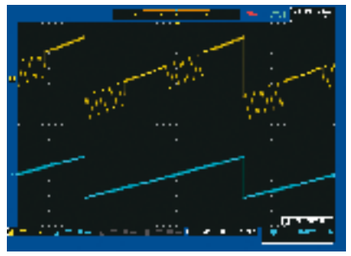


●Output : 1 Vp-p setting
CH1 :
bandwidth setting : 30 MHz
CH2 :
bandwidth setting : 100 MHz, band-limited by 30 MHz cut-off frequency low-pass filter (LPF)*

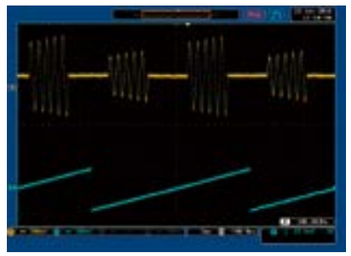
* NF filter 3660 A

Burst and modulation, sweep and modulation

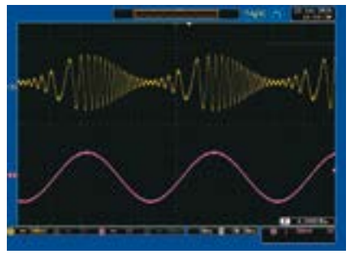
Internal modulation or external modulation is possible at the same time as the burst oscillation.
Also, external modulation can be used in an oscillation sweep.



DC offset modulation of burst oscillation with rising ramp wave



Amplitude modulation of burst oscillation with rising ramp wave



Amplitude modulation with frequency sweep of sine wave

Generate complex waveforms freely. Also have the fulfilled functions of arbitrary waveform generator.

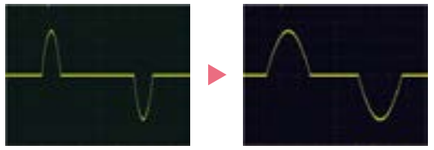
Parameter-variable waveforms + Arbitrary waveforms + Sequence function

Parameter-variable waveforms

Recently, the arbitrary waveform needs has increasing in the market, the “Parameter-variable waveform” has been appreciated from users. It is the original function of NF’s function generator equipped since previous models.
The 25 types of waveforms that must generally be created as arbitrary waveforms and are commonly used waveforms as simulated signals in such fields as electronic circuit, communications and machinery are built in as standard waveforms.
The specific parameters related to waveforms can be set by operating control panel of the generator. While waveforms are being output, it is also possible to change multiple parameters.

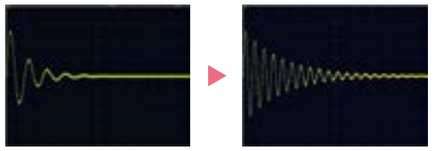
■ CF controlled sine

Variable parameter: crest factor



■ Damped oscillation

Variable parameters: oscillation frequency, damping time constant



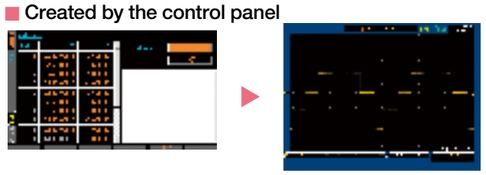
Arbitrary waveforms

Based on maximum 1Mi words/waveform and on-board 4Mi words memory, maximum 128 of arbitrary waveforms can be output.

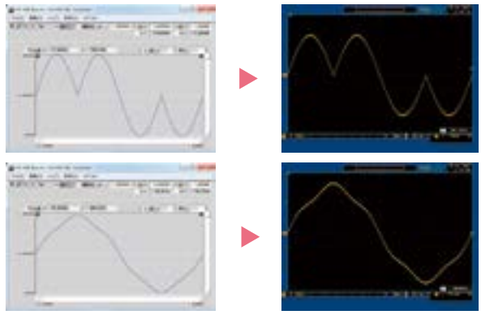
* Mi represents 2^{20}=1048576

- Waveforms can be created by the control panel or by using the included arbitrary waveform editor
- Waveform data can also be stored in an external USB memory
- Parameter-variable waveforms can be saved as arbitrary waveforms and reused

■ Created by the control panel



■ Created using the arbitrary waveform editor

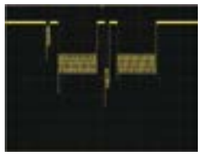


Sequence function

The waveform, frequency, phase, amplitude, DC offset, square wave duty can all be output while being changed one after another.
Variety of parameters change, like rapid change and sweep or repeat and jump, can be set freely.
As a result, not only ever-changing signals, such as mechanical vibrations and voltage fluctuations, but also long and complex output pattern can be programmed easily even.
Using the included sequence editor, you can efficiently create complex programs in a short time.
The combination of parameter-variable waveforms is also possible.

■ Sequence waveform example

Automotive equipment standard test



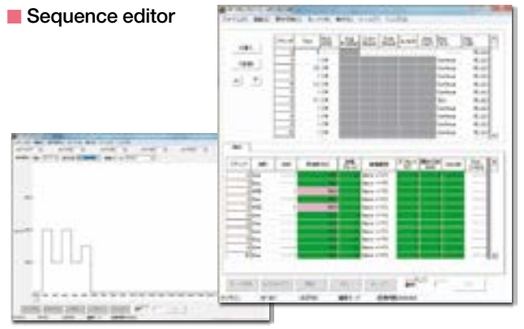
Environmental conditions and electrical testing for electrical and electronic equipment: ISO 16750:2006

Basic electrocardiogram waveform

Sequence function overview

- Channel parameters in step:
  Waveform, frequency, phase, amplitude, DC offset, square wave duty
- Step control parameters:
  Step time, hold operation, jump destination, jump count, step stop phase, branch operations, step termination control, step sync code output
- Number of steps: 1 to 255 (per sequence)
- Number of saving memory : 10 sequences. (saved in the non-volatile memory, can also be saved to USB memory)
- Available waveforms: sine wave, square wave, noise, DC, arbitrary waveform (ramp wave and parameter-variable waveforms can be saved and used as arbitrary waveforms)
- Maximum number of usable waveforms: 128
- Automatic execution possible when the power is turned on

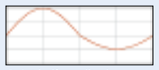
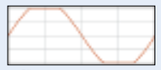
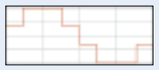
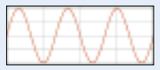
■ Sequence editor



Waveform

25 types of Parameter-variable waveforms

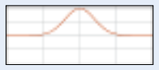
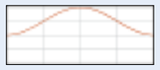
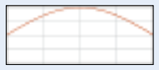
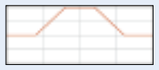
steady group

Unbalance sine	Clipped sine	CF controlled sine	Conduction angle controlled sine	Staircase sine	Multiple cycle sine
					
● 1st half amplitude ● 2nd half amplitude	● Clip rate	● Crest factor	● Conduction angle	● Number of steps	● Number of cycles ● Start phase

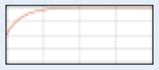
Transient sine group

On-phase controlled sine	Off-phase controlled sine	Chattering-on sine	Chattering-off sine
			
● Complete-on phase ● On-slope time	● Off-phase ● Off-slope time	● On-phase ● Number of chattering ● On-state time ● Off-state time	● Off-phase ● Number of chattering ● On-state time ● Off-state time

Pulse waveform Group

Gaussian pulse	Lorentz pulse	Haversine	Half-sine pulse	Trapezoid pulse	Sin (x) / x
					
● Standard deviation	● Half value of width	● Width	● Width	● Slope width ● Upper base width	● Number of zero crossings

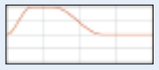
Transient response group

Exponential rise	Exponential fall	2nd-order LPF step response	Damped oscillation
			
● Time constant	● Time constant	● LPF natural frequency ● LPF Q	● Oscillation frequency ● Damping time constant

Surge group

Oscillation surge	Pulse surge
	
● Oscillation frequency ● Damping time constant ● Trailing time constant	● Rising time ● Duration time

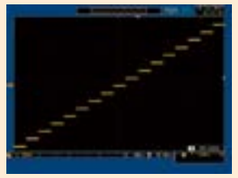
Other group

Trapezoid with offset	Half-sine edge pulse	Bottom-referenced ramp
		
● Leading delay ● Rising-slope width ● Upper base width ● Falling-slope width ● Offset	● Leading edge time ● Trailing edge time ● Duty	● Symmetry

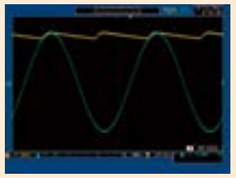
Application-specific waveform example using a variety of functions

Arbitrary waveform example created based on a customer request

Staircase waveform



Staircase waveform



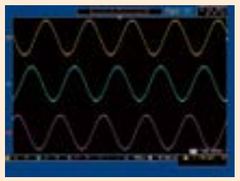
Full-wave rectifier circuit ripple waveform

Intermittent sine wave (3 waves + 1 wave)

Three-phase alternating current waveform

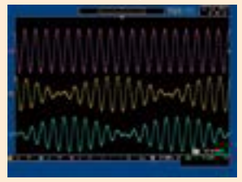
● Used functions: 2-channel ganged operation, sub-output

The main output from CH1 and CH2 is ganged, a sine wave is output from the sub-output, and a synchronized three-phase AC signal is generated. The frequency can be continuously changed, even keep 120°phase differences for each output.



Resolver signal (motor)

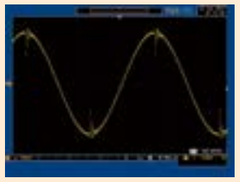
● Used function: Amplitude modulation



The sine wave is amplitude modulated and output from CH1, and the another sine wave modulated by forward 90° phase shift modulation wave, has output from CH2.

LED dimmer noise

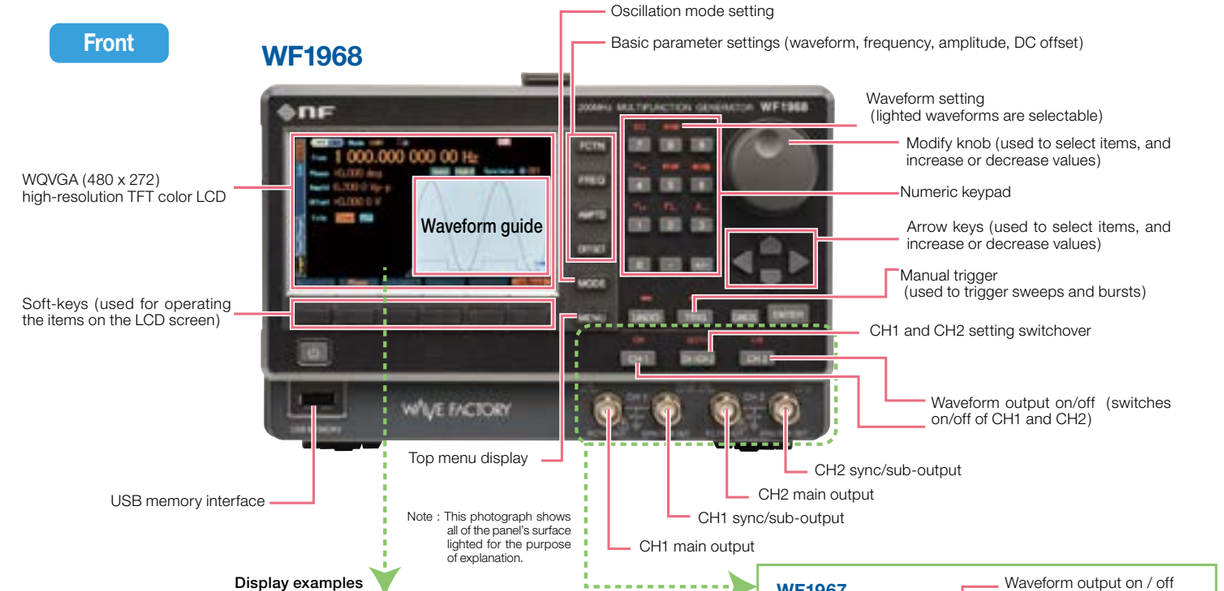
● Used function: Parameter-variable waveform



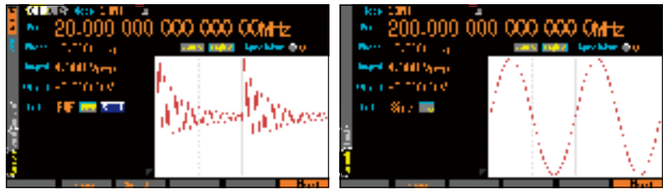
Output as an arbitrary waveform by adding the damped oscillation wave of the parameter-variable waveform to the sine wave.

Easy-to-read display and an easy-to-understand key layout. Make reliable settings using agile operations.

Front

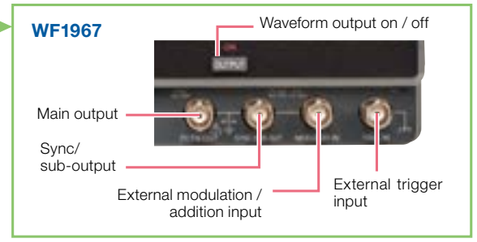


Display examples

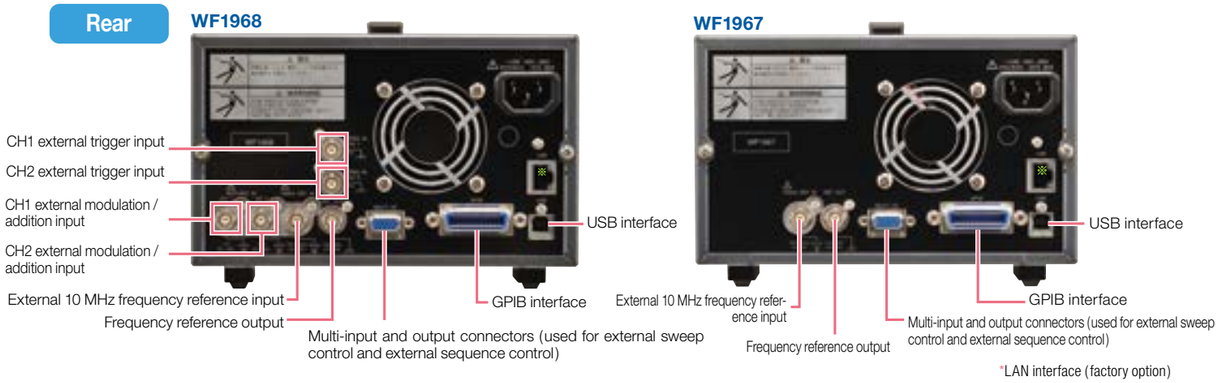


WF1968

WF1967



Rear



Packed with various features that can improve usability and expand the range of applications.

- High-resolution TFT color LCD display.
- USB memory interface for load and save files
  For managing the files for various settings and arbitrary waveforms
- Waveform guide
  Displays the set waveform, and supports intuitive operations
- Setting memory: 10 sets
- User-defined units
  Set arbitrary units using a specified conversion formula (for frequency, cycle, amplitude, DC offset, phase, duty)
- Load impedance
  Set and display the output voltage at a specified load impedance
- External 10 MHz frequency reference input
  Inputting an external 10 MHz frequency standard signal to the external 10 MHz frequency reference input (10 MHz REF IN) enables highly accurate frequency output.
- Multiple unit synchronization
  Synchronous operation of up to six units is possible through master-slave connections
- USB and GPIB interfaces equipped.
- Arbitrary waveform editor and sequence editor are included as standard.
- Interchangeable Virtual Instruments (IVI) instrument drivers are included as standard.

SPECIFICATIONS

WAVE FACTORY

Unless otherwise spesified, the value assumes the following conditions:continuous oscillation, load of 50Ω, oscillation setting of 10 Vp-p/50Ω, DC offset setting of 0 V, auto range, waveform amplitude range of ±FS, external addition turned off, AC voltage is the rms value.
*Ki and Mi represent 2^{10}=1024 and 2^{20}=1048576, respectively. IEC 60027-2/IEEE 1541-2002
∗1 : Guaranteed numeric value. Other numeric values are nominal or typical (typ.) values.

Waveform and Oscillation Mode

Output waveform	Standard waveform (sine, square, pulse, ramp, parameter-variable, noise (Gaussian distribution), DC), and arbitrary waveform.
Oscillation mode	Continuous, modulated, burst, sweep, sequence In burst mode, modulation function is available and in sweep mode, modulation function is available

Frequency and Phase

Frequency setting range

Waveform \ Oscillation mode /Function	Continuous, modulation, sweep (continuous and single)	Sweep (gated single), burst, sequence
Sine	0.01μHz to 200MHz	0.01μHz to 100MHz
Square	0.01μHz to 70MHz	
Pulse	0.01μHz to 70MHz (not available for sequence)	
Ramp	0.01μHz to 20MHz	
Parameter-variable	0.01μHz to 20MHz	
Noise	Equivalent bandwidth: Select from 100M/30M/10M/3M/1M/300k/100kHz	
DC	Frequency setting is invalid	
Arbitrary	0.01μHz to 20MHz	

Frequency setting resolution	0.01μHz (< 50MHz), 0.1μHz (50MHz≤)
Frequency setting with a period	Setting with frequency that is inverse number of set period (less than 0.01μHz is rounded half up)
Frequency accuracy at shipping time∗1	±(3ppm of setting + 6pHz)
Frequency aging rate∗1	±1ppm/year

Phase setting range

Main-output	-1800.000° to +1800.000°(resolution 0.001°)
Sub-output/Sub-waveform	-180.000° to +180.000°(resolution 0.001°)

Output Characteristics

Amplitude

Setting range	0Vp-p to 20Vp-p/open, 0Vp-p to 10Vp-p/50Ω AC+DC≤±10V/open or less, ±2V/open (exceeding 110MHz)
Setting resolution	999.9mVp-p or less: 4 digits or 0.1mVp-p 1Vp-p or more: 5 digits or 1mVp-p
Accuracy∗1	±(1% of amplitude setting [Vp-p] + 2mVp-p)/open (1kHz sine wave, load open, amplitude setting 20mVp-p or greater)
Setting unit	Vp-p, Vpk, Vrms, dBV, dBm
Resolution of waveform amplitude	Approx. 16 bit (8mVp-p or greater / open)

DC offset

Setting range	±10V/open, ±5V/50Ω AC+DC≤±10V open/or less, ±2V/open(exceeding 110MHz)
Setting resolution	±499.9mV or less : 4 digits or 0.1mV ± 0.5V or more : 5 digits or 1mV
Accuracy∗1	±(|1% of DC offset setting [V]|+10mV +0.5% of amplitude setting [Vp-p])/open (10MHz or less, sine wave, load open, 20°C to 30°C)

Waveform output (Main-output)<FCTN OUT>

Output on/off control	On/Off (switch) (output terminal is released when out put off)
Output impedance	50Ω, unbalanced
Signal GND	Insulated from enclosure, maximum 42Vpk (DC + AC-peak)Each channel independent. Between channels is also maximum 42Vpk.

Synchronization/Sub-output <SYNC/SUB OUT>

Output signals	Reference phase synchronization, internal modulation synchronization, burst synchronization, sweep synchronization, sub-waveform, internal modulation signal, sweep X drive and off switching.
Sub-waveform	Analog waveform output synchronized with the main-output. Phase is variable to the reference phase synchronization signal, and the amplitude and offset are also adjustable. Available waveform : sine, square (duty 50%), ramp (symmetry 50%), rising ramp, falling ramp, noise and arbitrary waveform.
Internal modulation waveform	Modulation waveform at the time of internal modulation oscillation. Phase is variable to the reference phase synchronization signal, and which amplitude and offset are also adjustable independent from the modulation depth.
Output voltage	Each type of synchronized signal • TTL level (low level 0.4V/open or less, high level 2.7V/open or more) Sub-waveform/internal modulation waveform • Amplitude setting range: 0Vp-p to 6Vp-p/open, setting resolution 1mVp-p • DC offset setting range: ±3V/open, setting resolution 1mVp-p • A peak value combining waveform amplitude and DC offset is limited to ±3V/open or less. Sweep X drive : 0Vp-p to 6Vp-p/open
Output impedance	50Ω, unbalanced

Signal Characteristics

Sine wave

Amplitude frequency characteristics∗1	Up to 100kHz : ±0.1dB 100kHz to 5MHz : ±0.15dB 5MHz to 20MHz : ±0.2dB 20MHz to 50MHz : ±0.5dB 50MHz to 100MHz : ±0.7dB 100MHz to 200MHz : ±0.8dB [50mVp-p to 10Vp-p/50Ω, when 100MHz or greater, 50mVp-p to 2Vp-p/50Ω, reference frequency 1kHz]
Total harmonic distortion∗1	20Hz to 20kHz: 0.04% or less (1Vp-p/50Ω, sum up to 7th harmonic,noise is not included)
Harmonic spurious∗1	Up to 1MHz : −60dBc or less 1MHz to 5MHz : −50dBc or less 5MHz to 30MHz : −40dBc or less 30MHz to 200MHz : −30dBc or less [1Vp-p/50Ω, sum up to 5th harmonic]
Non-harmonic spurious∗1	Up to 8MHz : −55dBc or less 8MHz to 80MHz : −55dBc+20dB/dec or less 80MHz to 200MHz : −35dBc or less (2Vp-p/50Ω, measured at 500MHz bandwidth)

Square wave

Duty variable	Normal : setting range 0.0100% to 99.9900%(resolution 0.0001%) Upper limit(%): 100−frequency[Hz]/1,400,000 Lower limit(%): frequency[Hz]/1,400,000 Jitter 85ps rms or less typ.(100Hz or more) Extended: setting range 0.0000% to 100.0000%(resolution 0.0001%) Jitter 700ps rms or less typ.
Duty accuracy∗1	Up to 300kHz : ±0.1% of period (duty setting is 1% to 99%) 300kHz to 3MHz : ±1% of period (duty setting is 5% to 95%) 3MHz to 10MHz : ±3% of period (duty setting is 40% to 60%)
Rising/Falling time	4.6ns or less,∗1 4.4ns or less typ. (2Vp-p/50Ω)
Overshoot	5% or less typ.

Pulse wave

Pulse width	Duty setting range:0.0001% to 99.9999% (resolution 0.0001%) Time setting range:6.88ns to 99.9999Ms (resolution 0.001% or less of period or 0.01ns)
Rising/Falling time	Setting range: 4.21ns to 58.8Ms (resolution 3 digits or 0.01ns or 1ppm of period) Rising/Falling time independently set Minimum setting value: 1ppm or 4.21ns, whichever is larger
Overshoot	5% or less typ.
Jitter	90ps rms or less typ. (100Hz or more)

Ramp wave

Setting range of symmetry	Setting range of symmetry : 0.00% to 100.00% (resolution 0.01%) At sub-output, symmetry is 0%, 50%, 100% only

Noise

Noise equivalent bandwidth setting range	Select from 100M/30M/10M/3M/1M/300k/100kHz

Parameter-variable waveform

Steady sine group	Unbalance sine, clipped sine, CF controlled sine, conduction angle controlled sine, staircase sine and multiple-cycle sine
Transient sine group	On-phase controlled sine, off-phase controlled sine, chattering-on sine and chattering-off sine
Pulse waveform group	Gaussian pulse, lorentz pulse, haversine, half-sine pulse, trapezoid pulse and Sin(x)/x
Transient response group	Exponential rise, exponential fall, second order LPF step response and damped oscillation
Surge group	Oscillation surge, pulse surge
Other group	Trapezoid with offset, half-sine edge pulse and bottom referenced ramp
Use of waveform	Can be used after converted into arbitrary waveform with sequence function (sub-output is not selectable)

Arbitrary waveform

Waveform length	Number of control points 2 to 10,000 or 4Ki to 1Mi words (2^n, n=12 to 20)(Conrol points are linearly interpolated)
Total amount of saved waveforms	Maximum 128 waves or 4Mi words (total of channnels 1 and 2). Waveforms can be saved in the nonvolatile memory or external USB memory
Resolution of waveform date amplitude	16bit
Sampling rate	420MS/s

Modulation

Operation in the burst/sweep mode	Partly possible in the burst and sweep oscillation mode.
Modulation type	FM, FSK, PM, PSK, AM, DC offset modulation and PWM • Frequency setting is higher than 160MHz, external modulation of FM, FSK and AM are only selectable. • Simultaneously using the sweep function, FSK, PSK and the same modulation type as the sweep type are not selectable. • Simultaneously using the burst function, FSK, PSK can select in auto burst mode only.
Modulation source	Internal/external (selectable) • CH2 (WF1968 only) can select internal/external/CH1. (When trigger source of CH1 is external, CH1 is not available other than FSK and PSK) • Simultaneously using the sweep function, internal modulation source is not selectable.

Internal modulation

Internal modulation waveform	Other than FSK, PSK :Sine, square (duty 50%), triangle (symmetry 50%), rising ramp, falling ramp, noise, arbitrary waveforms FSK, PSK: Square wave (duty 50%) Noise equivalent bandwidth: Select from 100M/30M/10M/3M/1M/300k/100kHz
Internal modulation frequency	Other than FSK, PSK:0.1mHz to 20MHz (resolution 12 digits or 1μHz) FSK, PSK: 0.1mHz to 5MHz (resolution 11 digits or 1μHz)
Internal modulation synchronization output	Output waveform : A square wave with duty 50% rising at the zero phase of the internal modulation waveform. When internal modulation waveform is noise, the level is fixed to low. Output connector : Shared with synchronization/sub-output connector
Internal modulation waveform output	Output voltage : -3V to +3V/open. Output connector: Shared with synchronization/sub-output connector

External modulation

External modulation input	Other than FSK, PSK	Input voltage range: ±1V full scale Maximum allowable input: ±2V Input impedance: 10kΩ, unbalanced Input frequency: DC to 400 kHz (-3 dB) Input connector: BNC receptacle (MOD/ADD IN)
	FSK, PSK	Polarity: Positive/Negative (switch) Input frequency: DC to 5MHz Input connector: External trigger input (TRIG IN)
Signals selectable for synchronization/sub-output		Reference phase synchronization, internal modulation synchronization (when modulation source is internal), internal modulation signal (when modulation source is internal and other than FSK and PSK). Off (forcibly turned off also when the oscillation frequency may exceed 160MHz)

Modulation types and conditions

FM	Carrier waveform : Standard waveform except for noise, pulse wave and DC, and arbitrary waveform. Peak deviation :0.00μHz to less than 100MHz (resolution 8 digits or 0.01μHz).
FSK	Carrier waveform : Standard waveform except for noise, pulse wave and DC, and arbitrary waveform. Hop frequency : Within the allowable range of frequency for each carrier waveform (resolution 8 digits or 0.01μHz).
PM	Carrier waveform :Standard waveform except for noise and DC, and arbitrary waveform Peak deviation: 0.000° to 180.000° (resolution 0.001°)
PSK	Carrier waveform :Standard waveform except for noise and DC, and arbitrary waveform Deviation : -1800.000° to +1800.000° (resolution 0.001°)
AM	Carrier waveform : Standard waveform except for DC, and arbitrary waveform Modulation depth: 0.0 % to 100.0 % (resolution 0.1%) (DSB-SC and Non-DSB-SC)
DC offset modulation	Carrier waveform : Standard waveform and arbitrary waveform Peak deviation : 0V to 10V/open Setting resolution : 4 digits or 0.1mV (499.9mV or less), 5 digits or 1mV (0.5V or more).
PWM	Carrier waveform : Square wave and pulse wave Peak deviation : Square wave Duty variable range standard 0.0000% to 49.9900% (resolution 0.0001%) Duty variable range extend 0.0000% to 50.0000% (resolution 0.0001%) Pulse wave 0.0000% to 49.9000%(resolution 0.0001%)

■ Sweep

Sweep types	Frequency, phase, amplitude, DC offset and duty. When the upper limit exceeds 160MHz, only frequency and phase are available
Sweep function	One way (ramp waveform), shuttle (triangular waveform) (switch). Linear, logarithmic (switch). Common regardless of sweep type. However, logarithmic can use only frequency sweep.
Sweep range setting	Start and stop values or the center and span values are specified. Center value is simple average of start and stop value during frequency logarithmic sweep. Assigning a marker value to a center value is possible (inverse setting possible).
Setting range of sweep time	0.1ms to 10,000s (resolution 4 digits or 0.1ms)
Sweep mode	Continuous / Single-shot / Gated single-shot selectable Oscillation only occurs during sweep execution in the gated single-shot mode Gated single-shot is not available at DC waveform.
Operation	Start, stop, hold/resume, starting value output and stop value output.
Trigger source	Used for single-shot sweep and gated single-shot sweep Internal/external input terminal selecatble (CH2 can select from the same trigger source as CH1) Triger delay setting is invalid. Manual trigger is available.
Internal trigger	Used for single-shot sweep and gated single-shot sweep Period setting range:100.0μs to 10,000s (resolution 5 digits or 0.1μs)
Stop level setting	Specifies the signal level when gated single-sweep is stopped. Setting range : -100.00% to +100.00% (amplitude full-scale reference and resolution 0.01%) or off
Oscillation stop unit when gated single	Cycle/Half cycle (selectable)
Sweep input/output	Sweep synchronization/marker output (synchronization/sub-output connector) Sweep X drive output (synchronization/sub-output connector) Sweep external control input (multi input/output connector) Sweep external trigger input (external trigger input terminal)
Signals selectable for synchronization/sub-output	Reference phase synchronization, sweep synchronization/marker, sweep X drive off
Use of modulation function	External modulation other than sweep type is simultaneously available (other than FSK, PSK)

■ Burst/Gate/Trigger

Burst/Gate

Burst mode	Auto burst, trigger burst, gate and triggered gate
Target waveform	Auto, trigger burst : Standard waveform except for noise and DC, and arbitrary waveform Gate, triggered gete : standard waveform except for DC, and arbitrary waveform
Mark/Space wave number setting range	0.5 to 999,999.5 cycles, 0.5 cycle unit
Oscillation stop unit at gate	Cycle/Half cycle (selectable)
Phase setting range	-1800.000° to +1800.000° (resolution 0.001°)
Stop level	The signal level is specified when oscillation is stopped. Setting range : -100.00% to +100.00% (with reference to the full scale of amplitude, resolution 0.01%) or off. Oscillation stops at the set oscillation start/stop phase when the stop level is set to off.
Trigger source	Internal trigger oscillator, external input terminal (selectable) CH2 can select the same trigger source as CH1. (WF1968) Manual trigger available. Used except for auto burst
Internal trigger	Period setting range: 1.0μs to 1,000s (resolution 5 digits or 0.1μs) Used except for auto burst
External trigger input	Positive, negative, disabled (selectable) Input connector: External trigger input terminal. Used except for auto burst
Trigger delay	Setting range: 0.0ns to 1000.0000s (resolution 8 digits or 0.1ns) Additional delay approx. 380ns Valid in the trigger burst only, valid in the internal and external trigger source
Trigger jitter	0.2ns rms or less typ.
Use of modulation function	Internal modulation or external modulation can use simultaneously with the burst oscillation. FSK nad PSK can be selected in auto burst mode only

Trigger

External trigger input	Independent for each channel, however CH1 input can be shared with CH2
Input voltage	TTL level (low level is 0.8V or lower, high level is 2.6V or higher)
Maximum allowable input	-0.5V to +5.5V
Minimum pulse width	5ns
Input impedance	10kΩ (pull up to +3.3V), unbalanced
Input connector	BNC receptacle (TRIG IN)
Internal trigger oscillator	For sweep, trigger and independent for each channel (Not available for synclator)
Manual trigger	Used for single-shot sweep, gated single-shot sweep, trigger burst, gate and triggered gate. Panel key operation. (Not available for synclator).

■ Synclator Function

Frequency range	20Hz to 10MHz (Synclator function available)
Synchronization target	External trigger input terminal CH2 can select the same trigger source as CH1(WF1968 only) Trigger delay setting is invalid
Synchronization source input	Positive/Negative (selectable)
Phase difference	The phase difference between the signal input from the synchronization source and the main-output signal is adjustable.

■ Sequences

Step control parameters	Step time, hold operation, jump destination, jump count, step stop phase, branch operation, step termination control and step synchronization code output
Channel parameters in step	Waveform, frequency, phase, amplitude, DC offset and square wave duty
Available waveforms	Sine, square, noise and arbitrary waveform (the ramp and parameter-variable waveforms can be used after being saved as arbitrary waveform)
Maximum number of waveforms	128
Number of saving sequences	10 sequences (saved in the built-in non volatile memory) Allowed saving external USB memory
Number of steps	Maximum 255 steps per sequence
Step time	0.1 ms to 1,000s (resolution 4 digits or 0.01ms)
Operation in step	Constant, keep and linear interpolation (except for waveform switching)
Number of jumps	1 to 9999 or unlimited.
Step stop phase setting range	0.000° to 360.000° (CH1 reference phase. resolution 0.001°) or invalid.
Branch operation	Branches to the specified step when the branch signal is input.

■ 2-Channel Ganged Operation (WF1968 only)

Channel mode	Two channels independent, 2-phases (same frequency), constant frequency difference, constant frequency ratio, differential output (same frequency, amplitude and DC offset at reverse phase waveform), differential output2(same frequency and amplitude. DC offset is reverse phase waveform, reversed polarity)
Equivalent setting, same operation	Set two channels at the same time availabe.
Frequency difference setting range	0.00 μHz to less than 200 MHz (resolution: 0.01 μHz) CH2 frequency - CH1 frequency
Frequency ratio N:M setting range	1 to 9,999,999 (for each of N and M) N: M= CH2 frequency : CH1 frequency
Time difference between channels for 2-phase	±10ns or less typ. ±20ns or less*1 Same waveform (sine wave or square wave)

■ Other Input/Output

External 10 MHz frequency reference input

Input voltage	0.5Vp-p to 5Vp-p
Maximum allowable input	10Vp-p
Input impedance	1kΩ, unbalanced, AC coupled
Input frequency	10MHz (±5ppm : ±50Hz)
Input waveform	Sine or square wave (50%±5% duty)
Input connector	BNC receptacle (10MHz REF IN)

Frequency reference output (for synchronize multiple units)

Output voltage	1Vp-p/50Ω square wave
Output impedance	50Ω, AC coupled
Output frequency	10MHz
Output connector	BNC receptacle (REF OUT)

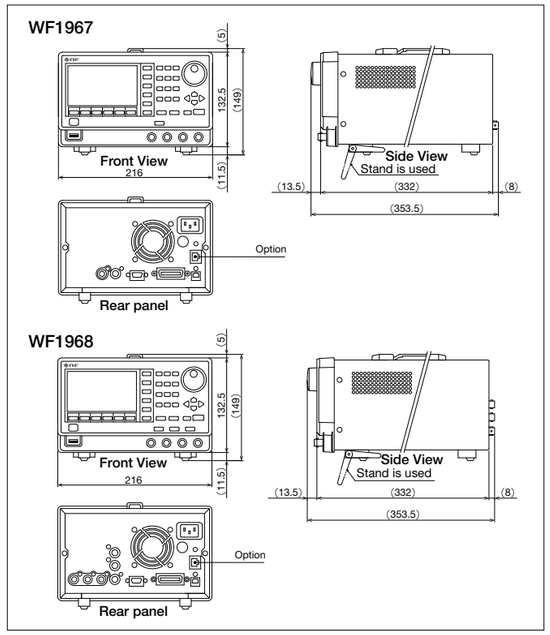
External addition input

Addition gain	x0.4, x2, x10 or off selactable The maximum output voltage range is fixed to 0.8Vp-p (x0.4) , 4Vp-p (x2) and 20Vp-p (x10) During external modulation, it is dedicated to external modulation input.
Input voltage	-1V to +1V
Maximum allowable input	±2V
Input frequency	DC to 100MHz (-3dB)
Input impedance	10kΩ, unbalanced
Input connector	BNC receptacle (MOD/ADD IN)

Multi-I/O

Multi-I/O connector	Used for sweep external control and sequence external control (Multi-I/O cable is optional)

■ Dimensions



■ Other Functions

Phase synchronization		Function to restart from the phase where the output waveforms for all the channels are set, automatic execution at channel mode switching
Synchronization of multiple units		Up to 6 units can be connected in the form of master/slave (including master unit) Connected with BNC cables by using REF OUT and external 10 MHz REF IN
User defined unit	Function	Sets and displays the value in any unit, using a specified conversion expression.
	Setting target	Frequency(Hz), period(sec), amplitude(Vp-p, Vpk), DC offset(V), phase(deg), and duty(%)
	Conversion expression	[(internal setting)+n]×m, [$\log_{10}$(internal setting)+n]×m Specify a conversion formula and values of n and m. (internal setting : the value of setting target)
	Unit character string	Up to four characters
Setting memory		10 sets (saved in the built-in non volatile memory) Allowed saving to external USB memory
Control and setting at power-on operation		Parameter setting(the operation state just before when the power was turned off is restored, the contents of setting memory No.1). Output on/off setting, sequence auto run setting on/off setting
External control interface		GPIB IEEE-488.1/USB USBTMC, USB 1.1 Full-speed SCPI-1997/IEEE-488.2, LAN(optional)

■ General

Display	4.3 inch TFT color LCD
Input/Output ground	• The signal grounds for waveform output, sync/sub output and external modulation/addition input are insulated from the enclosures. (These signal grounds are common within the same channel.) • The signal ground for external 10 MHz REF IN is insulated from the enclosures. • Each signal ground for CH1, CH2 and external 10 MHz REF IN are independent. • Maximum withstand voltage 42Vpk(DC + ACpeak)
Power supply	AC100V to 230V ±10%(250V or lower.) 50Hz/60Hz±2Hz
Power consumption	WF1967 : 65VA or lower. WF1968 : 85VA lower.
Operation temperature/humidity range	0°C to +40°C, 5% to 85% RH (Absolute humidity: 1 g/m^3 to 25 g/m^3, no condensation)
Dimensions(mm)	216(W)×132.5(H)×332(D)(not including protrusions)
Weight	Approx. 3.0kg (main unit excluding accessories)
Accessories	• Instruction Manual (operation) • CD – PDF manuals Operation, external control, arbitrary waveform editor and sequence editor – Application software Arbitrary waveform editor, sequence editor IVI(I Interchangeable Virtual Instruments) driver • Power code set (2m with 3-prong plug)

■ Application software

•Sequence editor

Editing functions	• Initializes, copies, pastes, inserts and deletes steps • Saves and reads sequence data to/from a file • Sequence can be edited without connecting the device
Display functions	• Editing screen: Lists parameters for each step • Sequence view screen: Graphs changes of up to five parameters
Transfer functions	• Transfers and reads sequence data to/from the device • Transfers to the device the arbitrary waveform used in the sequence
Device control functions	• Output on/off • Starts, stops, and holds the sequence • Can monitor the execution status of sequence
Operating environment	OS : Windows 7/8.1/10(32bit / 64bit) Japanese/English Hard disk free space: 10MB or more

•Arbitrary waveform editor

Editing functions	• Generation (standard waveform and a mathematical expression) • Interpolation (straight line, spline and continuous spline) • Math operation (+, –, ×, ÷) of waveform • Contraction and extension (vertical and horizontal directions) • Cuts, copies and pastes some part of waveform • Saves and reads arbitrary waveform data to/from a file • Waveforms can be edited without connecting the device
Display functions	• Zoom in/out • Scroll • Display unit (coordinates) selectable • Cursor (A, B)
Transfer functions	• Transfers and reads arbitrary waveform data to/from the device
Device control functions	• Major parameter setting
Operating environment	OS : Windows 7/8.1/10(32bit / 64bit) Japanese/English Hard disk free space: 10MB or more

Ordering information

Model name	Product Name	Frequency	Number of channels	
WF1967	Multifunction Generator	200MHz	1	Arbitrary waveform editor and sequence editor included as standard.
WF1968	Multifunction Generator	200MHz	2	Arbitrary waveform editor and sequence editor included as standard.

■ Option

PA-001-1318 Multi-I/O cable (Used for external sweep control and external sequence control)

PA-001-2342 LAN interface (Factory Option)

PA-001-2592 Rack Mount Kit (JIS, for 1 Unit)

PA-001-2593 Rack Mount Kit (JIS, for 2 Units)

PA-001-2594 Rack Mount Kit (EIA, for 1 Unit)

PA-001-2595 Rack Mount Kit (EIA, for 2 Units)

Related products : Choose the Best Product for your Application WAVE FACTORY family

Multifunction Generator WF1947/WF1948

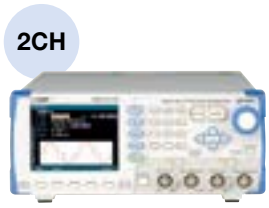
WF1947

WF1948

- Frequency setting range : 0.01μHz to 30MHz
- Amplitude resolution : 16-bit
- Output waveform :
  Sine wave, square wave, pulse wave, ramp wave, noise (Gaussian distribution), DC, arbitrary waveform
- Internal/external modulation :
  FM, FSK, PM, PSK, AM, DC offset, PWM

Multifunction Generator WF1973/WF1974

WF1973



WF1974

- Frequency setting range : 0.01μHz to 30MHz
- Amplitude resolution : 14-bit
- Output waveform :
  Sine wave, square wave, pulse wave, ramp wave, noise (Gaussian distribution), DC, arbitrary waveform
- Parameter-variable waveform : 25 types
- Internal/external modulation :
  FM, FSK, PM, PSK, AM, DC offset, PWM
- Sequence function

Note: Briefly lists the main differences in these products' specifications, but there are other additional differences in their functions and performance. Be sure to check a detailed catalog or specifications for further information.

COSINUS MESSTECHNIK GMBH

MULTIFUNCTION GENERATOR

WF1947/WF1948

0.01 µHz to 30 MHz

This is a standard Function Generator.

WAVE FACTORY

"The Function Generator" that NF offers

Ever since NF developed the first function generator in Japan, we've been addressing the true needs of our customers. Our function generators have been evolving along with our customers' desires and our determination to satisfy them.
These new products are new additions to our WAVE FACTORY product lineup. WAVE FACTORY products have accurate and stable output, an abundance of output waveforms, various oscillation modes for various purposes, outstanding user-friendliness and the flexible generation of waveforms that engineers need.
NF considers oscillators that offer the flexible generation of waveforms as the standard, and we continue to offer function generators with ever more advanced functions.

WAVE FACTORY

WF1947 (1ch) / **WF1948** (2ch)
0.01 μHz to 30 MHz

Rear Panel

○The photo shows the WF1948 (two channels)
The display here shows all the items that can be displayed on the panel.

▶Low noise

The noise level is reduced to roughly one-tenth of those of previous models* at comparatively high voltage output (about 2 Vp-p/50 Ω, without DC superposition) and within frequencies of up to 300 kHz. By employing an attenuator, the noise level at the low voltage output of about 1 Vp-p or lower has been reduced to between a half and one-third those of previous models. In all of the output ranges, dramatic noise reduction has been realized, which makes this product perfect for a wide range of uses.

▶Low distortion

A complete revision of the circuitry has realized the generation of low-distortion sine waves with total harmonic distortion of 0.4% or less. In addition to the 16-bit resolution of waveform amplitude, high-quality sine waves are produced.(Frequency setting range : 20 Hz-20 kHz, amplitude: 0.25 Vp-p/50 Ω or greater)

▶Waveform amplitude resolution: 16 bits

The circuit structure we developed has realized a 16-bit resolution of waveform amplitude, which is the highest of any oscillator designed for a maximum frequency of 30 MHz. High-quality 16-bit resolution of waveform amplitude is provided for all the waveforms you might need, including sine, square and arbitrary waveforms.

▶High amplitude setting accuracy

The auto range function facilitates the optimum selection of output voltage range. Further, by reducing the deterioration of the amplitude setting accuracy due to the setting level, it is possible to obtain a very high amplitude setting accracy. The "fixed output range" mode can be selected when discontinuous oscillation caused by changing the range is undesirable.

▶Floating

Each output terminal is insulated from the housing, which makes it possible to connect the terminal to equipment with dissimilar electric potentials. The inclusion of floating output terminals reduces noise caused by ground loops.

▶Low fan noise

The rotational frequency (Or revolution per minute) of the fan is controlled according to the detected ambient temperature. At normal room temperature, excluding start-up and abnormal operation, the noise is one-tenth of that of previous models*.

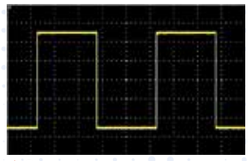
*Previous models : WF1973/WF1974

Wide array of output waveforms

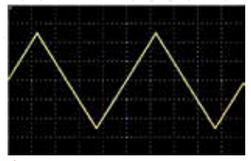
Output waveforms Sine, square, pulse, ramp and arbitrary waveforms, noise, and DC

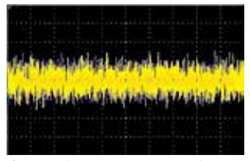
In addition to generating standard waveforms such as sine and square waveforms, it is possible to generate arbitrary waveforms of up to 512k words. Up to 128 waveforms can be stored in the 4M-word memory. All the generated waveforms have 16-bit high resolution. High-quality waveforms are indispensable for improvement in the repeatability (Or reproductivity) of tests.
Arbitrary waveforms can be set on the main unit, and the provided arbitrary waveform creation software "Arbitrary Wave Editor" makes waveform editing smooth.


▲Sine wave


▲Square wave


▲Pulse wave (Rising/falling time variable)


▲Ramp wave (Symmetry variable)


▲Noise (Gaussian distribution)

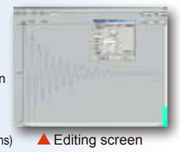

▲Arbitrary wave (overshoot)

Software for generating arbitrary waveforms "Arbitrary Wave Editor"

Software for easily generating complex arbitrary waveforms.
This software allows waveforms to be generated and math operations to be conducted by the import of mathematical expressions and external data.

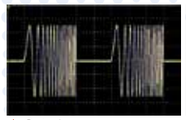
Major functions

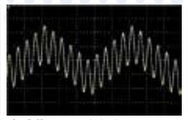
- Generation using standard waverofrm and mathematical equations.
- Straight line, spline and continuous spline interpolation
- Math operation (addition, subtraction, multiplication, and division of waveform)
- Contraction and extension (vertical and horizontal directions)

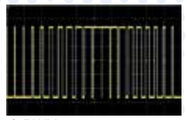

▲Editing screen

Various oscillation modes

Sweep and modulation functions

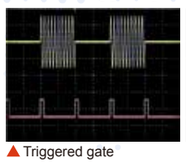

▲Gated sweep

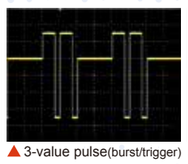

▲Offset modulation

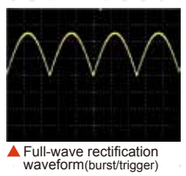

▲PWM

It's possible to perform sweeps not only of frequencies, but also of amplitudes, phases, offsets and duties (0% to 100%). In sweeping, it is possible to combine one-way or shuttle, linear or logarithmic slope*, and continuous, single-shot or gated single-shot modes.
FM, FSK, PM, PSK, AM and DC offset modulations and PWM are supported. Internal and external modulations are possible.
*Logarithmic mode is supported only for frequency sweeping.

Burst / trigger / gate

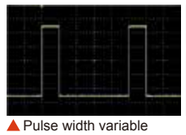

▲Triggered gate

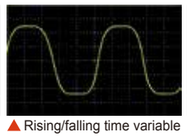

▲3-value pulse(burst/trigger)

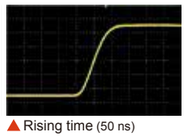

▲Full-wave rectification waveform(burst/trigger)

In the burst oscillation mode, oscillation can be started or stopped at any wave count. WF1947 and WF1948 support four modes ;
Auto burst : No trigger is needed
Trigger burst : Oscillation in sync with the trigger
Gate: Oscillation in sync with the gate signal
Triggered gate : Gate oscillation switched on/off by gate upon trigger
The phase where oscillation starts/stops and the level at which oscillation starts/stops can be set.

As pulse generator


▲Pulse width variable


▲Rising/falling time variable

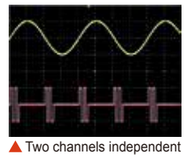

▲Rising time (50 ns)

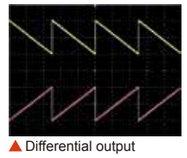
You can use this waveform generator as a signal source for digital circuits or a pulse generator. The duty/time and the rising time/falling time of pulse waves can be individually set. The generator is suited to the operation testing of a wide variety of digital equipment and devices, data transmission equipment and more.

2-channel Ganged Operation

The dual-channel WF1948 offers channel modes of two phases, constant frequency difference, constant frequency ratio and differential outputs. Various types of sweeps are possible withthe two channels in ganged operation mode.
Each channel has a floating output terminal.

- Independent output (Indep)
  Two channels programmed separately.
- Two phase (2-Phase)
  Same frequency.
- Constant frequency difference (2-Tone)
  Difference in frequencies is constant.
- Constant frequency ratio (Ratio)
  Ratio of frequencies is constant.
- Differential output (Diff)
  Reverse phase waveform with identical frequency, amplitude, and DC offset.


▲Two channels independent


▲Differential output

Other functions

- **External 10MHz frequency reference input, frequency reference output, synchronous operation of multiple generators**
  A high-accuracy frequency can be output when an external 10 MHz standard signal is input into the external 10 MHz frequency reference input (REF IN). Synchronous operation of up to six units is possible in the form of master/slave connections,using the frequency reference output (REF OUT) and frequency reference input (REF IN).
- **External addition input**
  This adds external signals to the waveform output signal.
- **User-defined unit**
  The value in any unit can be set using a specified conversion expression. (Frequency, period, amplitude, DC offset, phase, and duty)
- **Waveform monitor**
  This displays the set waveform.
- **Memory to save setting**
  Ten settings can be saved


Waveform monitor

▼Frequency and Phase

Frequency setting ranges

Oscillation mode / Waveform	Continuous, modulation, and sweep (continuous, single)	Sweep (gated) and burst
Sine	0.01 μHz to 30 MHz	0.01 μHz to 10 MHz
Square	0.01 μHz to 20 MHz	0.01 μHz to 10 MHz
Pulse	0.01 μHz to 20 MHz	0.01 μHz to 10 MHz
Ramp	0.01 μHz to 5 MHz	
Noise	The equivalent bandwidth is fixed to 26 MHz	
DC	Frequency setting invalid	
Arbitrary	0.01 μHz to 5 MHz	

Frequency setting resolution	0.01 μHz
Frequency accuracy *	± (3 ppm of setting + 2 pHz), aging rate* : ±1 ppm/year
Phase setting range	−1800.000° to +1800.000°

▼Output Characteristics

Amplitude	Setting range	0 Vp-p to 20 Vp-p/open, 0 Vp-p to 10 Vp-p/50 Ω AC + DC ≤ ± 10 V/open
	Setting resolution	999.9 mVp-p or less : 4-digit/0.1 mVp-p 1 Vp-p or greater : 5-digit/1 mVp-p
	Accuracy *	± (0.8% of amplitude setting [Vp-p] + 2 mVp-p)/open (1 kHz sine wave, amplitude setting : 20 mVp-p/open or greater)
	Setting unit	Vp-p, Vpk, Vrms, dBV, and dBm
	Resolution of waveform	16 bit (8 mVp-p/open or greater)
DC offset	Setting range	±10 V/open, ±5 V/50 Ω
	Setting resolution	±499.9 mV or less : 4-digit/0.1 mV, ±0.5 V or greater : 5-digit/1 mV
	Accuracy *	± (| 1% of DC offset setting [V] | + 5 mV + 0.5% of amplitude setting [Vp-p])/open (when outputting sine waves of 10 MHz or less)
Output impedance		50 Ω unbalanced
Output voltage of Synchronous/sub output		Sync signals TTL level, internal modulation signal −3 V to +3 V/open, sweep X drive 0 V to +3 V/open

▼Signal Characteristics

Sine	Amplitude frequency characteristics*	Up to 100 kHz : ±0.1 dB 100 kHz to 5 MHz : ±0.15 dB 5 MHz to 20 MHz : ±0.3 dB 20 MHz to 30 MHz : ±0.5 dB (± 0.8 dB at 2.8 Vp-p/50 Ω or higher) (50 mVp-p to 10 Vp-p/50Ω, reference frequency 1 kHz)		
	Total harmonic distortion*	20 Hz to 20 kHz : 0.04% or less (0.25 Vp-p to 10 Vp-p/50 Ω)		
	Harmonic spurious*		0.5 Vp-p to 2 Vp-p/50 Ω	2 Vp-p to 10 Vp-p/50 Ω
		Up to 1 MHz	−60 dBc or less	−55 dBc or less
		1 MHz to 10 MHz	−50 dBc or less	−43 dBc or less
		10 MHz to 30 MHz	−40 dBc or less	−30 dBc or less
	Non-harmonic spurious*	Up to 1 MHz : −65 dBc or less*, −70 dBc or less (typ.) 1 MHz to 3 MHz : −65 dBc or less* (0.5 Vp-p to 10 Vp-p/50 Ω) 3 MHz to 30 MHz : −65 dBc+6 dB/oct or less* (0.5 Vp-p to 10 Vp-p/50 Ω)		
Square	Duty variable	Variable range : Normal or extended (selectable) Setting range : Normal range 0.0100% to 99.9900% Upper limit (%) : 100 - frequency (Hz)/400,000 Lower limit (%) : frequency (Hz)/400,000 Extended range 0.0000% to 100.0000%		
	Rising/falling time*	15.5 ns or less (typ.), 17 ns or less *		
	Overshoot	5% or less typ.		
	Jitter	Normal variable range : 300 ps rms or less typ. Extended variable range : 2.5 ns rms or less typ.		
Pulse	Pulse width	Duty setting range : 0.0170% to 99.9830% Time setting range : 24.00 ns to 99.9830 Ms (resolution 0.01% of ftequency/0.01 ns)		
	Rising/falling time	Setting range : 15.0 ns to 62.5 Ms (resolution 3-digit/0.1 ns) Rising/falling time independently set, The minimum setting value is 0.01% of period or 15 ns, whichever is larger.		
	Overshoot	5% or less typ.		
	Jitter	500 ps rms or less typ. (10 kHz or more) 2.5 ns rms or less typ. (less than 10 kHz)		
Ramp		Symmetry setting range : 0.00% to 100.00%		
Arbitrary waveform	Waveform length	4 K to 512 K words (2^n, n=12 to 19) or the number of control points is 2 to 10,000 (Control points are linearly interpolated.)		
	Total of waveform saving capacity	Up to 128 waves or 4 M words (combined total for channels 1 and 2) Saved in the nonvolatile memory		
	Amplitude resolution	16 bit		
	Sampling rate	120 MS/s		

▼Modulation

Modulation type		FM, FSK, PM, PSK, AM, DC offset modulation, PWM
Internal modulation	Modulation waveform	Other than FSK, PSK : Sine, square (duty of 50%), triangle (symmetry 50%), rising ramp, falling ramp, noise, arbitrary waveforms FSK, PSK: Square (duty of 50%)
	Modulation frequency	Other than FSK, PSK, DC offset modulation : 0.1 mHz to 1 MHz (8-digit/0.1 mHz resolution) FSK, PSK : 0.1 mHz to 3 MHz (8-digit/0.1 mHz resolution) DC offset modulation : 0.1 mHz to 100 kHz (8-digit/0.1 mHz resolution)
External modulation	Input voltage range	±1 V full scale (other than FSK and PSK)
	Input impedance	10 kΩ unbalanced (other than FSK and PSK)
	Input frequency	DC to 40 kHz/−3 dB (other than FSK and PSK), DC to 3 MHz (FSK, PSK)

▼Sweep

Sweep type	Frequency, phase, amplitude, DC offset, and duty
Sweep function	One-way (ramp waveform shape)/shuttle (triangle waveform shape) selectable Linear/log (frequency sweep only) selectable
Sweep range setting	Start and stop values or the center and span values are specified.
Sweep time setting range	0.1 ms to 10,000 s (4-digit/0.1 ms resolution)
Sweep mode	Continuous/single-shot/gated single-shot selectable Oscillation only occurs during sweep execution in the gated single-shot mode.
Trigger source	Internal/external selectable
Internal trigger oscillator	Period setting range : 100.0 μs to 10,000 s (5-digit/0.1 μs resolution)
Stop level setting	Specifying signal level while oscillation is stopped during gated single shot sweep Setting range : −100.00% to +100.00% of amplitude full scale or off
Sweep input/output	Sweep sync/marker output, sweep X drive output, sweep external control input, sweep external trigger input

▼Burst/Trigger/Gate Operation

Burst mode	Auto burst, trigger burst, gate, and triggered gate modes (The gate is turned on/off at each trigger in the triggered gate mode.)
Number of mark/space waves	0.5 cycles to 999,999.5 cycles, in 0.5-cycle unit
Oscillation stop unit in the gate mode	1 cycle or 0.5 cycles selectable
Phase setting range	−1800.000° to +1800.000°
Stop level	Specifiying signal level while oscillation is stopped Setting range : −100.00% to +100.00% Oscillation stops at the set oscillation start/stop phase when the stop level is set to off.
Trigger source	Internal or external selectable, manual trigger allowed
Internal trigger oscillator	1.0 μs to 1,000 s (5-digit/0.1 μs resolution)
Trigger delay	0.00 μs to 100.00 s (8-digit/0.01 μs resolution) Except for latent delay. Valid in the trigger burst mode only.
External trigger input	TTL level, input impedance 10 kΩ (pulled up to +3.3 V), unbalanced
Manual trigger	Panel key operation, trigger delay allowed

▼2-channel Ganged Operation(WF1948 only)

Channel mode	Two channels independent, two phases (same frequency), constant frequency difference, constant frequency ratio, and differential output (same frequency, amplitude, DC offset, reversed waveform)
Same value setting, same operation	Set two channels at the same time.
Frequency difference setting range	0.00 μHz to less than 30 MHz (0.01 μHz resolution) CH-2 frequency - CH-1frequency
Frequency ratio N : M setting range	1 to 9,999,999 (for each of N and M) N : M= CH-2 frequency : CH-1 frequency

▼Other Functions

External 10 MHz frequency reference input	Input voltage : 0.5 Vp-p to 5 Vp-p, Sine or square
Frequency reference output	Output voltage : 1 Vp-p/50 Ω, square, 10 MHz (for Synchronization of multiple units)
External addition input	Gain : ×0.4, ×2, ×10 or off, selectable Input voltage/frequency : −1 V to +1 V, DC to 10 MHz (−3 dB) Input impedance : 10 kΩ unbalanced
Synchronous operation of multiple units	Up to 6 units can be connected in the form of master/slave, using the frequency reference output and external 10 MHz frequency reference input
User defined unit	Sets and displays the value in any unit, according to the specified conversion expression. Setting target : Frequency, period, amplitude, DC offset, phase, and duty
Setting memory	10 settings can be memorized (saved in the nonvolatile memory).
Interface	GPIB, USBTMC (SCPI-1999, IEEE-488.2)
Phase synchronization	Function to restart from the phase where the output waveforms for all the channels are set, automatic execution at channel mode switching

▼Generals

Display	3.5 inch TFT color LCD
Input/output ground	The signal grounds for waveform output, sync/sub output and external modulation/addition input are insulated from the housing. The signal ground for external 10 MHz frequency reference input is insulated from the housing.
Power requirements	AC100 V to 230 V ±10% (250 V max.) 50 Hz/60 Hz ±2 Hz
Dimensions(mm)	216(W)×132.5(H)×288(D)
Power consumption	WF1947 : 50 VA max. WF1948 : 75 VA max.
Operation temperature/ humidity range	0°C to +40°C, 5% to 85% RH (Absolute humidity : 1 g/m³ to 25 g/m³, no condensation)
Weight	Approx. 2.6 kg (main unit excluding accessories)
Safety and EMC	EN 61010-1:2010/EN 61326-1:2013

* Guaranteed numerical value. Other numerical values are nominal or typical (typ.) values

- The content of this catalog is current as of October 25st, 2024.
- External view and specifications are subject to change without prior notice.
- Please check the latest specifications, prices, and lead time for purchase.
- The company names and product names described here are trademarks or registered trademarks of respective owners.

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COSINUS MESSTECHNIK GMBH

WF1981 / WF1982 / WF1983 / WF1984

MULTIFUNCTION GENERATOR

WAVE FACTORY

0 to 30 MHz	21 Vp-p	Low jitter	Large-capacity arbitrary waveforms
0 to 60 MHz	16 bit	Low distortion	Parameter-variable waveforms

Essential waveforms can be generated effortlessly

- **0 to 30 MHz / 0 to 60 MHz**
  Resolution 0.01 µHz
- **1-channel / 2-channels**
- **16-bit, 21 Vp-p / open** POINT!
- **Low distortion and low jitter**
- **Floating between input and output, isolated between channels**
  (2-channel model)
- **Sub-output** – Independent from the main output POINT!
- **26 types of parameter-variable waveforms** POINT!
- **Pulse edge variable function** POINT!
- **High-speed and large-capacity arbitrary waveforms**
  240 M samples/sec., 64 Mi words/waveform(WF1983/WF1984)
- **2-channel mode** (WF1982/WF1984)
- **Syncrator function** POINT!

Lineup

Model	WF1981	WF1982	WF1983	WF1984
Number of channels	1	2	1	2
Frequency range	0 to 30 MHz		0 to 60 MHz	
Output voltage	0 Vp-p to 21 Vp-p/open			
Amplitude resolution	16 bit			
Arbitrary waveform	32 Mi words/waveform		64 Mi words/waveform	

To improve the "quality" and "efficiency" of testing"

As a signal source for testing across a wide range of fields

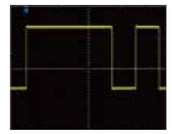
Power semiconductor — For evaluating switching characteristics

Double pulse test

Parameter-variable waveform "Double pulse waveform"

On/off time can be freely set while outputting two pulse signals.

Variable parameters :
Rise time, Fall time,
Lower bottom time, Upper bottom time



Automotive — For verification of encoders, ECUs, etc.

Simulation of signal inputs for various ECUs

Noise superimposition testing on signal lines and power supplies

- Generate various analog and digital signals freely
- Multi-channel: sub-outputs and multiple units can be connected.
- Sequence function, large-capacity arbitrary waveforms
- Combined with bipolar power supply, high-voltage/large-current testing is possible.

Piezoelectric elements — For evaluation tests involving actual operation

Haptics research

In research involving generation of vibration using piezoelectric elements, parameters such as amplitude, frequency, rise/fall times, can be controlled with high resolution, enabling accurate reproduction of subtle tactile sensations.

Application of ultrasound

Combined with a bipolar power supply, the unit applies high voltage/large current to devices, achieving stable operation and enabling dynamic performance evaluation.

HSA series

Combined with a bipolar power supply

WAVE FACTORY

The performance and features necessary to achieve the expected signal output

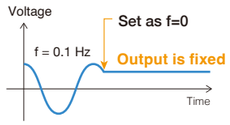
The stability in frequency and amplitude, noise performance, oscillation modes, and other capabilities required to faithfully generate desired waveforms

60 MHz / 30 MHz, High Accuracy and High Resolution

All models maintain a frequency accuracy of ±(1 ppm of setting + 4 pHz) and feature a frequency setting resolution of 0.01 µHz, ensuring high resolution across a wide frequency range.

Tips!

Setting the frequency to 0 during output allows users to maintain the output voltage at the current phase. For example, users can fix the output at a desired voltage level using a low-frequency signal.

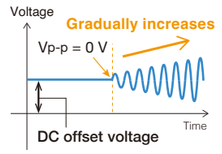


Output Voltage 21 Vp-p / open

The maximum output voltage is 21 Vp-p / open and a DC offset voltage is ±10.5 V. It can also be set to 0Vp-p. Even if the output is divided due to low load impedance, appropriate voltage can be expected at the load terminal.

Tips!

Users can set the DC offset voltage and gradually increase the amplitude of the superimposed wave from 0 Vp-p. For example, intentionally superimposing noise as part of the device's signal source.



Auto-ranging (20 V / 4 V / 0.8 V)

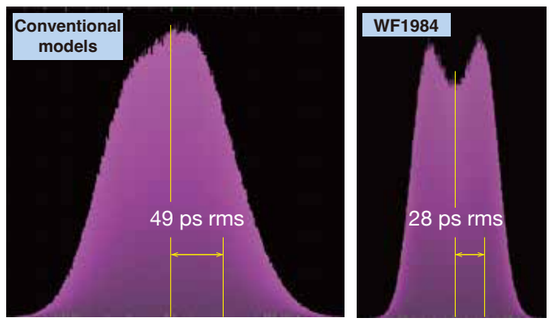
The auto-ranging function automatically selects the optimal output voltage range across the entire output voltage range. This reduces the decrease in amplitude setting accuracy due to the set level. Additionally, if discontinuity in amplitude due to range switching is a concern, selecting range hold is also possible.

Amplitude Resolution 16 bits

The device maintains high resolution over a wide output voltage range and outputs waveforms with high reproducibility. The setting resolution is 0.1 mVp-p (for amplitudes < 3 V), ensuring stable output of low-amplitude signals.

Low Jitter < 40 ps rms

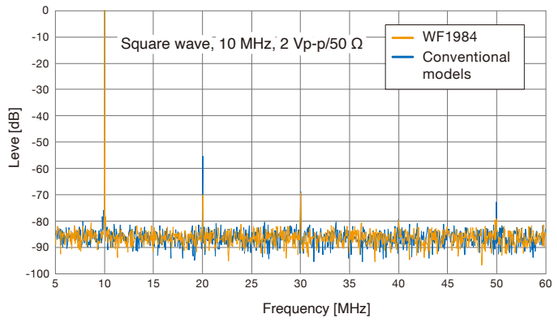
Jitter has been significantly reduced compared to conventional models, enabling stable square wave output. Trigger jitter has also been reduced to below 300 ps rms (typ.).



Square wave, 1.11 MHz, 2 Vp-p / 50 Ω

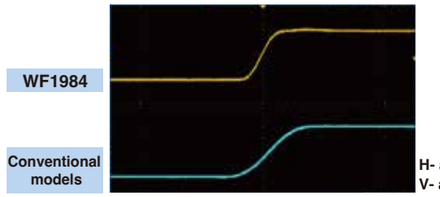
Low Distortion < 0.03%

We have achieved a total harmonic distortion (THD) of 0.03% or less (10 Hz to 20 kHz, 2 Vp-p/50 Ω). Significant improvements have been made in harmonic spurs, achieving -60 dBc typical (2 Vp-p/50 Ω).



Fast Rise/Fall Time 7.7ns

We have achieved high-speed rise and fall times in pulse waves. Compared to conventional models, we have significantly improved the reproducibility of square waves.



H- axis : 10 ns/div.
V- axis : 500 mV/div.

Wide Range of Output Waveforms

We offer sine waves, square waves (with variable duty cycle), pulse waves (variable pulse width, duty cycle, rise/fall times), ramp waves (variable symmetry), Gaussian noise, DC, and 26 other waveforms commonly used in various fields as “Parameter-variable waveforms.”

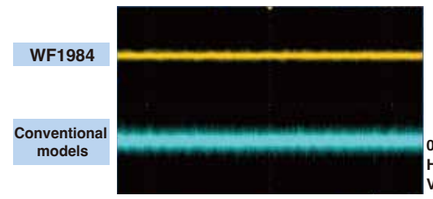
CHECK! Parameter-Variable Waveforms P.8

Variety of Oscillation Modes

We offer a variety of oscillation modes, including continuous, sweep (frequency, phase, amplitude, DC offset, duty), burst (auto burst, triggered burst, gate, triggered gate), sequence, internal modulation / external modulation (FM, FSK, PM, PSK, AM, DC offset modulation, PWM). Each mode supports diverse settings, facilitating the efficient output of various test signals and streamlining complex testing processes.

Low Noise

We have significantly reduced the noise level compared to conventional models.



0 V output
H- axis : 1 ms/div.
V- axis : 2 mV/div.

High-speed and Large-capacity arbitrary waveforms 240 MS/sec, 64 Mi words

The WF1983 and WF1984 offer arbitrary waveform sampling rates of 240 M samples/sec. with a maximum of 64 Mi* words per waveform. The WF1981 and WF1982 provide 120 M samples/sec. and a maximum of 32 Mi* words per waveform. All four models are equipped with large capacity memory totaling approximately 4 Gi* words. Arbitrary waveforms can also be saved to an external USB memory. Waveform creation can be performed using the unit or PC application software.

*Mi = 2^{20} = 1,048,576, Gi = 2^{30} = 1,073,741,824

CHECK! Arbitrary Waveforms P.7

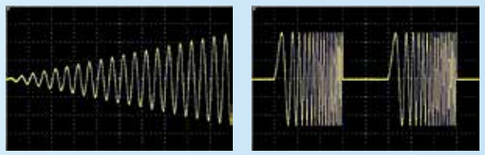
Sequence Function Max. of 1023 steps

We have incorporated a sequence function that allows for output while sequentially changing waveform, frequency, amplitude, DC offset, phase, and duty cycle. This can be programmed using either the unit or PC application software. The maximum number of steps has increased fourfold compared to conventional models, accommodating even lengthy and complex output patterns.

CHECK! Sequence Function P.7

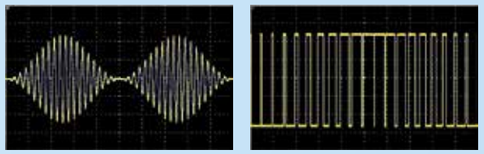
WAVE FACTORY COLLECTION
Waveforms

Sweep



Sweep　Gated sweep

Modulation

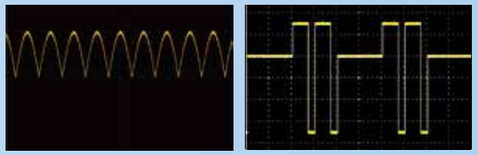


AM　PWM

Burst / Trigger / Gate

Triggered burst　Gate　Triggered gate

Combining oscillation modes



Full-wave rectified waveform　3-value pulse

The performance and features necessary to achieve the expected signal output

As a Pulse Generator

The fast rise time and low jitter make these devices ideal as a signal source for testing digital circuits and electronic devices. In addition to independent settings for duty/pulse width, rise and fall times, the pulse wave has a pulse edge variable function, is available allowing versatile editing of pulse transition sections through this function.

CHECK! Pulse Edge Variable Function P.7

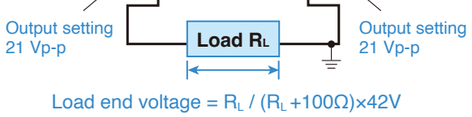
Floating

The signal ground for waveform output is isolated from the case, allowing connection to equipment at different electrical potentials. This reduces noise caused by ground loops. In the 2-channel model, isolation between channels is also maintained.

Tips!

In the 2-channel model, by connecting in series, users can achieve a maximum of 42 Vp-p open-circuit sine wave output.

WF1984



Load end voltage = R_L / (R_L +100Ω)×42V

* The upper frequency limit is around 100 kHz, do not connect anything to SYNC/SUB OUT.

External Addition Input

Users can add signals from an external source to internally generated waveforms and output them. Phase difference can also be set as desired. The input frequency ranges from DC to 10 MHz.

Tips!

In the 2-channel model, it is possible to add waveforms from CH1 and CH2. By connecting CH1's output to CH2's additive input, the waveforms from both channels are combined. This allows for easy implementation of harmonic addition and noise superposition.

Upper and Lower Limiting Function

By setting upper and lower limits on the configuration values, it prevents excessive output due to operational errors. This is particularly effective for tests involving outputting high voltage or large current when connected to power amplifiers.

- Applicable settings: frequency, positive and negative peak values of output voltage, phase and duty

Real-time Frequency Response Correction

Suppresses amplitude fluctuations in oscillation frequency and frequency sweeps.

Burst + Modulation / Sweep + Modulation

It is possible to perform internal modulation/external modulation simultaneously with burst oscillation. External modulation can be used during sweep oscillation.

Multi-Channel

Multiple channels can be configured when multiple signals are required for testing

WAVE FACTORY

Sub-Output Function

The sub-output function can generate independent continuous signals from the main output. It allows setting waveform, phase, amplitude, DC offset, and phase difference with respect to the main output. When using internal modulation function on the main output, modulation waveforms can be output from the sub-output. It offers flexible settings that defy typical expectations of a sub-output. The 1-channel models are designed to function as 2-channel (2CH) models.

Tips!

Waveforms of the main output and sub-outputs can be added and output using DC offset modulation. Various synchronization outputs such as reference phase synchronization output and burst synchronization output are also possible for the sub-output.

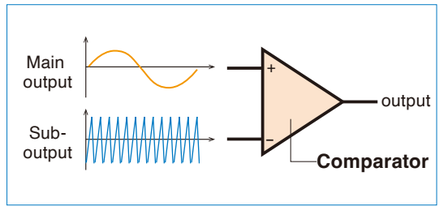
Main Output and Sub-Output

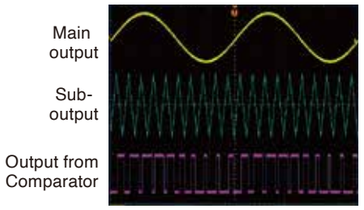
	Max. voltage	Frequency*	Phase	Waveforms	Oscillation modes	Terminals
Main output	±21 V	0 to 60 MHz 0 to 30 MHz	±180°	Sine wave, Square wave, Pulse wave, Ramp wave, Parameter-variable waveform, Noise, DC, Arbitrary waveform	Continuous, Sweep, Burst, Internal modulations, External modulations	FCTN OUT
Sub-output	±3.3 V	0 to 5 MHz	±180°	Sine wave, Square wave (50% duty), Triangle wave (50% symmetry), Rising / Falling ramp wave, Parameter-variable waveform, Noise, Arbitrary waveform	Continuous only	SYNC/SUB OUT

* Continuous, sine wave

Example of application

- Using the main output and sub-output to verify a comparator circuit.
- Inputting sine wave and triangle wave at different frequencies.
- observing the output of the comparator.





2-Channel Mode (WF1982/WF1984)

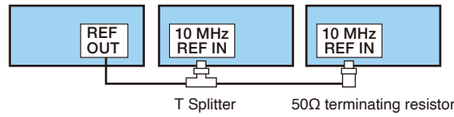
In addition to independent settings for each channel, settings such as 2-phase and constant frequency difference can be made, and various sweeps can be performed with the 2-channel mode. Each output channel is isolated from the case, and each is also equipped with an external modulation/addition input and an external triggered input to ensure the independence of each channel.

- Independent
- 2-phase (same frequency)
- Constant frequency difference
- Constant frequency ratio
- Differential output (inverted phase waveform with same frequency, amplitude, and DC offset)
- Differential output 2 (inverted phase waveform with same frequency and amplitude, with opposite polarity DC offset)

Multi-Unit Synchronization

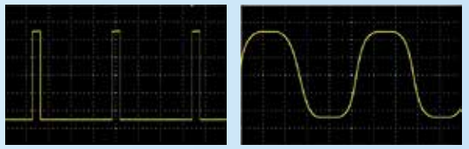
It is possible to synchronize up to 6 units (12 channels maximum for 2-channel models) simultaneously. By utilizing sub-output function, configurations can extend to accommodate up to 24 output channels.

Example (3 units)



WAVE FACTORY COLLECTION
Waveforms

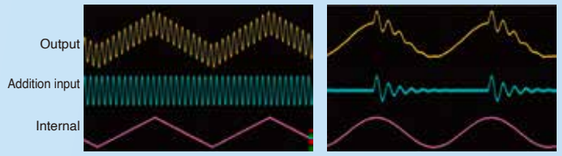
As a Pulse Generator



Pulse width variable

Rising/Falling time variable

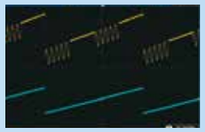
External Addition



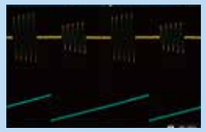
DC offset

Surge wave

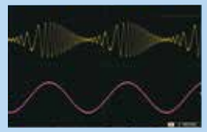
Burst + Modulation, Sweep + Modulation



DC offset modulation (Rising ramp waveform)

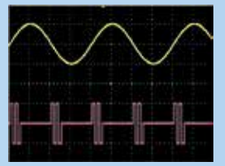


Amplitude modulation (Rising ramp waveform)

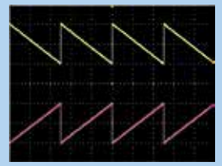


Frequency sweep with amplitude modulation

2-Channel Mode



Independent



Differential output

Create complex waveforms with ease

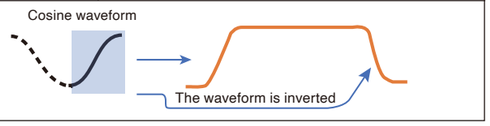
Whether it's modifying pulse waves and sine waves, generating specialized waveforms for specific fields, or designing custom user-original waveforms, our products provide robust support for waveform creation.

Pulse Edge Variable Function

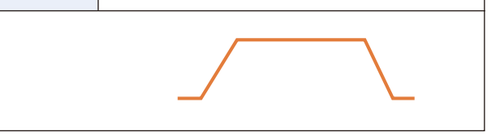
The rising/falling transition portion (pulse edge) of the pulse waveform can be edited. In addition to general straight lines, cosine, parameter variable, and arbitrary waveforms can be set. For example, pulse waves can be freely processed by adding overshooting or ringing. It is also possible to change the waveform in real time while outputting without interrupting the test.

Available edges

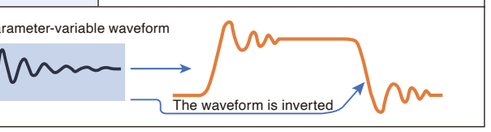
Cosine	●**Rise**: the 180°to 360°portion of the cosine waveform ●**Fall**: the invert of the rise waveform



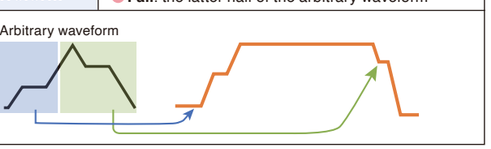
Straight line	●Straight line for both the rise and the fall

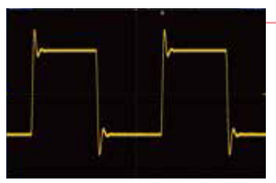


Parameter-variable waveform	●**Rise**: the selected parameter-variable waveform ●**Fall**: the invert of the rise waveform



Arbitrary waveform	●**Rise**: the first half of the arbitrary waveform ●**Fall**: the latter half of the arbitrary waveform





Using the built-in second-order low-pass filter (LPF) waveform as a parameter-variable waveform, users can create a square wave with overshoot and ringing.

Arbitrary Waveforms
Long memory/High-speed sampling

Featuring a large-capacity waveform memory of up to 64Mi words per waveform and a total capacity of approximately 4Gi words, this model significantly surpasses conventional products. This expanded memory allows for the output of more complex waveforms. Additionally, the previously fixed sampling rate is now variable, enabling the output of longer waveforms by using slower sampling rates.

Tips!

The large-capacity waveform memory is ideal for reproducing waveforms recorded with a data logger. By matching the sampling rate at the time of recording, waveforms can be reproduced without calculating the period or frequency.

- Can be created using the unit or control software.
- Waveform data can also be saved to an external USB memory.
- Parameters can be adjusted and saved as arbitrary waveforms for reuse.

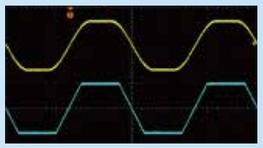
Sequence Function

Outputs can be made while successively changing waveform, frequency, phase, DC offset, and square wave duty. With flexible control of abrupt changes, sweeps, repetitions, and jumps, signals with long and complex output patterns that change from moment to moment, such as mechanical vibration and voltage fluctuations, can be easily programmed.

- Maximum number of steps 1023, Maximum number of usable waveforms 1023
- Can be created using the unit or separately provided control software.
- Sequence data can also be saved to USB memory.
- Sequence data created for conventional models (WF1973/WF1974/WF1967/WF1968) can also be used.

WAVE FACTORY COLLECTION
Waveforms

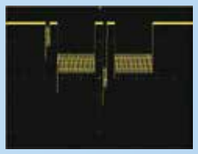
Pulse Edge Variable



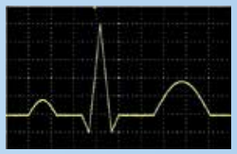
Top : Cosine
Bottom : Straight line

Parameter-variable waveform
Top : Exponential rise
Bottom : Trapezoid wave with offset

Example of Sequence waveforms



ISO 16750:2006 Automotive Electrical Equipment Test



Cardiac

Pulse edge variable function | Arbitrary waveforms | Sequence function | Parameter-variable waveforms

WAVE FACTORY

Parameter-variable waveforms

The unit includes 26 types of waveforms, commonly used as simulation signals in fields such as power, circuits, and machinery, pre-built that would typically need to be created as custom waveforms. Unique parameters for these waveforms can be set using the panel controls on the unit. Additionally, you can modify multiple unique parameters while outputting the waveform. Custom waveforms can also be saved, edited, and reused as needed.

Tips!

The waveforms included as parameter-variable waveforms typically need to be created as custom waveforms if users want to modify parameters other than frequency and amplitude. However, with parameter-variable waveforms, users can easily adjust waveform-specific parameters using numerical input or modification knobs.

●**Example of damped oscillation waveform**

Frequency: 10 Hz Time constant: 10 %

Variable parameters
- Oscillation frequency
- Damping time constant

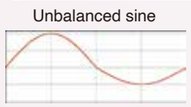
Parameters can be changed with the modify knob!

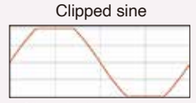
Frequency: 4 Hz
Time constant: 10 %

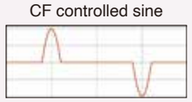
Frequency: 10 Hz
Time constant: 20 %

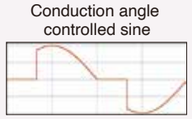
26 types of parametervariable waveforms

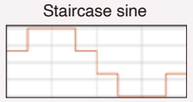
Steady-state sine waves

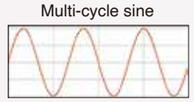
Unbalanced sine

●1st half amplitude ●2st half amplitude

Clipped sine

●Clipped ratio

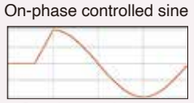
CF controlled sine

●Crest factor

Conduction angle controlled sine

●Conduction angle

Staircase sine

●Number of steps

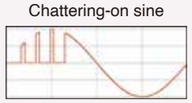
Multi-cycle sine

●Number of cycles ●Start phase

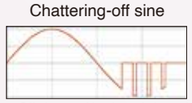
Transient sine waves

On-phase controlled sine

●Complete-on phase ●On-slope time

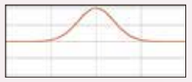
Off-phase controlled sine

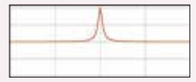
●Off phase ●Off-slope time

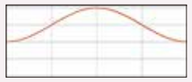
Chattering-on sine

●On phase ●Number of chattering ●On-state time ●Off-state time

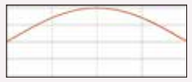
Chattering-off sine

●Off phase ●Number of chattering ●On-state time ●Off-state time

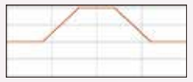
Pulse waveforms

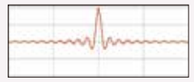
Gaussian pulse

●Standard deviation

Lorentz pulse

●Half value of width

Haversine

●Width

Half-sine pulse

●Width

Trapezoid pulse

●Slope width ●Upper base width

Sin(x)/x

●Number of zero crossings

Transient response waveforms

Exponential rise

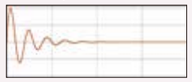
●Time constant

Exponential fall

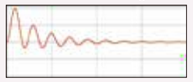
●Time constant

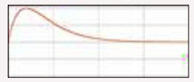
2nd-order LPF step response

●LPF natural frequency ●LPF Q

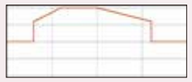
Damped oscillation

●Oscillation frequency ●Damping time constant

Surge waveforms

Oscillation surge

●Oscillation frequency ●Damping time constant ●Trailing time constant

Pulse surge

●Rising time ●Duration time

Other waveforms

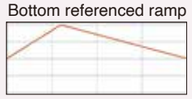
Trapezoid with offset

●Leading delay ●Rising-slope width ●Upper base width ●Falling-slope width ●Offset

NEW Double pulse

●Rising time ●Falling time ●Bottom base time 1/ Top base time 1 ●Bottom base time 2/ Top base time 2

Half sine edge pulse

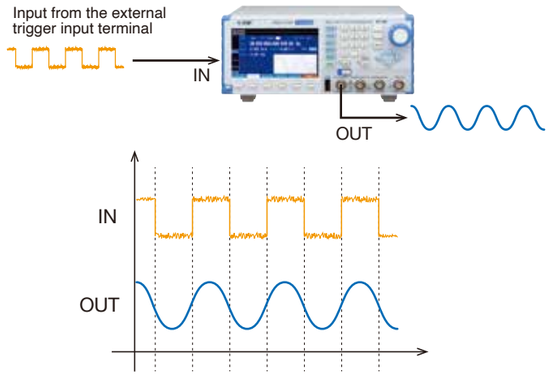
●Leading edge time ●Trailing edge time ●Duty

Bottom referenced ramp

●Symmetry

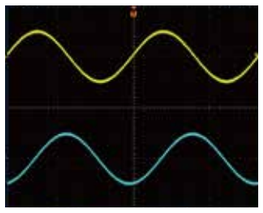
We offer a wealth of features along with excellent operability

Syncrator Function

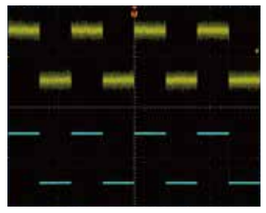
This feature automatically synchronizes the main output signal with an externally input signal. It is also possible to adjust the phase difference between the external input signal and the main output. This function is useful for applications involving waveform conversion or correction of fluctuating signals, as well as for rotational systems.



Example of application



Top: Input
Bottom: Output shifted by 90°



Top: Noisy input
Bottom: Synchronized and cleaned-up output

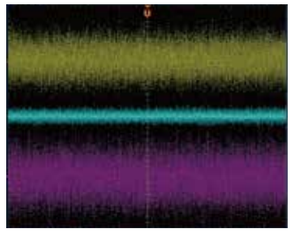
Noise Equivalent Bandwidth Setting

The noise waveform can be set to six different equivalent bandwidths: 30 MHz, 10 MHz, 3 MHz, 1 MHz, 300 kHz, and 100 kHz. Typically, when the bandwidth is limited using an external filter, the amplitude also decreases. However, it is possible to limit the noise bandwidth without needing an external filter while maintaining a constant amplitude (effective noise value).

Top: Conventional model
(Bandwidth is fixed at 26 MHz)

Middle: Conventional model
1 MHz LPF passed separately

Bottom: WF1983
(Bandwidth : 1MHz)



Rich features that enhance usability and expand application range

- **Equipped with a USB memory interface for reading and writing files**
- **Setting Memory**: Stores up to 10 sets of settings.
- **User-Defined Units**: Enables setting in arbitrary units usingΩ specified conversion formulas (frequency, period, amplitude, DC offset, phase, duty).
- **Load Impedance**: Allows setting and displaying output voltage at specified load impedance.
- **External 10 MHz frequency reference input**
- **USB / LAN interfaces**
- **GPIB (WF1983 / WF1984)**
- **2U half-rack size, lightweight, approx. 1.8 kg**

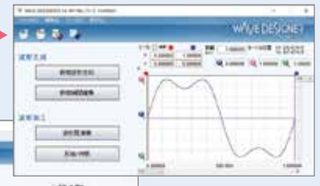
The software that supports arbitrary waveform generation and sequence editing

Control Software

This software allows output control via PC. It also supports arbitrary waveform generation and sequence editing.

Controller

Arbitrary waveform creation



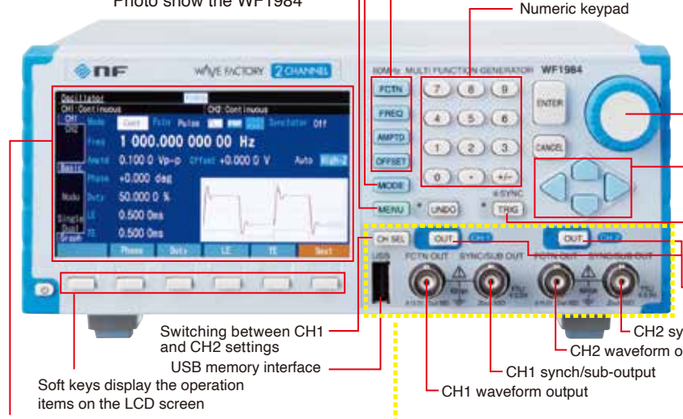
Sequence editing

WAVE FACTORY

Panel Component Names and Functions

2-channel models WF1982 / WF1984

Photo show the WF1984



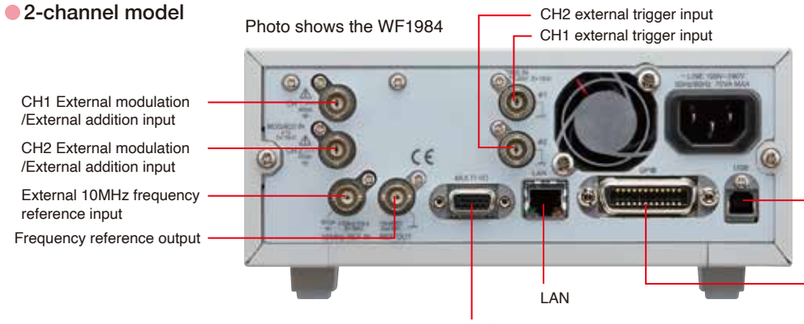
1-channel models: WF1981/WF1983

* Each models are the same except for the input/output connectors on the front panel.

Back panel

2-channel model

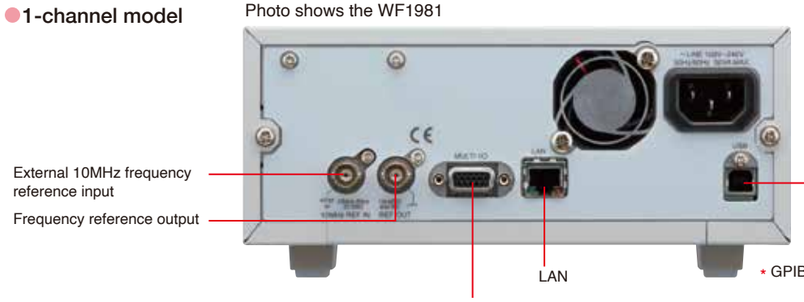
Photo shows the WF1984



* Not equipped for the WF1982

1-channel model

Photo shows the WF1981



* GPIB comes as a standard for the WF1983

WAVE FACTORY

Specifications

Unless otherwise specified, the conditions are as follows: waveform output (FCTN OUT) is the target, oscillation is continuous, load is 50 Ω, amplitude setting is 10 Vp-p/50 Ω, DC offset setting is 0 V, auto range for output voltage, amplitude range of waveform is ±FS, external addition is off, and AC voltage is effective value measurement.

Waveform, Oscillation Mode

Waveform	Sine wave, square wave, pulse wave, ramp, parameter-variable wave, noise (gauss distribution), DC
Oscillation Mode	Continuous, modulation, sweep, burst, sequence

Frequency

	30 MHz			60 MHz		
Model name	WF1981 (1ch) / WF1982 (2ch)			WF1983 (1ch) / WF1984 (2ch)		
Oscillation Mode/ Function / Waveform	Continuous, modulation, sweep(continuous, single)	Sweep(Gated single), burst	Sequence	Continuous, modulation, sweep(continuous, single)	Sweep(Gated single), burst	Sequence
Sine wave	0 to 30 MHz	0 to 10 MHz	0 to 10 MHz	0 to 60 MHz	0 to 20 MHz	0 to 20 MHz
Square wave	0 to 15 MHz	0 to 10 MHz	0 to 10 MHz	0 to 30 MHz	0 to 20 MHz	0 to 20 MHz
Pulse wave	0 to 15 MHz	0 to 10 MHz	Not available	0 to 30 MHz	0 to 20 MHz	Not available
Ramp wave	0 to 5 MHz		0 to 5 MHz	0 to 10 MHz		0 to 10 MHz
Parameter-variable waveform	0 to 5 MHz		0 to 5 MHz*2	0 to 5 MHz		0 to 5 MHz*2
Noise	Equivalent bandwidth : select from 30 M / 10 M / 3 M / 1 M / 300 k / 100 kHz			Equivalent bandwidth : select from FULL / 30 M / 10 M / 3 M / 1 M / 300 k / 100 kHz		
DC	Invalid frequency setting			Invalid frequency setting		
Arbitrary waveform	0 to 5 MHz (Limited by number of samples and sampling rate)			0 to 15 MHz (Limited by number of samples and sampling rate)		

Frequency setting resolution	0.01 μHz(< 50 MHz), 0.1 μHz (50 MHz ≤)*3
Frequency setting with period	Setting with frequency that is inverse number of set period less than 0.01 μHz is rounded off
Frequency accuracy at shipment*1	±(1 ppm of setting + 4 pHz)
Frequency aging rate*1	±1 ppm/year

Phase

Waveform Output	-1800.000° to +1800.000° (resolution 0.001°)
Sub-output/Sub-waveform	-180.000° to +180.000° (resolution 0.001°)

Output Characteristics

Amplitude

Setting range	0 Vp-p to 21 Vp-p/open, 0 Vp-p to 10.5 Vp-p/50 Ω A peak value combining waveform amplitude and DC offset is limited to ±10.5 V/open or less.
Setting resolution	2.9999 Vp-p or less: 0.1 m Vp-p /open 3.000 Vp-p or more: 1 m Vp-p /open
Accuracy*1	± (1% of amplitude setting [Vp-p] +2 m Vp-p)/open Conditions: Continuous, 1 kHz sine, amplitude 20 m Vp-p to 20 Vp-p/open
Setting unit	Vp-p, Vpk, Vrms, dBV, dBm
Range	Auto, hold (switchable)
Resolution of waveform amplitude	Approx. 16 bit Conditions: Amplitude setting 8 mVp-p/open or more

DC offset

Setting range	±10.5 V/open, ±5.25 V/50 Ω
Setting resolution	-2.999 9 V to +2.999 9 V: 0.1 mV/open -3.000 V or less and +3.000 V or more: 1 mV/open
Accuracy*1	± (|1% of DC offset setting [V]|+5 mV +0.5% of amplitude setting [Vp-p])/open

Waveform Output < FCTN OUT >

On/off control	On, off (switchable) terminal is in an open condition when off
Impedance	50 Ω, unbalanced
Short-circuit protection	Protection against short circuit with signal GND

Synchronization/Sub-output < SYNC/SUB OUT >

Output signals (switchable)	Reference phase synchronization, burst synchronization, sweep synchronization, sequence step synchronization, sub-waveform, internal modulation synchronization, and off
Sub-waveform	Analog waveform output independent from the main-output Frequency, phase, amplitude, and offset are also adjustable.
Internal modulation waveform	Modulation waveform at the time of internal modulation oscillation. Amplitude and offset are also adjustable independent from the modulation depth.
Output voltage	Each type of synchronized signal: TTL level (low level 0.4 V or less, high level 2.7 V/open or more) Sub-waveform/ Internal modulation waveform: -3.3 V to +3.3 V/open
Impedance	50 Ω, unbalanced

Main Signal Characteristics

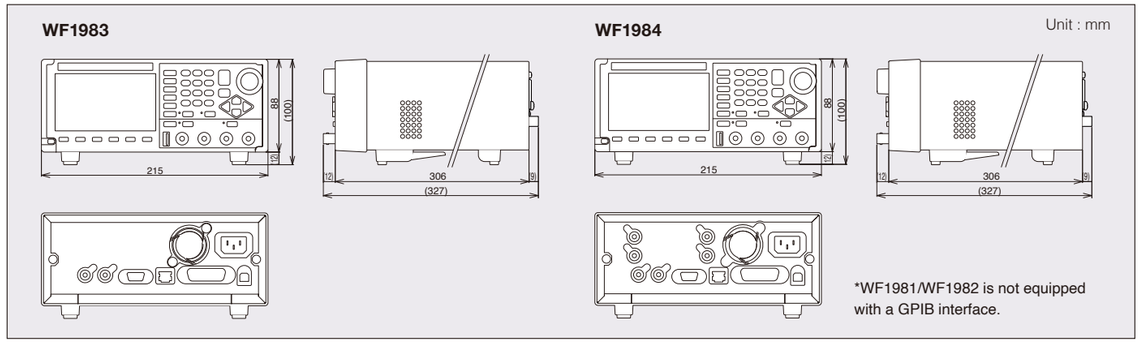
Sine wave

Amplitude frequency characteristics*1	Up to 100 kHz : ±0.1 dB 100 kHz to 5 MHz : ±0.15 dB 5 MHz to 20 MHz : ±0.3 dB 20 MHz to 30 MHz : ±0.5 dB 30 MHz to 60 MHz : ±0.7 dB*3 (Conditions: Amplitude 50 mVp-p to 10 Vp-p/50 Ω, frequency 1kHz reference)
Total harmonic distortion	10 Hz to 20 kHz : 0.03% or less typ. Conditions : Amplitude 2 Vp-p/50 Ω, sub-output off, sum up to 7th harmonic, noise is not included.
Harmonic spurious	1 MHz or less : -65 dBc or less typ. 10 MHz or less : -60 dBc or less typ. 10 MHz to 30 MHz : -60 dBc + 20 dB/dec or less typ. (WF1981/WF1982) 10 MHz to 60 MHz : -60 dBc + 20 dB/dec or less typ. (WF1983/WF1984) Conditions : Amplitude 2 Vp-p/50 Ω,sub-output off
Non-harmonic spurious	10 MHz or less : -70 dBc or less typ. 10 MHz to 30 MHz : -65 dBc or less typ. (WF1981/WF1982) 10 MHz to 60 MHz : -65 dBc or less typ. (WF1983/WF1984) Conditions : Amplitude 2 Vp-p/50 Ω, sub-output off

Square wave

Duty variable range	Standard : 0.0001% to 99.9999% (resolution 0.0001%) Limited by frequency Jitter 40 ps rms or less typ. (100 Hz or more) Extended : 0.000 0% to 100.0000% (resolution 0.0001%) Jitter 1.3 ns rms or less typ.
Duty accuracy*1	Up to 100 kHz : ±0.1% of period (duty setting is 1% to 99%) 100 kHz to 1 MHz : ±1% of period (duty setting is 5% to 95%) 1 MHz to 3 MHz : ±3% of period (duty setting is 40% to 60%)
Rising / falling time	8.0 ns typ, but when continuous oscillation mode
Overshoot	2% or less typ.

Outline dimensional drawing



Pulse Wave

Available edge waveform	Transition part of the pulse is selectable from cosine, linear, parameter-variable waveform and arbitrary waveform.
Pulse width*4	Duty setting range: 0.000 1% to 99.999 9% (resolution 0.000 1%) Period setting range: 12 ns to 99.999 9 Ms (resolution 0.000 1% or less of period or 0.01 ns)
Rising/falling time*4	7.7 ns to 59.03 Ms (resolution 4 digits or 0.01 ns) Independent setting of rising and falling edge times Minimum setting value 0.000 1% of period or 7.7 ns, whichever is larger
Overshoot*4	2% or less typ.
Jitter*4	40 ps rms or less typ. (100 Hz or more) 1.3 ns rms or less typ. (less than 100 Hz)

Ramp Wave

Setting range of symmetry	0.00% to 100.00% (resolution 0.01%)

Parameter-variable Waveform

Steady sine group	Unbalance sine, Clipped sine wave, CF controlled sine wave, Staircase sine wave, Multiple-cycle sine wave
Transient sine group	On-phase controlled sine wave, Off-phase controlled sine wave, Chattering-on sine wave, Chattering-off sine wave
Pulse group	Gaussian pulse, Lorentz pulse, Haversine, Sine wave half cycle pulse, Trapezoid pulse, Sin(x)/x
Transient response group	Exponential rise, Exponential fall, 2nd order LPF step response, Damped oscillation
Surge group	Oscillation surge, Pulse surge
Other group	Trapezoid wave with offset, Double pulse, Half-sine edge pulse, Bottom referenced ramp
Reusing waveforms	Parameter-variable waveforms can be used by saving them as arbitrary waveforms

Arbitrary Waveform

Waveform length	16 words to 32 Mi words (WF1981/WF1982), 16 words to 64 Mi words (WF1983/WF1984) or 2 to 10,000 control points (linear, interpolation is performed between control points)
Total amount of waveforms that can be saved	Approx. 4 Gi words (common for all channels) Saving of maximum of 4 096 waveforms. Saved to non-volatile memory ,saving to USB Flash Drive is possible.
Resolution of waveform amplitude	16 bit
Sampling rate	0 to 120 MS/s (WF1981/WF1982) 0 to 240 MS/s (WF1983/WF1984) Resolution: 16 digits or 100 nS/s

*1 The values are guaranteed values. Other values are nominal or typical values.
*2 Convert to arbitrary waveform and use
*3 WF1983/ WF1984
*4 When the edge waveform is cosine

Modulation

Modulation type	FM, FSK, PM, PSK, AM, DC offset modulation and PWM PM and PSK are not possible for parameter-variable waveform and arbitrary waveform
Modulation source	Internal, external (switchable)
Simultaneous use with burst and sweep	Some modulation is possible in the burst and sweep oscillation modes.

Internal modulation

Internal modulation waveform	Except for FSK, PSK: Sine wave, square wave (duty 50%), triangle wave (symmetry 50%), rising ramp wave, falling ramp wave, noise, arbitrary waveform FSK, PSK: Square wave (duty 50%)
Internal modulation frequency	0 to 5 MHz (Resolution 0.01 μHz)
Internal modulation synchronization output	Output voltage : -3.3 V to +3.3 V/open.

External modulation

Modulation input	Except for FSK and PSK	Input voltage range: ±1 V full scale Maximum allowable input: ±2 V Input impedance: 10 kΩ, unbalanced Input frequency: DC to 50 kHz (-3 dB) Input connector: BNC receptacle (MOD / ADD IN)
	FSK and PSK	Polarity : Positive, negative (switchable) Input frequency : DC to 5 MHz Input connector : BNC receptacle (TRIG IN)

Modulation Conditions

FM	Carrier waveform : Arbitrary waveforms and standard waveforms except for noise, pulse wave, and DC Peak deviation range : 0.00 μHz to less than 15 MHz (WF1981/WF1982) : 0.00 μHz to less than 30 MHz (WF1983/WF1984) (resolution 8 digits or 0.01 μHz)
FSK	Carrier waveform : Arbitrary waveforms and standard waveforms, except for noise, pulse wave, and DC. Hop frequency range : Within the allowable range of frequency for each carrier waveform (resolution 8 digits or 0.01 μHz).
PM	Carrier waveform : Arbitrary waveforms and standard waveforms except for parameter-variable waveforms, noise, and DC Peak deviation setting range : 0.000° to 180.000° (resolution 0.001°)
PSK	Carrier waveform : Arbitrary waveforms and standard waveforms except for parameter-variable waveforms, noise, and DC Setting range of deviation : -1800.000° to +1800.000° (resolution 0.001°)
AM	Carrier waveform : Arbitrary waveforms and standard waveforms except for DC.Modulation depth setting range : 0.00% to 100.00% (resolution 0.01%)(DSB-SC and non DSB-SC are available)
DC offset modulation	Carrier waveform : Arbitrary waveforms and standard waveforms Peak deviation setting range : 0 V to 10.5 V/open Peak deviation setting resolution : 3 V < 5 digits or 0.1 mV 3 V ≥ 4 digits or 1 mV
PWM	Carrier waveform : Square wave and pulse wave Peak deviation setting range : Square wave 0.0000% to 49.9999% (Resolution 0.000 1%) Pulse Wave 0.0000% to 49.9999% (resolution 0.000 1%)

Specifications

Sweep

Sweep type	Frequency, phase, amplitude, DC offset, and duty
Sweep function	One way (ramp), shuttle (triangular) (switchable) Linear, logarithmic (switchable)
Sweep range setting	Specify start value and stop value, or center value and span value
Sweep time setting range	0.1 ms to 10,000 s (resolution 5 digits or 10 µs)
Operation	Start, stop, hold, resume, start value output and stop value output.
Trigger source	Internal, external (switchable) Common regardless of sweep type. Trigger delay setting is disabled. Manual trigger available.
Internal trigger oscillator for sweep	Period setting range 0.1 µs to 10,000 s (resolution 7 digits or 2.5 ns)
Stop level setting	Setting range: -100.00% to +100.00% (amplitude full-scale reference and resolution 0.01%) or off
Oscillation stop unit when gated single	Cycle, Half Cycle (switchable)
Sweep input/output	Sweep sync/marker output (SYNC/SUB OUT) Sweep external control input (Multi-I/O connector) Sweep external trigger input (TRIG IN)
Simultaneous with modulation function	Modulation operation possible at the same time as sweep oscillation

Burst/Gate/Trigger

Burst/Gate

Burst mode	Auto burst, trigger burst, gate, triggered gate
Target waveform	Auto burst, trigger burst: Arbitrary waveforms and standard waveforms except for Noise and DC. Gate, triggered gate : Arbitrary waveforms and standard waveforms except for DC
Mark wave/ space wave number setting range	0.5 to 999,999.5 cycles, in 0.5-cycle units or infinite
Oscillation stop unit at gate	1-cycle units, 0.5-cycle units (switchable)
Setting range of start/ stop oscillation phase	-1,800.000° to +1,800.000° (resolution 0.001°)
Stop level setting range	Specifies the signal level when oscillation is stopped. Setting range : -100.00% to +100.00% (amplitude full-scale reference and resolution 0.01%) or off
Trigger source	Internal, external (switchable). Manual trigger available.
Internal trigger oscillator for burst	Period setting range : 0.1 µs to 10,000 s (resolution 7 digits or 2.5 ns) Burst external trigger input (used except for auto burst)
Burst external trigger input	Polarity Positive, negative, disable (switchable) Input connector : external trigger input terminal.
Trigger delay setting range	0.00 ns to 1,000 s (resolution 8 digits or 100 ps) Latent delay approx. 0.48 µs
Trigger jitter	300 ps rms or less typ.
Simultaneous with modulation function	Modulation operation possible at the same time as burst oscillation

Triggers

External trigger input	For single sweep, gated single sweep, trigger burst, gate, trigger gate, sequence, and synclator function
Input voltage	TTL level (low 0.8 V or lower, high 2.6 V or higher)
Max. allowable input	-7 V to +7 V
Min. pulse width	50 ns
Input impedance	10 kΩ, unbalanced (pull up to approx. +3 V)
Input connector	BNC receptacle (TRIG IN)
Manual trigger	For single sweep, gated single sweep, trigger burst, gate, and trigger gate

Synclator Function

Input frequency range	30 Hz × m to 5 MHz / n (m : frequency division ratio, n : multiplication ratio)
Output frequency range	30 Hz to 5 MHz
Setting ranges of m and m	1 to 64 (for each of m and n)
Input connector	External trigger input (TRIG IN) Trigger delay setting is disabled
Phase difference	The phase between the input external signal and the waveform output can be set freely

Sequences

Step control parameters	Step time, hold operation, jump destination, jump count, step end phase, branch operation, step termination control, step synchronization code output
Intra-step channel parameter	Waveform, frequency, phase, amplitude, DC offset and square wave duty
Available waveforms	Sine wave, square wave, noise, DC and arbitrary waveform. Ramp and parameter-variable waveforms can be used by saving them as arbitrary waveforms
Max. number of waveforms	1,023 (each channel)
Number of sequences	99 sets (saved to non-volatile memory)
Max. number of steps	1,023 steps at a maximum per sequence
Step time setting range	0.1 ms to 1,000 s (resolution 5 digits or 0.01 ms)
Intra-step operation	Constant, keep, linear interpolation (excluding waveform switching)
Jump count setting range	1 to 9999 or infinite
Step end phase setting range	0.000° to 360.000° (CH1 reference phase, resolution 0.001°) or disabled
Branch operation	Branches to the specified step when the branch is detected.
Control at step end	Stop or move to the next step

2 Channel Coordination Operation (WF1982/WF1984)

Channel mode	2 channels independent, 2-phases , constant frequency difference, constant frequency ratio, differential output (Oscillation with the same frequency and amplitude reverse phase waveform. DC offset changes to the same polarity.), differential output 2 (Same as differential output but DC is reversed polarity.)
Same value, same operation	2 channels can be set simultaneously
Frequency difference setting range	WF1981/WF1982: 0.00 µHz to less than 30 MHz WF1983/WF1984: 0.00 µHz to less than 60 MHz CH2 frequency - CH1 frequency (Resolution: 0.01 µHz)
Frequency ratio N:M setting range	1 to 9,999,999 (for both N and M) N:M = CH2 frequency:CH1 frequency
Phase synchronization operation	Auto executed when the channel mode is changed
Time difference between channels for 2-phase*1	±20 ns or less (±10 ns or less typ.) Conditions: Same waveform (sine or square)

Other I/Os

External 10 MHz frequency reference input

Input voltage	0.5 Vp-p to 5 Vp-p
Max. allowable input	10 Vp-p
Input impedance	300 Ω, unbalanced, AC coupled
Input frequency	10 MHz (±0.5% (±50 kHz))
Input waveform	Sine or square wave (50%±5% duty)
Input connector	BNC receptacle (10 MHz REF IN)

Frequency reference output(Multiple equipment synchronization)

Output voltage	1 Vp-p/50 Ω square wave
Output impedance	50 Ω, AC coupled
Output frequency	10 MHz
Output connector	BNC receptacle (10MHz REF OUT)

External addition input

Addition gain	×0.4, ×2, ×10, or off (switchable) The maximum output range is fixed to 0.8 Vp-p for ×0.4, 4 Vp-p for ×2, and 20 Vp-p for ×10.
Input voltage	-1 V to +1 V
Max. allowable input	±2 V
Input frequency	DC to 10 MHz (-3 dB)
Input impedance	10 kΩ, unbalanced
Input connector	BNC receptacle (MOD/ADD IN)

Multi-I/O

Multi-I/O connector	Sweep external control, sequence external control (dedicated cable is optional)

Other Functions

Phase synchronization		Restart the output waveforms of all channels from the set phase
Synchronization of Multiple Units		Max. 6 units
User-defined Units	Function	Set and display settings in any unit based on a specified conversion expression
	Setting items	Frequency (Hz), cycle (sec), amplitude (Vp-p, Vpk), DC offset (V), phase (deg) and duty (%)
	Conversion expression	[(setting target value)+n]×m or [log10(setting target value)+n]×m
	Unit string	Maximum 4 characters
Setting Value Upper and Lower Limit Function		Function : Limit the upper and lower limits of setting values. However, this is not applied to external addition. Setting target : Frequency, negative and positive values of output voltage (amplitude setting [Vp-p] ÷ 2 + DC offset setting [V]), phase, duty. Setting range and resolution : In accordance with the setting range of each target
Setting saving memory		10 sets (saved to non-volatile memory) Saving to USB Flash Drive is possible.
Remote Interfaces		GPIB: IEEE-488.1, IEEE-488.2 (WF1983/WF1984) USB: USBTMC, USB 1.1 Full Speed LAN: TCP/IP, 10/100Base-T

Control software

Function	Remote control	Setting, saving, and reading parameters
	Status monitor	Monitor and display the status of connected devices
	Creating arbitrary waveform data	Waveform generation, editing, transfer, and display
	Edit a sequence	Edit a sequence,modiflying, saving transfer, and display
Environment	Hard disk	64MB or more
	OS	Windows10/11 (64bit, Japanese version/English version)
	Interface	USB/LAN
	Software component	Microsoft .NET Framework 4.8 or later VISA environment

General

Display	4.3 inch TFT color LCD
I/O ground	-Signal grounds for waveform output, synchronization/ sub-output, external modulation/addition input are insulated from the enclosure. (These signal grounds are shared within the same channel.) -The signal ground for the external 10MHz frequency reference input (10MHz REF IN) is insulated from the enclosure. -Each of the signal grounds of CH1, CH2, and 10 MHz reference input are independent. -The maximum withstand voltage : 42 Vpk (DC+AC peak)
Power supply	100 V to 240 V AC, 50 Hz/60 Hz ±2 Hz
Power consumption	WF1981/WF1983 : 50 VA or less WF1982/WF1984 : 75 VA or less
Overvoltage category	II
Ambient temperature/ humidity range conditions	0°C to +40°C, 5%RH to 85%RH (Where absolute humidity is 1 g/m³ to 25 g/m³, non-condensing)
Pollution degree	2
Installation location	Indoor use
Dimension	215 (W) × 88 (H) × 306 (D) mm (excluding protrusions)
Weight	Approx. 1.8 kg (excluding accessories)
Accessories	Safety Information, Quick start guide, Power cable set

Options

Models	Products
PA-001-1318	Multi-I/O Cable
PA-001-3838	Rack Mount Kit (EIA, for 1 unit)
PA-001-3839	Rack Mount Kit (EIA, for 2 units)
PA-001-3840	Rack Mount Kit (JIS, for 1 unit)
PA-001-3841	Rack Mount Kit (JIS, for 2 units)

Modification available

- **Maximum output voltage expansion**
  30 Vp-p/open, output impedance 5 Ω setting
- **Resonance point tracking function**
  For driving piezoelectric devices with power amplifiers

WAVE FACTORY

Multifunction Generator

WF1967/ WF1968

200 MHz

WF1968

High performance and functionality

- 0.01 µHz to 200 MHz
- Max.20 Vp-p/open
- Low jitter, low distortion
- Sub channel : 2-ch model as 4 phase signal generator
- parameter-variable waveform, sequence function, high speed/large capacity arbitrary waveform

High Speed Bipolar Amplifier / Bipolar Amplifier

Amplify the output of function generator

High Speed Bipolar Amplifier **HSA series**

Stable output for capacitive / inductive load.

Max. 1 MHz

- 4-quadrant operation
- Low output impedance
- Gain setting, polarity switching, DC bias voltage setting

Model	Frequency	Voltage	Current
HSA42011	DC to 1 MHz	150 Vp-p	3 Ap-p
HSA42012	DC to 1 MHz	150 Vp-p	6 Ap-p
HSA42014	DC to 1 MHz	150 Vp-p	12 Ap-p
HSA42051	DC to 500 kHz	300 Vp-p	2.83 Ap-p
HSA42052	DC to 500 kHz	300 Vp-p	5.66 Ap-p

Bipolar DC Power Supply **BP series**

Constant voltage / Constant current Max. current ±100 A

±10 A

±30 A

- Output voltage : ±60 V, 120V p-p
  Output current : ±10 A to ±100 A (10 models)
- Frequency : DC to 150 kHz (CV mode)
  : DC to 70 kHz (CC mode)
- Two mode selectable, Constant voltage / Constant current
- Up to 255 steps sequence function
- Response calibration function, Voltage / Current limiter, measurement function

*Note: The contents of this catalog are current as of July 26th, 2024.
Product appearance and specifications are subject to change without notice.
Before purchase, contact us to confirm the latest specifications, price and delivery date.

COSINUS MESSTECHNIK GMBH

WAVE FACTORY

MULTIFUNCTION GENERATOR

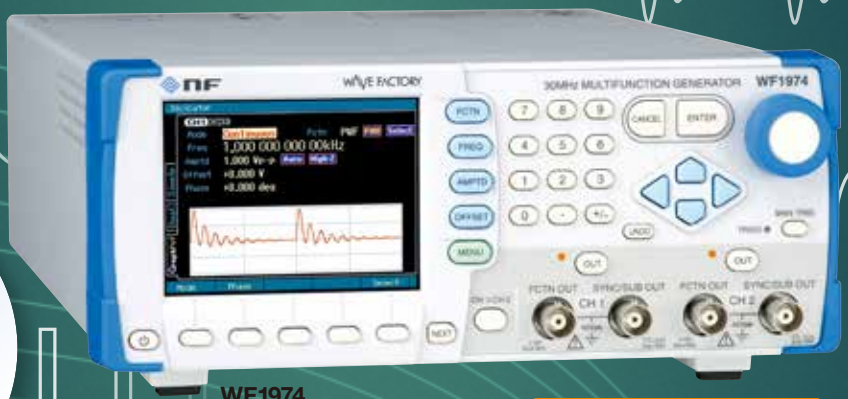
WF1973/WF1974

Effortless waveform generation via an intuitive graphical user interface

Upcoming general-purpose signal source that is a must for engineers

1CH/30 MHz

WF1973



WF1974

2CH/30 MHz

Wide Frequency Range
0.01 µHz to 30 MHz

Various Types of Output Waveforms
Equipped with standard, arbitrary and "parameter-variable" waveforms

Useful Programming Function
The sequence function enables you to easily program output patterns.

Wide Array of Oscillation Modes
Continuous, burst/trigger/gate, internal/external modulation, sweep, and sequence oscillation

2-channel Mode
Two independent channels, two phases, constant frequency difference, constant frequency ratio, and differential output

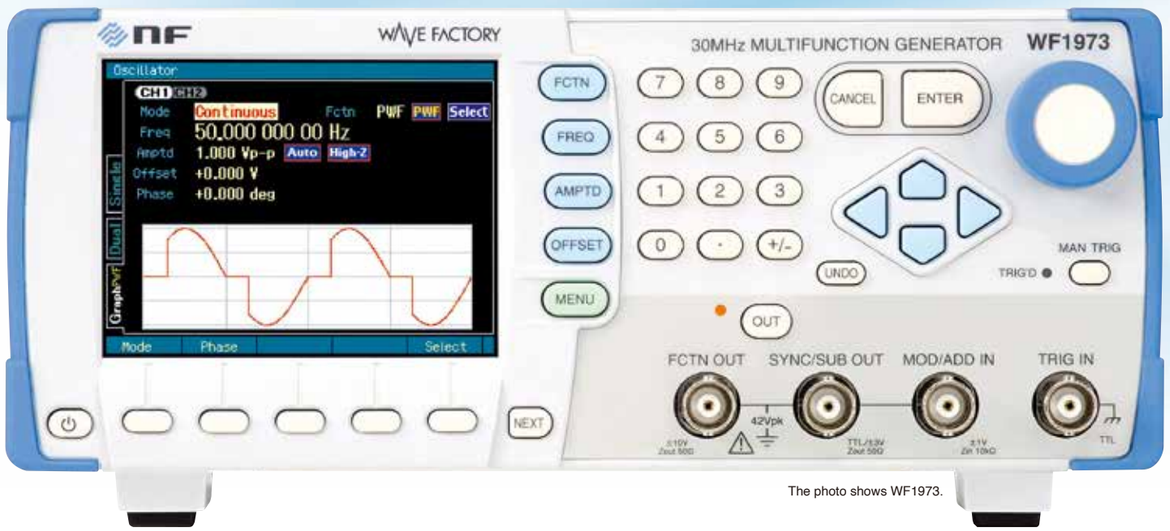
Functions
Synchronous operation of multiple units, usable as a pulse generator, external addition input, user-defined units and more

Pursuit of Usability
Flat and lightweight (88 mm high, 2.1 kg), each channel insulated from the housing, USB/GPIB interface, and more

Generate the waveforms you need–effortlessly!

Wide array of functions for a broad range of applications

While the WF1973 and WF1974 can generate standard waveforms such as sine and square waves, application-specific waveforms such as Gaussian pulse and chattering, and arbitrary waveforms, these generators also have a wide array of functions, including sequence, modulation, and sweep. These are up-and-coming general-purpose signal sources that are a must for engineers and should be kept on hand for a wide variety of applications.



The photo shows WF1973.

WAVE FACTORY

MULTIFUNCTION GENERATOR

WF1973 [1CH] **WF1974** [2CH]

0.01 μHz to 30 MHz

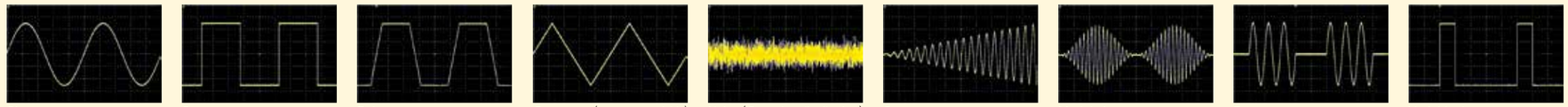
CE

Anytime, Anywhere

Handy signal source generates basic functions quickly and reliably

The WF1973 and WF1974 are easy to use as general-purpose signal sources for routine tests. Both standard waveforms and various modifying functions, including sweep, modulation, burst and duty variable, can be operated intuitively. Use of direct digital synthesis (DDS) ensures superior stability and repeatability, and so supports reliable testing.

DDS method · Continuous · Sweep · Modulation · Burst · Trigger · Gate · DC offset · Duty variable · Rising/falling variable ····· etc.



Sine wave · Square wave · Pulse wave · Ramp wave (symmetry variable) · Noise (Gaussian distribution) · Sweep · Modulation · Burst · Variable duty square wave

Three methods allow you to generate or program Any Waveform!

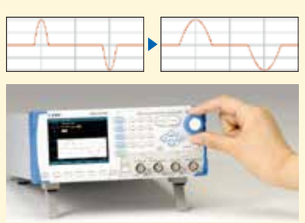
The desired waveform can be quickly found and generated.

Parameter-Variable Waveform

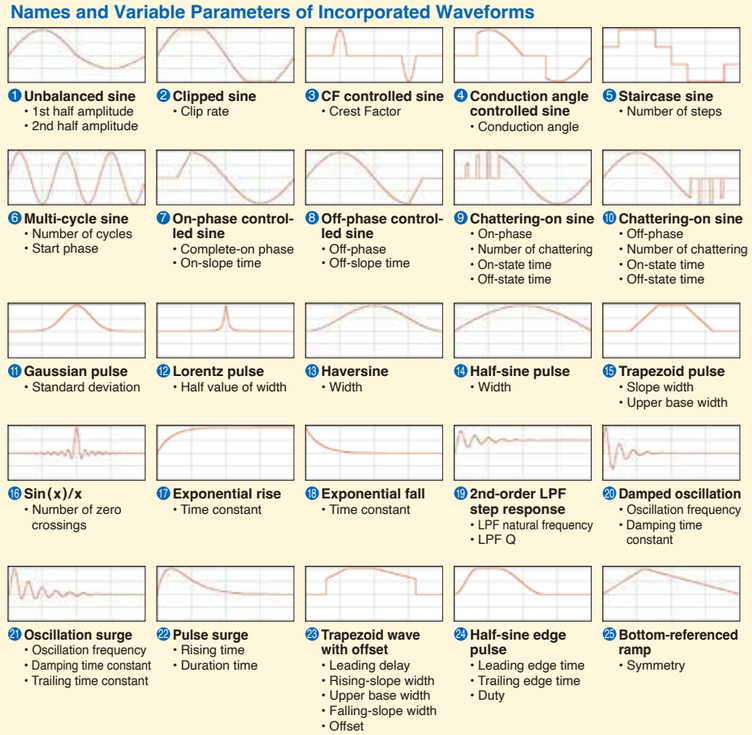
NF has incorporated an innovative waveform library called a parameter-variable waveform function.
The parameter-variable waveform offers an easy-order waveform system. The appropriate waveform for your purpose can be generated easily: just select a preprogrammed waveform and edit it using parameters specific to your requirements. The 25 types of available waveforms include circuit-related, communication-related, and machine-related waveforms.

For Example

The CF (crest factor) can be set within a range from 1.41 to 10.00 and varied easily using the modify knob.
Waveforms generated in this way can be treated as standard waveforms with respect to frequency, amplitude, oscillation mode and other parameters.



Names and Variable Parameters of Incorporated Waveforms



1. **Unbalanced sine**
   • 1st half amplitude
   • 2nd half amplitude
2. **Clipped sine**
   • Clip rate
3. **CF controlled sine**
   • Crest Factor
4. **Conduction angle controlled sine**
   • Conduction angle
5. **Staircase sine**
   • Number of steps
6. **Multi-cycle sine**
   • Number of cycles
   • Start phase
7. **On-phase controlled sine**
   • Complete-on phase
   • On-slope time
8. **Off-phase controlled sine**
   • Off-phase
   • Off-slope time
9. **Chattering-on sine**
   • On-phase
   • Number of chattering
   • On-state time
   • Off-state time
10. **Chattering-on sine**
    • Off-phase
    • Number of chattering
    • On-state time
    • Off-state time
11. **Gaussian pulse**
    • Standard deviation
12. **Lorentz pulse**
    • Half value of width
13. **Haversine**
    • Width
14. **Half-sine pulse**
    • Width
15. **Trapezoid pulse**
    • Slope width
    • Upper base width
16. **Sin(x)/x**
    • Number of zero crossings
17. **Exponential rise**
    • Time constant
18. **Exponential fall**
    • Time constant
19. **2nd-order LPF step response**
    • LPF natural frequency
    • LPF Q
20. **Damped oscillation**
    • Oscillation frequency
    • Damping time constant
21. **Oscillation surge**
    • Oscillation frequency
    • Damping time constant
    • Trailing time constant
22. **Pulse surge**
    • Rising time
    • Duration time
23. **Trapezoid wave with offset**
    • Leading delay
    • Rising-slope width
    • Upper base width
    • Falling-slope width
    • Offset
24. **Half-sine edge pulse**
    • Leading edge time
    • Trailing edge time
    • Duty
25. **Bottom-referenced ramp**
    • Symmetry

Flexible Program Output Patterns

Sequence Function



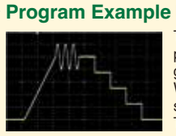
Main unit graph screen

The sequence function programs and sequentially outputs parameters such as waveform, frequency and amplitude. Repetition, jump and other such behavior can be programmed, so constantly changing signals—such as machine vibration and voltage fluctuation—and long complex output patterns can be generated easily. The sequence function allows sudden changes to parameters, and can be used with parameter-variable waveforms and sweep functions. The sequence function substantially expands the range of applications for which our function generators are suitable.

- Parameters: waveform, frequency, phase, amplitude, DC offset, square wave duty, step time, hold operation, jump destination, number of jumps, step stop phase, branch operation, step termination control, and more
- Number of steps: 1 to 255 per sequence
- Number of saved sequences: 10
- Maximum number of usable waveforms: 128

Sequence Editor

Program Example Using the Sequence Function



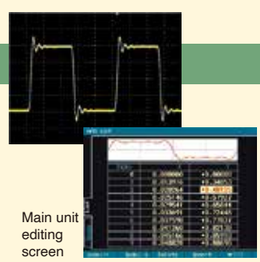
The table on the right shows the program (sequence list) used to generate the signal on the left. The WF1973 and WF1974 can execute such simple programs automatically. The Sequence Editor facilitates generation, editing, and a number of other processes for more complicated programs.

Step	Waveform	Frequency [Hz]	Amplitude [Vp-p]	Offset [V]	Step time [s]	Sweep
1	DC	—	0	0	0.15	—
2	DC	—	0	5	0.2	ON
3	Sine	20	2	5	0.15	—
4	DC	—	0	5	0.1	—
5	DC	—	0	3.75	0.1	—
6	DC	—	0	2.5	0.1	—
7	DC	—	0	1.25	0.1	—
8	DC	—	0	0	0.1	—

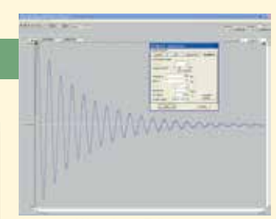
Up to 512 K words/Waveform, 4 M words

Arbitrary Waveforms

Arbitrary waveforms up to 512 K words can be output. Up to 128 waveforms can be stored in the large 4 M words memory. Highly precise waveforms are generated using high-resolution (14-bit), high-speed (120M samples/sec) sampling. Waveforms can be generated easily either via the control panel (linear interpolation of control points) or in software using the Arbitrary Waveform Editor, which also allows external data to be imported and mathematical expressions to be applied.
Preprogrammed parameter-variable waveforms can be retrieved and edited as required.



Main unit editing screen

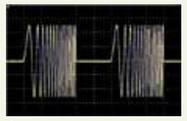


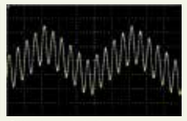
Arbitrary Waveform Editor

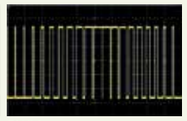
Fully equipped with the functions and performance that are required for function generators. The WF1973 and WF1974 are simple to operate and provide high-precision waveforms for a wide range of applications.

Multifunctional — A variety of oscillation modes and flexible scalability

Sweep and modulation functions


Gated sweep

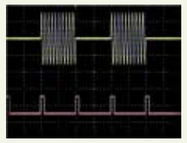

Offset modulation

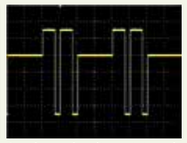

PWM

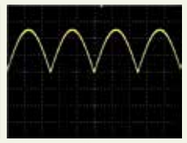
Frequency, phase, amplitude, DC offset and duty sweeps can be performed in one-way or shuttle, linear or logarithmic slope*, and continuous, single-shot or gated single-shot modes. Marker and X-drive outputs are available. DC offset modulation and PWM modes are supported as well as FM, FSK, PM, PSK, and AM—both internal and external modulation. These function generators can address a wide range of applications.

* Logarithmic mode is supported only for frequency sweeping.

Burst/trigger/gate


Triggered gate


3-value pulse (burst/trigger)


Full-wave rectification waveform (burst/trigger)

In the burst oscillation mode, oscillation can be started or stopped at any wave count.

WF1973 and WF1974 support four modes;

Auto burst: No trigger is needed

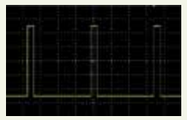
Trigger burst: Oscillation in sync with the trigger

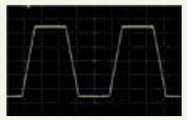
Gate: Oscillation in sync with the gate signal

Triggered gate: Gate oscillation switched on/off by gate upon trigger

The phase where oscillation starts/stops and the level at which oscillation starts/stops can be set.

As pulse generator


Pulse width variable


Rising/falling time variable


Rising time (15 ns) X: 10 ns/DIV Y: 2 V/DIV

With great speed and operability, the WF1973 and WF1974 show excellent performance when used as a pulse generator or signal source for digital circuits. The duty/time, rising time, and falling time of pulse waves can be individually set, so these generators are best suited to operation testing of a wide variety of digital equipment and devices, data transmission equipment, and more.

External 10 MHz frequency reference input, synchronous operation of multiple generators

A high-accuracy frequency can be output when an external 10 MHz standard signal is input into the external 10 MHz frequency reference input (REF IN).

Synchronous operation of up to six units is possible in the form of master/slave connections*, using the frequency reference output (REF OUT) and frequency reference input (REF IN). A multi-channel (multi-phase) oscillator can be configured.

* A BNC cable is used for connection.


WF1973 rear panel

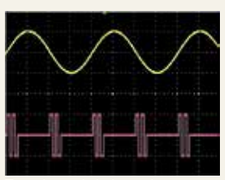
2 Channels — Ideal 2-channel generator

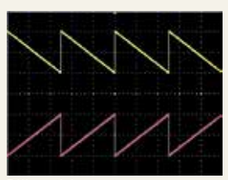

WF1974


WF1974 rear panel

The WF1974 is a dual-channel function generator. Each channel is insulated from the housing and has the same functions and performance as a single-channel WF1973. In addition, the WF1974 offers two phase, constant frequency difference, constant frequency ratio and differential output—all features that are unique to NF dual-channel function generators.

- Independent output (Indep) : Two channels programmed separately.
- Two phase (2-Phase) : Same frequency.
- Constant frequency difference (2-Tone) : Difference in frequencies is constant.
- Constant frequency ratio (Ratio) : Ratio of frequencies is constant.
- Differential output (Diff) : Reverse phase waveform with identical frequency, amplitude, and DC offset.


Two channels independent

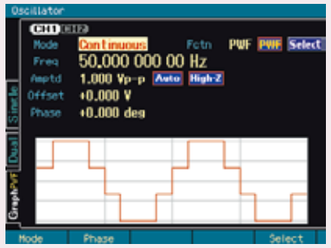

Differential output

High Accuracy — High specifications to generate quality waveforms

Above all else, function generators must be very accurate. The WF1973 and WF1974 are high-specification instruments that deliver exceptional precision, stability and reliability in support of a wide variety of applications.

- Frequency accuracy : ±(3 ppm of setting + 2 pHz) (External frequency reference of 10 MHz usable.)
- Frequency resolution : 0.01 µHz
- Amplitude accuracy : ±(1% of amplitude setting [V_{p-p}] + 2 mV_{p-p})/open
- Phase setting resolution : 0.001 (setting range: –1800.000 to +1800.000)
- Duty setting range : 0.0000% to 100.0000%; resolution: 0.0001%
- Pulse wave rising/falling time: 15.0 ns to 58.8 Ms; 3-digit resolution/0.1 ns
- Resolution of arbitrary waveform data amplitude: 16 bits

Operability — Thorough pursuit of usability



Waveform display

The TFT color LCD display with the QVGA high resolution has been adopted. A variety of setup parameters can be seen at a glance and the set waveform is also displayed. Setting errors can be avoided because the waveform to be output can be intuitively checked.

User-defined unit function

The frequency, period, phase, amplitude, DC offset and duty can be set and displayed in desired unit (up to four characters), using a specified conversion expression.

Other features

- Input/output signal ground independent of housing and signal ground between channels also insulated.
- Output voltage under specified load impedance can be set and displayed.
- External signals can be added and output.
- Up to ten settings can be saved.
- USB and GPIB interfaces.
- LabVIEW driver included.
- Power supply input for 90 V AC to 250 V AC enables worldwide use.
- Flat and light body (88 mm high, about 2.1 kg)

Applications — We can satisfy a variety of waveform-related needs.

Electronic equipment and parts

Ultrasonic motor drive testing, differential/balanced input testing, LCD panel operation testing, copier drum (developing bias) testing, digital circuit evaluation testing, and evaluation of ICs

Communication and audio equipment

Testing of echo cancellers which act as IQ signal generator/clock sources for mobile communication systems, amplifier and speaker tone burst testing and linearity measurement, and wireless communication equipment evaluation testing

Automobiles

Gear rotation signal simulation, precision work for turbo chargers, inverter evaluation, ABS and power-steering device testing, ECU and sensor operation testing

Machinery, controls, and construction

Industrial robot and servo system adjustment and testing, pulse motor driving, building vibration experiments (for incorporating vibration testers), water-tank-based wave generation tests, and material fatigue testing

Other applications

Simulation of biosignals, electrolysis, electroplating, and battery charge/discharge testing, breaker testing, three-phase power source simulation, power source modulation testing, a frequency standard for measurement equipment management room, experiments and science projects in universities and technical colleges

Power amplifier that boosts output

High-Speed Bipolar Amplifier —BA4825/HSA Series


Example when combined with BA4825

NF recommends using our high-speed bipolar power amplifiers (BA4825/HSA Series) as power amplifiers for drive testing and other applications where a high voltage is applied to DUT, such as electronic parts or devices. These power amplifiers attain high-speed response and high voltage output, as well as wide frequency range. In addition, four-quadrant operation enables them to serve as the source (supply) and sink (absorption) for positive/negative voltage and current. They stably operate (output power) under capacitive or inductive loads such as a piezoelectric element or solenoid.

BA4825

- Wide band: DC, up to 2 MHz
- High voltage output: 300 V_{p-p}
- Output current: 0.5 Arms
- Slew rate: 500 V/µs
- Low output impedance
- Output polarity switching function and more

HSA Series

- Wide band: DC, up to 1 MHz
- High voltage output: up to 300 V_{p-p}
- Slew rate: up to 475 V/µs
- Low output impedance
- DC offset and more

Specifications

▼ Waveform and Oscillation Mode

Output waveforms	Sine, square, pulse, ramp, and parameter-variable waveforms (25 types), noise (Gaussian distribution), DC, and arbitrary waveform
Oscillation modes	Continuous, modulation, sweep, burst, and sequence

▼ Frequency and Phase

Frequency setting range

Oscillation mode / Waveform	Continuous, modulation, and sweep (continuous/single-shot)	Sweep (gated single-shot) and burst	Sequence
Sine	0.01 µHz to 30 MHz	0.01 µHz to 10 MHz	0.01 µHz to 10 MHz
Square	0.01 µHz to 15 MHz	0.01 µHz to 10 MHz	0.01 µHz to 10 MHz
Pulse	0.01 µHz to 15 MHz	0.01 µHz to 10 MHz	not avaiable
Ramp	0.01 µHz to 5 MHz		0.01 µHz to 5 MHz*2
Parameter-variable	0.01 µHz to 5 MHz		0.01 µHz to 5 MHz*2
Noise	The equivalent bandwidth is fixed to 26 MHz.		
DC	Frequency setting invalid		
Arbitrary	0.01 µHz to 5 MHz		

Frequency setting resolution	0.01 µHz
Frequency accuracy*1	±(3 ppm of setting + 2 pHz), aging rate*1: ±1 ppm/year
Phase setting range	–1800.000° to +1800.000°

▼ Output Characteristics

Amplitude	Setting range	0 V_{p-p} to 20 V_{p-p}/open, 0 V_{p-p} to 10 V_{p-p}/50 Ω AC+DC ≤ ±10 V/open
	Setting resolution	999.9 mV_{p-p} or less: 4-digit/0.1 mV_{p-p} 1 V_{p-p} or greater: 5-digit/1 mV_{p-p}
	Accuracy*1*3	±(1% of amplitude setting [V_{p-p}] + 2 mV_{p-p})/open
	Setting unit	V_{p-p}, V_{pk}, V_{rms}, dBV, and dBm
	Resolution of waveform amplitude	Approx. 14 bits (36 mVp-p/open or greater)
DC offset	Setting range	±10 V/open, ±5 V/50 Ω
	Setting resolution	499.9 mV or less: 4-digit/0.1 mV, ±0.5 V or greater: 5-digit/1 mV
	Accuracy*1	±(|1% of DC offset setting [V]|+ 5 mV + 0.5% of amplitude setting [V_{p-p}])/open (20°C to 30°C when outputting sine waves of 10 MHz or less)
Output impedance		50 Ω unbalanced
Synchronous/sub output		Sync signals: TTL level Internal modulation signal: –3 V to +3 V/open Sweep X drive: 0 V to +3 V/open

▼ Signal Characteristics

Sine wave	Amplitude frequency characteristics*1	Up to 100 kHz : 0.1 dB 100 kHz to 5 MHz : 0.15 dB 5 MHz to 20 MHz : 0.3 dB 20 MHz to 30 MHz : 0.5 dB (±0.8 dB at 2.8 V_{p-p}/50 Ω or greater) (50 mV_{p-p} to 10 V_{p-p}/50 Ω ,1 kHz reference)	
	Total harmonic distortion*1	10 Hz to 20 kHz : 0.2% or less (0.5 V_{p-p} to 10 V_{p-p}/50 Ω)	
	Harmonic spurious*1		0.5 V_{p-p} to 2 V_{p-p}/50 Ω / 2 V_{p-p} to 10 V_{p-p}/50 Ω
		to 1 MHz	–60 dBc or less / –60 dBc or less
		1 MHz to 10 MHz	–50 dBc or less / –43 dBc or less
		10 MHz to 30 MHz	–40 dBc or less / –30 dBc or less
	Non-harmonic spurious*1	to 1 MHz –60 dBc or less 1 MHz to 10 MHz –50 dBc or less 10 MHz to 30 MHz –45 dBc or less	(0.5 V_{p-p} to 10 V_{p-p}/50 Ω)
Square wave	Duty variable	Standard: Setting range: 0.0100% to 99.9900% Upper limit (%): 100 – frequency (kHz)/300 Lower limit (%): frequency (kHz)/300 Jitter: 300 ps rms or less typ. Extended: Setting range: 0.0000% to 100.0000% Jitter: 2.5 ns rms or less typ.	
	Rising/falling time*1	17 ns or less	
	Overshoot	5% or less typ.	
Pulse wave	Pulse width	Duty setting range: 0.0170% to 99.9830% Time setting range: 25.50 ns to 99.9830 Ms	
	Rising/falling time	Setting range 15.0 ns to 58.8 Ms (3-digit/0.1 ns) Rising/falling time independently set The minimum setting value is 0.01% of period or 15 ns, whichever is larger.	
	Overshoot	5% or less typ.	
Ramp wave		Symmetry setting range: 0.00% to 100.00%	
Parameter-variable waveforms	Function	5% or less typ.	
	Waveform types and names: Steady sine wave group	Unbalanced sine, clipped sine, CF controlled sine, conduction angle controlled sine, staircase sine, and multi-cycle sine waves	
	Waveform types and names: Transient sine wave group	On-phase controlled sine, off-phase controlled sine, chattering-on sine, and chattering-off sine waves	
	Waveform types and names: Pulse waveform group	Gaussian pulse, Lorentz pulse, Haversine, half-sine pulse, trapezoid pulse, and Sin (x)/x	
	Waveform types and names: Transient response waveform group	Exponential rise, exponential fall, 2nd order LPF step response, and damped oscillation	
	Waveform types and names: Surge waveform group	Oscillation surge and pulse surge	
	Waveform types and names: Others group	Trapezoid with offset, half-sine edge pulse, and bottom referenced ramp waves	

Arbitrary waveform	Waveform length	4 K to 512 K words (2^n, n=12 to 19) or the number of control points is 2 to 10,000 (Control points are linearly interpolated.)
	Total of waveform saving capacity	Up to 128 waves or 4 M words (total of channels 1 and 2), saved in the nonvolatile memory.
	Resolution	16 bits
	Sampling rate	120 MS/s

▼ Modulation

Internal modulation	Modulation waveforms	Other than FSK and PSK: Sine, square (duty of 50%), triangle (symmetry of 50%), rising ramp, falling ramp, noise, arbitrary waveforms FSK and PSK: Square (duty of 50%)
	Modulation frequency	Other than FSK and PSK: 0.1 mHz to 100 kHz (5-digit/0.1 mHz) FSK and PSK: 0.1 mHz to 1 MHz (5-digit/0.1 mHz)
External modulation	Input voltage range	±1 V full scale (other than FSK and PSK)
	Input impedance	10 kΩ, unbalanced (other than FSK and PSK)
	Input frequency	DC to 25 kHz (other than FSK and PSK) DC to 1 MHz (FSK and PSK)
Modulation types and conditions	FM	Carrier waveform: Arbitrary waveform and standard waveform other than noise, pulse, and DC Peak deviation: 0.00 µHz to less than 15 MHz
	FSK	Carrier waveform: Arbitrary waveform and standard waveform other than noise, pulse, and DC Hop frequency: Within the frequency settable range for each carrier waveform
	PM	Carrier waveform: Arbitrary waveform and standard waveform other than noise and DC Peak deviation : 0.000° to 180.000°
	PSK	Carrier waveform: Arbitrary waveform and standard waveform other than noise and DC Deviation: –1800.000° to +1800.000°
	AM	Carrier waveform: Arbitrary waveform and standard waveform other than DC Modulation depth: 0.0% to 100.0% (DSB-SC and non-DSB-SC supported)
	DC offset modulation	Carrier waveform: Standard waveform and arbitrary waveform Peak deviation: 0 V to 10 V/open
	PWM	Carrier waveform: Square wave and pulse wave Peak deviation: Square wave of normal duty variable range: 0.0000% to 49.9900%, Square wave of extended duty variable range: 0.0000% to 50.0000%, Pulse: 0.0000% to 49.9000%

▼ Sweep

Sweep types	Frequency, phase, amplitude, DC offset, and duty
Sweep functions	One-way (ramp wave shape)/shuttle (triangle wave shape) selectable Linear/logarithmic selectable (only when sweeping the frequency)
Sweep range setting	The start and stop values or the center and span values are specified.
Sweep time setting range	0.1 ms to 10,000 s (4-digit/0.1 ms)
Sweep modes	Continuous/single-shot/gated single-shot selectable Oscillation only occurs during sweep execution in the gated single-shot mode.
Trigger source	Internal/external selectable
Internal trigger oscillator	Period setting range: 100.0 µs to 10,000 s (5-digit/0.1 s)
Stop level setting	The signal level while oscillation is stopped in the gated single-shot sweep mode is specified. Setting range: –100.00% to +100.00% (with reference to the full scale of amplitude) or off
Sweep input/output	Sweep sync/marker output, sweep X drive output, sweep external control input, and sweep external trigger input

▼ Burst/Trigger/Gate

Burst modes	Auto burst, trigger burst, gate, and triggered gate modes (The gate is turned on/off at each trigger in the triggered gate mode.)
Number of mark/space waves	0.5 to 999,999.5 cycles, in 0.5-cycle units
Number of oscillation waves in the gate mode	1 cycle/0.5 cycles selectable
Phase setting range	–1800.000° to +1800.000°
Stop level	The signal level while oscillation is stopped is specified. Setting range: –100.00% to +100.00% Oscillation stops at the set oscillation start/stop phase when the stop level is set to off.
Trigger source	Internal/external selectable, manual trigger allowed
Internal trigger oscillator	1.0 µs to 1,000 s (5-digit/0.1 µs)
Trigger delay	0.00 µs to 100.00 s (5-digit/0.01 µs) Except for latent delay. Valid in the trigger burst mode only.
External trigger input	TTL level Input impedance 10 kΩ (pulled up to +3.3 V) Unbalanced
Manual trigger	Panel key operation

▼ Sequence

Step control parameters	Step time, hold operation, jump destination, number of jumps, step stop phase, branch operation, step termination control, and step sync code output
Channel parameters in step	Waveform, frequency, phase, amplitude, DC offset, and square wave duty
Available waveforms	• Sine, square, noise, DC, and arbitrary waveforms • The ramp and parameter-variable waveforms can be used after being saved as arbitrary waveform.
Max. number of usable waveforms	128
Number of saved sequences	10 sequences (saved in the nonvolatile memory)
Number of steps	Up to 255 steps per sequence
Step time	0.1 ms to 1,000 s (4-digit/0.01 ms)
Operation in step	Constant, keep, and linear interpolation (except for waveform switching)
Number of jumps	1 to 999 or unlimited
Branch operation	Branched to the specified step when the branch signal is input.

▼ 2-channel Ganged Operation (WF1974 only)

Channel modes	Two channels independent, two phases (same frequency), constant frequency difference, constant frequency ratio, and differential output (same frequency, amplitude, DC offset, reversed waveform)
Equivalent setting, same operation	Set two channels at the same time.
Frequency difference setting range	0.00 µHz to less than 30 MHz (resolution: 0.01 µHz) CH2 frequency – CH1 frequency
Frequency ratio N:M setting range	1 to 9,999,999 (for N and M, respectively) N:M = CH2 frequency:CH1 frequency
Phase synchronization	Function to restart from the phase where the output waveforms for all the channels are set, automatic execution at channel mode switching

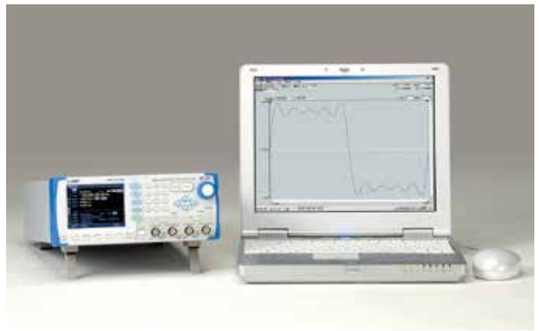
▼ Other Functions

External 10 MHz frequency reference input		Input voltage: 0.5 V_{p-p} to 5 V_{p-p}, sine or square waves
Frequency reference output		For synchronization when more than one WF1973 and/or WF1974 are used. Output voltage: 1 V_{p-p}/50 Ω,square wave, 10 MHz
External addition input	Function	Function to add the external signal to the waveform output signal
	Addition gain	×2/×10/off selectable The maximum output voltage range is fixed to 4 V_{p-p} (×2) or 20 V_{p-p} (×10).
	Input voltage/input frequency	–1 V to +1 V DC to 10 MHz (–3 dB)
	Input impedance	10 kΩ, unbalanced
Multi input/output		Used for sweep and sequence control
Synchronization of multiple units		Sync operation is possible. Up to 6 units can be connected with BNC cables in the form of master/slave connections, using the frequency reference output and external 10 MHz frequency reference input.
User-defined unit	Function	Sets and displays the value in any unit, using a specified conversion expression.
	Setting target	Frequency, period, amplitude, DC offset, phase, and duty
	Conversion expression	[(setting target value)+n]×m or [$\log_{10}$ (setting target value)+n]×m The conversion expression, n and m are to be specified.
	Unit character string	Up to four characters
Memory to save setting		10 settings can be memorized (saved in the nonvolatile memory).
Interface		GPIB and USBTMC (SCPI-1999 and IEEE-488.2)

▼ General Characteristics

Display	3.5" TFT color LCD
Input/output ground	• The signal grounds for waveform output, sync/sub output and external modulation/addition input are insulated from the housing. (These signal grounds are common within the same channel.) • The signal ground for external 10 MHz frequency reference input is insulated from the housing. • Each signal ground for CH1, CH2 and external 10 MHz frequency reference input is independent.
Power supply	AC100 V to 230 V ±10% (250 V max.) 50 Hz/60 Hz ±2 Hz
Power consumption	WF1973: 50 VA max. WF1974: 75 VA max.
Operation temperature/humidity range	0°C to +40°C, 5%RH to 85%RH (Absolute humidity: 1 g/m³ to 25 g/m³, no condensation)
Weight	Approx. 2.1 kg (main unit excluding accessories)
Safety and EMC	Safety: EN 61010-1: 2010 EMC: EN 61326-1: 2013

• Unless otherwise specified, the value assumes the following conditions: continuous oscillation, load of 50Ω, oscillation setting of 10 V_{p-p}/50 , DC offset setting of 0 V, auto range, waveform amplitude range of FS, external addition turned off; the AC voltage is the rms value.
*1: Guaranteed numerical value. Other numerical values are nominal or typical (typ.) values.
*2: Used after converted into arbitrary waveform
*3: Conditions: 1 kHz Sine, Amplitude 20 mV_{p-p} or greater/open



▼ Sequence Editor

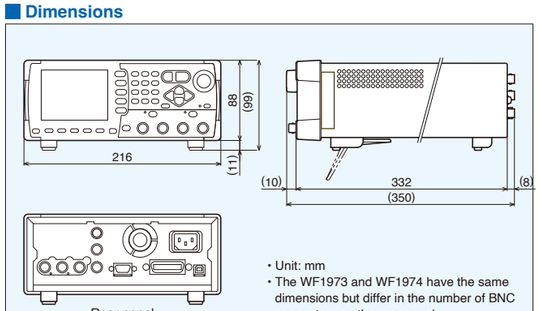
Editing functions	• Initializes, copies, pastes, inserts, and deletes steps • Saves and reads sequence data to/from a file • Sequence can be edited without connecting the device.
Display functions	• Editing screen: Lists parameters for each step. • Sequence view screen: Graphs changes of up to five parameters.
Transfer functions	• Transfers and reads sequence data to/from the device. • Transfers to the device the arbitrary waveform used in the sequence.
Device control functions	• Output on/off • Starts, stops, and holds the sequence. • Can monitor the execution status of sequence.
Operating environment	• PC that can display 1024 × 768 (pixels) × 256 colors • Microsoft Windows10 (32bit/64bit) • USB interface • NI-VISA from National Instruments • USB driver (required)

▼ Arbitrary Waveform Editor

Editing functions	• Generation (standard waveform and a mathematical expression) • Interpolation (straight line, spline, and continuous spline) • Math operation (addition, subtraction, multiplication, and division of waveform) • Contraction and extension (vertical and horizontal directions) • Cuts, copies, and pastes some part of waveform • Undo function • Saves and reads arbitrary waveform data to/from a file • Waveforms can be edited without connecting the device.
Display functions	• Zoom in/out • Scroll • Display unit (coordinates) selectable • Cursor (A, B)
Transfer function	• Transfers and reads arbitrary waveform data to/from the device.
Device control function	• Major parameter setting
Operating environment	※Same as the operating environment for the Sequence Editor.

Accessories	• Instruction Manual (Basic) • CD PDF manuals, Arbitrary Waveform Editor Sequence Editor, LabVIEW driver • Power cord set
Option	Multi input/output cable (model name: PA-001-1318)

Dimensions



• Unit: mm
• The WF1973 and WF1974 have the same dimensions but differ in the number of BNC connectors on the rear panel.
• This diagram shows the WF1974.

■ WAVE FACTORY Lineup/Selection Guide

The following list summarizes the features of each model. For detailed specifications, refer to their respective catalogs, Web pages, or other documents.

		30 MHz				200 MHz	
Model name		WF1973	WF1974	WF1947	WF1948	WF1967	WF1968
Appearance		 WF1974		 WF1948		 WF1968	
Oscillation frequency		0.01 μHz to 30 MHz		0.01 μHz to 30 MHz		0.01 μHz to 200 MHz	
Number of channels		1	2	1	2	1	2
Vertical resolution for waveform		14 bits		16 bits		16 bits	
Waveform and frequency range	∿	0.01 μHz to 30 MHz		0.01 μHz to 30 MHz		0.01 μHz to 200 MHz	
	⊓ (duty fixed)	0.01 μHz to 15 MHz		0.01 μHz to 20 MHz		0.01 μHz to 70 MHz	
	⊓ (duty variable)						
	⊓	0.01 μHz to 15 MHz		0.01 μHz to 20 MHz		0.01 μHz to 70 MHz	
	∿ (symmetry variable)	0.01 μHz to 5 MHz		0.01 μHz to 5 MHz		0.01 μHz to 20 MHz	
	Parameter-variable waveforms (25 types)	0.01 μHz to 5 MHz		—		0.01 μHz to 20 MHz	
	Arbitrary waveform	0.01 μHz to 5 MHz		0.01 μHz to 5 MHz		0.01 μHz to 20 MHz	
	Noise	Bandwidth: 26 MHz		Bandwidth: 26 MHz		Equivalent bandwidth: Select from 100 M/30 M/10 M/3 M/1 M/300 k/100 kHz	
Frequency setting resolution		0.01 μHz				0.01 μHz (< 50MHz), 0.1 μHz (50MHz ≤)	
Rising/falling variable		Pulse: 15 ns to 58.8 Ms		Pulse: 15 ns to 62.5 Ms		Pulse: 4.21 ns to 58.8 Ms	
Arbitrary waveform data length/ number of waves		4K words to 512 K words/ 128 waves, 4 M words				4 Ki words to 1 Mi words/ 128 waves, 4 Mi words*1	
Maximum output voltage/resolution		20 Vp-p/open, 10 Vp-p/50 Ω, Resolution: 0.1 mVp-p or 1 mVp-p (depending on conditions)					
Oscillation mode	Continuous oscillation	○	○	○	○	○	○
	Burst/trigger/gate/ triggered gate	○	○	○	○	○	○
	Sweep	Frequency, phase, amplitude, DC offset, duty ratio					
	Internal modulation	FM, FSK, PM, PSK, AM, DC offset and PWM					
	External modulation						
	Burst with modulation/ Sweep with modulation	—	—	—	—	○	○
	Sequence	○	○	—	—	○	○
	Two channel mode	—	○	—	○	—	○
Synchronous operation		○	○	○	○	○	○
Synclator function		—	—	—	—	○	○
Synchronization/sub-output		Sync signals/Internal modulation sync/Sweep X drive				Sync signals/Internal modulation sync/ Sweep X drive/Sub output*3	
Input/output floating		○	○	○	○	○	○
Isolation between channels		—	○	—	○	—	○
External addition		○	○	○	○	○	○
GPIB interface		○	○	○	○	○	○
USB interface		○	○	○	○	○	○
Arbitrary Waveform Editor		○	○	○	○	○	○
Sequence Editor		○	○	—	—	○	○
Power supply		90 to 250 V AC					
Power consumption		50 VA or less	75 VA or less	50 VA or less	75 VA or less	65 VA or less	85 VA or less
External dimensions (mm)*2		216 (W) × 88 (H) × 332 (D)		216 (W) × 132.5 (H) × 288 (D)		216 (W) × 132.5 (H) × 332 (D)	
Weight		approx. 2.1 kg		approx. 2.6 kg		approx. 3.0 kg	

*1 Ki and Mi represent 2^{10}=1024 and 2^{20}=1048576
*2 Not including projections
*3 Available waveform : sine, square (duty 50%), ramp (symmetry 50%), rising ramp, falling ramp, noise and arbitrary waveform.

Note: The contents of this catalog are current as of October 25th, 2024
- Products appearance and specifications are subject to change without notice.
- Before purchase contact us to confirm the latest specifications, price and delivery date.

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