

## Data Sheet

# 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.

### 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.

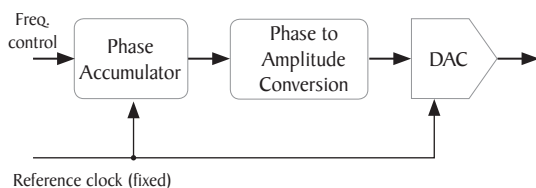


Fig 1 - DDS

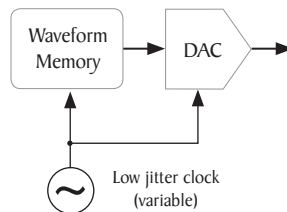


Fig 2 - point-by-point AWG

### 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-kpts 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

### Applications

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

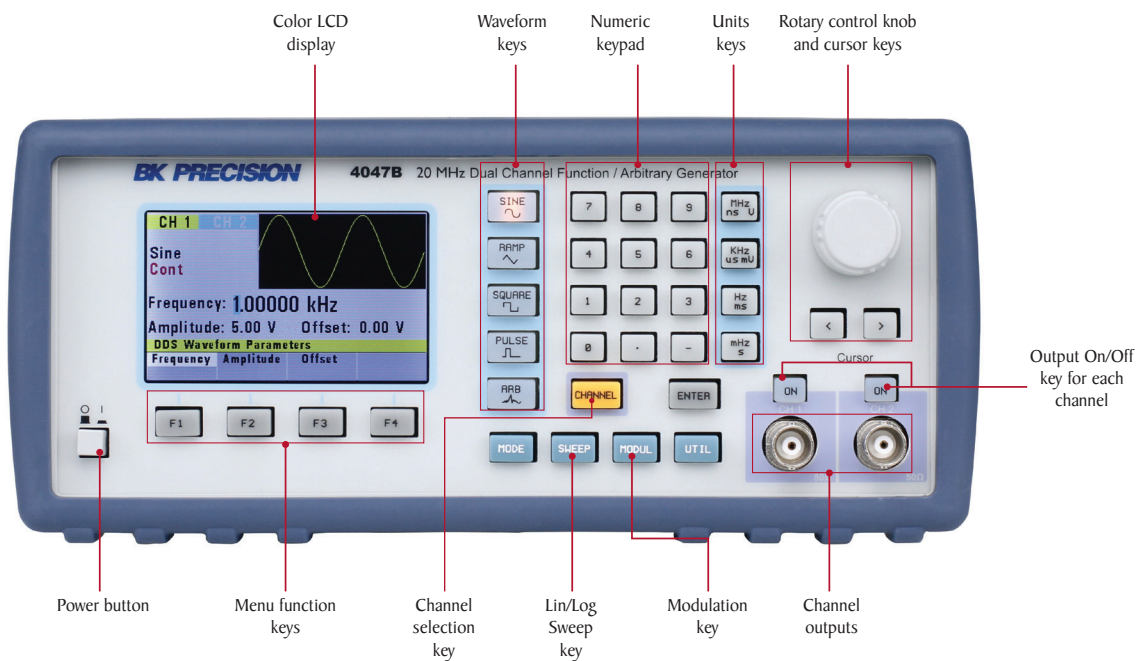


For more information, visit [www.bkprecision.com/WaveXpress](http://www.bkprecision.com/WaveXpress)

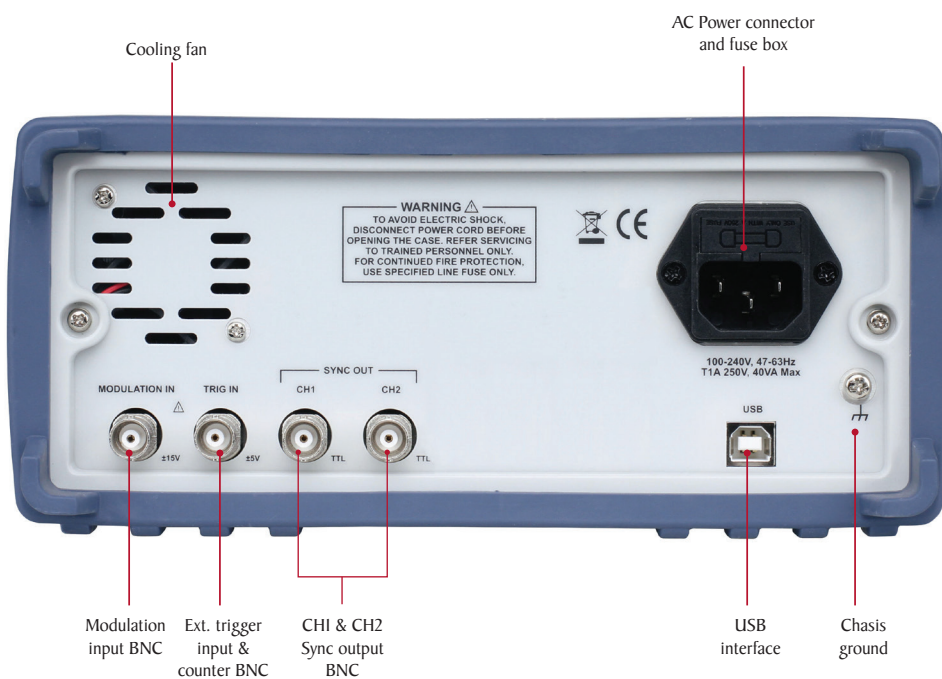
## Front panel

### 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.

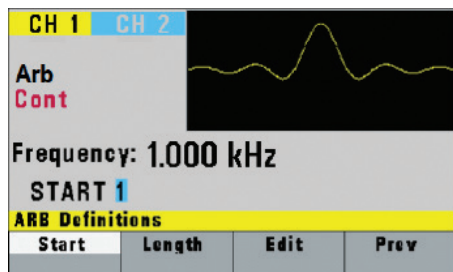


## Rear panel



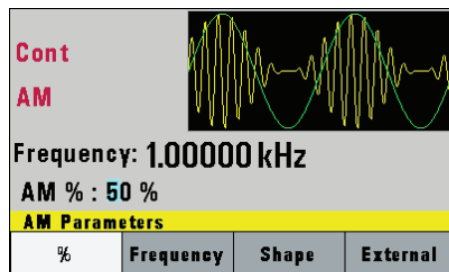
## Flexible operation

### Front panel arbitrary waveform generation



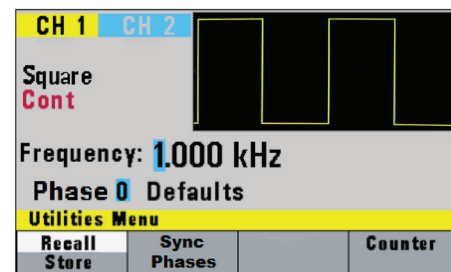
From the front panel, waveforms can be defined from scratch by entering data point-by-point or by loading and modifying predefined waveforms.

### Versatile features



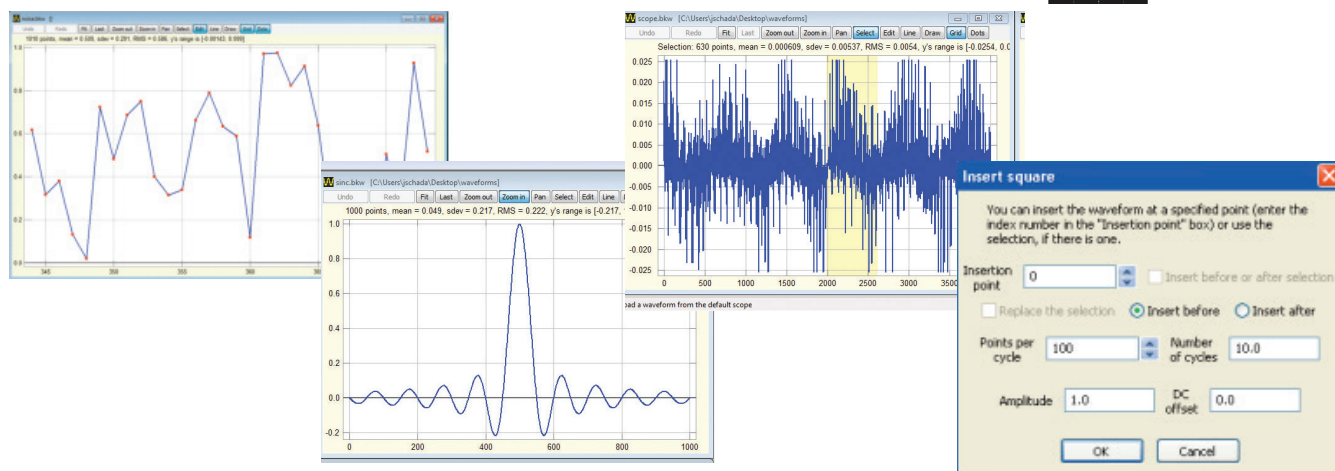
The 4047B provides AM, FM, PM, FSK, and PWM modulation along with linear/logarithmic sweep and built-in counter capabilities. Internal and external sources can be used for triggering and modulating the signal.

### 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

**20 MHz Dual Channel Function / Arbitrary Generator**  
**Model 4047B**

| 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)<br>at < 500 Hz: 0.001% + 0.006 Hz                                                                                                                                                     |
| <b>Output Characteristics</b>                     |                                                                                                                                                                                                       |
| Amplitude Range                                   | 10 mVpp to 10 Vpp (into 50 $\Omega$ );<br>20 mVpp to 20 Vpp (open circuit)                                                                                                                            |
| Amplitude Resolution                              | 3 digits (1,000 counts)                                                                                                                                                                               |
| Amplitude Accuracy                                | $\pm 2\% \pm 20$ mV of programmed output from 1.01 V - 10 V                                                                                                                                           |
| Flatness                                          | $\pm 0.5$ dB to 1 MHz<br>$\pm 1$ dB to 20 MHz                                                                                                                                                         |
| Offset Range                                      | -4.99 V to 4.99 V (into 50 $\Omega$ )                                                                                                                                                                 |
| Offset Resolution                                 | 10 mV, 3 digits                                                                                                                                                                                       |
| Offset Accuracy                                   | $\pm 2\% \pm 10$ mV (into 50 $\Omega$ )                                                                                                                                                               |
| Output Impedance                                  | 50 $\Omega \pm 2\%$                                                                                                                                                                                   |
| Output Protection                                 | Protected against short circuit or accidental voltage<br>practically available in electronic laboratories, applied to the main<br>output connector                                                    |
| <b>Waveform Characteristics</b>                   |                                                                                                                                                                                                       |
| Harmonic Distortion<br>(3 Vp-p into 50 $\Omega$ ) | 0 - 1 MHz, < -60 dBc<br>1 MHz - 5 MHz, < -50 dBc<br>5 MHz - 12 MHz, < -45 dBc<br>12 MHz - 20 MHz, < 50 dBc                                                                                            |
| Rise/Fall Time (square, pulse)                    | $\leq 20$ ns (10% to 90% at full amplitude into 50 $\Omega$ )                                                                                                                                         |
| Variable Duty Cycle/Symmetry                      | Square: 20% - 80% to 2 MHz<br>Triangle: 1% - 99% in 1% steps, up to 200 kHz                                                                                                                           |
| Symmetry Accuracy at 50%                          | $\pm 1\%$                                                                                                                                                                                             |
| Pulse Width<br>(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)<br>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<br>which time one waveform cycle is generated to programmed param-<br>eters. Frequency of waveform cycle is limited to 1 MHz. |
| Gate                                              | Same as triggered mode, except waveform is executed for the dura-<br>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<br>trigger rate 0.1 Hz - 1 MHz (1 $\mu$ s - 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 $\mu$ Hz to max frequency/2                                                                   |
| Frequency Shift Keying (FSK)   | Carrier             | Sine, Square, or Triangle                                                                       |
|                                | Source              | Internal, External                                                                              |
|                                | Rate                | $\leq 100$ kHz                                                                                  |
| Phase Modulation (PM)          | Carrier             | Sine, Square, or Triangle                                                                       |
|                                | Source              | Internal, External                                                                              |
|                                | Internal Modulation | 0.1 Hz - 20 kHz                                                                                 |
|                                | Deviation           | 0 - 360 $^\circ$ , 0.1 $^\circ$ 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<br>Maximum rate 1 MHz<br>Minimum width > 50 ns<br>Input impedance 1 k $\Omega$   |
| Sync OUT                       |                     | TTL pulse at programmed frequency;<br>50 $\Omega$ source impedance                              |
| Modulation IN                  |                     | 5 Vp-p for 100% modulation<br>10 k $\Omega$ input impedance<br>DC to > 20 kHz minimum bandwidth |
| <b>Counter Characteristics</b> |                     |                                                                                                 |
| Range                          |                     | 50 Hz to 50 MHz                                                                                 |
| Resolution                     |                     | Auto ranging, up to 8 digits                                                                    |
| Accuracy                       |                     | $\pm 0.02\% \pm 2$ 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 $\pm 10\%$ , 47-63 Hz                                                          |
| Max. Power Consumption         |                     | < 30 VA                                                                                         |
| Operating Temperature          |                     | 32 $^\circ$ F to 122 $^\circ$ F (0 $^\circ$ C to 50 $^\circ$ C)                                 |
| Storage Temperature            |                     | 14 $^\circ$ F to 158 $^\circ$ F (-10 $^\circ$ C to 70 $^\circ$ C)                               |
| Humidity                       |                     | 95% R.H. 0 $^\circ$ C to 30 $^\circ$ 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<br>EN55082, EN61010, CE approved                   |
| <b>Three-Year Warranty</b>     |                     |                                                                                                 |
| Included Accessories           |                     | Power cord, USB (type A to B) interface cable,<br>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  $^\circ$ C  $\pm$  5  $^\circ$ C.  
Specifications are subject to change without notice.