

# 20 MHz Dual Channel Function / Arbitrary Generator

## Model 4047B



The 4047B Dual Channel Function/Arbitrary Waveform Generator is capable of generating stable and precise sine, square, triangle, pulse, and arbitrary waveforms. CH1 and CH2 outputs are fully independent with individual on/off buttons and can both be varied from 0 to 10 Vpp into 50 ohms (up to 20 Vpp into open circuit). The generator provides linear and logarithmic sweep capabilities, AM/FM/PM/FSK/PWM modulation, and a continuously variable DC offset to inject signals directly into circuits at the

correct bias level. Separate output amplitude and DC offset amplifiers let you set a large DC offset (e.g.  $\pm 4.99$  V) with a small amplitude output signal (e.g. 10 mV).

The 4047B seamlessly integrates with B&K Precision's waveform editing software WaveXpress, allowing users to generate complex arbitrary waveforms that can be output via the instrument's 14-bit, 125 MSa/s, 16 kpts arbitrary waveform generator.

### Features & Benefits

- Dual-channel operation with each channel providing the rated amplitude (10 Vpp) over the entire frequency range
- Sine and square waveforms up to 20 MHz
- True point-by-point 14-bit, 125 MSa/s, 16-kpt arbitrary waveform generator
- Bright color display with waveform preview
- Synchronize the phase of both channels with the push of a button
- Linear and logarithmic sweep
- AM, FM, PM, FSK, and PWM internal and external modulation capabilities
- Gate and burst mode
- Independent output and DC offset amplifiers allow for small amplitude output signals with large DC offsets
- Low-jitter square wave generation for simulating reliable clock signals, generating triggers, or validating serial data buses
- USB interface
- SCPI-compliant command set
- Internal/external triggering
- Built-in counter
- Short circuit protection for resistive and capacitive loads on outputs and overvoltage protection on inputs

### Dual architecture design

The 4047B's dual architecture, a feature typically only found in more expensive generators, provides all the benefits of a DDS and a true point-by-point arbitrary waveform generator (AWG) combined, without any limitations imposed by either technology. The DDS chip produces standard sine and triangle waveforms with high frequency resolution and at a low cost. The true point-by-point AWG implementation (Fig 2) offers improved signal integrity for arbitrary waveforms by producing significantly less jitter and distortion compared to a DDS-based architecture. Custom arbitrary waveform generation is implemented with a variable clock signal to reproduce each point stored in memory without skipping or repeating data points, a problem typically found in DDS based designs with fixed reference clocks.

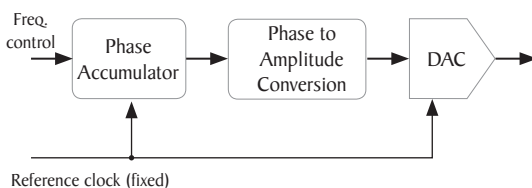


Fig 1 - DDS

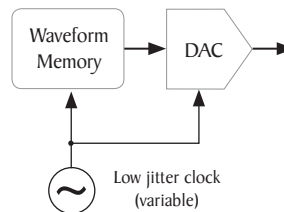


Fig 2 - point-by-point AWG

### Applications

This generator is suitable for a wide range of applications including electronic design, sensor simulation, functional test, or serial data bus validation.

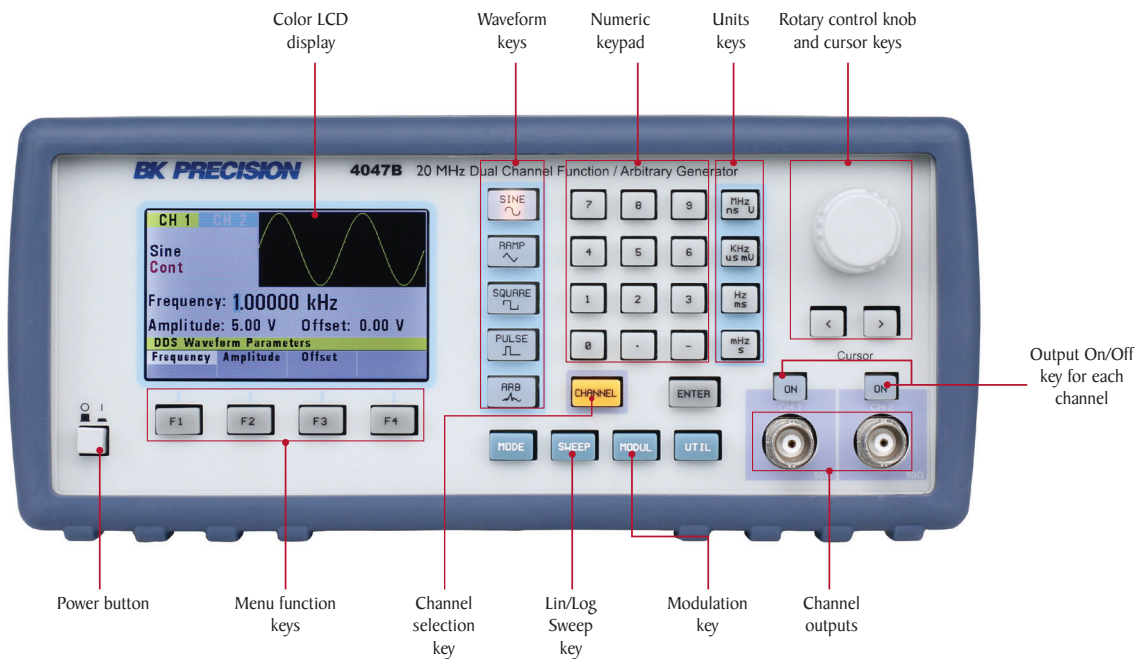


For more information, visit [www.bkprecision.com/WaveXpress](http://www.bkprecision.com/WaveXpress)

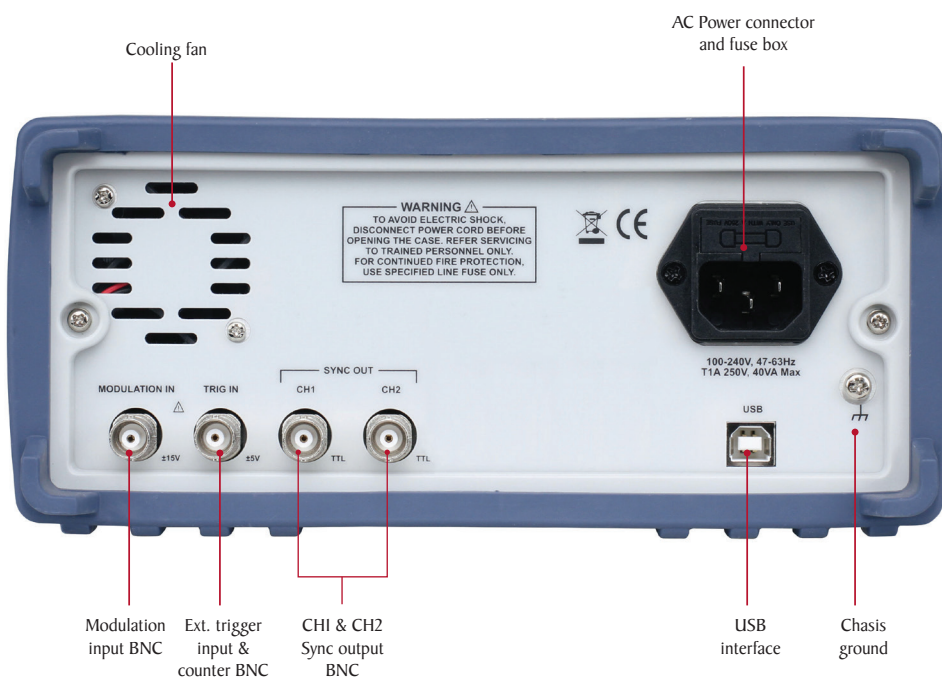
## Front panel

### Intuitive user interface

Easily adjust all waveform parameters using the intuitive menu-driven front panel keypad with dedicated channel selection keys, numeric keypad, and rotary control knob.

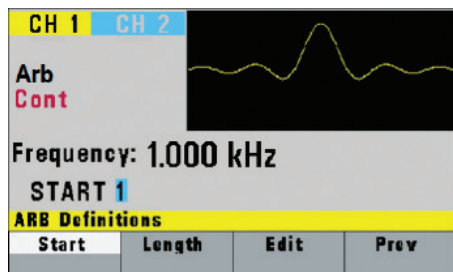


## Rear panel



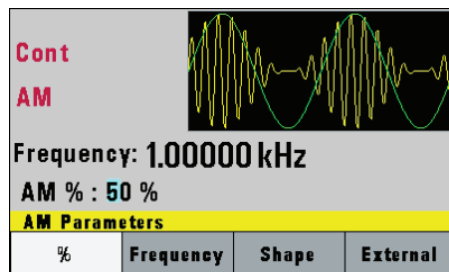
## Flexible operation

### Front panel arbitrary waveform generation



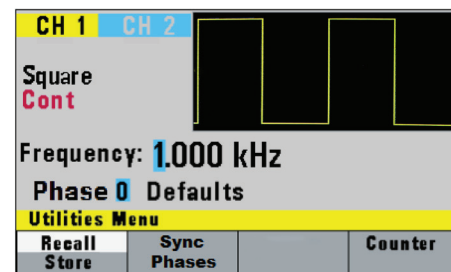
From the front panel, waveforms can be defined from scratch by entering data point-by-point or by loading and modifying predefined waveforms.

### Versatile features



The 4047B provides AM, FM, PM, FSK, and PWM modulation along with linear/logarithmic sweep and built-in counter capabilities. Internal and external sources can be used for triggering and modulating the signal.

### Channel phase synchronization



Easily synchronize the phase of both channels with the push of the Sync Phases button to ensure the desired output signal timing.

## Powerful waveform editing tool



WaveXpress is a comprehensive stand-alone application allowing users to easily generate, edit, and upload custom arbitrary waveforms to the generator via the remote interface. Use the software to generate waveforms by importing a csv file or define via freehand, point draw, and waveform math functions.

### Features & Benefits

- Import waveforms from B&K scopes
- Autoscan function automatically detects instruments connected via RS232, USB, or GPIB
- Insert commonly used waveforms and different types of noise
- Numerous transformations for changing a waveform. User-defined transformations can be added in the python programming language
- Dialog settings are remembered for faster repetitive work
- Undo/redo functions allow quick experimentation

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Specifications	4047B
Channels	2
<b>Frequency Characteristics</b>	
Sine	0.01 Hz - 20 MHz
Square	0.01 Hz - 20 MHz
Triangle	0.01 Hz - 2 MHz
Pulse	0.01 Hz - 20 MHz
Resolution	up to 8 digits
Accuracy	0.001% (10 ppm) at < 500 Hz: 0.001% + 0.006 Hz
<b>Output Characteristics</b>	
Amplitude Range	10 mVpp to 10 Vpp (into 50 Ω); 20 mVpp to 20 Vpp (open circuit)
Amplitude Resolution	3 digits (1,000 counts)
Amplitude Accuracy	± 2% ± 20 mV of programmed output from 1.01 V - 10 V
Flatness	± 0.5 dB to 1 MHz ± 1 dB to 20 MHz
Offset Range	-4.99 V to 4.99 V (into 50 Ω)
Offset Resolution	10 mV, 3 digits
Offset Accuracy	± 2% ± 10 mV (into 50 Ω)
Output Impedance	50 Ω ± 2%
Output Protection	Protected against short circuit or accidental voltage practically available in electronic laboratories, applied to the main output connector
<b>Waveform Characteristics</b>	
Harmonic Distortion (3 Vp-p into 50 Ω)	0 - 1 MHz, < -60 dBc 1 MHz - 5 MHz, < -50 dBc 5 MHz - 12 MHz, < -45 dBc 12 MHz - 20 MHz, < 50 dBc
Rise/Fall Time (square, pulse)	≤ 20 ns (10% to 90% at full amplitude into 50 Ω)
Variable Duty Cycle/Symmetry	Square: 20% - 80% to 1 MHz Triangle: 1% - 99% in 1% steps, up to 200 kHz
Symmetry Accuracy at 50%	± 1%
Pulse Width (period 100 s - 50 ns)	10 ns to <(Period - 10 ns), 10 ns resolution
Variable Edge Time	100 ns to Width/0.625 (50 % duty cycle) 10 ns resolution
Jitter (square, pulse)	< 50 ps rms (cycle-to-cycle, typical)
<b>Arbitrary Waveform Characteristics</b>	
Sampling Rate	8 ns to 100 s
Vertical Resolution	14 bits
Accuracy	0.001%
Resolution	4 digits
Waveform Length	2 to 16,382 points
Jitter	< 50 ps rms (cycle-to-cycle, typical)
<b>Operating Modes</b>	
Continuous	Output continuous at programmed parameters
Triggered	Output quiescent until triggered by an internal or external trigger, at which time one waveform cycle is generated to programmed param- eters. Frequency of waveform cycle is limited to 1 MHz.
Gate	Same as triggered mode, except waveform is executed for the dura- tion of the gate signal. The last cycle started is completed.
Burst	2-65535 cycles
Trigger Source	Trigger source may be internal, external, or manual. Internal trigger rate 0.1 Hz - 1 MHz (1 us - 10 s)

Modulation Characteristics		
Amplitude Modulation (AM)	Carrier	Sine, Square, or Triangle
	Source	Internal, External
	Internal Modulation	0.1 Hz - 20 kHz
	Depth	0% to 100%
Frequency Modulation (FM)	Carrier	Sine, Square, or Triangle
	Source	Internal, External
	Internal Modulation	0.01 Hz - 20 kHz
	Deviation	1 μHz to max frequency/2
Frequency Shift Keying (FSK)	Carrier	Sine, Square, or Triangle
	Source	Internal, External
	Rate	≤ 100 kHz
Phase Modulation (PM)	Carrier	Sine, Square, or Triangle
	Source	Internal, External
	Internal Modulation	0.1 Hz - 20 kHz
	Deviation	0 - 360 °, 0.1 ° resolution
Pulse Width Modulation (PWM)	Source	Internal, External
	Width	1% to 99%
	Internal Modulation	0.01 Hz - 100 kHz
<b>Sweep Characteristics</b>		
Sweep Shape	Linear or Logarithmic, up or down	
Sweep Time	10 ms to 100 s	
<b>Input and Output</b>		
Trigger IN	TTL compatible Maximum rate 1 MHz Minimum width > 50 ns Input impedance 1 kΩ	
Sync OUT	TTL pulse at programmed frequency; 50 Ω source impedance	
Modulation IN	5 Vp-p for 100% modulation 10 kΩ input impedance DC to > 20 kHz minimum bandwidth	
<b>Counter Characteristics</b>		
Range	50 Hz to 50 MHz	
Resolution	Auto ranging, up to 8 digits	
Accuracy	± 0.02% ± 2 digits	
Sensitivity	25 mVrms typical	
<b>General</b>		
Memory Storage	20 instrument settings	
Arbitrary Memory	16,382 points in flash memory	
Power Requirements	100 V - 240 V AC ± 10%, 47-63 Hz	
Max. Power Consumption	< 30 VA	
Operating Temperature	32 °F to 122 °F (0 °C to 50 °C)	
Storage Temperature	14 °F to 158 °F (-10 °C to 70 °C)	
Humidity	95% R.H. 0 °C to 30 °C	
Dimensions (W x H x D)	8.39" x 3.46" x 8.27" (213 x 88 x 210 mm)	
Weight	5.5 lbs (2.5 kg)	
Safety and EMC Standards	EN55011 for radiated and conducted emissions EN55082, EN61010, CE approved	
<b>Three-Year Warranty</b>		
Included Accessories	Power cord, USB (type A to B) interface cable, certificate of calibration	

Note: All specifications apply to the unit after a temperature stabilization time of 15 minutes over an ambient temperature range of 23 °C ± 5 °C. Specifications are subject to change without notice.