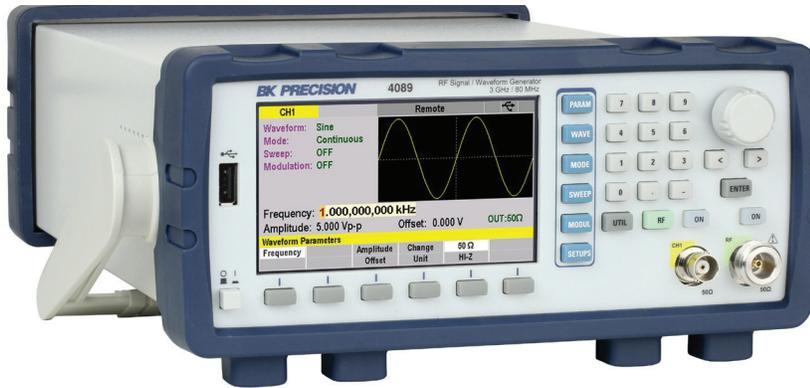


# RF Signal/Waveform Generator

## 4088 Series



The 4088 Series RF Signal/Waveform Generators feature a 2-in-1 combination providing both an RF signal generator and an AWG/Function generator in one compact package. The dedicated RF channel produces pure continuous waveform (CW) signals up to 3 GHz with modulation and sweep capabilities. The innovative design of this series integrates a fully featured AWG/Function generator capable of outputting arbitrary waveforms in addition to precise sine, square, triangle, and pulse waveforms up to 80 MHz. With the ability to generate both RF and AWG/Function signals simultaneously, the 4088 Series can save cost and space by replacing multiple generators in a variety of R&D, manufacturing, design verification, service, and education applications.

The RF generator covers a frequency range of 50 MHz to 1.5 GHz/3 GHz with excellent frequency stability and low phase noise. In addition to CW signals, these instruments can generate amplitude (AM), frequency (FM), phase (PM), and pulse modulated signals. External modulation signals can be applied using the rear panel modulation input. The sweep function is available to test devices and components across various RF signal ranges.

The AWG/Function generator employs both truepoint-by-point AWG and DDS based architectures to produce clean output signals with low jitter and high signal fidelity. Generate high resolution true arbitrary waveforms up to 250 MSa/s without skipping points. Equipped with preprogrammed shapes and a built-in editor, this instrument allows users to quickly produce custom signals directly from the front panel. For more intricate designs, the included PC software offers a diverse tool-set to streamline the creation of complex patterns. Additionally, custom arbitrary (.arb) files can be saved to a USB drive and uploaded via the front panel port.

### AWG Applications

True point-by-point AWG capabilities make these generators suitable for simulating reliable clock signals, generating triggers, or validating serial data buses. Applications include electronic design, sensor simulation, and other applications requiring precise arbitrary waveform generation.

### Features and benefits

#### RF Signal

- RF signal frequency up to 1.5 GHz/3 GHz
- Frequency characteristics:  $\pm 3$  ppm accuracy,  $\pm 1$  ppm stability, 0.1 Hz resolution
- Amplitude range from -110 dBm to +13 dBm
- Amplitude level accuracy  $< \pm 1$  dB
- Phase noise  $< -117$  dBc/Hz
- Internal or external AM/FM/PM and pulse modulation functions
- Reverse power protection up to 30 V DC or +25 dBm RF power

#### AWG/Function Generator

- 16-bit resolution, 250 MSa/s, up to 4 Mpts arbitrary waveform generator
- Generate sine and square waves from 1  $\mu$ Hz up to 80 MHz
- Generate triangle/ramp up to 5 MHz and pulse waveforms up to 10 MHz
- Amplitude up to 10 Vpp into 50  $\Omega$  or up to 20 Vpp into open circuit
- 12 built-in arbitrary waveforms
- Internal or external modulation functions: AM, FM, PM, PWM, BPSK, and FSK
- Continuous, triggered, burst, and gate modes
- Variable DC offset  $\pm 5$  V
- Low jitter  $< 25$  ps
- Internal/external triggering and programmable markers

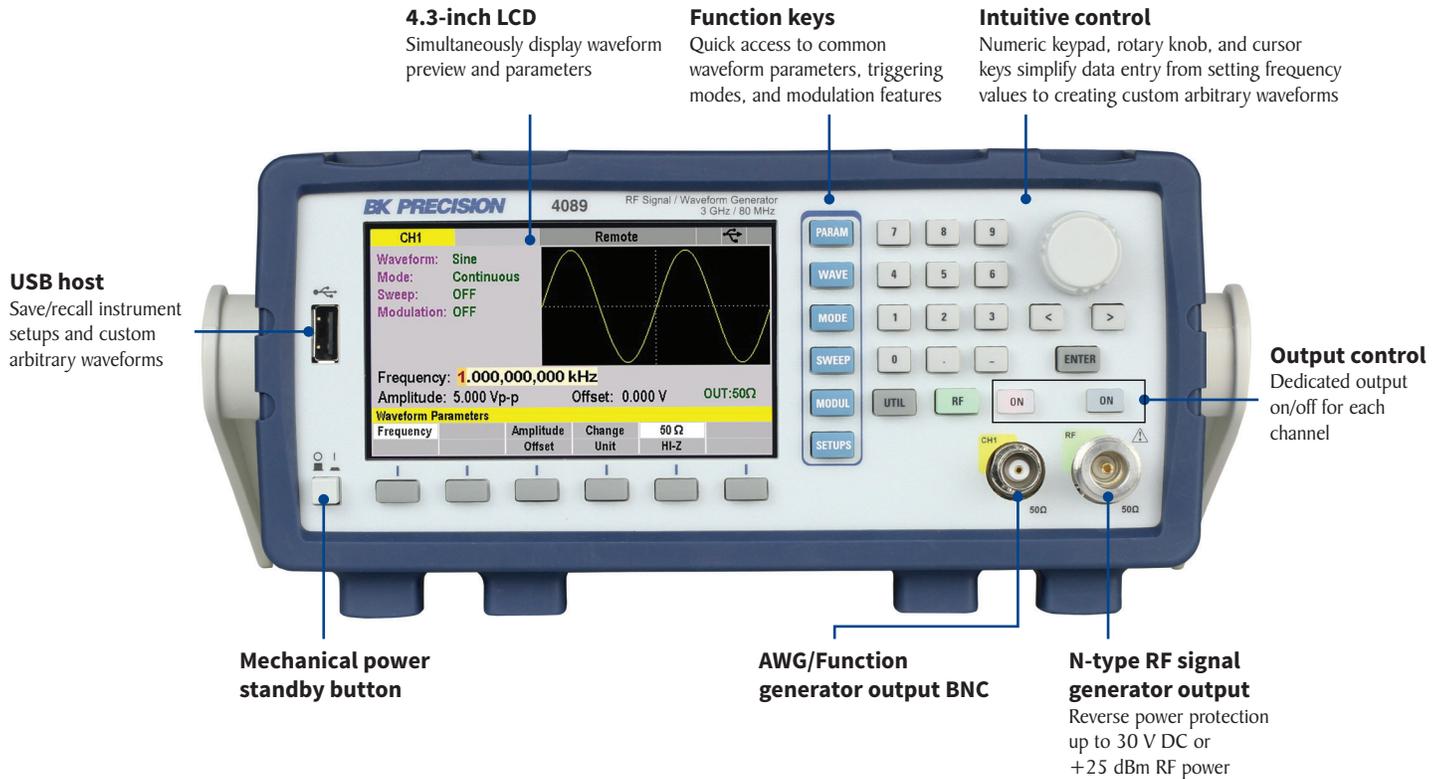
#### General

- 4.3-inch LCD screen with IPS technology for wider viewing angles
- Internal memory to store/recall up to 99 instrument setups
- Linear and logarithmic sweep
- NISPOM-compliant sanitization to securely restore factory settings
- USB (USBTMC-compliant) and LAN interfaces standard, GPIB optional.
- LabVIEW™ driver provided
- Supports industry-standard SCPI commands

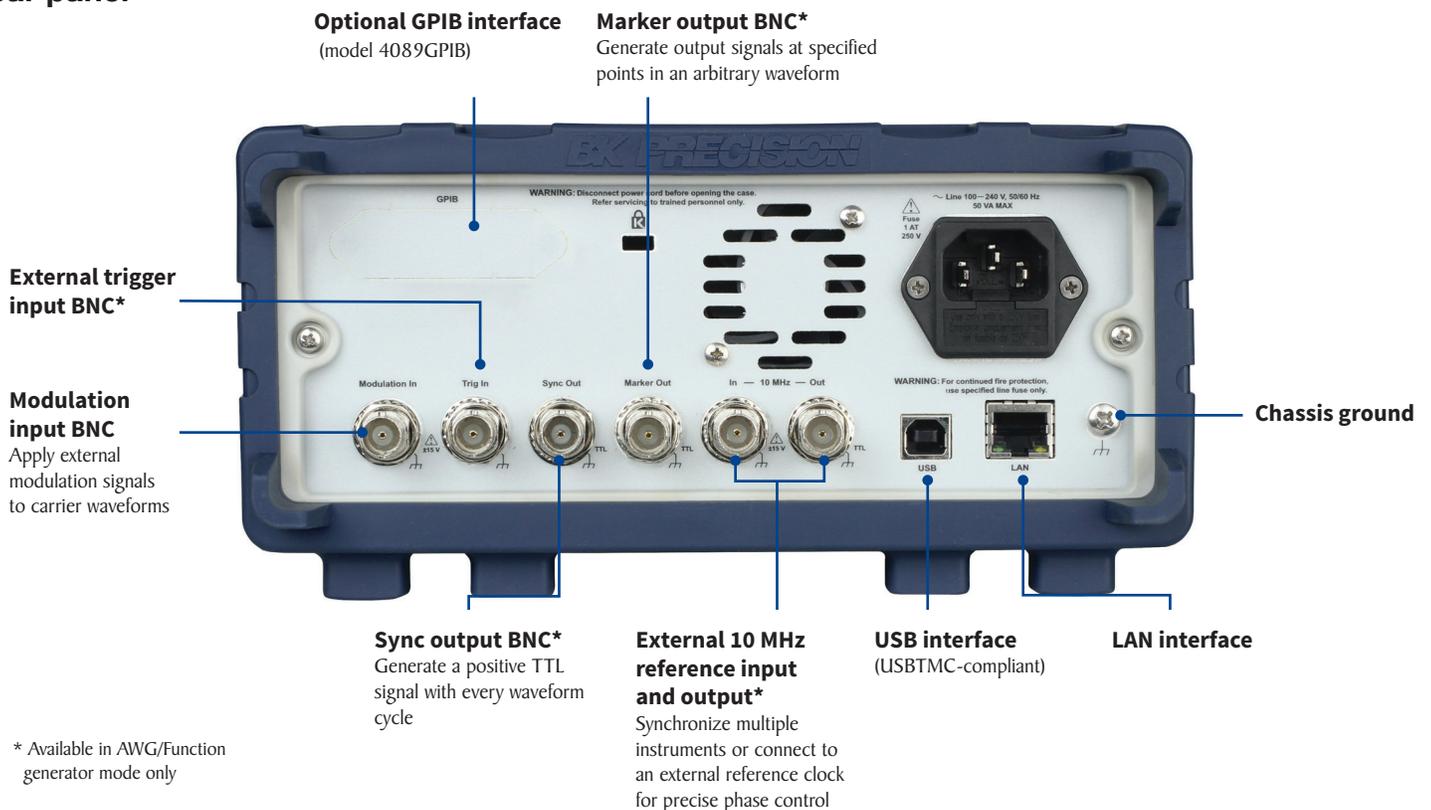
Model*	4088	4089
Channels	RF Signal + AWG/Function Waveform Channel	
<b>RF Signal Generator</b>		
Frequency Range	50 MHz to 1.5 GHz	50 MHz to 3 GHz
<b>AWG/Function Generator</b>		
Sine and Square Frequency Range	1 $\mu$ Hz to 50 MHz	1 $\mu$ Hz to 80 MHz
Arbitrary Waveform Length	4 Mpts	4 Mpts

\* GPIB option available with model 4089GPIB only

## Front panel



## Rear panel



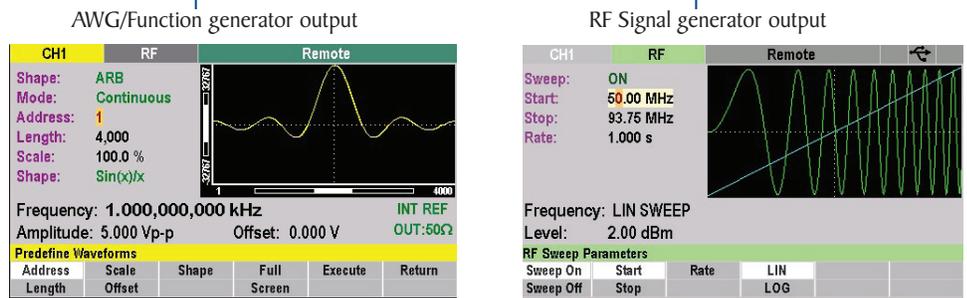
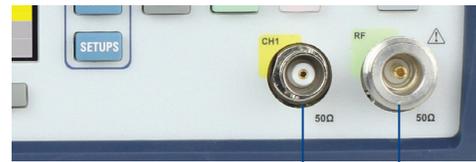
\* Available in AWG/Function generator mode only

## Operation Highlights

### 2-in-1 value

The 4088 Series RF Signal/Waveform Generators combine the benefits and capabilities of two separate instruments in one compact 2U form factor to save cost and bench space.

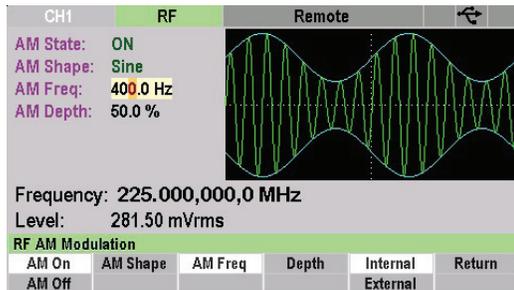
At the press of a button, seamlessly toggle operating modes between a capable AWG/Function generator or RF signal generator with the ability to output both channels simultaneously.



Individual output channels and configuration interfaces offer intuitive control over both AWG/Function and RF parameters to meet a variety of general purpose testing needs.

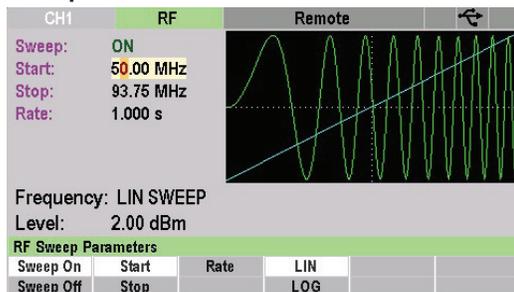
### Tools when you need them

#### Modulation



Internal/External analog modulation is available in both RF and AWG/Function operating modes. Additional digital modulations available in AWG/Function generator mode include binary phase-shift (BPSK) and frequency-shift keying (FSK).

#### Sweep



RF signals as well as standard function generator signals including square and triangle waveforms can be swept linearly or logarithmically at specified start/stop frequencies. The sweep rate can be adjusted from 10 ms to 100 s in RF mode or up to 500 s in AWG/Function generator mode.

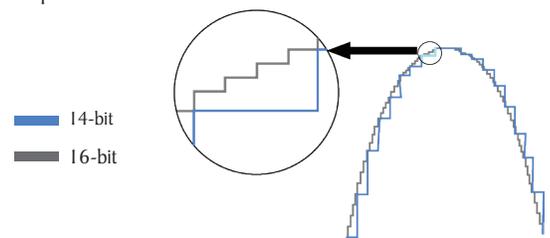
#### RF signal generator key specifications

The 4088 Series offer a best-in-class price-performance ratio.

Frequency range	50 MHz to 1.5 GHz (4088) 50 MHz to 3.0 GHz (4089)
Frequency accuracy	± 3 ppm
Frequency stability	± 1 ppm drift per year
Output power	-110 dBm to +13 dBm
Level accuracy	< ± 1 dB
Phase noise	< -117 dBc/Hz
Non-harmonics (Spurious)	< -60 dBc at 0 dBm output in CW mode

#### True AWG characteristics

- ▶ 16-bit sampling for enhanced resolution resulting in lower distortion and more accurate waveforms
- ▶ Deep arbitrary waveform length adjustable from 2 points up to 4 million points
- ▶ Sampling rate up to 250 MSa/s



16-bit vertical resolution

## Operation highlights

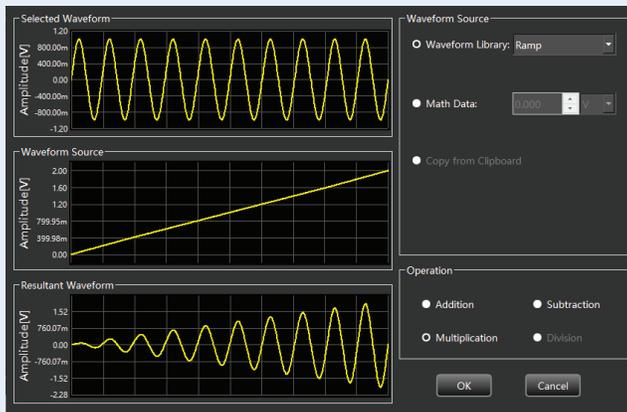
### Versatile arbitrary waveform generation tools

The 4088 Series offer several ways to generate and download custom arbitrary waveforms to the instrument:

#### Waveform creation and editing

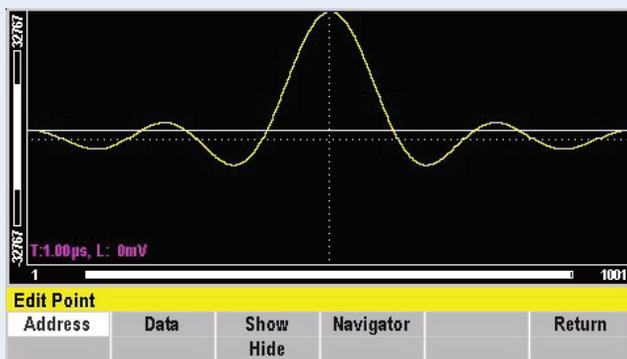
Generate and edit custom arbitrary waveforms with the provided software tools (4088 Series software) or enter waveform data directly from the instrument's front panel.

#### Software



Generate complex arbitrary waveforms with tools that allow you to draw, edit, and combine waveforms.

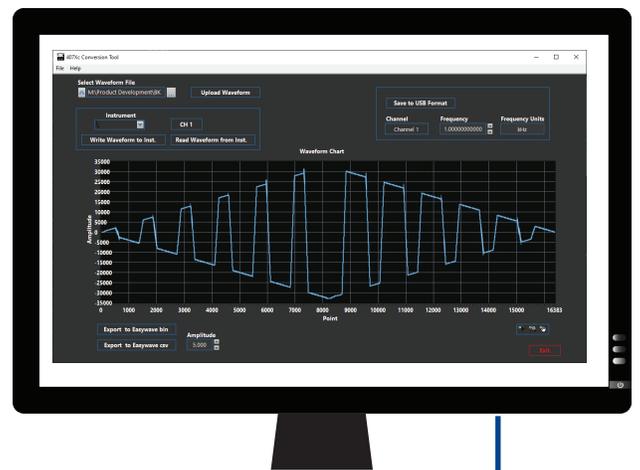
#### Front panel



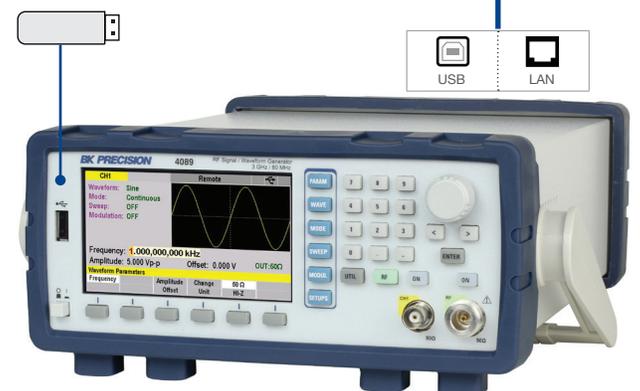
Generate or edit arbitrary waveforms directly from the front panel by defining individual points, lines, or copying and pasting sections.

#### Uploading custom waveforms

Use the 407XC software utility to import waveform data in .txt or .csv format for download to the instrument for execution. Waveform data can be directly uploaded via USB or LAN interface or by saving it in \*.arb format to a USB drive.



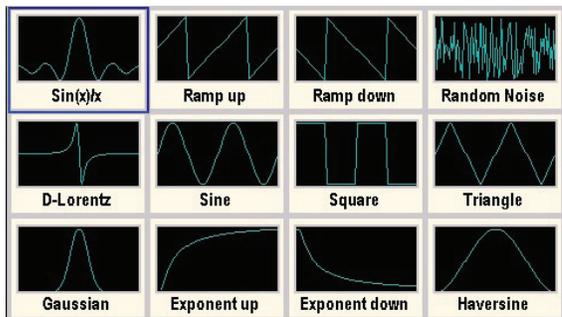
Save/Recall custom .arb files



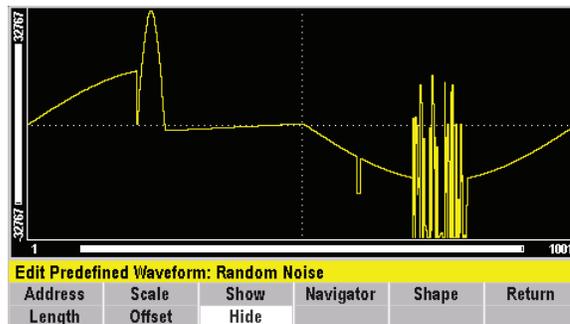
## Operation highlights

### Built-in waveform editor

Select from a variety of built-in arbitrary waveforms.



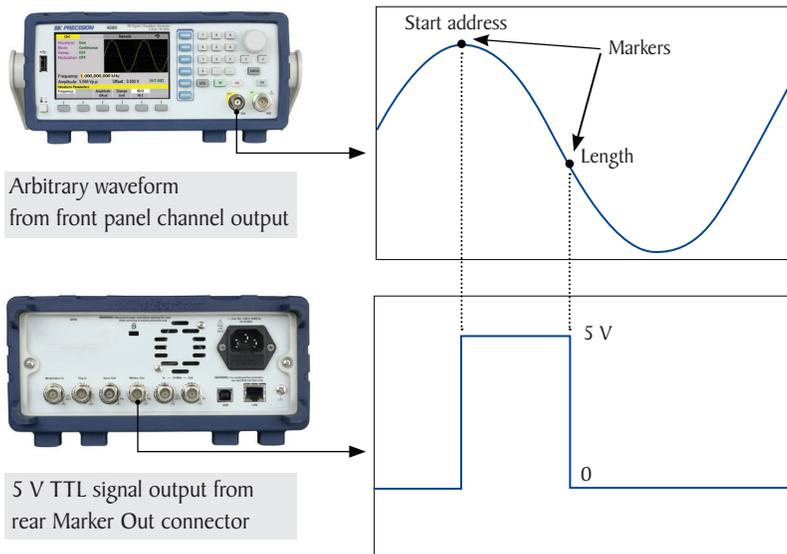
Draw lines, and modify waveforms on a point-by-point basis, or combine aspects from multiple pre-defined waveform such as injecting noise into a sine wave.



### Programmable markers

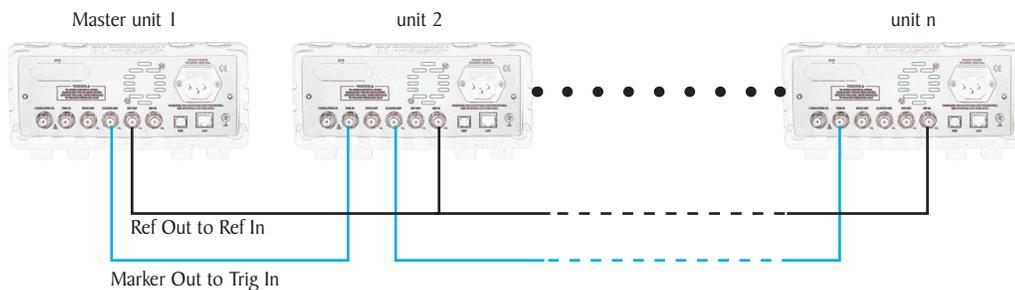
Markers can be added to custom arbitrary waveforms for applications requiring precise synchronization between two signals.

The figure illustrates how a separate 5 V TLL signal is generated from the rear panel marker out BNC for the designated section of the arbitrary waveform. The maximum marker length is 4000 points. This feature is also useful for triggering another signal at a specific time or event in the arbitrary waveform signal.



### Special application

Multi-unit/channel synchronization capabilities allow for simulation of a real world 3-phase or multi-phase AC network where one of the phases is degraded.



Multi-unit/channel synchronization

### AWG/Function Generator Modulation, Burst, and Sweep Capabilities

Carrier	AM	FM	PM	FSK	BPSK	PWM	Burst	Sweep
Sine	✓	✓	✓	✓	✓	--	✓	✓
Square	✓	✓	✓	✓	✓	✓	✓	✓
Triangle	✓	✓	✓	✓	✓	--	✓	✓
Pulse	✓	--	--	--	--	--	✓	--
Arbitrary	✓	--	--	--	--	--	✓	--

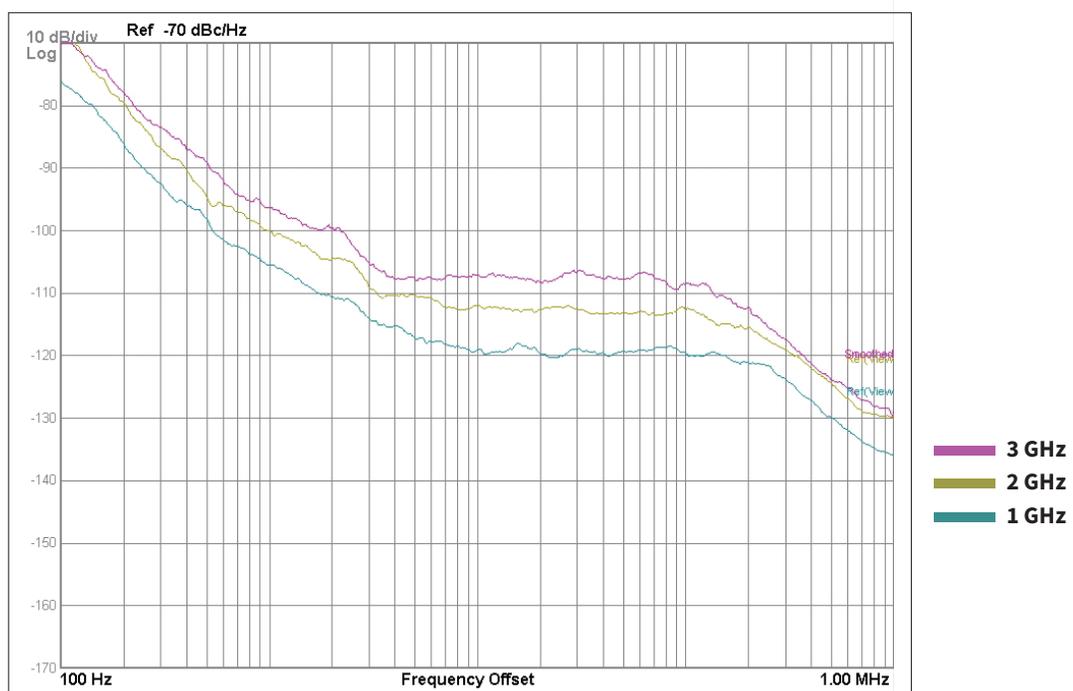
## RF Generator Specifications

Note: All specifications apply to the unit after a temperature stabilization time of 20 minutes over an ambient temperature range of  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  and a maximum relative humidity of 90%. Specifications are subject to change without notice.

Model	4088	4089
<b>Frequency</b>		
Range	50 MHz to 1.5 GHz	50 MHz to 3.0 GHz
Resolution	0.1 Hz, 11 digits	
<b>Reference Frequency</b>		
Accuracy	$\pm 3$ ppm, 0 to 40 $^{\circ}\text{C}$	
Stability	$\pm 1$ ppm, 0 to 40 $^{\circ}\text{C}$	
Aging Rate	$\pm 1$ ppm/year	
<b>Spectral Purity</b>		
Harmonics	< -25 dBc at 0 dBm output in CW mode	
Non-harmonics (Spurious)	< -60 dBc at 0 dBm output in CW mode	
<b>SSB Phase Noise</b>		
At 1 GHz, 10 kHz Offset	< -117 dBc/Hz	
Residual FM	50 Hz rms (0.1 Hz to 20 kHz bandwidth)	
Residual AM	0.02% rms (0.1 Hz to 20 kHz bandwidth)	

<b>Output Characteristics</b>		
<b>Amplitude</b>		
Output Impedance	50 $\Omega$ , AC coupled	
Range	-110 to +13 dBm	-110 to +13 dBm to 2.0 GHz -90 to +13 dBm, 2.0 GHz to 3.0 GHz
Resolution	0.01 dB	
Accuracy	< $\pm 1$ dB, -90 to +13 dBm	
Units	dBm or Vrms	
VSWR	< 1.8 (typical)	
Reverse Output Protection	Up to 30 V DC or +25 dBm RF power	

### 4088 Series SSB Phase Noise (Typical)



## RF Generator Specifications (cont.)

Model	4088	4089
<b>Modulation Characteristics</b>		
<b>Amplitude Modulation (AM)</b>		
AM Range	0 to 100%	
Resolution	0.1%	
Modulation Source	INT / EXT	
Modulation Accuracy	< 5% of reading at 0 dBm, 50% modulation, 1 kHz sine wave	
Modulation Distortion	< 3%, at 30% modulation with 1 kHz sine wave	
<b>Frequency Modulation (FM)</b>		
Frequency Deviation	0 to 500 kHz ( $f_{out} \leq 150$ MHz) 0 to 1 MHz ( $f_{out} : 150$ MHz to 3 GHz)	
Resolution	1 Hz or 4 Digits	
Modulation Source	INT / EXT	
Deviation Accuracy	< 5%	
Modulation Distortion	< 1%, at 100 kHz deviation with 1 kHz sine wave	
<b>Phase Modulation (PM)</b>		
Phase Deviation	0 to 6.28 rad (0° to 360°)	
Resolution	0.01 rad	
Modulation Source	INT / EXT	
Deviation Accuracy	< 5%	
Modulation Distortion	< 1%, at 5 rad deviation with 1 kHz sine wave	
<b>Pulse Modulation</b>		
ON/OFF Ratio	> 60 dBc at 1 GHz	
Source	INT / EXT	
Repetition Rate	1 $\mu$ s to 10 s (0.1 Hz to 1 MHz)	
Mode	Logic HI for RF ON	
Rise and Fall Times	< 50 ns	
EXT Input Levels	TTL	
<b>Internal Modulation Source</b>		
Frequency	0.01 Hz to 100 kHz	
Resolution	1 Hz, 4 digits	
Waveform	Sine, Triangle, Square	
External Modulation	DC to 100 kHz	
External Input Level	2.5 Vpp for $\pm$ full deviation	

<b>Sweep Characteristics</b>	
Ranges	50 MHz to 93.75 MHz
	93.75 MHz to 187.5 MHz
	187.5 MHz to 375 MHz
	375 MHz to 750 MHz
	750 MHz to 1500 MHz
	-   1500 MHz to 3000 MHz
Frequency Resolution	1 kHz
Sweep Shape	Linear or Logarithmic
Sweep Time	10 ms to 100 s
Time Resolution	3 digits

## AWG/Function Generator Specifications

Model	4088	4089
Maximum Frequency	50 MHz	80 MHz
<b>Waveforms</b>		
Standard	Sine, Square, Triangle/Ramp, Pulse	
Built-in Arbitrary	Sine, Triangle, Square, Noise, Ramp Up, Ramp Down, Sine(X)/X, Exponential Up, Exponential Down, Gaussian, Lorentz, Haversine	
User-defined Arbitrary	4 Mpts	4 Mpts
<b>Operating Modes</b>		
Operating Modes	Continuous, Triggered, Burst, Gated, Phase	
Triggered	Frequency of waveform cycle is limited to 10 MHz	
<b>Sine</b>		
Frequency Range	1 $\mu$ Hz to 50 MHz	1 $\mu$ Hz to 80 MHz
Resolution	1 $\mu$ Hz	
<b>Amplitude Flatness (relative to 1 kHz, 5 Vpp output)</b>		
$f_{OUT} \leq 1$ MHz	$\pm 0.1$ dB	
$f_{OUT} \leq 1$ MHz to 30 MHz	$\pm 0.5$ dB	
$f_{OUT} \leq 30$ MHz to 80 MHz	$\pm 1$ dB	
<b>Harmonic Distortion (typical)</b>		
$f_{OUT} \leq 100$ kHz	-65 dBc	
$f_{OUT} \leq 1$ MHz	-55 dBc	
$f_{OUT} \leq 20$ MHz	-40 dBc	
$f_{OUT} \leq 50$ MHz	-35 dBc	
$f_{OUT} \leq 80$ MHz	-30 dBc	
THD: 20 Hz to 20 kHz	< 0.04%	
<b>Spurious</b>		
$f_{OUT} \leq 1$ MHz	-70 dBc	
$f_{OUT} \geq 2$ MHz	-70 dBc, increasing +20 dB/decade	
<b>Phase Noise (<math>f_{out}=10</math> MHz)</b>		
10 kHz offset	-117 dBc	
<b>Square</b>		
Frequency Range	1 $\mu$ Hz to 50 MHz	1 $\mu$ Hz to 80 MHz
Rise & Fall Time	< 5 ns (10% to 90%) at full amplitude into 50 $\Omega$	
Overshoot	< 2% at 5 Vpp	
Variable Duty Cycle Range	20.0%-80.0% up to 10 MHz square frequency	
Duty Cycle Resolution	0.1%	
Duty Cycle Accuracy	< $\pm 0.1\% \pm 5$ ns	
Jitter (rms)	< 25 ps	

<b>Ramp &amp; Triangle</b>		
Frequency Range	1 $\mu$ Hz to 5 MHz	
Resolution	1 $\mu$ Hz	
Variable Duty Cycle	0%-100% to 500 kHz 20%-80% to 2 MHz Fixed 50% to 5 MHz	
Duty Cycle Resolution	0.1%	
Linearity	< 0.1% of signal amplitude from 5%-95%, up to 200 kHz	
<b>Pulse</b>		
Frequency Range	1 mHz to 10 MHz	
Resolution	1 $\mu$ Hz	
Pulse Width	20 ns minimum, 1 ns resolution, 999 s max	
Variable Edge Time	< 10 ns to pulse period (depending on pulse width)	
Jitter (rms)	< 25 ps	
<b>Arbitrary Waveform Characteristics</b>		
Waveform Length	2 pt to 16,777,216 pt	2 pt to 33,554,432 pt
Sampling Rate	250 MSa/s, point execution rate adjustable from 4 ns to 100 s	
Vertical Resolution	16 bits (65,536 levels)	
Noise	Programmable 1% to 100% or added to arbitrary waveform	
Bandwidth	50 MHz max (2-point waveform length)	
Frequency	Accuracy: $\pm 10$ ppm Rate Resolution: 10 ps, up to 8 digits	
Rise & Fall Time	< 5 ns (typical)	
Jitter (rms)	< 25 ps	
<b>Sweep Characteristics</b>		
Sweep Shape	Linear and Logarithmic, up or down	
Sweep Time	10 ms to 500 s	
Sweep Trigger Mode	Internal, External, Continuous, or Burst	

## AWG/Function Generator Specifications (cont.)

Output Characteristics	
<b>Signal Output</b>	
Output Impedance	50 $\Omega$ (typical)
Output Protection	Protected against short circuit or nominal accidental voltages applied to the main output connector
Output ON-OFF Feed-through	> 80 dB at 10 MHz
<b>Amplitude</b>	
Range	3 mVpp to 10 Vpp into 50 $\Omega$
Resolution	1 mV, 4 digits (10,000 counts)
Units	Vpp, Vrms, or dBm selectable
Accuracy (at 1 kHz)	$\pm 1\%$ of setting $\pm 1$ mVpp
<b>DC Offset</b>	
Range	$\pm 5$ V into 50 $\Omega$
Resolution	1 mV, 4 digits resolution
Accuracy	$\pm 1\%$ of offset setting $\pm 0.25\%$ of amplitude setting $\pm 2$ mVpp
<b>Frequency</b>	
Accuracy	$\pm 3$ ppm, 0 to 50° C
Aging	$\pm 1$ ppm/year
<b>Burst Characteristics</b>	
Waveforms	Sine, Square, Triangle, Pulse, Arb
Count	1-999,999 cycles
Trigger Source	Manual, Internal, External
<b>Inputs and Outputs</b>	
Trigger IN	TTL Compatible Maximum rate: 20 MHz Minimum width: 20 ns Input impedance: 10 k $\Omega$ nominal
Sync OUT	TTL pulse at programmed frequency, 50 $\Omega$ impedance
Modulation IN	2.5 Vpp for 100% modulation 1 k $\Omega$ input impedance DC to 50 kHz bandwidth
Marker OUT	Positive TTL pulse, user programmable in arbitrary waveform, 50 $\Omega$ impedance
External Reference OUT	10 MHz clock for synchronization, TTL, 50 $\Omega$ impedance
External Reference IN	10 MHz from an external source, > 1 k $\Omega$ impedance, > 1 Vpp

Modulation Characteristics	
Modulation Types	AM, FM, PM, PWM, FSK, BPSK
<b>Amplitude Modulation (AM)</b>	
Carrier	Sine, Square, or Triangle
Source	Internal, External
Depth	0% to 100%
<b>Frequency Modulation (FM)</b>	
Carrier	Sine, Square, or Triangle
Source	Internal, External
Deviation	1 $\mu$ Hz to max frequency/2
<b>Frequency-shift Keying (FSK)</b>	
Carrier	Sine, Square, or Triangle
Source	Internal, External
Rate	0.01 Hz to 1 MHz
<b>Phase Modulation (PM)</b>	
Carrier	Sine, Square, or Triangle
Source	Internal, External
Deviation	0 to 360°, 0.1° resolution
<b>Binary Phase-shift (BPSK)</b>	
Carrier	Sine, Square, or Triangle
Source	Internal, External
Rate	0.01 Hz to 1 MHz
<b>Pulse Width Modulation (PWM)</b>	
Carrier	Square
Source	Internal, External
Internal Modulation	0.01 Hz to 100 kHz
Deviation	0% to 100% of pulse width, 0.1% resolution
<b>Internal Modulation</b>	
Waveform	Sine, Square, or Triangle
Frequency	0.01 Hz to 20 kHz
Resolution	4 digits
<b>Internal Trigger</b>	
Repetition	1 $\mu$ s to 100 s (0.01 Hz to 1 MHz)
Resolution	4 digits
Accuracy	$\pm 10$ ppm

## General

General		
Display Resolution	4.3" color LCD with IPS technology, 480 x 272 dots	
I/O interfaces	USB (USBTMC-compliant), LAN, GPIB (optional)	
Storage Memory	99 full panel settings at power-off, including last working set-up 1 Gbit flash file system for arbitrary waveform storage	
Dimensions (W x H x D)	8.4" x 3.5" x 12" (213 mm x 88 mm x 300 mm)	
Weight	6.61 lbs (3 kg)	
AC Input	90 to 264 VAC (< 40 VA)	
Temperature	Operation	32 °F to 122 °F (0 °C to 50 °C)
	Storage	-4 °F to 158 °F (-20 °C to 70 °C)
Humidity	95% RH, 0 °C to 30 °C	
Warranty	3 Years	
Standard Accessories	Power cord, USB cable, test report, and certificate of calibration	

Regulatory Compliance	
Electromagnetic Compatibility	According to EN55011 for radiated and conducted emissions
Electrical Discharge Immunity	According to EN55082
Safety	According to EN61010, CE approved

## Ordering information

Model	Description
4088	1.5 GHz/50 MHz RF Signal/Waveform Generator
4089	3 GHz/80 MHz RF Signal/Waveform Generator
4089GPIB	3 GHz/80 MHz RF Signal/Waveform Generator with GPIB

## About B&K Precision

For more than 70 years, B&K Precision has provided reliable and value-priced test and measurement instruments worldwide.

Our headquarters in Yorba Linda, California houses our administrative and executive functions as well as sales and marketing, design, service, and repair. Our European customers are most familiar with B&K through our French subsidiary, Sefram. Engineers in Asia know us through our B+K Precision Taiwan operation. The independent service centers in Singapore and Brasil service customers in Singapore, Malaysia, Vietnam, Indonesia and South America, respectively.



● B&K Precision group member ● Independent service center ● Service center location

## Quality Management System

B&K Precision Corporation is an ISO9001 registered company employing traceable quality management practices for all processes including product development, service, and calibration.

ISO9001:2015

Certification body NSF-ISR  
Certificate number 6Z241-IS8



## Video Library

View product overviews, demonstrations, and application videos in English, Spanish and Portuguese.

<http://www.youtube.com/user/BKPrecisionVideos>

## Product Applications

Browse all of our supported product and mobile applications.

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