Dual Channel Function/Arbitrary Waveform Generators
4050B Series

The 4050B Series Dual Channel Function/Arbitrary Waveform Generators are capable of generating stable and precise sine, square, triangle, pulse, and arbitrary waveforms. With an easy-to-read color display and intuitive user interface with numeric keypad, these instruments offer plenty of features including linear/logarithmic sweep, built-in counter, extensive modulation and triggering capabilities, a continuously variable DC offset, and a high performance 14-bit, 150 MSa/s arbitrary waveform generator. CH1 and CH2 outputs can both be varied from 0 to 10 Vpp into 50 ohms (up to 20 Vpp into open circuit).

Easily create custom arbitrary waveforms using the included waveform editing software or use any of the 196 built-in predefined arbitrary waveforms. More than 1000 user-defined 16k point arbitrary waveforms can be saved to the instrument. Additionally, the included LabVIEW™ drivers allow users to conveniently load and save .csv or .txt file data directly into the arb memory without having to use waveform editing software.

Extensive modulation capabilities include amplitude and frequency modulation (AM/FM), double sideband amplitude modulation (DSB AM), amplitude and frequency shift keying (ASK/FSK), phase modulation (PM), phase shift keying (PSK), and pulse width modulation (PWM).

The standard external 10 MHz reference clock input and output allows users to synchronize their instrument with another generator. Additionally, the generators offer powerful channel copy, track and combine functionality and the phase of both output channels can be synchronized conveniently with the push of a button. These handy features are typically not found in function generators at this price point.

These versatile function/arbitrary waveform generators are suitable for education and other applications that require high signal fidelity, a variety of modulation schemes, or arbitrary waveform generation capabilities.

<table>
<thead>
<tr>
<th>Model</th>
<th>4053B</th>
<th>4054B</th>
<th>4055B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine and square frequency range</td>
<td>1 µHz – 10 MHz</td>
<td>1 µHz – 30 MHz</td>
<td>1 µHz – 60 MHz</td>
</tr>
</tbody>
</table>
Dual Channel Function/Arbitrary Waveform Generators
4050B Series

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. Connect your USB flash drive to the USB host port to quickly save and recall instrument settings and waveforms.

Rear panel

10 MHz reference clock input/output connector to synchronize your signals to a master time base.
Dual Channel Function/Arbitrary Waveform Generators
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Flexible operation

Channel copy and sync function

Channel tracking function

Channel combine function

Harmonics function

Generate arbitrary waveforms with ease

Save time with the 4050B Series’ two independent channels to output synchronous signals. With a push of a button, all waveform parameters can be quickly copied between channels to set up identical output signals. Phase between channels can also be adjusted from the front panel.

Customize your generator’s channel output configuration with frequency, amplitude, and phase coupling. When enabled, CH1 and CH2 can automatically track according to the user’s set frequency, amplitude, and phase deviation ratio between channels.

Create complex waveforms by internally adding each channel’s waveform and outputting the combined waveform on channel 1 or 2.

Generate harmonics up to the 10th order with independent amplitude and phase settings.

The 4050B Series features a large, non-volatile flash memory of about 100 MB, allowing users to create, store, and recall >1000 user-defined 16k point arbitrary waveforms or output any of the 196 built-in predefined arbitrary waveforms.

The provided waveform editing software can be used to create point-by-point arbitrary waveforms via freehand or waveform math functions. A standard USB interface on the rear panel allows users to easily interface with a PC to load these arbitrary waveforms into the instrument. The front panel also offers a convenient USB host port for connecting your USB flash drive to save/recall instrument settings and waveforms.

For applications requiring high signal integrity and edge stability, the 4050B Series can produce low jitter pulse waveforms (Fig 2) compared to conventional DDS generators (Fig 1). The instrument can also generate pulses with minimum rise/fall times of 16.8 ns (Fig 3), minimum pulse width of 32 ns (Fig 4) and maximum rise/fall times of 22.4 seconds.

Generate high performance square waves with < 3.4 ns rise/fall times (Fig 5) and rms jitter < 300ps + 0.05 ppm of period (Fig 6).
## Dual Channel Function/Arbitrary Waveform Generators

### 4050B Series

## Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>4053B</th>
<th>4054B</th>
<th>4055B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channels</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sine &amp; Square</td>
<td>1 µHz – 10 MHz</td>
<td>1 µHz – 30 MHz</td>
<td>1 µHz – 60 MHz</td>
</tr>
<tr>
<td>Triangle, Ramp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise (±3 dB)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arbitrary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 25 ppm (1 year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>1 µHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Arbitrary Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Built-in Waveforms</td>
<td>196 built-in waveforms (includes DC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waveform Length</td>
<td>16k points / Ch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Resolution</td>
<td>14 bits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>150 MSa/s (DDS mode)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Rise/Fall Time</td>
<td>6.5 ms (typical)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jitter (pk-pk)</td>
<td>8 ns (typical)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-volatile Memory Storage</td>
<td>&gt; 1000 16k points waveforms (100 MB in file system)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Output Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplitude Range</td>
<td>2 mVpp – 10 Vpp into 50 Ω (4 mVpp – 20 Vpp into open circuit), ≤ 10 MHz</td>
<td>2 mVpp – 5 Vpp into 50 Ω (4 mVpp – 10 Vpp into open circuit), &gt; 10 MHz</td>
<td></td>
</tr>
<tr>
<td>Amplitude Resolution</td>
<td>up to 4 digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplitude Accuracy (10 kHz Sine)</td>
<td>± (1 % + 1 mVpp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplitude Flatness</td>
<td>± 0.3 dB (reference 10 kHz, 2.5 Vpp, 50 Ω load)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross Talk</td>
<td>&lt; -60 dBc (both channels set to 0 dBm, sine 50 Ω load)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offset Range (DC)</td>
<td>± 5 V into 50 Ω (± 10 V into open circuit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offset Resolution</td>
<td>up to 4 digits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offset Accuracy</td>
<td>± (offset setting value x 1 % + 3 mV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Output Impedance</td>
<td>50 Ω, high impedance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Protection</td>
<td>short-circuit protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waveform Characteristics (sine, square, triangle, ramp)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonic Distortion (Sine)</td>
<td>DC – 10 MHz, &lt; - 60 dBc / 10 MHz – 30 MHz – 45 dBc / 30 MHz – 60 MHz, &lt; -40 dBc (0 dBm input signal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Harmonic Distortion (Sine)</td>
<td>10 Hz – 20 kHz at 0 dBm, &lt; 0.15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spurious (non-harmonic)</td>
<td>DC – 10 MHz, &lt; - 65 dBc / 10 MHz – 30 MHz, &lt; -55 / 30 MHz – 60 MHz, &lt; -40 (0 dBm input signal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rise/Fall Time (square)</td>
<td>&lt; 4.2 ns (10 % – 90 %, at 1 Vpp into 50 Ω)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable Duty Cycle (square)</td>
<td>0.0001% - 99.999% (depending on frequency setting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymmetry (10% duty cycle)</td>
<td>1% of period ± 20 ns (typical, 1 kHz, 1 Vpp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jitter (rms) cycle to cycle (square)</td>
<td>300 ps + 0.00 ppm of period (typical, 1 kHz, 1 Vpp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramp Symmetry</td>
<td>0% – 100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity (triangle, ramp at 1 kHz, 1 Vpp, 100% symmetry)</td>
<td>&lt; 1% of peak output (typical)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Dual Channel Function/Arbitrary Waveform Generators
#### 4050B Series

<table>
<thead>
<tr>
<th>Model</th>
<th>4053B, 4054B &amp; 4055B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pulse</strong></td>
<td></td>
</tr>
<tr>
<td>Pulse Width</td>
<td>32.6 ns minimum, 100 ps resolution, 1,000,000 s max.</td>
</tr>
<tr>
<td>Rise/Fall Time</td>
<td>16.8 ns (1 Vpp, 50 I% – 90% 50 Ω load)</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>0.008% resolution</td>
</tr>
<tr>
<td>Overshoot</td>
<td>&lt; 3% (100 kHz, 1 Vpp)</td>
</tr>
<tr>
<td>Jitter (rms) cycle to cycle</td>
<td>300 ps + 0.05 ppm of period (typical, 1 kHz, 1 Vpp)</td>
</tr>
<tr>
<td><strong>Burst</strong></td>
<td></td>
</tr>
<tr>
<td>Waveform</td>
<td>sine, square, ramp, pulse, arbitrary, noise</td>
</tr>
<tr>
<td>Type</td>
<td>cycle (1-100,000 cycles), infinite, gated</td>
</tr>
<tr>
<td>Start/Stop Phase</td>
<td>0° – 360°</td>
</tr>
<tr>
<td>Internal Period</td>
<td>1 μs – 1000 s</td>
</tr>
<tr>
<td>Gated Source</td>
<td>internal, external trigger</td>
</tr>
<tr>
<td>Trigger Source</td>
<td>internal, external, manual</td>
</tr>
<tr>
<td><strong>Phase Offset</strong></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0° – 360°</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.1°</td>
</tr>
</tbody>
</table>

### AM, FM & PM Modulation Characteristics
- **Carrier**: sine, square, ramp, arbitrary (except DC)
- **Source**: internal, external
- **Internal Modulation Waveform**: sine, square, ramp, noise, arbitrary (1 mHz - 20 kHz)
- **AM Modulation Depth**: 0% – 120%, 0.1% resolution
- **FM Frequency Deviation**: 0 – 0.3% bandwidth, 10 MHz resolution
- **PM Phase Deviation**: 0 – 360°, 0.1° resolution

### ASK & FSK Modulation Characteristics
- **Carrier**: sine, square, ramp, arbitrary (except DC)
- **Source**: internal, external
- **Modulation Waveform**: 50% duty cycle square waveform (1 mHz – 50 kHz)

### PWM Modulation Characteristics
- **Source**: internal, external
- **Internal Modulation Waveform**: sine, square, ramp, arbitrary (except DC)
- **Internal Modulation Frequency**: 1 mHz – 20 kHz

### DSB-AM Modulation Characteristics
- **Carrier**: sine, square, ramp, arbitrary (except DC)
- **Source**: internal, external
- **Modulation Waveform**: sine, square, ramp, noise, arbitrary (1 mHz – 20 kHz)

### Sweep Characteristics
- **Waves**: sine, square, ramp, arbitrary (except DC)
- **Sweep Shape**: linear or logarithmic, up or down
- **Sweep Time**: 1 ms – 500 s
- **Sweep Trigger**: internal, external, manual

### Auxiliary Input / Output
- **Modulation Input**: ±6 Vpp (typical) for 100% modulation
  - Maximum input voltage: 7 V
  - Input impedance: 10 kΩ
- **Sync and Trigger Out**: TTL compatible *1)
  - Output impedance 10 kΩ
  - Minimum pulse width: 500 ns
- **Trigger In**: TTL compatible *2)
  - Input impedance: 10 kΩ
  - Minimum pulse width: 100 ns
  - Response time 100 ns (max) in sweep mode and 600 ns (max) in burst mode

### Reference Clock
- **Input**: Frequency Range: 10 MHz ± 1 kHz (typical)
  - Min. Voltage Input: 1 V
  - 5 kΩ input impedance
- **Output**: Frequency Range: 10 MHz ± 25 ppm (typical)
  - Voltage Level: 3.3 V (typical), 2 V (minimum)
  - 50 kΩ output impedance

### Frequency Counter
- **Measurement**: frequency, period, duty cycle, positive/negative pulse width
- **Measurement Range**: 100 mHz – 200 MHz (DC coupling)
  - 10 Hz – 200 MHz (AC coupling)
- **Input Range**: 100 mV to ±2.5 V (< 100 MHz, DC coupling)
  - 200 mV to ±2.5 V (100 MHz – 200 MHz, DC coupling)
  - 100 mV to ±5 V (100 MHz – 200 MHz, AC coupling)
- **Input Impedance**: 1 MΩ
  - Coupling: AC, DC, HF, REJ

### Environmental and Safety
- **Temperature**: operating: 32°F – 104°F (0°C – 40°C)
  - storage: -4°F – 140°F (-20°C – 60°C)
- **Humidity**: < 86% RH, ≤90% RH
  - 104°F (40°C), ≤50% RH
- **Altitude**: operating: below 9,842 ft (3,000 m)
  - storage: below 49,212 ft (15,000 m)
- **Electromagnetic Compatibility**

### General
- **Display**: 4.3” TFT-LCD display, 480 x 272
- **Interfaces**: LAN & USB (standard), GPIB (optional), USB host port
- **Storage Memory**: Arbitrary waveforms and instrument settings share the same non-volatile storage memory of 100 MB.
- **Power**: 100 – 240 VAC ± 10%, 50 / 60 Hz
  - 100 – 120 VAC ± 10%, 400 Hz
- **Power Consumption**: 50 W max.
- **Dimensions (W x H x D)**: 263 x 96 x 295 mm (10.3” x 3.78” x 11.6”)
- **Weight**: 3.32 kg (7.32 lbs)

### Three-Year Warranty

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1) \( V_{OH} = 3.8 \text{ V} \) (\( I_{OH} = -8 \text{ mA} \)), \( V_{OL} = 0.44 \text{ V} \) (\( I_{OL} = 8 \text{ mA} \))

2) \( V_{TR} = 2 \text{ V (min) / 5.5 \text{ V (max)} , V_{IL} = -0.3V \text{ (min) / 0.8 \text{ V (max)}} \)
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 center in Singapore services customers in Singapore, Malaysia, Vietnam, and Indonesia.

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

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