DDS Function Generator

# DFG-6000 Series

(DFG-6003/6005/6010/6020)

## DDS Function Generator User's Manual

EZ DIGITAL

# Introduction of DFG-6000 series function generator

The present guide is valid for DFG-6000 series function generator: DFG-6003, the maximum frequency of sinewave is 3MHz; DFG-6005, the maximum frequency of sinewave is 5MHz; DFG-6010, the maximum frequency of sinewave is 10MHz; DFG-6020, the maximum frequency of sinewave is 20MHz. With Direct Digital Synthesis (DDS) technology, DFG-6000 series function generators are of the high performance indexes and function characteristics which are necessary for the fast completion of measuring. The simple and clear front panel design and VFD fluorescent display interface are convenient for the users to operate and observe.

The generators are of the following advanced specifications and powerful function characteristics:

- **High frequency accuracy:** up to the level of $10^{-5}$.
- **High frequency resolution:** 40mHz frequency resolution for whole frequency range.
- **Unlimited measurement range:** without limitation for the whole range, digital setting directly.
- **Non-intergraded process:** up to the stable value immediately when switching, continuous signal phase and amplitude without deflection.
- **High waveform accuracy:** the output waveform is synthesized by the computation value of functions with higher waveform accuracy and less distortion.
- **Multi-waveform:** 16 types of waveforms can be output.
- **Square characteristics**: Accurate square duty cycle can be set.
- **Ramp characteristics:** May set accurate ramp symmetry
- **Frequency sweeping:** Be of the function of frequency sweeping, start point and end point can be set arbitrarily.
- **Computation function:** Frequency or period, amplitude virtual value or peak-peak value can be selected.
- **Operation mode:** Keyboard operation, fluorescent display screen, direct digital setting or continuous adjusting by knobs.
- **High reliability:** Large scale integrated circuit, surface-mount technology, high reliability and long service life

- **Programmable interface:** Equipped with USB device interface.

### DFG-6000 series function generators and accessories (package list)

- DFG-60xx function generator 1
- 3-core power supply 1
- Testing cable 1
- CD(user's guide, interface demonstration) 1

# Summary of this Guide

## Chapter 1 Getting started

To learn the basic operation of the generator.

## Chapter 2 Principle introduction

To describe the basic working principle of the generator.

## Chapter 3 Reference

To introduce the functions, operations and applications of the generator.

## Chapter 4 Service and support

To promise warranty and technological support of the generator.

## Chapter 5 Specification

To list the function characteristics and specifications of the generator.

**Note:** This document is just a guide of operation of this instrument, it is unavoidable for not-so-adequate description of technology and wrong printing, please excuse any modification of the contents without special notification.

# Content

# Chapter 1 Getting started

The front and rear panels, operations and functions of the DFG-6000 series function generator are described in this chapter so as to help users to master the basic operation as quickly as possible.

## 1.1 Preparing the generator for use

### 1.1.1 Check the generator and the accessories

Check the completeness of the generator and its accessories based on the package list. If the packing box is damaged badly, please keep it till the generator passes the performance test.

### 1.1.2 Connect to power supply

Boot the generator only under the following conditions.

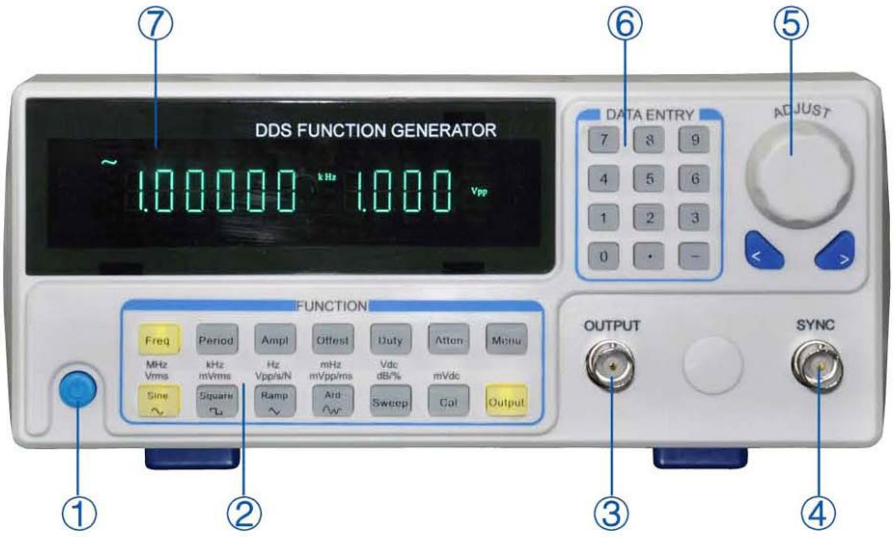
Voltage: AC 100 to 240V Frequency: 45 to 65Hz

Power consumption: ＜30VA Temperature: 0 to 40℃ Humidity: ＜80％

Plug the attaching plug into an AC100~240V outlet with grounding conductor, press the mains switch on the panel in to turn on the generator. The generator now is initializing itself and obtaining the default parameters, outputting sine waveform under continuous working state, with frequency and amplitude of the signal displayed.

**Warning: In order to ensure the security of the operator, use triple- core socket outlet with grounding conductor.**

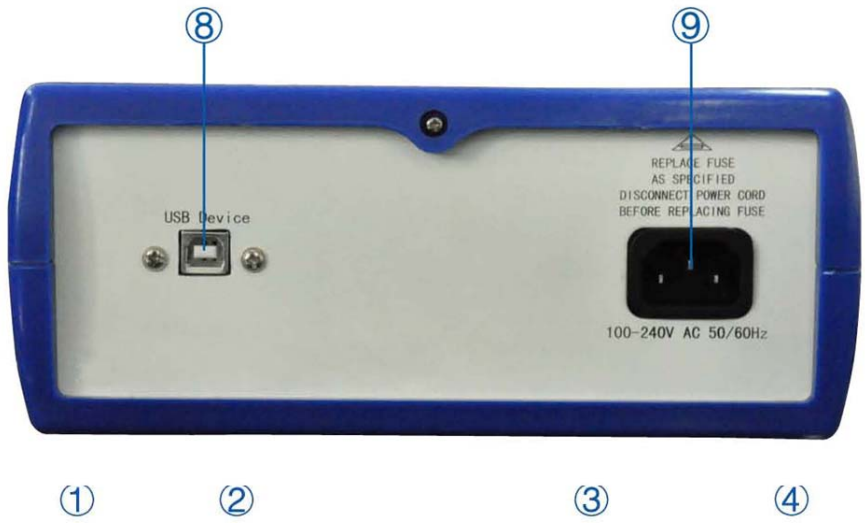
## 1.2 Front panel




1. Power 2. Function keys 3. Waveform output 4. Sync output

5. Adjusting knob 6. Numeric keys 7. Display screen

## 1.3 Rear panel




8.USB device interface 9. Power outlet

## 1.4 Display introduction

The display screen display two groups of digits, the group on the left with 6 digits shows frequency, period, attenuation, duty cycle and so on of the

signals. And the four digits on the right show amplitude, offset and so on of the signals. There are also letter and letter indicator lights on the display screen, to indicate present waveform signal, parameter options and also units of parameters.

## 1.5 Keyboard introduction

There are totally 28 keys on the front panel (see front panel picture), the functions of which respectively are:

【0】【1】【2】【3】【4】【5】【6】【7】【8】【9】keys: Digits inputting key.

【.】key: Point inputting key.

【-】key: Minus inputting key, press this key to input minus under "**offset"** option. Press this key to enable or disable the key-tone circularly under other options.

【＜】key: Move the cursor left; delete the input when inputting digits.

【＞】key: Move the cursor right.

【Freq】key：select frequency; disable calibration process when calibrating.

【Period】【Ampl】【Offset】keys: set respectively period, amplitude and offset.

【Duty】key: select duty cycle of square and symmetry of ramp.

【Atten】key: select amplitude attenuation.

【Output】key: open and close output signal circularly.

【Sine】【Square】【Ramp】keys: select respectively sinewave, square and ramp three common waveforms.

【Arb】key: select 13 kinds of waveforms besides three common ones with the waveforms sequence number.

【Sweep】key: enter and exit frequency sweeping function.

【Cal】key: select parameter calibration function.

Unit key: The six keys with unit characters above them on the bottom of the instrument are not shift keys, but double-function keys, press these keys directly to execute the functions marked on themselves; when inputting digits with numeric keys, press these six keys to select the unit of the inputting and

end the digits inputting at the same time.

【Menu】key: key for menu, select different options circularly under different functions, see below list：

### Options list of menu

| Function | Option |
|---|---|
| Continuous | Phase and version of waveform |
| Frequency sweeping | Start frequency, end frequency, sweep time, sweep mode |
| Calibration | Calibration value: zero, offset, amplitude, frequency, amplitude flatness |

## 1.6 Basic operation

Below are some samples to describe the basic operation of the generator, for more complex usage and problems, please refer to the details in chapter 3.

**1.6.1 Continuous function:** continuous function is default after booting, and the instrument outputs signal with continuous signal.

**Frequency setting:** Set the frequency value at 3.5 kHz

【Freq】【3】【.】【5】【kHz】.

**Frequency adjusting:** Press【＜】or【＞】key to move the cursor, switch the adjusting knob left or right to decrease or increase the digit on the cursor position, borrowing from or carry to the former digit continuously. Move the cursor left to do rough adjusting, and right to do fine adjusting. The adjusting knob is applicable for adjusting digits of other options too, which will not be described any more.

**Period setting:** set the period as 2.5ms

【Period】【2】【.】【5】【ms】。

**Amplitude setting:** set the amplitude as 1.5Vpp

【Ampl】【1】【.】【5】【Vpp】。

**Attenuation setting:** set the attenuation as 0dB（Auto attenuation is default after booting）

【Atten】【0】【dB】。

**Offset setting:** set DC offset as -1Vdc

【Offset】【-】【1】【Vdc】。

**Common waveform selection:** select square（sine wave is default after booting）

【Square】。

**Duty cycle setting:** set the duty cycle of square as 20%

【Duty】【2】【0】【%】。

**Other waveforms selection:** Select exponent waveform (sequence number 12, see sequence number list of 16 kinds of waveforms)

【Arb】【1】【2】【N】

Below content shows the frequency sweeping function, in order to observe and measure, users may set the continuous signal as sinewave, with amplitude of 1Vpp，and offset of 0Vdc。

**1.6.2 Frequency sweeping function:**

Press【**Sweep**】key to output frequency sweeping signal.

**Start frequency setting:** Set the start frequency at 5kHz

Press【Menu】key to light the "**Start**" letter, press【5】【kHz】.

**End frequency setting:** Set the end frequency at 2kHz

Press【Menu】key to light the "Stop" letter, press【2】【kHz】.

**Sweeping time setting:** Set the sweeping time at 5s

Press【Menu】key to light the "**Time**" letter, press【5】【s】.

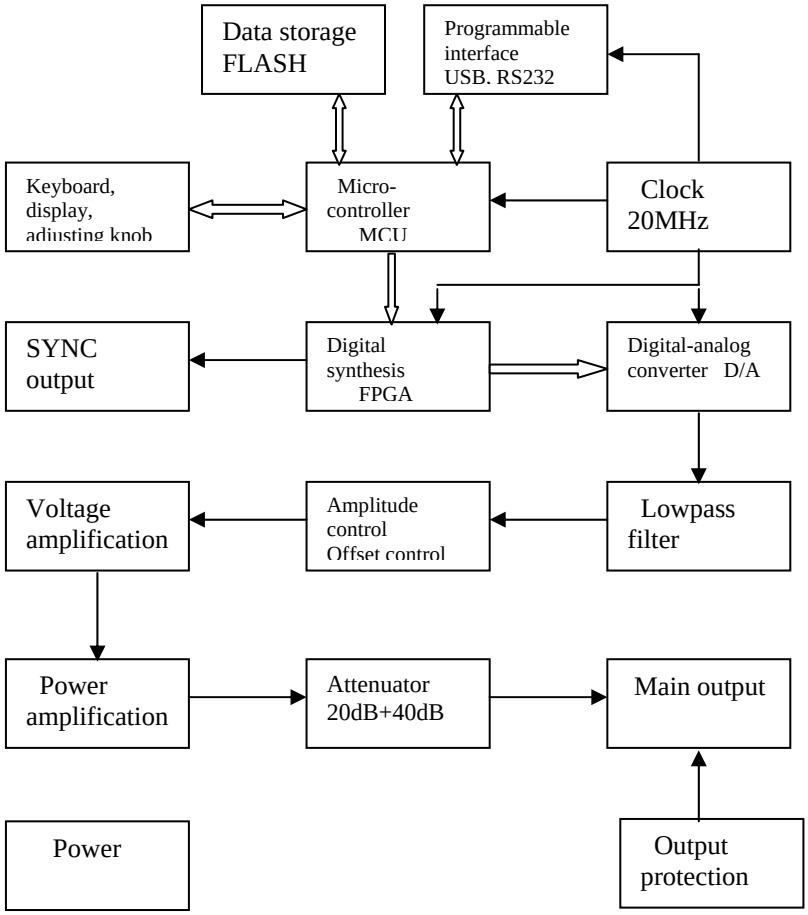
**Sweeping mode setting**：set logarithm sweeping mode

Press【Menu】key, press【1】【N】.

# Chapter 2 Principle introduction

This chapter describes the basic concept of signal shaping and internal operation of the generator, to help users to learn more about the performance and specifications, then operate the generator more smoothly.

## 2.1 Principle diagram of generator



## 2.2 DDS working principle

To generate a voltage signal, traditional analog function generator adopt electronic components to consist oscillator by many different means, the signals generated are of poor frequency accuracy and stability, low resolution, inconvenient to set frequency and programmed with computer, but request complex techniques. Direct Digital Synthesis (DDS) technology is an up-to-date technique to generates signals, it need no oscillator but digital synthesis technique to generate series of data-current which convert to analog signals through digital-analog converter.

To generate a sine signal, for example, the function of y＝sinx should be digitally quantized first, and then taking x as the address and y as the quantized data to store them into waveform memorizer. DDS uses phase adding technique to control the address of waveform memorizer. Add a phase increment on the present result of phase accumulator in each sampling clock period so as to change the output frequency value by change phase increment. According to the address from the phase accumulator, take the quantized data out from the wave memorizer and then convert it into analog voltage via digit-analog converter and operation amplifier. Since the waveform data are discontinuous sampling, stair sine waveform is output from DDS generator. The included high-level harmonic wave should be filtered by lowpass filter so to output a continuous sine wave. With high accurate reference voltage source in digit-analog converter, the output waveform is if high amplitude accuracy and stability.

Amplitude controller is a multiplication digital-analog converter, analog signal that has been filtered is the voltage standard of the digital-analog converter, this standard multiplies amplitude value inputting with the numeric key to make output signal frequency be equal to this inputting value. Offset controller is also a multiplication digital-analog converter, a high-accuracy DC voltage standard of which multiplies offset value inputting with the numeric key to make the output signal offset be equal to this inputting value. The synthesized signal from amplitude and offset controllers is amplified by the power amplifier and voltage amplifier then output from output port.

## 2.3 Control working principle

Micro-controller controls the keyboard and display parts with interface circuit, when a key is pressed, the micro-controller recognizes the code of pressed key and executes corresponding command program of this key. The display circuit will work to display the instrument's working state and each parameter.

Switch the adjusting knob on the panel to change the digit on the cursor position, generating a trigger pulse every 15°rotation. The microprocessor could judge the rotation is left or right, if it is left, the number in the position of cursor will be subtracted by 1; if it is right, the number in the position of cursor will be added by 1 with continuous carry or borrow.

# Chapter 3 Reference

## 3.1 Data input

**3.1.1 Input with the numeric keys** Select an option and input with the numeric keys the parameters of this option. The ten digit keys are of the function of inputting data from left to right one by one. Point is allowed in this data, but only the first one is valid when more than one points inputted. Under "offset" function, minus may be input. The digit keys input digit to the display area which do not work yet and could be deleted by pressing 【＜】, or select this option again , to input right one if it is a wrong input, but these must happen before pressing an unit key. End the digits input and make them valid by pressing an unit key.

For any input by pressing the point key and the units, the generator will display this input in its own certain form. Such as, the generator displays 1.50000 kHz for both of input of 1.5 kHz and 1500 Hz.

**3.1.2 Adjust with the adjusting knob** In actual operations, users may use the adjusting knob to continuously adjust the signal. Press 【＜】or 【＞】to move the cursor left or right. Rotate the adjusting knob on the front panel right to add the digit on the cursor position by 1, it can do a carry to the former; rotate the adjusting knob left to subtract the digit on the cursor position by 1, it can borrow digit from the former. The digit adjusted by the adjusting knob works immediately and no need to press unit key. Move the cursor to the left to do rough adjusting by the knob, and to the right to do fine adjusting.

**3.1.3 Selection of the inputting means** For known data, it is the most convenient to use numeric keys to input as it can be gotten easily without the generating of transient data no matter how big the change of the data is, which is so important in some operations. For the modifying of the entered data or for entering sequence data to observe, it will be more convenient to use the adjusting knob. So user should select flexibly according to the different applications.

## 3.2 Continuous function

After booting, the generator takes continuous function as its default function, continuous function means the output signal is steady and continuous, of which the waveform, frequency, amplitude and phase do not change along with time.

**3.2.1 Frequency setting** Press【**Freq**】key, the light of which will be on, to display present frequency value. Input frequency value with numeric keys or adjusting knob and the signals of this frequency will be output from the output port.

**3.2.2 Period setting** Press【**Period**】key, the light of which will be on, to display present period value, input period value with numeric keys or adjusting knob. Frequency is synthesized in the internal of the generator, and converted to period when inputting and displaying. Limited by the frequency low resolution, for a comparatively long period, the generator could only output some frequency points with long period interval. Although the setting and displaying period value are accurate, the period of actual output signal may be comparatively different from them, which should be under consideration during operations.

**3.2.3 Amplitude setting** Press【**Ampl**】key, the light of which will be on, to display present amplitude value, input amplitude value with numeric keys or adjusting knob and the signals of this amplitude will be output from the output port.

The relation between maximum amplitude and offset value should be below formula, if the setting of amplitude exceeds specification, the generator will modify it until it is within the range of allowed maximum amplitude value.

$$Vpp \leq 2\times (10-|offset|)$$

**3.2.4 Amplitude value form** There are two forms for amplitude input and display: peak-peak form and RMS form. Press 【**Vpp**】or【**mVpp**】to input amplitude peak-peak value after inputting the digits, press【**Vrms**】or【**mVrms**】to input amplitude RMS value. RMS value is applicable only to sinewave, square wave and ramp wave, and other waveforms could only be shown by amplitude peak-peak value.

**3.2.5 Amplitude attenuation setting** Press【**Atten**】key, the light of "***Atten***" will be on and show the present attenuation value. Amplitude

attenuation is auto as default of booting and there display "***Auto***", the generator will select automatically proper attenuation proportion according to the amplitude setting value, higher amplitude resolution, higher signal-noise ratio and less waveform distortion could be realized at the same time regardless of the amplitude magnitude of the signal. The output signal makes a momentary hop when the attenuation changes, which is not welcome in some operations, but the generator has fixed attenuation function to avoid this circumstance. Input attenuation values of 0dB，20dB，40dB and 60dB with the numeric keys, input 80dB to select auto attenuation. Users may use the adjusting knob as well, the attenuation changes to next one for every step of the rotation. When select fixed attenuation mode, the attenuation is fixed while the signal amplitude changes, and the output signal could changes continuously within the whole amplitude range. But higher distortion of the waveform and poor signal-noise ratio maybe appear when the attenuation is 0dB and the amplitude of the signal is small.

**3.2.6 Output load** The setting value of amplitude is calibrated when the output end is open. The real voltage of output load is the setting value of amplitude multiplied by the assignment ratio of load impedance（including inductance and condensance）and output impedance. The output impedance of the generator is fixed at 50Ω. When the load impedance is high enough, the assignment ratio approaches to 1. The voltage loss of output impedance can be neglected. The real voltage approaches to the setting value of amplitude. But when the load impedance is lower, the voltage loss of output impedance cannot be neglected. It should be paid more attention that the real voltage does not accord with the setting value of amplitude.

With 50Ω output resistance, a momentary short-circuit of the output port makes no damage to the generator, but the users should try to avoid long time short-circuit under high voltage output as a danger of making damage to the generator. The generator has function of opposite voltage protection, with which the generator close output automatically, make an alarm with the output indicating light off when carelessly connect a high voltage(less than 30V) to the output port. Open the output by pressing 【**Output**】key only after the fault cleared.

**3.2.7 Offset setting** Press【**Offset**】key, the light of which will be on, to display present offset value. Input offset value with the numeric keys or adjusting knob for the output signal to generate this DC offset.

The relationship between the maximum DC offset and amplitude value should be below formula, if the setting of offset exceeds, the generator will modify it until it is within the limit of the maximum offset value.

$$|offset| \leq 10 - Vpp \div 2$$

When it comes to adjust the DC offset of the output signals, it is more convenient to use the adjusting knob than the numeric keys. As usual, taking no account of the sign of the present DC offset, right rotation makes the DC level up, while left rotation makes it down, the sign of the DC offset value changes automatically when passing the zero point.

**3.2.8 DC voltage output** Set amplitude at 0V, the offset value could be set arbitrarily within ±10V range, the generator is now a DC voltage power supply and outputs specified DC voltage signal.

**3.2.9 Output waveform selection** The generator could output 16 kinds of waveforms. Press 【**Sine**】【**Square**】【**Ramp**】keys directly to select these three kinds of common waveforms, the corresponding waveform character light will be on. The character of other waveform is "***Arb***". Users may select all 16 kinds of waveforms with waveform sequence number, press 【**Arb**】, then press numeric keys or adjust the knob to input waveform sequence number and select waveform specified by the sequence number.

## Waveform sequence numbers list

| Sequence No. | Waveform | Sequence No. | Waveform |
|---|---|---|---|
| 00 | Sine | 08 | Limit sine |
| 01 | Square | 09 | Exponent |
| 02 | Ramp | 10 | Logarithm |
| 03 | Pos-pulse | 11 | Tangent |
| 04 | Neg-pulse | 12 | Sin(x)/x |
| 05 | Stair | 13 | Half round |
| 06 | Noise | 14 | Cardiac |
| 07 | Half sine | 15 | Quake |

**3.2.10 Duty cycle setting** When the present selection of waveform is square or ramp(including pos-pulse and neg-pulse) or ramp), users may press **【Duty】** key to display present duty cycle value, input duty cycle value with numeric keys or adjusting knob, then the output will be square or ramp with a fixed duty cycle value. The definition of square duty cycle is the ratio of high level time of one square to the period of this square. The usual thought of square duty cycle is 50%, waveforms with other duty cycle are usually named pulse. The definition of ramp duty cycle is the ratio of rising time of one ramp to the period of this ramp. The ramp duty cycle is also named ramp symmetry, ramp with 100% symmetry is named rising ramp, ramp with 0% is named as falling ramp, and ramp with symmetry of 50% is named triangle wave.

When the frequency of square is comparatively high, the setting of duty cycle is limited by the edge time, in a relationship as below formula:

Duty cycle× Period≥2× Edge time or

Duty cycle ×Period≤ Period－（2× Edge time）

**3.2.11 Output phase setting**

Under continuous function, press 【Menu】 to display output phase value, set phase value with numeric keys or adjusting knob, there are only two values, 0 and 1, for phase setting. When setting the phase as 0, the phase of signal from 《OUTPUT》 port is the same with the one of signal from《SYNC》port, while when setting the

phase as 1, the two are opposite.

### 3.2.12 Software version number

Under continuous function, press【**Menu**】to show the software version number：xxxx.xx of the generator, which is helpful for maintain and could not be set or changed.

## 3.3 Frequency sweeping function

In frequency sweep, the output frequency changes from the start frequency point to the end frequency point according to the setting sweep time. Users may sweep within the whole frequency range. During this process, the phase of output signals is continuous. All the 16 kinds of waveform could be swept, of course it makes no sense to sweep DC or noise. Linearity frequency sweeping is similar with ramp frequency modulation, with the difference of, frequency sweeping does not use modulation waveform, but continuously output a series of discrete frequency points according to certain time interval.

Press【**Sweep**】key, the light of it will be lighted and the generator enters frequency sweeping function.

**3.3.1 Start and end frequency** Press【**Menu**】key to light "***Start***" letter and then set start frequency point. Press【**Menu**】key to light "***Stop***" letter and then set end frequency point. If the end frequency value is more than the start frequency value, the sweep is positive from lower frequency to higher frequency, increasing step by step from the start frequency to the end frequency and then return to the start frequency. If end frequency value is less than the start frequency value, the sweep is opposite from higher frequency to lower frequency, decreasing step by step from the start frequency to the end frequency and then return to the start frequency.

**3.3.2 Sweeping time** Press【**Menu**】key to light "***Time***" letter and then set sweep time value. Sweep time means the time of sweeping from the start frequency point to the end frequency point. The sweep time of every frequency point is the same, so the longer the sweep time is, the more frequency points are swept, the less the step of the frequency point is, and

the finer the sweep is. The shorter of the sweep time is, the less frequency points are swept, the more the step of the frequency point is, and the rougher the sweep is.

**3.3.3 Sweeping mode** Press【**Menu**】key to set sweeping mode. Set the value as 0, the character "***linear***" will be lighted, and the sweeping mode now is linearity. Set the value as 1, the character "***log***" will be lighted, to select logarithm mode.

Under linearity sweeping mode, the frequency step is fixed, but a fixed frequency step always does a bad effect when sweeping comparatively wide-range frequency. In that case, the resolution is high when sweeping high end of frequency, the frequency changes slowly, and the sweeping is fine. But the resolution is low when sweeping the low end of frequency, the frequency changes very quickly, the sweeping is rough. So linearity sweeping is applicable only for sweeping with narrow frequency range.

Under logarithm sweeping mode, the frequency step value is not fixed but changes according to logarithm relation. When sweeping the high end of frequency, the frequency step value is comparatively large; when sweeping the low end of frequency, the frequency step value is comparatively small. The frequency change is comparatively average for sweeping with wide frequency range. So logarithm sweeping is applicable for sweeping with wide frequency range.

**3.3.4 Sync output** During frequency sweeping, the "***Sync***" port on the front panel output a sync signal. A sync signal is a pulse wave signal with TTL level, of which the rising edge of the pulse is match along with the start point of the sweeping, and the falling edge is match along with the middle point of the sweeping area, the period of the pulse wave is the same with sweeping time.

Under sweeping function, press【**Sweep**】key(the "***Sweep***" key-light will be off) to exit frequency sweeping function and return back to continuous function.

## 3.4 Output port

There are two output ports on the front panel of the instrument, users must not input signal to the output port as a possibility of damaging the instrument.

**3.4.1 Signal output port《Output》：** the signals that the instrument generates are all output from the signal output port, press **【Output】** key to open or close the signal from the output port circularly. The output port is open when the "***Output***"light is on, and close when the "***Output***" is off。If wrongly connect external high voltage to signal output port, instrument will suffer "inverse filling" danger, and then instrument will turn on the protection function, close immediately signal output port and make an alarm with the "***Output***"light off. In this case, you must check external load, only after eliminating the failure can press **【output】** key to open signal output port.

**3.4.2 Sync output port《Sync》：** output pulse wave compatible with TTL and CMOS, high level＞4V，low level ＜0.3V.

A. Under continuous function, sync signal is a square signal with TTL level, the frequency of sync signal is the same as the frequency of the signal from《Output》port, when the phase is set to be 0, the phase of sync signal is the same as the phase of the signal from the 《Output》port. When the phase is set to be 1, the phase of sync signal is the opposite of the phase of the signal from the 《Output》port.

B. Under frequency sweep function, the sync signal is a pulse signal with TTL level，the rising edge of the pulse wave match along with the start point of the sweep, and the falling edge of the pulse wave match along with the middle point of sweep range, the period of pulse wave is the same as sweep time.

## 3.5 Programmable interface

There is an USB device interface 《**USB Device**》on the rear panel of the instrument, through which the instrument could be programme-controlled by connecting to computer with an USB cable，the use method of this interface is described in detail in the CD that attached with the instrument.

## 3.6 Parameter calibration

The instrument is calibrated before shipment, but some specifications may change a bit lot during long time of use. To ensure the accuracy, the instrument should be calibrated termly. Users may regain the accuracy of the instrument by operating the keyboard to calibrate the main specifications without removing the cover of the instrument.

**3.6.1 Enable calibration** After booting, the calibration is in off state, and the generator could not be calibrated without inputting calibration password, this is a way to protect calibrated parameters which may be changed carelessly. To enable calibration, select sine wave and then press【**Cal**】key, the calibration password displayed as 0, input calibration password 1900, press【**N**】key to enable calibration.

**3.6.2 Parameters calibration** Press【**Menu**】key to display calibration value on the left, and calibration sequence number on the right when setting calibration conditions automatically. Adjust calibration value to calibrate present selected calibration option and make the output expected. Continue to press 【**Menu**】key and the calibration sequence number will increase step by step, users could calibrate all those options respectively, which is shown in the following list. During calibration process, press【**Cal**】key at any time then press【**Menu**】key to return the calibration sequence number to 00.

**Parameter calibration table**

| Sequence No. | Default calibration value | Output nominal value | Adjust the calibration value till the output is within the error range |
|---|---|---|---|
| 00 | 2047 | 0Vdc | Zero calibration：output DC voltage －20～20mVdc |
| 01 | 870 | 10Vdc | Offset calibration：output DC voltage 9.88～10.12Vdc |
| 02 | 873 | 7Vrms | Amplitude calibration：output AC voltage 6.928～7.072Vrms |
| 03 | 300 | 0.71Vrms | Amplitude calibration：output AC voltage 0.701～0.719Vrms |
| 04 | 500 | 1MHz | Frequency calibration：output frequency 1MHz±20Hz |
| 05～** | 100 | 5Vpp | Flatness calibration：output amplitude 4.5Vpp～5.5Vpp |

** The sequence No. of DFG-6003 is 05~07, DFG-6005 is 05～09, DFG-6010 is 05～14, DFG-6020 is 05～24.

**3.6.3 Disable calibration** After finishing the calibration, press【**Cal**】key and there display ***1900***, press any numeric keys then【**N**】key to store the calibration parameters. If wrong calibration occurred, press 【**Freq**】key to disable calibration and exit without storing calibration parameters. After rebooting, the generator automatically recalls and uses the calibration parameters stored during last calibration.

## 3.7 Default setting

### 3.7.1 Continuous function: continuous function is default after booting.

Waveform: sinewave Frequency: 1kHz Amplitude: 1Vpp

Attenuation: auto Offset: 0Vdc Duty cycle: 50%

Output phase: 0° Output port: open

### 3.7.2 Frequency sweeping function

Start frequency: 100H End frequency: 1kHz Sweep time: 3s

Sweep mode: linearity

# Chapter 4 Maintenance

Fuse replacement
Adjust and calibration
Cleaning and decontamination

***CAUTION***

***IT IS ESSENTIAL FOR SAFETY TO PROPERLY MAINTAIN AND SERVICE THIS INSTRUMENT***

***WARNING***

***VOLTAGES WITHNIN THIS INSTRUMENT ARE SUFFICIENTLY HIGH TO ENDANGER LIFE. COVERS MUST NOT BE REMOVED EXCEPT BY PERSONS QUALIFIED AND AUTHORIZED TO DO SO AND THESE PERSONS SHOULD ALWAYS TAKE EXTREAME CARE ONCE THE COVERS HAVE BEEN REMOVED***

## 4.1 Fuse replacement

Disconnect and remove all connection from any live power source.
Unscrew fuse holder by screw driver.
Locate the defective fuse and remove it by gentling pulling-out
Install a new fuse of the SAME SIZE AND RATING
Screwing fuse holder

***CAUTION***

***MAKE SURE THAT THE RATED AND SPECIFIED FUSE ARE USED FOR REPLACEMENT***

## 4.2 Adjustment and calibration

It's recommendable to regularly adjust and calibrate this instrument.
Qualified and authorized personnel only should execute performance and procedure.

## 4.3 Cleaning and decontamination

The instrument can be cleaned with a soft cloth to remove any oil, grease or grime. Never use liquid solvents or detergents. If the instrument gets wet for any reason, dry the instrument using low pressure cleans where water or air could enter into the instrument while drying.

# Chapter 5 Specifications (see note 1)

## 5.1 Output characteristics

### 5.1.1 Waveform characteristics

- Waveform types: 16 kinds of waveforms including sine, square, ramp, exponent, logarithm, noise and so on. Waveform length: 1024 points
- Sampling rate: 100 MSa/s
- Waveform amplitude resolution: 8 bits
- Sinewave harmonic distortion: (1Vpp)

  ≤－40dBc（＜5MHz） ≤－35dBc（≥5MHz）
- Sinewave total distortion:(20Hz to 20kHz, 20Vpp) ≤1％
- Rising/Falling edge time of square: ≤35ns Overshoot: ≤ 10 ％
- Duty cycle of square: 0.1％～99.9％(limited by edge time)
- Ramp wave symmetry: 0.0％～100.0％

### 5.1.2 Frequency characteristics

- Frequency range:

  Sinewave: 40mHz to 20MHz (see note 2) Square: 40mHz～5MHz

  Others: 40mHz to 1MHz
- Frequency resolution: 40mHz
- Frequency accuracy: ±($2\times10^{-5}$+ 40mHz)

### 5.1.3 Amplitude characteristics(Auto-attenuation, offset 0Vdc)

- Amplitude range: frequency≤8MHz： 0～10Vpp(50Ωload)

  0～20Vpp(open-circuit load)

  frequency＞8MHz：0～9Vpp(50Ωload)

  0～18Vpp(open-circuit load)
- Amplitude resolution: 5mVpp(Amplitude＞2Vpp); 0.5mVpp(Amplitude≤2Vpp)
- Amplitude accuracy(1kHz,＞5mVrms): ±(1％ of setting＋2mVrms)
- Amplitude flatness(Sinewave, compared to 1MHz, 5Vpp): ±10％
- Output impedance: 50Ω

#### 5.1.4 Offset characteristics (0Vpp amplitude)

- Offset range: ±5Vdc(50Ωload) ±10Vdc(open-circuit load)
- Resolution: 5mVdc
- Offset accuracy: ±(1% of setting value＋20mVdc)

#### 5.1.5 Frequency sweeping characteristics

- Sweeping range: Start and end frequency can be set arbitrarily.
- Sweeping time: 50ms to 500s
- Sweeping mode: linearity, logarithm

## 5.2 Sync output characteristics

**5.2.1 Waveform characteristics:** Square, edge time≤20nS

**5.2.2 Amplitude characteristics:** TTL, CMOS compatible,

low level＜0.3V, high level＞4V

## 5.3 Programmable interface

USB device interface, of which the operation guide is in the CD attached with the generator.

## 5.4 General characteristics

#### 5.4.1 Power condition

- Voltage: AC 100 to 240V
- Frequency: 45 to 65Hz
- Power consumption: ≤20VA

#### 5.4.2 Environment conditions

- Temperature: 0 to 40℃
- Humidity: ≤80%

#### 5.4.3 Operation characteristics

Fully key operation, continuously adjust with adjusting knob.

**5.4.4 Display** VFD fluorescence display screen

**5.4.5 Dimension** 313 mm×256 mm×102 mm Weight: 2 kg

### 5.4.6 Technique

Surface-mount technology, large scale integrated circuit & high reliability.

**Note 1:** The test of the specifications should be done around temperature of 18℃ to 28℃, after 30 minutes of booting.

**Note 2**: Sinewave frequency range of DFG-6003: 40mHz to 3MHz

Sinewave frequency range of DFG-6005: 40mHz to 5MHz

Sinewave frequency range of DFG-6010: 40mHz to 10MHz

Sinewave frequency range of DFG-6020: 40mHz to 20MHz

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