B+K PRECISION®

Model **4001A, 4003A**

Sweep Function Generator

INSTRUCTION MANUAL

Table of Contents

Section 1

Safety Guidelines

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must sometimes be performed where exposed voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. A voltage as low as 35 volts DC or AC (RMS) should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices to prevent contact with exposed high voltage and to steer current away from your heart in case of accidental contact with high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions.

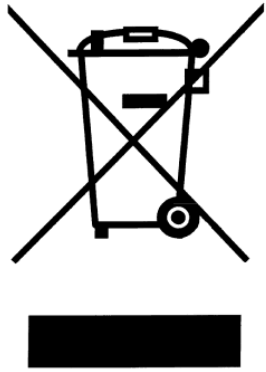
1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high voltage circuits. Discharge high voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor to stand on and an insulated work surface on which to place equipment and make certain such surfaces are not damp or wet.
4. Use the time proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When testing AC-powered equipment, remember that AC line voltage is usually present on some power input circuits such as the on-off switch, fuses, power transformer etc. any time the equipment is connected to an AC outlet, even if the equipment is turned off.
6. Some equipment with a two-wire AC power cord, including some with polarized power plugs, is the "hot chassis" type. A plastic wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test equipment. Always connect an isolation transformer between the AC outlet and the equipment under test. The B&K Precision Model TR-110 or 1604 Isolation Transformer or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire AC equipment as "hot chassis" unless you are sure it is isolated chassis or an earth ground chassis.
7. On test instruments or any equipment with a 3-wire AC power plug, use only a 3-wire outlet. This is a safety feature to keep the housing or other exposed elements at earth ground.
8. B&K Precision products are not authorized for use in any application involving direct contact between our product and the human body or for use as a critical component in a life support device or system. Here "direct contact" refers to any connection from or to our equipment via any cabling or switching means. A "critical component" is any component of a life support device or system whose failure to perform can be reasonably expected to cause failure of that device or system or to affect its safety or effectiveness.

Never work all alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

Compliance Statements

Disposal of Old Electrical & Electronic Equipment (Applicable in the European Union and other European countries with separate collection systems)

This product is subject to Directive 2002/96/EC of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be disposed of as unsorted municipal waste. Please utilize your local WEEE collection facilities in the disposition of this product and otherwise observe all applicable requirements.



Section 2

Introduction

Models 4001A and 4003A are 4 MHz sweep function generators. Model 4003A has an added feature of a 20 MHz digital counter. The function generator generates sinusoidal, triangular, ramp, square, and pulse waveforms. The type of function is selectable through a rotary switch.

The frequency is settable from 0.5 Hz to 4 MHz of the function with range selector switch and the frequency control knob for variable adjustments with multiplication factor of 0.04 to 4.0 of the selected frequency range.

The signal amplitude can be adjusted from 0.2 V to 20 Vpp with no load conditions and 0.1 V to 10 Vpp with a 50 ohm load termination.

The MAIN output has the provision of SYNC output signal (TTL level) when selected.

The sweep generator offers linear or log sweep with variable sweep rate and adjustable sweep width.

(model 4003A only)
Auto ranging, 5-digit frequency counter is provided with range from 0.2 Hz to 20 MHz and resolution of 0.01 Hz. The counter is utilized for external as well as internal functions.

(model 4003A only)
In addition to the features above, an external voltage signal can be used to control the frequency of the function. With AC input signal, FM output can be generated.

Section 3

Technical Specifications

3.1 FREQUENCY CHARACTERISTICS

Waveforms:	Sine, Square, Triangle, Ramp, ± Pulse
Range:	0.5 Hz to 4 MHz in 6 ranges
Tuning Range:	Variable multiplication factor of 0.04 to 4.0 of selected range
Resolution:	0.001 Hz (model 4003A only)
Operating Modes:	Normal, Sweep, VCF
Frequency Stability:	Output will change less than 0.1 % for 15 minutes after switching ON and it will change less than 0.2 % for 24 Hours after switching ON

3.2 OUTPUT CHARACTERISTICS

Impedance:	50 Ω ± 2 %.
Level:	Variable control From ≤ 0.2 Vpp (no load, Amplitude knob in pull position) ≤ 0.1 Vpp (50Ω load, Amplitude knob in pull position) To ≥ 20 Vpp (no load, Amplitude knob in push position) ≥ 10 Vpp (50Ω load, Amplitude knob in push position)
Attenuation:	-20 dB ±2%
DC Offset:	Variable: ±10 V open circuit, ± 5 V into 50 Ω

3.3 SINE WAVE

Distortion:	< 2% (1 Hz – 100 kHz)
Harmonic Ratio:	< 30 dB, 100 kHz to 4 MHz
Frequency Response:	< 0.5 dB to 100 kHz < 1.5 dB, 100 kHz to 4 MHz

3.4 TRIANGULAR WAVE

Symmetry:	50 % (positive half) to 50 % (negative half) < 2%, 1 Hz to 100 kHz

3.5 RAMP WAVE

Frequency Range:	0.5 Hz to 3.5 MHz
Symmetry:	80% (rise wave) to 20% (fall wave) < 5%, 1 Hz to 100 kHz
Rising Wave Linearity:	< 2%, 1 Hz to 100 kHz

3.6 SQUARE WAVE

Symmetry:	50 % (positive half) to 50 % (negative half) < 2%, 1 Hz to 100 kHz
Rise Time:	< 90 ns, (20 Vpp, no load)

3.7 POSITIVE PULSE

Frequency Range:	0.5 Hz to 3.5 MHz
Pulse Width:	15% of time period of the set frequency
Symmetry:	20% to 80%, < 5%, 1 Hz to 100 kHz
Rise Time:	< 90 ns, (20 Vpp, no load)

3.8 NEGATIVE PULSE

Frequency Range:	0.5 Hz to 3.5 MHz
Pulse Width:	15 % of time period of the set frequency
Symmetry:	80% to 20%, < 5%, 1 Hz to 100 kHz
Rise Time:	< 90 nS, (20 Vpp, no load)

3.9 SYNCHRONOUS OUTPUT

Impedance:	50 Ω ± 2 %
Level (TTL):	Approx. 3 Vpp fixed amplitude
Level (CMOS):	Variable 4 Vpp to 15 Vpp (+/- 1 Vpp)
Rise Time (TTL):	< 60 ns
Rise Time (CMOS):	< 90 ns

3.10 VCF INPUT

Input Level:	0 to 10 V
Input Frequency:	DC to 1 kHz

3.11 SWEEP OPERATION

Operating Mode:	Linear/ LOG
Sweep Rate:	5 s to 10 ms
Width:	1:1 to 1:100

3.12 SWEEP SYNCHRONOUS OUTPUT

Output waveform:	Linear/LOG ramp wave
Amplitude:	10 Vpp (no load), 5 Vpp (1 kΩ load)

3.13 FREQUENCY COUNTER (model 4003A only)

Display:	5-digit, auto range
Display Unit:	Hz/kHz auto range
Resolution:	0.01 Hz (max.)
Accuracy:	< 0.02 % ± 1 digit, for ≥ 1 kHz
Temp coefficient:	< 10 PPM / °C

3.14 EXTERNAL COUNTER (model 4003A only)

Max. Input Voltage:	< 150 Vrms
Input Frequency:	0.2 Hz to 20 MHz
Coupling:	HF - for more than 100 kHz LF - with 100 kHz filter for less than 100 kHz
Sensitivity:	<100 mVrms (1 MHz), <200 mVrms (>1 MHz)

3.15 AC INPUT: 115 V AC ±10 %, 50/60 Hz, fuse 600 mA or
230 V AC ±10 %, 50/60 Hz, fuse 300 mA

3.16 OPERATING ENVIRONMENT

Temperature:	0 to 40ºC
Humidity:	10% to 80%

3.17 STORAGE

Temperature:	- 20ºC to 70ºC
Humidity:	0% to 90%

3.18 DIMENSIONS: W x H x D – 11” x 3.6” x 11.9” (279.4 x 91.4 x 302.3 mm)

3.19 WEIGHT: 5.5 lbs (2.5 kg.)

3.20 ACCESSORY: Power Cord, User’s Manual

NOTE: Specifications are subject to change without notice.

To ensure the most current version of this manual, please download the current version here:
http://www.bkprecision.com/search/manual/4001A_4003A

For current up-to-date product information, please visit www.bkprecision.com

Section 4

Controls & Indicators

4.1 FRONT PANEL (Refer to Figure 1 & Figure 2)

1. **POWER SWITCH**
   Pushing the switch "ON" will light the LED of the 5 digit display to indicate power ON.
2. **FREQUENCY CONTROL KNOB**
   Used to adjust the required frequency for selected range with the multiplication factor of 0.04 to 4.0.
3. **SYNC OUTPUT**
   The TTL level square signal output synchronous with frequency of MAIN output.
4. **SWEEP OUTPUT**
   Sweep signal is available regardless of position of SWEEP ON switch (turned on and off by SWEEP RATE knob).
5. **MAIN OUTPUT**
   Function output signal provides normal mode or sweep mode output depending on mode selected. The maximum output impedance is 50 Ω.
6. **AMPLITUDE KNOB**
   The amplitude of the signal can be adjusted from 0.2 Vpp to 20 Vpp at no load. Pull the knob to attenuate the signal 10 times.
7. **DC OFFSET**
   This knob can apply a DC offset to the MAIN output signal. Turn the knob clockwise for positive offset and counterclockwise for negative offset.
8. **SWEEP RATE**
   This knob is used to adjust the sweep rate from 5 seconds to 10 milliseconds. Also if this knob is pulled, then sweep mode operation will be ON.
9. **SWEEP WIDTH**
   This knob is used to adjust the sweep width. When the knob is in "Push" condition, a linear sweep output will be available. When knob is in "Pull" condition, a log sweep output will be available.

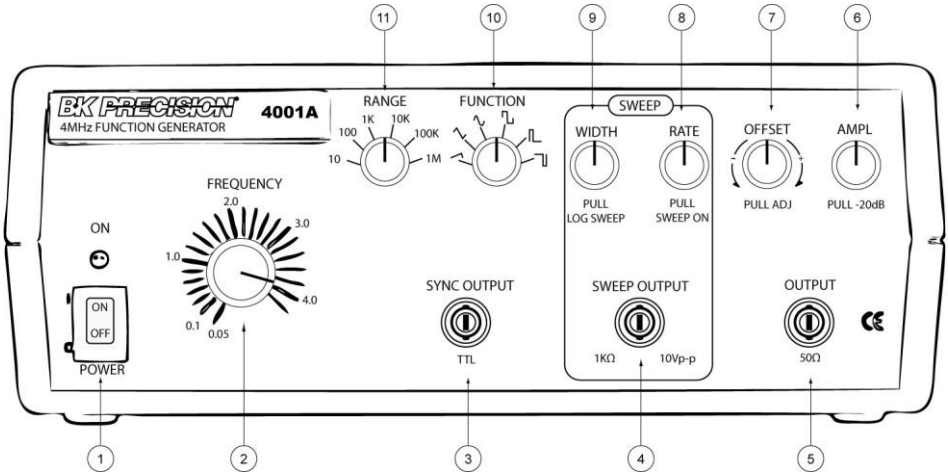


Figure 1 – Front Panel Controls (4001A)

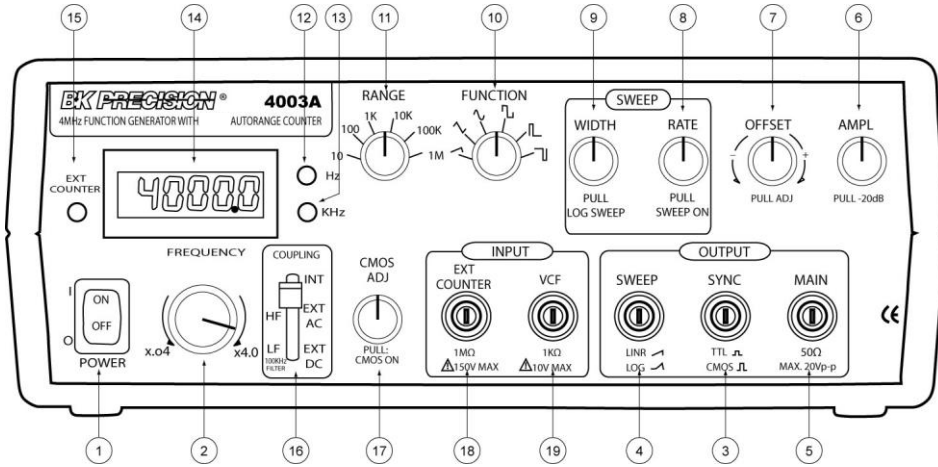


Figure 2 - Front Panel Controls (4003A)

10. **FUNCTION SELECTOR SWITCH**
    A rotary switch for waveform selection.

11. **FREQUENCY RANGE SELECTOR SWITCH**
    A rotary switch to select the range from 10 Hz to 1 MHz in 6 steps.

(Refer to

Figure 2**)**

12. **Hz LED**
    Green LED will light when the MAIN output frequency is in Hz.

13. **kHz LED**
    Red LED will light when the MAIN output frequency is in kHz.

14. **5-DIGIT LED DISPLAY**
    Indicates frequency of MAIN output or the frequency of signal connected to external input.

15. **EXT COUNTER LED**
    LED turns ON when external frequency counting is selected by coupling switch.

16. **COUPLING SWITCH**
    It is a three-way switch to select internal / external high frequency / external low frequency mode.

17. **CMOS ADJUST KNOB**
    For adjusting the CMOS level of SYNC output while in CMOS mode. Pull the knob for CMOS ON.

18. **EXTERNAL INPUT BNC**
    Connector for counting external signal frequency.

19. **VCF INPUT BNC**
    For connecting external DC or AC signal from 0 to 10 V to achieve voltage controlled frequency output.

4.2 REAR PANEL (Refer to Figure 3)

1. **40mm FAN**
   Provided on rear panel for cooling purposes.

2. **KENSINGTON SECURITY SLOT**
   For use with Kensington locks to secure your product and prevent theft.

3. **AC SOCKET AND FUSE DEPARTMENT**
   The socket has a fuse plug, which is used for fuse replacement and input line voltage selection. Selection of input line voltage (110/230 VAC) depends on how fuse plug is inserted. Refer to arrow marks on fuse plug and the mark on the panel.

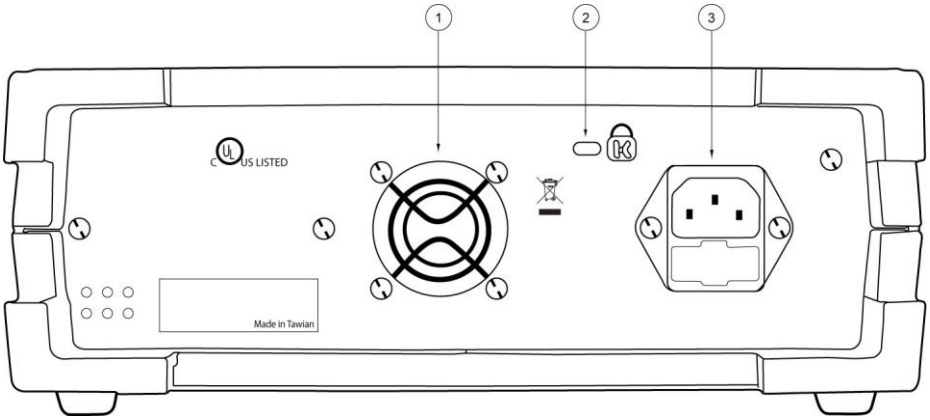


Figure 3 - Rear Panel

Section 5

Operating Instructions

Before applying power to unit, make sure that input voltage setting is correct and the ventilation holes are not blocked. Ensure that ventilation fan is working well.

It is necessary to inspect the generated signal with an oscilloscope before connecting it to any electronic circuit. Hence use of oscilloscope is mentioned in the procedure.

Turn on the instrument with POWER SWITCH provided on the front panel. The display shows the reading as per present settings.

5.1 FUNCTION GENERATOR OUTPUT

1. Select the type of waveform required by FUNCTION SELECTOR SWITCH.
2. Select the range of frequency by FREQUENCY RANGE SELECTOR SWITCH.
3. Connect MAIN output signal to Channel 1 of oscilloscope and SYNC output signal to Channel 2 of oscilloscope. Set the trigger source of oscilloscope at Channel 2.
4. Set the frequency of the signal by adjustment knob. The display shows the frequency reading of signal.
5. Adjust the amplitude of the signal by AMPLITUDE KNOB. Pull the knob if the signal is to be attenuated 10 times.
6. Set the DC offset of signal by DC OFFSET knob to required level (-10 V to +10 V).
7. Check the impedance of the load before connecting (50 W max.).

5.2 SWEEP GENERATOR OUTPUT

1. Connect MAIN output to Channel 1 of oscilloscope and SWEEP output to Channel 2.
2. Channel 2 displays linear sawtooth waveform. SWEEP output is available regardless of SWEEP ON switch. If SWEEP WIDTH knob is pulled, then log sweep will be available.
3. Adjust the sweep rate by SWEEP RATE knob (adjustable from 5 s to 10 ms).
4. Adjust the starting frequency as explained in 5.1.
5. Pull the SWEEP RATE knob to turn sweep mode ON.
6. Channel 1 will display sweep wave.
7. Adjust the sweep width using the SWEEP WIDTH knob (1:1 to 1:100).

5.3 FREQUENCY COUNTER (model 4003A only)

1. Check the COUPLING switch position. The HF position is used for frequencies more than 100 kHz. LF position is used for frequencies less than 100 kHz.
2. The EXT COUNTER LED will be ON when COUPLING switch is selected for counting mode.
3. Connect the signal to EXT COUNTER BNC.

4. Display will show the frequency and Hz / kHz LED's will light depending on the frequency.

5.4 VOLTAGE CONTROLLED FREQUENCY OPERATION (model 4003A only)

The 4003A can be operated as a voltage controlled generator by using an external control voltage applied to the VCF input.

1. Select the desired frequency range and waveform.
2. Set the starting frequency with the variable control. Apply a positive DC voltage to the VCF input to increase the frequency. A voltage from 0 to +10 V will cause the frequency to increase by a factor of 100.

5.5 FUNCTION GENERATOR APPLICATIONS GUIDEBOOK

B&K Precision offers a "Guidebook to Function Generators", which describes numerous applications for this instrument, including hook-up details. It also includes a glossary of function generator terminology and an explanation of function generator circuit operation. It may be downloaded free of charge on our website, www.bkprecision.com.