Data Sheet

Dual Channel Function/Arbitrary Waveform Generators

4050 Series

The 4050 Series Dual Channel Function/Arbitrary Waveform Generators are capable of generating stable and precise sine, square, triangle, pulse, and arbitrary waveforms. With easy-to-read color displays and an 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, 125 MSa/s arbitrary waveform generator. The main output voltage can be varied from 0 to 10 Vpp into 50 ohms (up to 20 Vpp into open circuit) and the secondary output can be varied from 0 to 3 Vpp into 50 ohms (up to 6 Vpp into open circuit).

Easily create custom arbitrary waveforms using the included waveform editing software or output any of the 48 built-in predefined arbitrary waveforms. Up to 10 user-defined 16 kpt arbitrary waveforms can be saved to the instrument. Additionally, the included LabVIEW™ drivers allow users to conveniently load and save .CSV or text 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), and pulse width modulation (PWM).

The standard external 10 MHz reference clock input allows the instrument to be synchronized to an external 10 MHz source or another generator. This feature is typically not found in function generators at this price point. Additionally, the phase of both output channels can be conveniently synchronized with the push of a button.

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.

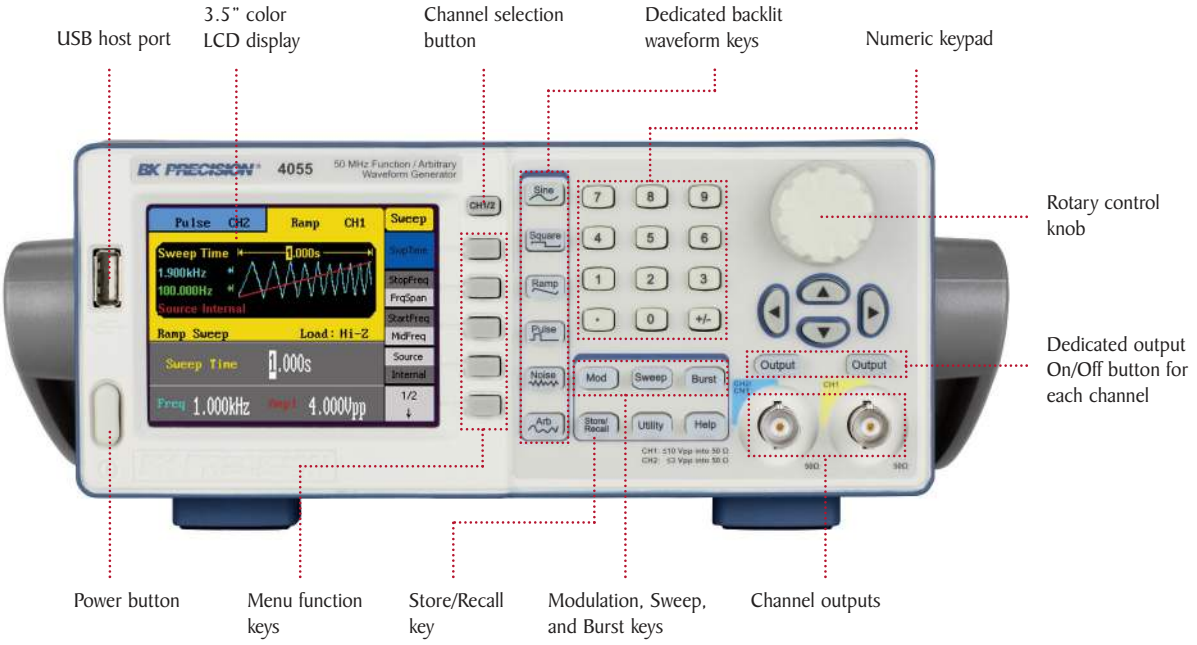
Features & Benefits

- 14-bit, 125 MSa/s, 16k point arbitrary waveform generator
- Generate sine waves up to 50 MHz
- Large 3.5-inch LCD color display with waveform preview
- Linear and logarithmic sweep
- AM, DSB-AM, ASK, FM, FSK, PM, and PWM modulation functions
- Variable DC offset
- Adjustable duty cycle
- Two independent channels with individual output ON/OFF buttons
- Internal/external triggering
- Gate and burst mode
- 48 built-in predefined arbitrary waveforms
- Store/recall up to 10 instrument settings and 10 arbitrary waveforms
- Built-in counter
- USB device port (USBTMC-compliant) and front panel USB host port
- GPIB connectivity with optional USB-to-GPIB adapter
- SCPI-compliant command set
- Arbitrary waveform editing software provided
- Short circuit protection on output
- LabVIEW™ drivers available

Model	4052	4053	4054	4055
Sine frequency range	1 μHz – 5 MHz	1 μHz – 10 MHz	1 μHz – 25 MHz	1 μHz – 50 MHz
Square frequency range	1 μHz – 5 MHz	1 μHz – 10 MHz	1 μHz – 25 MHz	

B&K PRECISION
ELECTRONIC TEST INSTRUMENTS

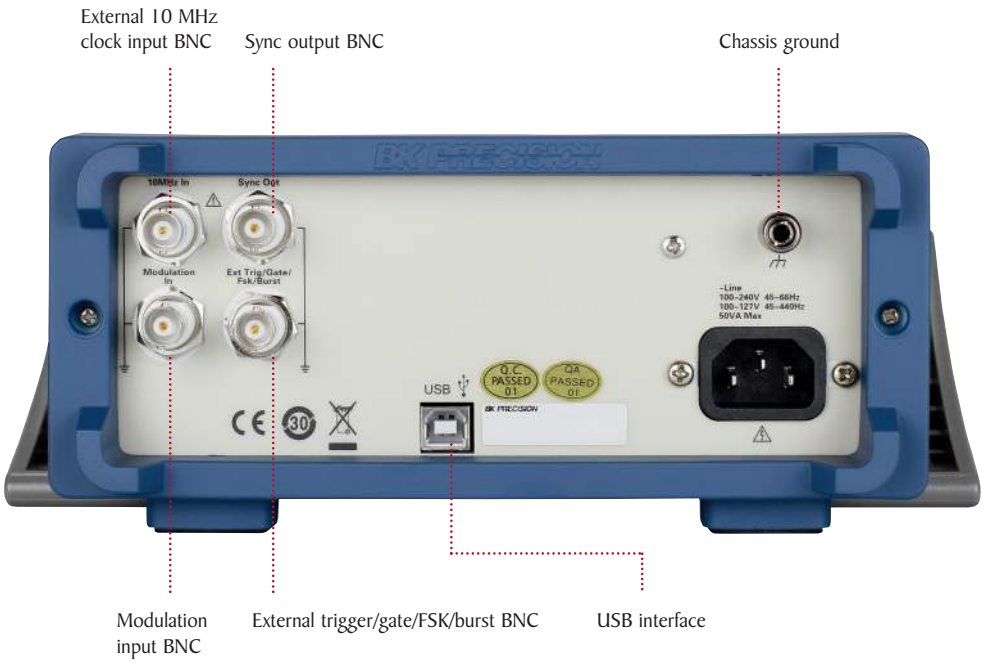
Front panel



Intuitive user interface

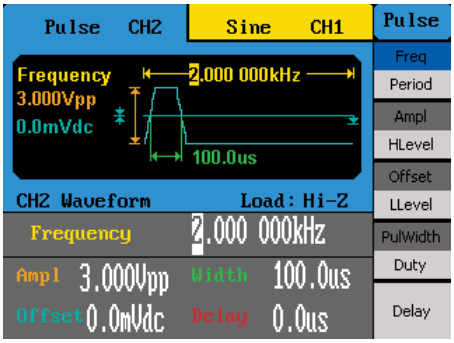
Easily adjust all waveform parameters using the intuitive menu-driven front panel keypad with dedicated waveform keys, numeric keypad, and rotary control knob. Connect your USB flash drive to the USB host port to quickly save and recall instrument settings and waveforms.

Rear panel



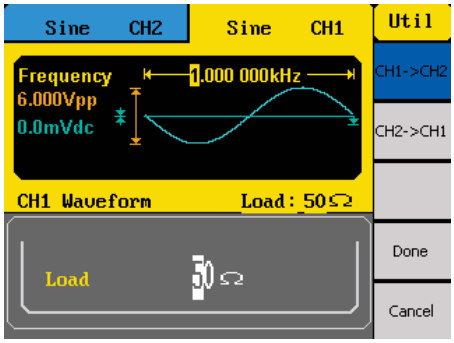
Flexible operation

Color display with waveform preview



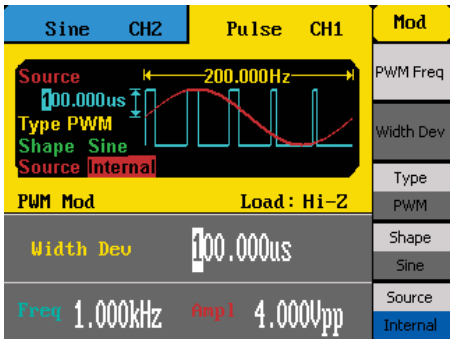
The large 3.5" color display highlights the currently selected channel and shows all relevant parameters with a preview of the waveform being generated.

Duplicate channel parameters



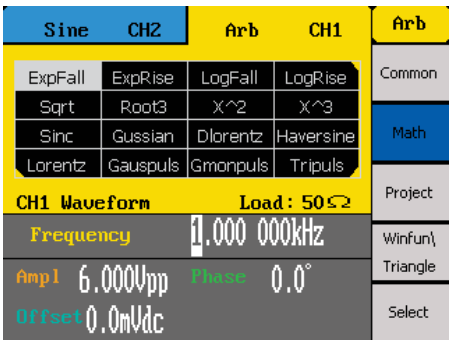
Quickly copy all waveform parameters between channels via the Utility menu. This feature can help you save time when you need to set up two identical output signals.

Wide variety of modulation schemes



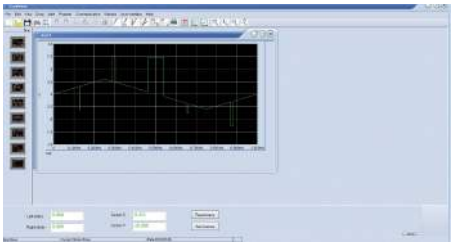
These instruments are capable of many different types of modulation for various applications. Modulate your waveforms with AM, DSB-AM, FM, PM, ASK, FSK, and PWM modulation schemes.

Arbitrary waveform generation



All models in the 4050 series have non-volatile memory to create, store, and recall up to 10 different arbitrary waveforms of up to 16,000 points each. Users can also output any of the 48 built-in predefined arbitrary waveforms.

Generate waveforms with ease



The provided waveform editing software can be used to create point-by-point arbitrary waveforms via freehand or waveform math functions. A standard USBTMC-compliant USB device port on the rear panel allows users to easily interface with a PC to load these arbitrary waveforms into the instrument.

Synchronization and external triggering

Use the external 10 MHz clock input to synchronize your signals to a master time base. The Sync output generates a TTL pulse for synchronization to a channel's frequency. An external trigger connector is also available for inputting or outputting trigger signals.

Specifications

Model	4052	4053	4054	4055
Channels	2			
Frequency Characteristics				
Sine	1 μHz – 5 MHz	1 μHz – 10 MHz	1 μHz – 25 MHz	1 μHz – 50 MHz
Square	1 μHz – 5 MHz	1 μHz – 10 MHz	1 μHz – 25 MHz	
Triangle, Ramp	1 μHz – 300 kHz			
Pulse	500 μHz – 5 MHz			
Gaussian Noise (-3 dB)	> 5 MHz	> 10 MHz	> 25 MHz	> 50 MHz
Arbitrary	1 μHz – 5 MHz			
Accuracy	± 50 ppm (90 days) ± 100 ppm (1 year)			
Resolution	1 μHz			
Arbitrary Characteristics				
Built-in Waveforms	48 built-in waveforms (includes DC)			
Waveform Length	16,000 points / Ch			
Vertical Resolution	14 bits			
Sampling Rate	125 MSa/s			
Minimum Rise/Fall Time	7 ns (typical)			
Jitter (pk-pk)	8 ns (typical)			
Non-volatile Memory Storage	10 waveforms			
Output Characteristics				
Amplitude Range	channel 1: 2 mVpp – 10 Vpp into 50 Ω (4 mVpp – 20 Vpp into open circuit), ≤ 10 MHz 2 mVpp – 5 Vpp into 50 Ω (4 mVpp – 10 Vpp into open circuit), > 10 MHz			
	channel 2: 2 mVpp – 3 Vpp into 50 Ω (4 mVpp – 6 Vpp into open circuit)			
Amplitude Resolution	up to 4 digits			
Amplitude Accuracy (100 kHz)	± (0.3 dB + 1 mVpp of setting value)			
Amplitude Flatness (relative to 100 kHz, 5 Vpp)	± 0.3 dB			
Cross Talk	< -70 dBc			
Offset Range (DC)	channel 1: ± 5 V into 50 Ω (± 10 V into open circuit)			
	channel 2: ± 1.5 V into 50 Ω (± 3 V into open circuit)			
Offset Resolution	up to 4 digits			
Offset Accuracy	± (|offset setting value| x 1% + 3 mV)			
Channel Output Impedance	50 Ω, high impedance			
Output Protection	short-circuit protection			
Sync Out	TTL compatible, 2 MHz maximum frequency > 50 ns width, not adjustable 50 Ω (typical) output impedance			
Waveform Characteristics				
Harmonic Distortion	DC – 1 MHz, < - 60 dBc 1 MHz – 5 MHz, < -53 dBc 5 MHz – 25 MHz, < - 35 dBc 25 MHz – 50 MHz, < -32 dBc			
Total Harmonic Distortion	DC – 20 kHz at 1 Vpp, < 0.2 %			
Spurious (non-harmonic)	DC – 1 MHz, < -70 dBc 1 MHz – 10 MHz, < -70 dBc + 6 dB/spectrum phase			
Phase Noise	10 kHz offset, - 108 dBc/Hz (typical)			
Rise/Fall Time (square)	< 12 ns (10 % – 90 %) at full amplitude into 50 Ω			
Variable Duty Cycle (square)	20% – 80% to 10 MHz 40% – 60% to 20 MHz 50% > 20 MHz			
Asymmetry (50% duty cycle)	1% of period + 20 ns (typical,1 kHz, 1 Vpp))			
Jitter (square)	0.1% of period (typical, 1 kHz, 1 Vpp)			
Ramp Symmetry	0% – 100%			
Linearity (triangle, ramp at 1 kHz, 1 Vpp, 100% symmetry)	< 0.1% of peak output (typical)			

Model	4052, 4053, 4054 & 4055
Pulse	
Pulse Width	16 ns minimum, 8 ns resolution
Rise/Fall Time	7 ns (typical) at 1 kHz, 1 Vpp from 10% to 90%
Duty Cycle	0.1% resolution
Overshoot	< 5%
Jitter (pk-pk)	8 ns
Burst	
Waveform	Sine, square, ramp, pulse, arbitrary (except DC)
Type	Cycle (1 – 50,000 cycles), infinite, gated
Start/Stop Phase	0 ° to 360 °
Internal Period	1 µs to 500 s
Gated Source	External trigger
Trigger Source	Internal, external, manual
Phase Offset	
Range	0 ° to 360 °
Resolution	0.1 °
Trigger Characteristics	
Trigger Input	
Max. Input Voltage	± 6 V
Input Level	TTL compatible
Slope	Rising or falling, selectable
Pulse Width	> 100 ns
Input Impedance	> 5 kΩ, DC coupling
Maximum Frequency	1 MHz
Input Latency	< 300 ns
Trigger Output	
Voltage Level	TTL compatible
Pulse Width	> 400 ns
Output Impedance	50 Ω
Maximum Frequency	1 MHz
AM, FM & PM Modulation Characteristics	
Carrier	Sine, square, ramp, arbitrary (except DC)
Source	Internal, external
Modulation Waveform	Sine, square, ramp, noise, arbitrary (2 mHz to 20 kHz)
AM Modulation Depth	0% to 120%, 0.1% resolution
FM Frequency Deviation	0 to 0.5*bandwidth, 10 µHz resolution
PM Phase Deviation	0 to 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 (2 mHz – 50 kHz)
DSB-AM Modulation Characteristics	
Carrier	Carrier sine, square, ramp, arbitrary (except DC)
Source	Source internal, external
Modulation Waveform	Sine, square, ramp, noise, arbitrary (2 mHz – 1 kHz)

PWM Modulation Characteristics	
Frequency	500 µHz – 20 kHz
Source	Internal, external
Modulation Waveform	Sine, square, ramp, arbitrary (except DC)
External Modulation	- 6 V to 6 V (max. width deviation)
Duty Cycle Modulating Frequency	2 mHz to 20 kHz
Sweep Characteristics	
Waveforms	Sine, square, ramp, arbitrary (except DC)
Sweep Shape	Linear or logarithmic, up or down
Sweep Time	1 ms to 500 s
Sweep Trigger	Internal, external, manual
Inputs	
Modulation In	± 6 Vpp for 100% modulation > 5 kΩ input impedance maximum voltage input: ± 6 V
Ext Trig/Gate/FSK/Burst	TTL compatible maximum voltage input: ± 6 V
External Clock	10 MHz ± 100 Hz, TTL compatible for synchronization to external 10 MHz clock or another generator
Frequency Counter	
Measurement	Frequency, Period, Positive/Negative pulse width, Duty cycle
Measurement Range (typical)	Single channel: 100 mHz to 200 MHz Pulse width/duty cycle: 1 Hz to 10 MHz
Frequency Resolution	6 bits
Input Range DC and AC Coupling (typical)	DC offset range: ± 1.5 VDC 450 mV to ± 2.5 V, (100 mHz to 10 MHz) 2.5 V to 5 V, (10 MHz to 50 MHz) 4.5 V to 5 V, (50 MHz to 200 MHz)
Pulse Width/Duty Cycle Voltage Range	50 mVrms to 5 Vpp
Input Impedance	1 MΩ
Coupling	AC, DC
Trigger Level Range (typical)	-3 V to 1.8 V
Environmental and Safety	
Temperature	Operating: 32 °F to 104 °F (0 °C to 40 °C) Storage: -4 °F to 140 °F (-20 °C to 60 °C)
Humidity	< 95° F (35 °C), ≤ 90 % RH 95 °F to 104 °F (35 °C to 40 °C), ≤ 60 % RH
Altitude	Operating: below 9,842 ft (3,000 m) Storage: below 49,212 ft (15,000 m)
Electromagnetic Compatibility	EMC Directive 2004/108/EC, EN61326:2006, EN61000-3-2:2006+A2:2009, EN61000-3-3:2008
Safety	Low voltage directive 2006/95/EC, EN61010-1:2001, EN61010-031:2002+A1:2008
General	
Display	Display 3.5" TFT-LCD display, 320 x 240
Interfaces	USBTMC (standard), GPIB (optional), USB host port
Storage Memory	10 instrument settings, 10 arbitrary waveforms
Power	100 to 240 VAC ± 10%, 50 / 60 Hz ± 5% 100 to 120 VAC ± 10%, 45 to 440 Hz
Power Consumption	50 W max.
Dimensions (W x H x D)	8.4" x 3.5" x 11.1" (213 x 89 x 281 mm)
Weight	5.7 lbs (2.6 kg)
Warranty	Three Years
Standard Accessories	Getting Started manual, full instruction manual on CD, AC power cord, USB type A-to-type B cable, certificate of calibration
Optional Accessories	USB-to-GPIB adapter (model AK40G)