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Model 4040DDS

20 MHz DDS Function Generator

OPERATING MANUAL

Limited Two-Year Warranty

B&K Precision 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 two years from date of purchase from an authorized B&K Precision distributor.

B&K Precision will, without charge, repair or replace, at its option, defective product or component parts. Returned product must be accompanied by proof of the purchase date in the form of a sales receipt.

To obtain warranty coverage in the U.S.A., this product must be registered by completing the warranty registration form on www.bkprecision.com within fifteen (15) days of purchase.

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.

B&K Precision shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitations of incidental or consequential damages. So the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may have other rights, which vary from state-to-state.

Safety Summary

The following safety precautions apply to both operating and maintenance personnel and must be observed during all phases of operation, service, and repair of this instrument. Before applying power, follow the installation instructions and become familiar with the operating instructions for this instrument.

Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. B&K Precision Corporation assumes no liability for a customer's failure to comply with these requirements. This is a Safety Class I instrument.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. This instrument is grounded through the ground conductor of the supplied, three-conductor ac power cable. The power cable must be plugged into an approved three-conductor electrical outlet. Do not alter the ground connection. Without the protective ground connection, all accessible conductive parts (including control knobs) can render an electric shock. The power jack and mating plug of the power cable meet IEC safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified maintenance personnel. Disconnect the power cord before removing the instrument covers and replacing components. Under certain conditions, even with the power cable removed, dangerous voltages may exist. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt any internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY THE INSTRUMENT

Do not install substitute parts or perform any unauthorized modifications to this instrument. Return the instrument to TEXIO for service and repair to ensure that safety features are maintained.

WARNINGS AND CAUTIONS

WARNING and **CAUTION** statements, such as the following examples, denote a hazard and appear throughout this manual. Follow all instructions contained in these statements.

A **WARNING** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in injury or death to personnel.

A **CAUTION** statement calls attention to an operating procedure, practice, or condition, which, if not followed correctly, could result in damage to or destruction of part or all of the product.

WARNING: *Do not alter the ground connection. Without the protective ground connection, all accessible conductive parts (including control knobs) can render an electric shock. The power jack and mating plug of the power cable meet IEC safety standards.*

WARNING: *To avoid electrical shock hazard, disconnect power cord before removing covers. Refer servicing to qualified personnel.*

CAUTION: *Before connecting the line cord to the AC mains, check the rear panel AC line voltage indicator. Applying a line voltage other than the indicated voltage can destroy the AC line fuses. For continued fire protection, replace fuses only with those of the specified voltage and current ratings.*

CAUTION: *This product uses components which can be damaged by electro-static discharge (ESD). To avoid damage, be sure to follow proper procedures for handling, storing and transporting parts and subassemblies which contain ESD-sensitive components.*

Contents

Section 1	Introduction	
1.2	Description	7
1.3	Specifications.....	7
Section 2	Installation	
2.1	Introduction	9
2.4	Instrument mounting	9
2.5	Power requirements	9
2.6	Grounding requirements	9
Section 3	Operating Instructions	
3.1	General Description.....	11
3.4	Connectors	12
3.6	Function Keys.....	13
3.10	Power-on Settings	17

Section 1

Introduction

1.1 Introduction

This manual contains information required to operate the MODEL 4040DDS – 20MHz DDS Function Generator. This section covers the instrument general description, instrument specifications and characteristics. Please note that the RS-232 connector on the back of the unit is not to be used as a programming or user interface. It is for factory use only.

1.2 Description

The MODEL 4040DDS is a versatile high performance function generator that produces Sine, Square and Triangle signals. Waveforms can be output in continuous, triggered or gated mode. AM and FM modulation combined with versatile Sweep capabilities make the unit suitable for a wide range of applications.

1.3 MODEL 4040DDS - SPECIFICATIONS

FREQUENCY CHARACTERISTICS (STANDARD WAVEFORMS)

Sine	-	0.1 Hz to 20 MHz
Square	-	0.1 Hz to 20 MHz
Triangle , Ramp	-	0.1 Hz to 2 MHz
Accuracy	-	0.01 % (100 ppm)
Resolution	-	4 digits or 10 mHz

OUTPUT CHARACTERISTICS

Amplitude Range	-	10mV to 10Vp-p into 50 ohms
Resolution	-	3 digits (1000 counts)
Amplitude Accuracy	-	± 2% ± 20mV of the programmed output from 1.01V- 10V
Flatness	-	0.5 dB at 1MHz 1 dB to 20 MHz
Offset Range	-	± 4.5V into 50 ohms, depending on the Amplitude setting
Offset Resolution	-	10 mV with 3 digits resolution
Offset Accuracy	-	± 2% ± 10mV into 50 ohms
Output Impedance	-	50 ohms
Output Protection	-	The instrument output is protected against short circuit or accidental voltage practically available in electronic laboratories, applied to the main output connector

WAVEFORM CHARACTERISTICS

Harmonic Distortion	-	0-20 KHz	-50 dBc
	-	20 KHz-100 KHz	-45 dBc
	-	100 KHz-1 MHz	-40 dBc
	-	1 MHz-20 MHz	-30 dBc
Spurious	-	DC-1MHz	<-55 dBc
Square Rise/Fall Time	-	< 20 ns (10% to 90%) at full amplitude into 50 ohms	
Variable Duty Cycle	-	20% to 80% to 2 MHz for Square and 10%-90% for Triangle	
Symmetry at 50%	-	< 1 %	

OPERATING MODES

Continuous	- Output continuous at programmed parameters.
Triggered	- Output quiescent until triggered by an internal or external trigger, then one waveform cycle is generated to programmed parameters, up to 2 MHz
Gate	- Same as triggered mode, except waveform is executed for the duration of the gate signal. The last cycle started is completed.
Trigger Source	- Trigger source may be internal, external or manual. Internal trigger rate 10 μ s to 10s.

MODULATION CHARACTERISTICS

Amplitude Modulation	
- Internal:	Sine signal of 1000 Hz Variable modulation from 0% to 100% in 1% steps.
- External:	5 V _{p-p} for 100% modulation, 10 Kohms input impedance, DC to 20 KHz bandwidth.
Frequency Modulation	
- Internal:	Sine signal of 1000 Hz
- External:	5 V _{p-p} for 100% deviation, 10 Kohms input impedance, DC to 20 KHz bandwidth.

SWEEP CHARACTERISTICS

Sweep Shape:	Linear and Logarithmic, up or down
Sweep Time:	10 ms to 50 s.

INPUTS AND OUTPUTS

Trigger In	- TTL compatible. - Max. rate 2MHz. - Minimum width 50ns.
Sync Out	- TTL pulse at programmed frequency, 50 ohms source impedance.
Modulation IN	- 5 V _{p-p} for 100% modulation . - 10 K Ω input impedance. Dc to >20 KHz minimum bandwidth.

GENERAL

Dimensions	- 8.4 inch (213 mm) wide - 3.5 inch (88 mm) high - 8.3 inch (210 mm) deep
Weight	- Aprox 2.5 Kg.
Power	- 90V-264V, 30 VA max
Temperature	- Operating - 0°C to +50°C, Non-operating - -10°C to +70°C
EMC	- According to EN55011 for radiated and conducted emissions.
Electrical Discharge Immunity	- According to EN55082
Safety Specifications	- According to EN61010

NOTE

Specifications are verified according to the performance check procedures in the technical manual.
Specifications not verified in the manual are either explanatory notes or general performance characteristics only.

Section 2

Installation

2.1 Introduction

This section contains installation information, power requirements, initial inspection and signal connections for MODEL 4040DDS - Function Generator.

2.2 Mechanical Inspection

This instrument was carefully inspected before shipment. Upon receipt inspect the instrument for damage that might have occurred in transit. If there is damage due to shipping, file a claim with the carrier who transported the unit. The shipping and packing material should be saved if reshipment is required. If the original container is not to be used, then use a heavy carton box. Wrap the unit with plastic and place cardboard strips across the face for protection. Use packing material around all sides of the container and seal it with tape bands. Mark the box "FRAGILE".

2.3 Initial Inspection

After the mechanical inspection, verify the contents of the shipment (accessories and installed options). If the contents are incomplete, or if the instrument does not pass the specification acceptance tests, notify the local service center.

2.4 Instrument Mounting

The MODEL 4040DDS - Function Generator is intended for bench use. The instrument includes a front feet tilt mechanism for optimum panel viewing angle. The instrument does not require special cooling when operated within conventional temperature limits. The unit can be installed in a closed rack or test station if proper air flow is assured for removing about 15 W of power dissipation.

2.5 Power Requirements

The MODEL 4040DDS can be operated from any source of 90V to 264V AC, frequency from 48Hz to 66Hz. The maximum power consumption is 30 VA. Use a slow blow fuse UL/CSA approved of 1A as indicated on the rear panel of the instrument.

The instrument power fuse is located in the AC input plug. To access the fuse, first disconnect the power cord and then remove the fuse cartridge.

2.6 Grounding Requirements

For the safety of operating personnel, the instrument must be grounded. The central pin on the AC plug grounds the instrument when properly connected to the ground wire and plugged into proper receptacle.

WARNING

TO AVOID PERSONAL INJURY DUE TO SHOCK, THE THIRD WIRE EARTH GROUND MUST BE CONTINUOUS TO THE POWER OUTLET. BEFORE CONNECTION TO THE POWER OUTLET, EXAMINE ALL CABLES AND CONNECTIONS BETWEEN THE UNIT AND THE FACILITY POWER FOR A CONTINUOUS EARTH GROUND PATH. THE POWER CABLE MUST MEET IEC SAFETY STANDARDS.

2.7 Signal Connections

Use RG58U 50 Ohm or equivalent coaxial cables for all input and output signals to and from the instrument.

Section 3

Operating Instructions

3.1 General Description

This section describes the displays, controls and connectors of the MODEL 4040DDS - Function Generator. All controls for the instrument operation are located on the front panel. The connectors are located on both front and rear panels.



Figure 3.1 - MODEL 4040DDS Front Panel

1. Power ON-OFF -Applies and removes AC power to the unit.
2. Display Window -Displays all instrument data and settings on a LCD.
3. Function Keys -Select the output waveform, Sine, Square, Triangle or the MODE, SWEEP and MODULATION..
4. Rotary Knob -Used to increment/decrement numerical values or to scan through the possible selections.
5. Modify Keys -Used to move the cursor (when visible) to either left or right.

3.2 Display Window

The MODEL 4040DDS has a graphic LCD display that can display up to 122 x 32 dots. When you power-on the unit the SINE is selected and its current settings appear in the display. The bottom displays a status line that corresponds to the function, parameter or mode displayed selected.

3.3 Front Panel Controls

The front-panel controls select, display, and change parameter, function, and mode settings. Use the rotary input knob and the cursor movement keys to enter data into the waveform generator.

To change a setting:

1. Press the key that leads to a required item.
2. Move cursor using cursor keys to the appropriate position in the numeric field (if applicable).
3. Use the rotary input to change the value of the displayed item. Changes take effect immediately.

The following subsections describe the function of each front panel key and connector.

3.4 Connectors

The function generator has all BNC connectors on the front panel where you can connect coaxial cables. These coaxial cables serve as carrier lines for input and output signals delivered to and from the function generator.

Output Connector

Use this connector to transfer the main output signal from the function generator.

Trig In Connector

Use this connector to apply an external trigger or gate signal, depending on the waveform generator setting, to the generator. This connector is also the input to the build-in counter, activated by pressing the COUNT pushbutton.

Sync Out Connector

Use this connector to output a positive TTL sync pulse generated at each waveform cycle.

Modulation In Connector

5V p-p signal for 100% modulation, 10Kohms input impedance with DC - >20 KHz bandwidth.

3.5 Output Connections

The waveform generator output circuits operate as a 50 ohms voltage source working into a 50 ohms load. At higher frequencies, non terminated or improperly terminated output cause aberrations on the output waveform. In addition, loads less than 50 ohms reduce the waveform amplitude, while loads more than 50 ohms increase waveform amplitude.

Excessive distortion or aberrations caused by improper termination are less noticeable at lower frequencies, especially with sine and triangle waveforms. To ensure waveform integrity, follow these precautions:

1. Use good quality 50 ohms coaxial cable and connectors.
2. Make all connections tight and as short as possible.

3. Use good quality attenuators if it is necessary to reduce waveform amplitudes applied to sensitive circuits.
4. Use termination or impedance-matching devices to avoid reflections.
5. Ensure that attenuators and terminations have adequate power handling capabilities.

If there is a DC voltage across the output load, use a coupling capacitor in series with the load. The time constant of the coupling capacitor and load must be long enough to maintain pulse flatness.

Impedance Matching

If the waveform generator is driving a high impedance, such as the 1 Mohm input impedance (paralleled by a stated capacitance) of an oscilloscope vertical input, connect the transmission line to a 50 ohms attenuator, a 50 ohms termination and to the oscilloscope input. The attenuator isolates the input capacitance of the device and terminates the waveform generator properly.

3.6 FUNCTION Keys

These keys select the main menus for displaying and changing a parameter, function or mode.

3.6.1 WAVEFORM Keys

The keys select the waveform output and displays the waveform parameters (frequency, amplitude or offset).

The SINE, RAMP and SQUARE pushbuttons select the output waveform. A build-in LED indicates the waveform selected.



Sine Menu

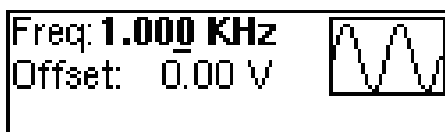
FREQ button - (Frequency) Selects and displays the frequency. Change the frequency setting using the cursor keys and the rotary knob. This pushbutton returns to Frequency display from any other menu displayed.

AMPL Knob - Changes the waveform Amplitude.

OFST button -Selects the Offset parameter. Change the offset by using the cursor keys and Amplitude/Offset rotary knob. If a certain setting cannot be produced, the waveform generator will display a "Setting Conflict" message.

Amplitude and Offset Interaction:

Amplitude and offset settings interact and are bound by hardware restrictions. In order to obtain the desired waveform the following amplitude and offset hardware limitations must be considered:

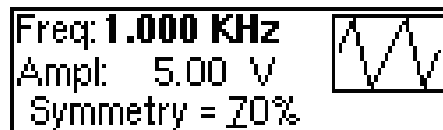


Offset Menu

The offset voltage has three ranges as follows:

Output Voltage Range	Constraints of Amplitude + Offset
1.01 volt to 10.00 volts	$(V_{p-p})/2 + \text{offset} \leq 5 \text{ volts}$
0.101 volt to 1 volt	$(V_{p-p})/2 + \text{offset} \leq 0.5 \text{ volts}$
0.010 volt to 0.100 volt	$(V_{p-p})/2 + \text{offset} \leq 0.05 \text{ volts}$

DUTY button - When the Square or Triangle waveforms are selected, the variable SYMMETRY is available. Change the waveform symmetry by using the cursor keys and rotary knob. If a certain setting cannot be produced, the waveform generator will display a warning message.



Symmetry Menu

3.6.2 MODE Key

Selects the output mode: CONT (Continuous), TRIG (Triggered) and GATE (Gated).

To select the output mode, press MODE. Each additional MODE key operation selects TRIG, GATE or CONT operating mode, Internal or External trigger source.



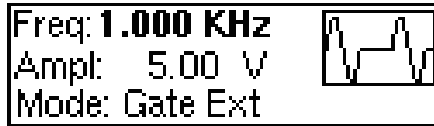
Mode Menu



Internal Trigger Menu



External Trigger Menu



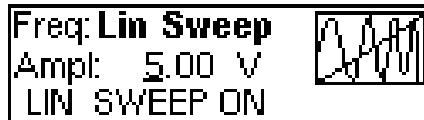
External Gate Menu

3.6.3 SWEEP Key

Selects the Sweep Mode and allows LINEAR or LOGARITHMIC sweep mode.

To select the sweep mode, press SWEEP. Each pushbutton operation selects the LIN, LOG or OFF mode.

The Sweep Start, Stop and Rate parameters are changed with the Utility key.



LIN Sweep Menu



LOG Sweep Menu

3.6.4 UTILITY Key



Utility Menu

Selects the Sweep parameters editing mode. The Sweep Start, Sweep Stop and Sweep Rate parameters are displayed and can be modified with the rotary knob.

Last parameter available on this menu is the Intensity mode.

Intensity - Change the intensity and contrast of the LCD display, for optimal viewing angle.

3.6.5 MODULATION Key

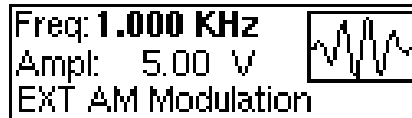
Selects the Modulation mode **AM** or **FM**.

To select the output mode, press MODUL key. Each additional operation selects the AM, FM or OFF mode:



AM Menu

The AM depth, from 0% to 100%, is changed with the rotary knob.

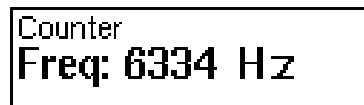


FM Menu

The FM deviation frequency is changed with the rotary knob.

3.6.6 COUNTER Key

By pressing this key, the build-in Frequency counter is enabled and the frequency of the signal connected to the TRIG IN connector is displayed. The counter is auto ranging with up to 8 digits resolution.



Counter Menu

3.7 Cursor Movement Keys

Use these keys to move the cursor (when visible) either left or right. They are used in conjunction with the rotary input knob to set the step size of the rotary input knob.

3.8 Rotary Input Knob

Use this knob to increase and decrease numeric values or to scroll through a list. The cursor indicates the low-order position of the displayed value which changes when you rotate the knob (for straight numeric entries only). For other types of data, the whole value changes when you rotate the knob.

3.9 Power-On Settings

At power-on, the waveform generator performs a diagnostic self-test procedure to check itself for errors. If it find an error, and error code and text appear in the display window. Other error codes appear when you enter and invalid front-panel setting.

When the waveform generator finishes the diagnostic self-test routine it enters the power-on default settings. Table 3-2 lists the factory default settings.

Table 3-2
Power-on Default Settings

Key Function		Comments
FREQUENCY	1000 Hz	Wave frequency
AMPLITUDE	5.00V	Peak to peak output amplitude
FUNCTION	SINE	Output waveform
OFFSET	0.00V	Zero offset
REPETITION	10ms	Internal trigger rate
MODE	CONT	Waveform mode
TRIG SOURCE	EXT	External trigger source
SWEEP	OFF	Sweep execution
MODULATION	OFF	Modulation execution