MULTIFUNCTION GENERATOR

WF1947/WF1948

0.01 μHz to 30 MHz

This is a standard Function Generator.

WAVE FACTORY

NF Corporation

“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.

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

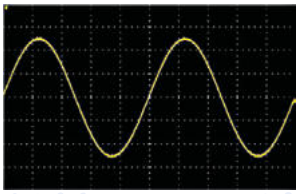
The rotational frequency (Or revolution per minute) of the fan is controlled according to the detected ambient temperature. At normal room temperature, excluding start-up and abnormal operation, the noise is one-tenth of that of previous models*.

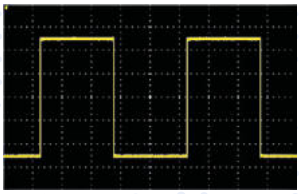
*Previous models : WF1973/WF1974

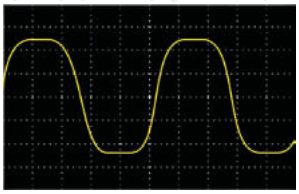
Wide array of output waveforms

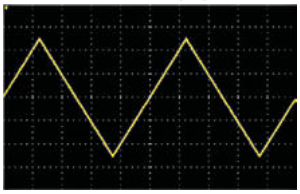
Output waveforms Sine, square, pulse, ramp and arbitrary waveforms, noise, and DC

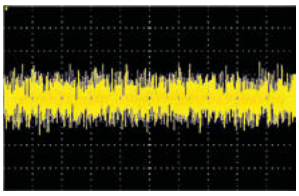
In addition to generating standard waveforms such as sine and square waveforms, it is possible to generate arbitrary waveforms of up to 512k words. Up to 128 waveforms can be stored in the 4M-word memory. All the generated waveforms have 16-bit high resolution. High-quality waveforms are indispensable 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.

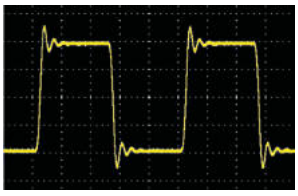

▲Sine wave


▲Square wave


▲Pulse wave (Rising/falling time variable)


▲Ramp wave (Symmetry variable)


▲Noise (Gaussian distribution)

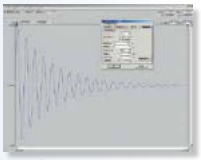

▲Arbitrary wave (overshoot)

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

MULTIFUNCTION GENERATOR WF1947/WF1948

WAVE FACTORY

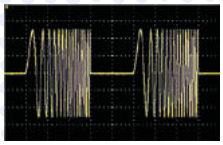
WF1947 (1ch) / WF1948 (2ch)
0.01 μHz to 30 MHz

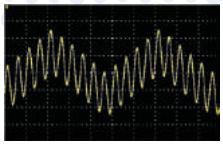
Rear Panel

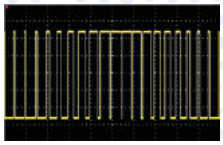
◎The photo shows the WF1948 (two channels)
The display here shows all the items
that can be displayed on the panel.

Various oscillation modes

Sweep and modulation functions

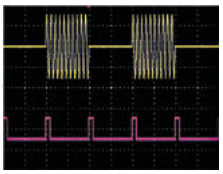

▲Gated sweep

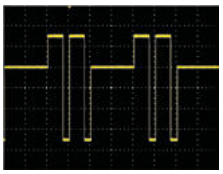

▲Offset modulation

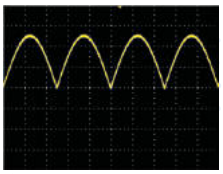

▲PWM

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

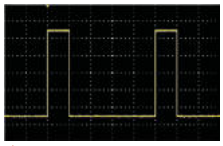

▲Triggered gate

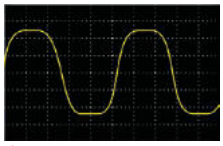

▲3-value pulse(burst/trigger)


▲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

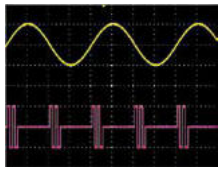

▲Rising time (50 ns)

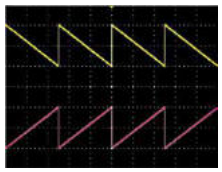
You can use this waveform generator as a signal source for digital circuits or a pulse generator. The duty/time and the rising time/falling time of pulse waves can be individually set. The generator is suited to the operation testing of a wide variety of digital equipment and devices, data transmission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

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