LODESTAR Electronics

A Subsidiary of B&K Precision Corp.

INSTRUCTION MANUAL

Model LS3005 & LS3002
Function Generators

GENERAL SAFETY SUMMARY

Review the following safety precautions to avoid injury and prevent damage to this product and any product connected to it. To avoid potential hazards, use this product only as specified

To avoid fire or personal injury:
Use proper power cord. Use only the power cord supplied with this product or a power cord that is specified for the country of use.

Ground the product: When using the supplied three prong power cord, this product is grounded through the grounding connector of the power cord. To avoid electrical shock, the grounding connector must be connected to earth ground. Before making connections to the input or output of the terminals of the product, ensure the product is properly grounded.

Observe all terminal ratings: To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate without covers. Do not operate this product with covers and panels removed.

Do not operate in an explosive atmosphere

Do not operate in wet or damp conditions.

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SAFETY TERMS AND SYMBOLS

These terms and symbols may appear on the product or in the user manual.

WARNING: Warning statements identify condition or practices that could result in injury or loss of life.

CAUTION: Caution statements identify conditions or practices that could result in damage to this product or other property.

Protective Ground
(Earth) Terminal

1. PRODUCT INTRODUCTION

1.1 Description

The Lodestar Electronics model LS3002 and LS3005 Function Generators are versatile signal sources combining several functions into one unit. Additionally, the instrument provides the added convenience of a built- in frequency counter. This allows for a more accurate determination of the output frequency than is possible with a simple calibrated dial.

The heart of the function generator is a voltage-controlled generator that produces precision sine, square, or triangle waves over the 0.5Hz to 5MHz range (LS3005) or 0.5Hz to 2MHz (LS3002) range respectively.

Due to their versatility, the instruments have many applications in both analog and digital electronics. The easy to use interface makes these generators especially suitable for educational users and hobbyists, but the instruments are also well suited for service, manufacturing and engineering applications.

1.1 Key Features

- Fully featured, easy to use function generator
- Sine, square, triangle, pulse and ramp output.
- DC Offset Control
  Continuously variable DC offset allows the output to be injected directly into circuits at the correct bias level.
- Duty Cycle Control
  Converts the instrument to a pulse generator capable of generating rectangular waves or pulses, ramp or sawtooth waves, and slewed sine waves.
- Separate outputs for TTL and CMOS signals. CMOS signal with adjustable range to fit the circuit.
- Built-In 4 Digit Counter

2. SPECIFICATIONS

FREQUENCY CHARACTERISTICS	Waveforms	Sine，Square，Triangle，Pulse，Ramp
	Range	2Hz to 2MHz (LS3002), 5Hz to 5MHz (LS3005) 6 ranges for each model
	Resolution	4 digits
	Variable Duty Cycle	20%－80% continuously variable
	Operating Modes	Normal, VCF (Voltage Controlled Frequency)
	Frequency Stability	≤ ± 1%

OUTPUT CHARACTERISTICS	Impedance	50Ω ± 10%
	Level	20V p-p Open circuit, 10Vp-p into 50 Ω
	Amplitude control	Variable
	Attenuation	Variable, 20 dB range typical. Attenuators: adjustable in 10dB ± 1dB steps, range -10dB to -70dB
	DC Offset	Variable: ± 10V open circuit, ± 5V into 50 Ω

SINE WAVE	Distortion	≤ 2% at 1kHz
	Flatness	LS3002: ≤ 1dB LS3005: < 0.3dB for 5Hz to 500kHz, ≤ 1dB 500 kHz – 5MHz

SQUARE WAVE	Symmetry	≤ ± 3%, 2Hz to 100 kHz
	Risetime	≤ 50 ns

TRIANGLE WAVE	Linearity	98%, at 1kHz

TTL OUTPUT	Level	≥ 3Vp-p (without any load)
	Rise Time	≤ 30 ns

CMOS OUTPUT	Max Frequency	2 MHz (LS3002), 5MHz (LS3005)
	Level	4Vpp ± 0.5Vpp to 14.5Vpp ± 0.5Vpp continuously variable
	Rise Time	≤ 120 ns

VCF	Input Voltage	-10V to +10V. Within this range, frequency change ≥ 100:1
	Input Impedance	1kΩ ± 10%

FREQUENCY COUNTER	Accuracy	timebase accuracy ± 1 count
	Range	2Hz to 20MHz
	Timebase accuracy	± 20 ppm (23 °C ± 5 °C)
	sensitivity	≤ 10MHz:600mVp-p ≥ 10MHz: 1.4 Vp-p
	Display	4 digits

General:

Power Requirements	AC 110V/220V ±10% selectable, 50/60Hz, 20W
Accessories included	AC Line Cord Instruction manual Spare fuse Output cable, BNC to alligator clips
Dimensions (W x H x D):	240 x 90 x 280 mm (9.45 x 3.54 x 11.02”)
Weight:	2.5Kg (5.56 lbs.)

Specifications and information provided are subject to change without notice.
Please visit www.lodestarelectronics.com for the most current product information.

3. SAFETY INFORMATION AND INSTALLATION

3.1 Unpacking the Instrument

The product has been fully inspected and tested before shipping from the factory. Upon receiving the instrument, immediately unpack and inspect it for any damages that might have been sustained during transportation. If any sign of damage is found, notify your local distributor immediately.

3.2 Checking the Line voltage

This instrument will operate on AC 220V or 110V. Before connecting the power plug to an AC line outlet, make sure the voltage selector is set to the position corresponding to the line voltage. Note that the instrument may be damaged if it is connected to the wrong AC line voltage.

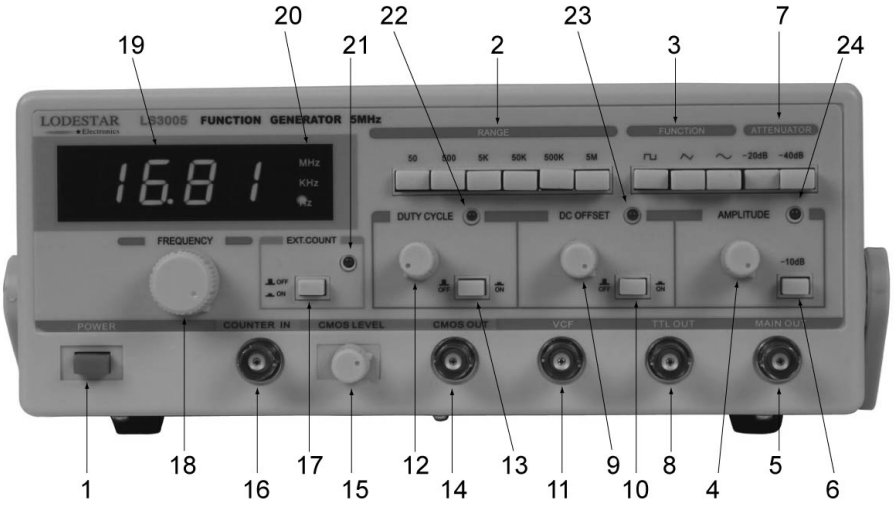
WARNING: To avoid electrical shock, the power cord protective grounding conductor must be connected to ground.

Replace the required fuses according to this table.

Line voltage	Range	Fuse
AC 220V	198V to 242V	T 0.25A, 250V
AC 110V	100V to 120V	T 0.5A, 250V

WARNING: To avoid personal injury, disconnect the power cord before removing the fuse holder.

4. FRONT PANEL INTRODUCTION



(1) POWER Switch.
Turns power on and off.

(2) RANGE Switch
Selects output frequency range. 6 ranges from 5Hz to 5MHz (model LS3005) and from 2Hz to 2MHz (model LS3002). Switch indicates maximum frequency of range and is adjusted with the FREQUENCY control to 0.1 times the maximum. For example, if the 500kHz range is selected, the output frequency can be adjusted from 50kHz to 500kHz.

(3) FUNCTION Switch
Selects sine, square, or triangle waveform at MAIN OUT terminal.

(4) AMPLITUDE Control
Controls the amplitude of the signal at the OUTPUT terminal.

(5) OUTPUT terminal
Waveform selected by FUNCTION switch as well as the superimposed DC OFFSET voltage is available at this jack.

(6) 10dB Switch
When engaged, the signal at the OUTPUT terminal is attenuated by 10dB.

(7) ATTENUATOR switches
When one or both buttons are engaged, the signal at the output terminal is attenuated by approximately 20,40 or 60dB

(8) TTL OUT terminal
A TTL square wave is output at this terminal. This output is independent of the output level and DC offset

(9) DC OFFSET Control.
Enabled by the DC OFFSET Switch (10). Clockwise rotation from center changes the DC offset in a positive direction while counterclockwise rotation from center changes the DC offset in a negative direction.

(10) DC OFFSET switch
When engaged, enables operation of the DC OFFSET control (9). LED (23) is lit when DC OFFSET mode is enabled..

(11) VCF terminal.
Voltage Controlled Frequency input. Permits external control of the generator output frequency by a DC voltage input at this input terminal. A positive voltage will increase the frequency.

(12) DUTY CYCLE Control
Enabled by the DUTY CYCLE switch (13). Rotation from center position adjusts the duty cycle of the main OUTPUT signal as well as the TTL and CMOS signal.

(13) DUTY CYCLE switch
When engaged, enables operation of the DUTY CYCLE control (12). LED (22) is lit when DC OFFSET mode is enabled.

(14) CMOS OUT terminal
A CMOS signal is output at this terminal. The level is depending on the position of the CMOS LEVEL knob. This output is independent of the AMPLITUDE and DC OFFSET controls.

(15) CMOS LEVEL Control
Rotating this control clockwise increases the amplitude of the CMOS signal at the CMOS OUT terminal.

(16) COUNTER IN
Input to the counter of the instrument

(17) EXT COUNT switch
This switch enables the EXTernal COUNTer mode. When enabled the frequency of the signal present at terminal (16) will be displayed.

18 FREQUENCY control
Adjustment of the output frequency from 10% to 100% the selected range.

19 COUNTER display
There are 2 display modes: when in normal mode or function generator mode, the displays shows the frequency of the internally generated waveform. When

mode EXT COUNT is enabled by pressing button (17), the frequency of the signal present at the COUNTER IN terminal will be displayed.

(20) Hz, kHz or MHz LED
Indicates whether the counter is reading in Hz, kHz or MHz.

(21) EXT COUNT indicator
This LED is lit when button (17) is pressed which enables EXT COUNT mode

(22) DUTY CYCLE indicator
This LED is lit when button (13) is pressed which enables adjustment of the duty cycle.

(23) DC OFFSET indicator
This LED is lit when button (10) is pressed which enables adjustment of the duty cycle.

(24) AMPLITUDE indicator
This LED is lit when the10dB button (6) is pressed.

5. OPERATING INSTRUCTIONS

The Lodestar Electronics models LS3002 and LS3005 Function Generators are versatile instruments capable of producing a variety of output waveforms. To gain a working familiarity with the unit, it is recommended to initially connect to an oscilloscope so that the effects of the various controls on the output waveforms can be observed. Use this manual as required for reference until becoming accustomed to the operating procedures.

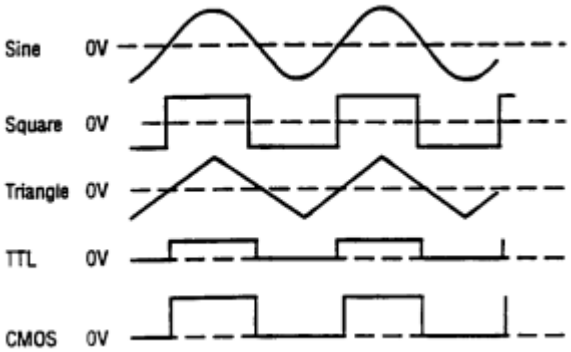
5.1 Getting Started - Frequency and Waveform Selection

l. Verify that the DUTY CYCLE (13), DC OFFSET (10) and all ATTENUATOR switches, -10dB (6), -20dB and -40dB (7) switches are in the OFF position (released). This will produce a symmetrical waveform unaffected by the other controls.

2. Plug the unit into an appropriate power source and turn it on.

3. Select the desired waveform (SINE, SQUARE, or TRIANGLE) by engaging one of the FUNCTION switches (3). Phase relationships of the waveforms are shown in figure 1.

Figure 1



4 Select the frequency of the waveform by engaging one of the RANGE switches (2). The output frequency is displayed, along with the appropriate measurement units, Hz, kHz or MHz on the LED display.

5 Rotate the FREQUENCY control (18) to quickly set the output frequency to the desired value.. The frequency selected is available at the MAIN OUT terminal (5). Additionally, a digital signal TTL and CMOS is available at the TTL OUT and CMOS OUT terminals. (for details refer to the “TTL/CMOS OUTPUT” section of this manual).

6 Adjust the amplitude of the output as desired using the AMPLITUDE (4) control. Rotation of this control varies the amplitude from maximum to 20dB below maximum. Additional fixed attenuation levels of -10dB to 70dB is available by pushing in a combination of the -10dB (6), -20dB or -40dB switches (7). The maximum signal level is 10V p-p (into 50 Ω).

7 A superimposed DC component can be added to the output signal by engaging the DC OFFSET switch (10) to enable operation of the DC OFFSET control (9). Rotation of this control adds a positive or negative DC component to the output signal. The DC component introduced is independent of the AMPLITUDE control and can be varied by ±10 volts open circuited or ±5 volts into 50Ω. The DC Offset does not affect the TTL/CMOS output jack. The effect of DC OFFSET is shown in Fig. 2.

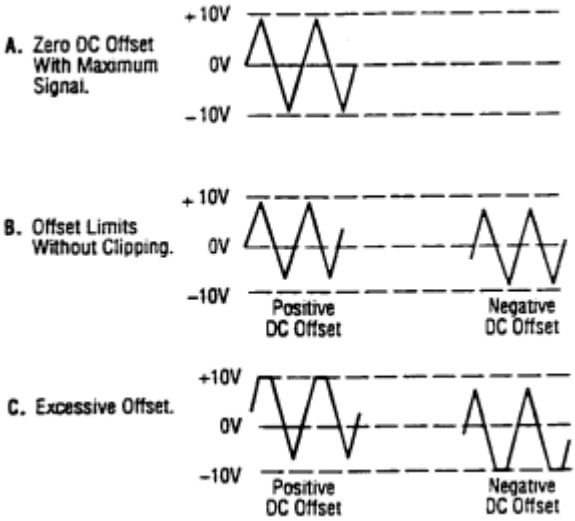


Figure 2

General guidelines

Counterclockwise rotation of the frequency control decreases the output frequency to approximately one-tenth of the maximum for the range selected (10:1). For example, if the 50K range is selected and the frequency control is set to full counterclockwise, the output frequency is approximately 5kHz.

Remember that the output signal swing of the generator is limited to ±10 volts open circuited or ±5 volts into 50Ω, and applies to the combined peak-to peak signal and DC offset. Clipping occurs slightly above these levels. Fig. 2 illustrates the various operating conditions encountered when using the DC offset. If the desired output signal is large or if a large DC offset is required, an oscilloscope should be used to make sure that the desired signal is obtained without undesirable clipping.

5.2 Duty Cycle Control

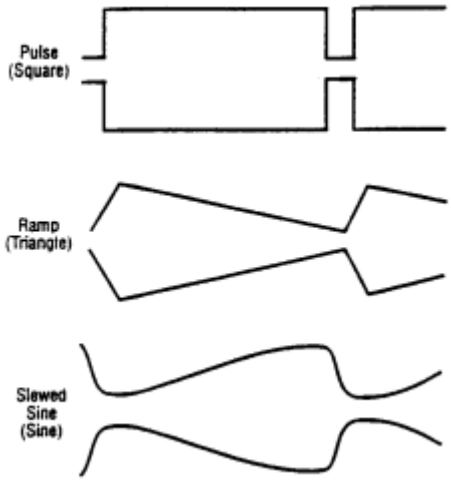
The DUTY CYCLE control can be used to alter the symmetry of the output waveform, to produce wave shapes such as those shown in Fig. 3. For a square wave, symmetry variation amounts to changing the duty cycle (ratio of "high" to "low" time), effectively converting the instrument into a pulse generator. For a triangle wave, the result is a ramp, and with a sine wave, a distorted wave shape called a slewed sine is produced. Models LS3005 and LS3002 provide for symmetry variation from 20% to 80%.

1. Select the waveform desired: SINE, SQUARE or TRIANGLE.
2. Engage the DUTY CYCLE switch (13) and adjust the DUTY CYCLE control (12) for the desired waveshape. Clockwise rotation from center results in an increase in

square wave duty cycle, and changes the sine and triangle waves as shown in the top waveform of each pair of Fig. 3. Counterclockwise rotation results in the bottom waveform in each pair.

3 Varying the duty cycle setting results in a slight change in frequency. Adjust the frequency controls as required.

Figure 3 – Duty Cycle Control



5.3 TTL and CMOS Output

The TTL and CMOS output terminals provide a fast rise time square wave output. Either a fixed TTL or a variable CMOS output level is available. The output is positive with respect to ground and can be used as an external sync pulse for oscilloscopes or as a variable frequency signal source for exercising logic circuits. Because of the fast rise time of this output, cable length should be minimized to limit ringing and overshoot.

1 Select the desired frequency range and adjust the frequency controls as required. The OUTPUT LEVEL and DC OFFSET controls have no effect on the signal at the TTL OUT and CMOS OUT terminals.

2 If a TTL level signal is required, connect to terminal TTL OUT. For CMOS signals, connect to terminal CMOS OUT and adjust the level of the signal by rotating the CMOS LEVEL control (15). The range is adjustable from 4V to 14.5V.

5.4 Voltage Controlled Frequency operation

Models LS3002 and LS3005 can be operated as a voltage-controlled generator by using an external control voltage applied to the VCF Input terminal. The externally applied voltage will vary the frequency which is preselected by the range switches and the frequency controls.

1 Select the desired frequency range and waveform.

2 To operate the function generator as a sweep generator, apply a positive going ramp signal to the VCF Input jack. As the ramp voltage increases, the frequency increases. The rate of sweep can be adjusted by varying the frequency of the ramp signal.

3 Do not apply more than ±10 volts (dc or dc + ac peak) to the VCG INPUT terminal. Inputs of more than 10 volts will not cause any further shift in the frequency and could cause damage to the generator.

5.5 Output Protection

Use care when connecting the function generator output to a signal injection point. Excessive voltage at the point of signal injection of the function generator can cause internal damage. Under normal operation, the generator output should never be connected to an external voltage other than low dc values that can be matched with the DC OFFSET control. The following protective measures are strongly recommended:

1 The user should understand the equipment under test well enough to identify valid signal injection points (i.e., the base of a transistor, a logic input of a gate, etc.). The voltage at valid signal injection points is rarely high enough to damage the instrument. 2. If in doubt about the safety of a signal injection point, measure the voltage present at the intended point of signal injection before connecting the function generator output to that point.

2 When applying the main output of the function generator to a circuit point containing a dc level, adjust the DC OFFSET control so that the dc level at the main output matches the circuit voltage.

3 Connect the TTL output only to TTL-level circuits.

4. Connect the CMOS output only to CMOS circuits. Measure the Vcc of the circuit under test and adjust the CMOS LEVEL control as instructed in the manual.

6. MAINTENANCE

WARNING

The following instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than what's described in the operating instructions unless you are qualified to do so.

6.1 Fuse Replacement

If the fuse blows, the power lamp indicators will not light and the oscilloscope will not operate. The fuse should not normally open unless a problem has developed in the unit. Try to determine and correct the cause of the blown fuse then replace only with the correct fuse. The fuse is located on the rear panel adjacent to the power cord receptacle.

WARNING. For continued fire protection, replace fuse only with 250V fuse of the specified type and rating, and disconnect power cord before replacing fuse.

6.2 Line Voltage Selection

To select the desired line voltage, simply set the slide switch on the rear panel to the appropriate voltage. Before you do so, unplug the unit and make sure the proper fuse is installed.

7 SERVICE INFORMATION

7.1 Warranty and Non-Warranty Service

Please contact your local distributor for warranty and service instructions.

7.2 Limited 90 day Warranty

The company warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of 90 days from date of purchase from your local distributor.

The company will, without charge, repair or replace, at its option, defective product or component parts. Please contact your local distributor for instructions.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. The warranty is void if the serial number is altered, defaced or removed.

The company shall not be liable for any consequential damages, including without limitation damages resulting from loss of use.

8 APPENDIX

8.1 CE Declaration

BK PRECISION

Declaration of CE Conformity
According to EEC directives and
NF EN 45014 norm

CE

	Responsible Party Manufacturers	***Alternate Manufacturing***
Name:	B&K Precision Corporation	***Site*** B&K China 1354
Manufacturer's Address	22820 Savi Ranch Pkwy. Yorba Linda, CA 92887-4610 USA	

Declares that the below mentioned product

Product Name: Function Generator

Part Numbers: LS3002, LS3005

complies with the essential requirements of the following applicable European Directives:

Low Voltage Directive 73/23/EEC (19.02.73)
amended by 93/68/EEC (22.07.93)

Electromagnetic Compatibility (EMC) 89/336/EEC (03.05.88)
amended by 92/68/EEC (22.07.93)

and conforms with the following product standards:

Safety	EN 61010-1:2001
EMC	EN 61326:1997 + A1:1998 + A2:2001 EN 50081-1 EN 50081-2

This Declaration of Conformity applies to above listed products place on the EU market after:

January 31 2007
Date

Victor Tolan
Victor Tolan
President

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Lodestar Electronics Co.
www.lodestarelectronics.com

Printed in China Ver. 1.0/0207