

Product Datasheet - Technical Specifications



More information in our Web-Shop at ► www.meilhaus.com

Your contact

Technical and commercial sales, price information,
quotations, demo/test equipment, consulting:

Tel.: **+49 - (0)81 41 - 52 71-0**

E-Mail: sales@meilhaus.com

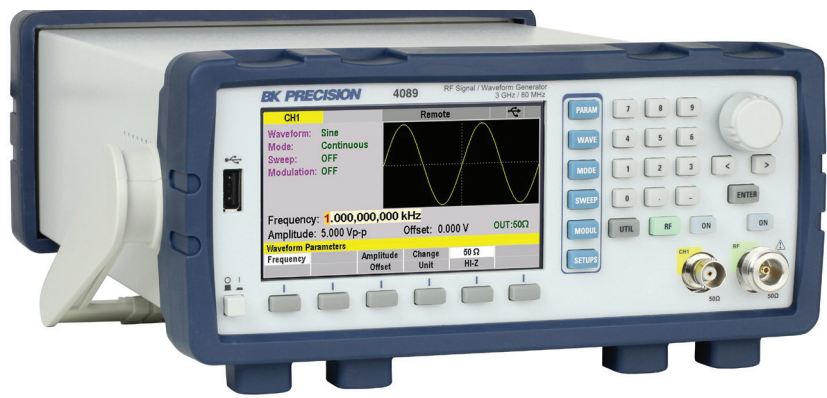
Meilhaus Electronic GmbH
Am Sonnenlicht 2
82239 Alling/Germany

Tel. **+49 - (0)81 41 - 52 71-0** E-
Mail sales@meilhaus.com

Mentioned company and product names may be registered trademarks of the respective companies. Errors and omissions excepted. © Meilhaus Electronic.

www.meilhaus.com

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.

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

* GPIB option available with model 4089GPIB only



Features and benefits

RF Signal

- RF signal frequency up to 1.5 GHz/3 GHz
- Frequency characteristics: ± 3 ppm accuracy, ± 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

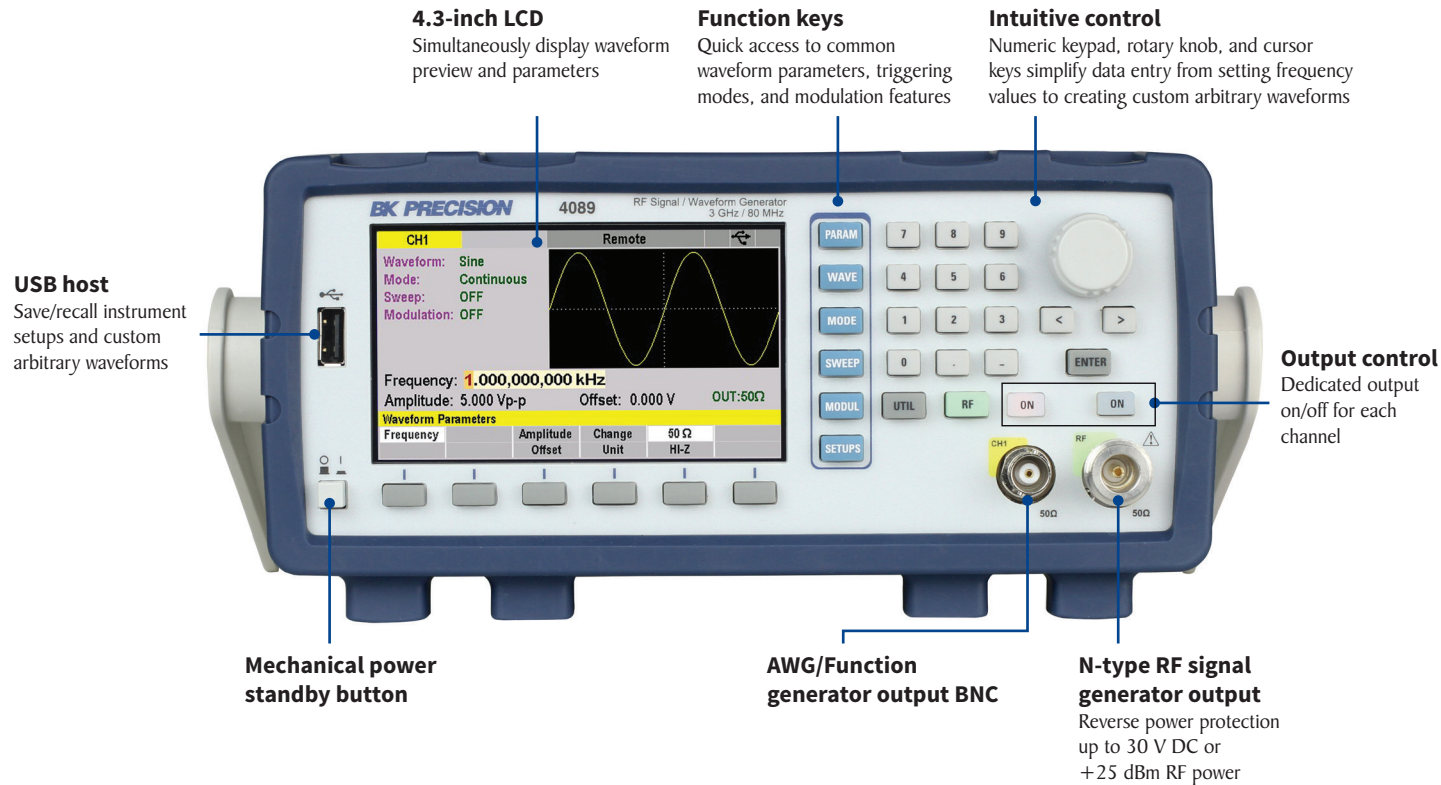
AWG/Function Generator

- 16-bit resolution, 250 MSa/s, up to 4 Mpts arbitrary waveform generator
- Generate sine and square waves from 1 μ 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 Ω 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 ± 5 V
- Low jitter < 25 ps
- Internal/external triggering and programmable markers

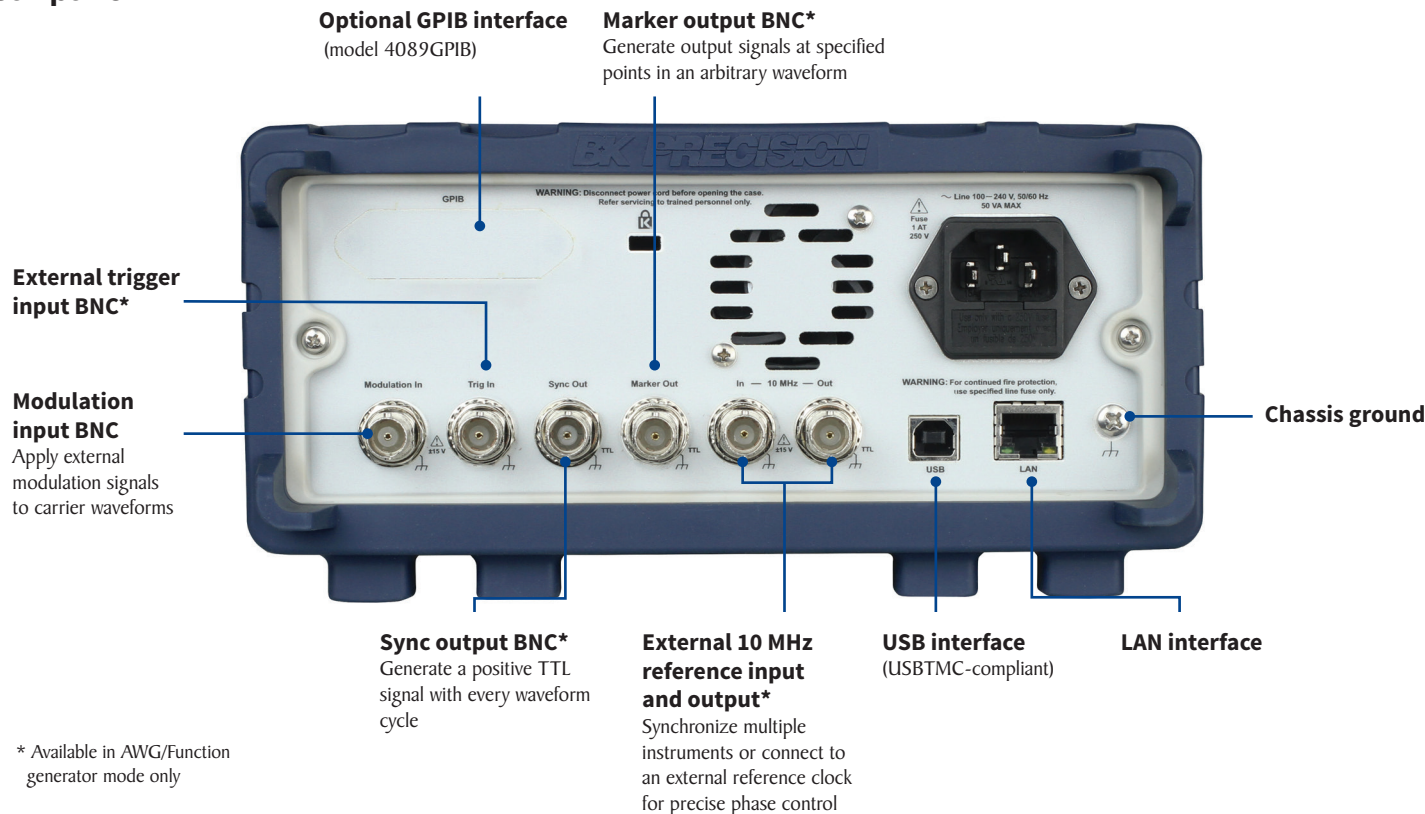
General

- 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

Front panel



Rear panel



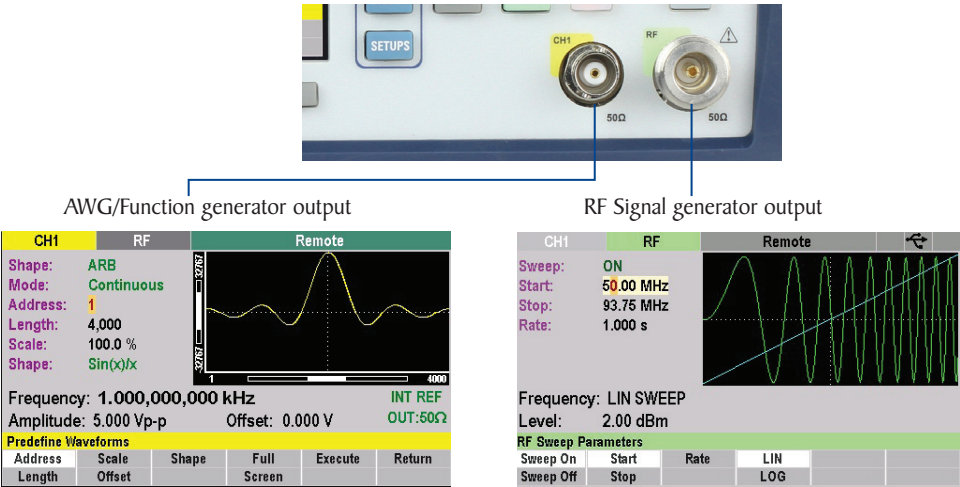
* Available in AWG/Function generator mode only

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.

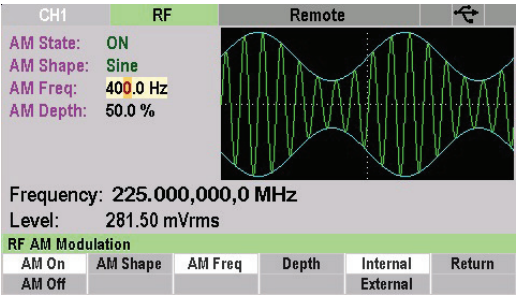
At the press of a button, seamlessly toggle operating modes between a capable AWG/Function generator or RF signal generator with the ability to output both channels simultaneously.



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).

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

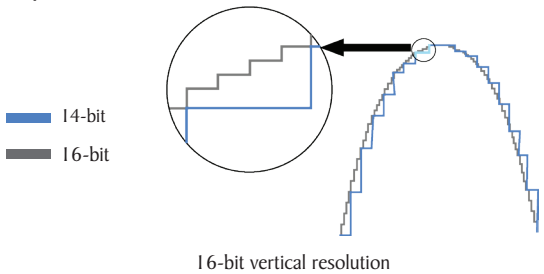
Sweep



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.

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



Operation highlights

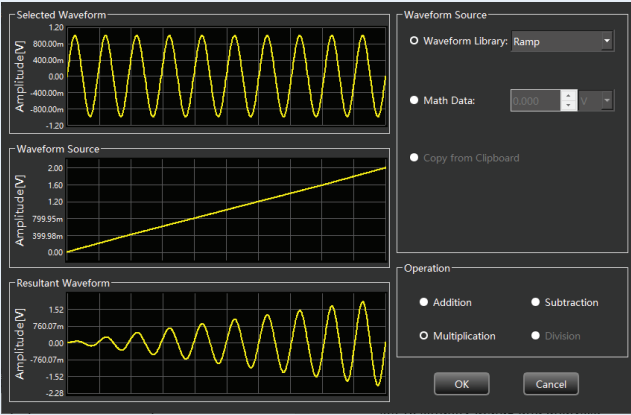
Versatile arbitrary waveform generation tools

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

Waveform creation and editing

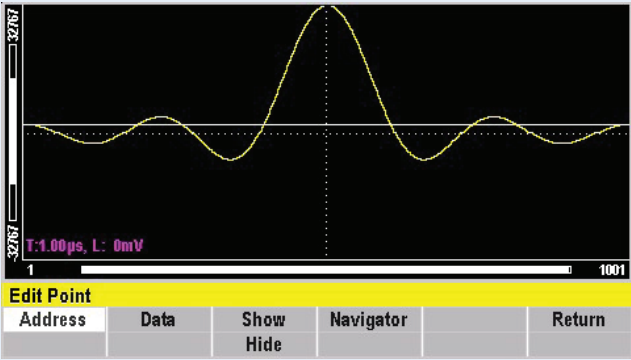
Generate and edit custom arbitrary waveforms with the provided software tools (4088 Series software) or enter waveform data directly from the instrument's front panel.

Software



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

Front panel



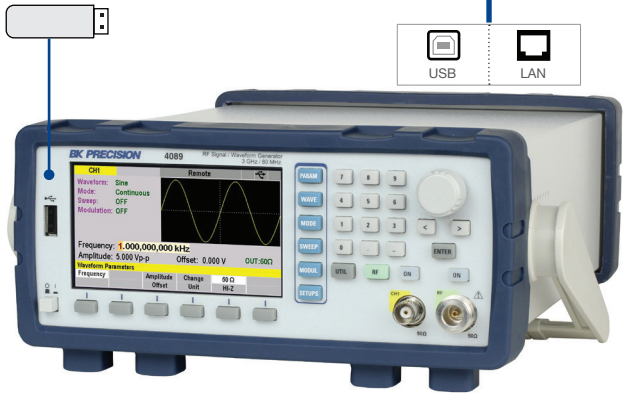
Generate or edit arbitrary waveforms directly from the front panel by defining individual points, lines, or copying and pasting sections.

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.



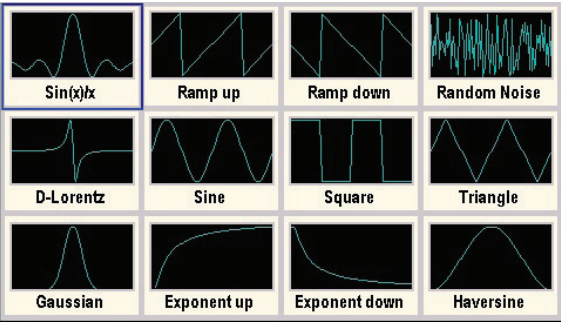
Save/Recall custom .arb files



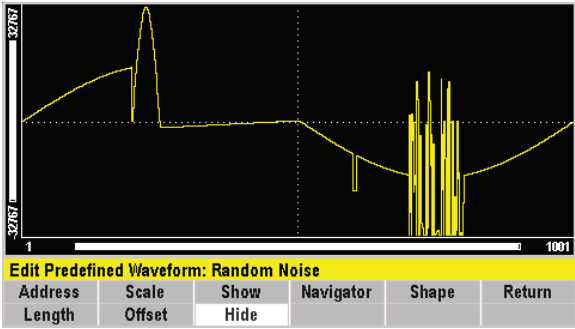
Operation highlights

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.



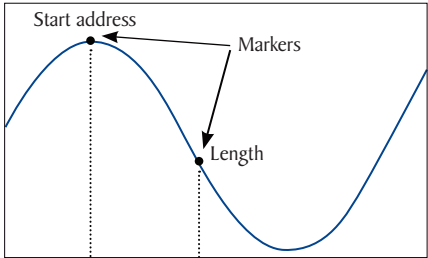
Programmable markers

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

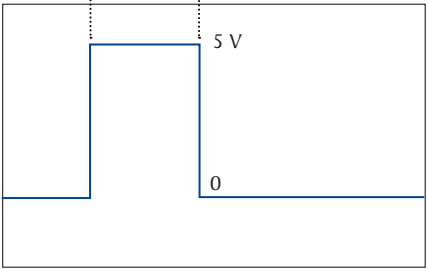
The figure illustrates how a separate 5 V TLL signal is generated from the rear panel marker out BNC for the designated section of the arbitrary waveform. The maximum marker length is 4000 points. This feature is also useful for triggering another signal at a specific time or event in the arbitrary waveform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



Arbitrary waveform
from front panel channel output

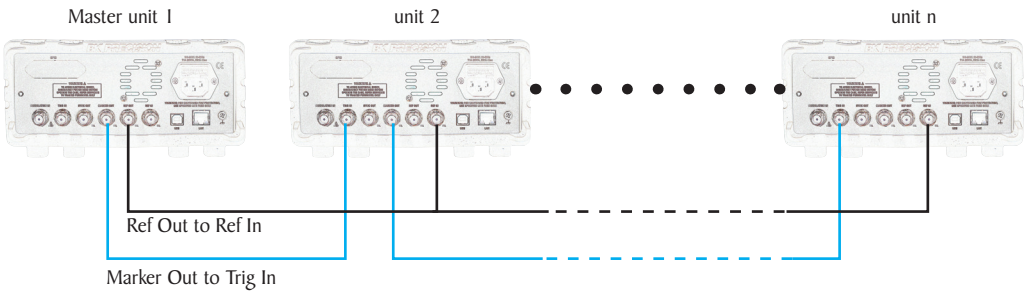


5 V TTL signal output from
rear Marker Out connector



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	√	--	--	--	--	--	√	--

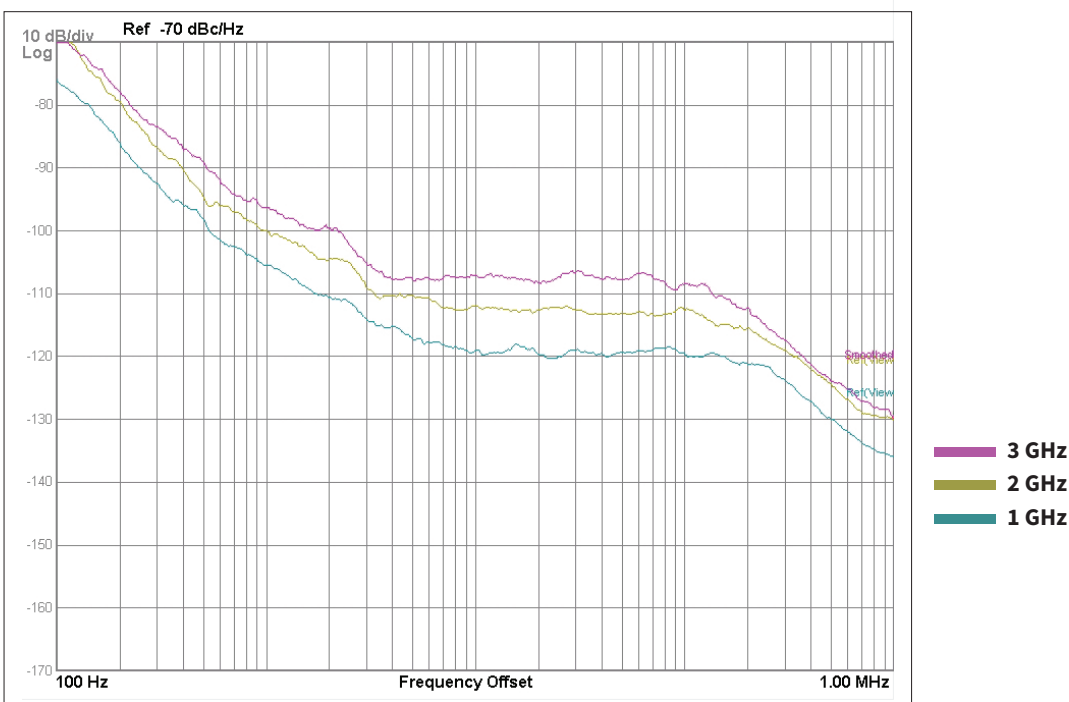
RF Generator Specifications

Note: All specifications apply to the unit after a temperature stabilization time of 20 minutes over an ambient temperature range of 23 °C ± 5 °C and a maximum relative humidity of 90%. Specifications are subject to change without notice.

Model	4088	4089
Frequency		
Range	50 MHz to 1.5 GHz	50 MHz to 3.0 GHz
Resolution	0.1 Hz, 11 digits	
Reference Frequency		
Accuracy	± 3 ppm, 0 to 40 °C	
Stability	± 1 ppm, 0 to 40 °C	
Aging Rate	± 1 ppm/year	
Spectral Purity		
Harmonics	< -25 dBc at 0 dBm output in CW mode	
Non-harmonics (Spurious)	< -60 dBc at 0 dBm output in CW mode	
SSB Phase Noise		
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)	

Output Characteristics		
Amplitude		
Output Impedance	50 Ω, 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	< ± 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
Modulation Characteristics		
Amplitude Modulation (AM)		
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	
Frequency Modulation (FM)		
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	
Phase Modulation (PM)		
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	
Pulse Modulation		
ON/OFF Ratio	> 60 dBc at 1 GHz	
Source	INT / EXT	
Repetition Rate	1 μ 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	
Internal Modulation Source		
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	

Sweep Characteristics		
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
Waveforms		
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
Operating Modes		
Operating Modes	Continuous, Triggered, Burst, Gated, Phase	
Triggered	Frequency of waveform cycle is limited to 10 MHz	
Sine		
Frequency Range	1 μ Hz to 50 MHz	1 μ Hz to 80 MHz
Resolution	1 μ Hz	
Amplitude Flatness (relative to 1 kHz, 5 Vpp output)		
$f_{OUT} \leq 1$ MHz	± 0.1 dB	
$f_{OUT} \leq 1$ MHz to 30 MHz	± 0.5 dB	
$f_{OUT} \leq 30$ MHz to 80 MHz	± 1 dB	
Harmonic Distortion (typical)		
$f_{OUT} \leq 100$ 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%	
Spurious		
$f_{OUT} \leq 1$ MHz	-70 dBc	
$f_{OUT} \geq 2$ MHz	-70 dBc, increasing +20 dB/decade	
Phase Noise (f_{out} =10 MHz)		
10 kHz offset	-117 dBc	
Square		
Frequency Range	1 μ Hz to 50 MHz	1 μ Hz to 80 MHz
Rise & Fall Time	< 5 ns (10% to 90%) at full amplitude into 50 Ω	
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	

Ramp & Triangle		
Frequency Range	1 μ Hz to 5 MHz	
Resolution	1 μ 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	
Pulse		
Frequency Range	1 mHz to 10 MHz	
Resolution	1 μ 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	
Arbitrary Waveform Characteristics		
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	
Sweep Characteristics		
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	
Signal Output	
Output Impedance	50 Ω (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
Amplitude	
Range	3 mVpp to 10 Vpp into 50 Ω
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
DC Offset	
Range	$\pm$ 5 V into 50 Ω
Resolution	1 mV, 4 digits resolution
Accuracy	$\pm$ 1% of offset setting $\pm$ 0.25% of amplitude setting $\pm$ 2 mVpp
Frequency	
Accuracy	$\pm$ 3 ppm, 0 to 50° C
Aging	$\pm$ 1 ppm/year
Burst Characteristics	
Waveforms	Sine, Square, Triangle, Pulse, Arb
Count	1-999,999 cycles
Trigger Source	Manual, Internal, External
Inputs and Outputs	
Trigger IN	TTL Compatible Maximum rate: 20 MHz Minimum width: 20 ns Input impedance: 10 k Ω nominal
Sync OUT	TTL pulse at programmed frequency, 50 Ω impedance
Modulation IN	2.5 Vpp for 100% modulation 1 k Ω input impedance DC to 50 kHz bandwidth
Marker OUT	Positive TTL pulse, user programmable in arbitrary waveform, 50 Ω impedance
External Reference OUT	10 MHz clock for synchronization, TTL, 50 Ω impedance
External Reference IN	10 MHz from an external source, > 1 k Ω impedance, > 1 Vpp

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