User's Guide

TFG 3600 Series

Synthesized Signal Generators

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Introduction

With Direct Digital Synthesis technique (DDS) and PLL technique, large scale of integrated circuit (FPGA) and System On Programmable Chip technique (SOPC), TFG3600 series synthesized signal generators are of the excellent technical performances and powerful function which are necessary for the fast measurement. TFT-LCD interface can show the illustration of output waveform and parameters. Keypads and knob are convenient for operation. The introduction of characteristics is following:

- **Double channels:** two independent channels
- **High frequency accuracy:** up to 10^{-6}.
- **High frequency resolution:** 1μHz (9 digits)
- **Unlimited measurement range:** digital setting directly for the whole range.
- **Non-intergraded process:** up to the stable value immediately when switching, continuous signal phase and amplitude without deflection.
- **High waveform accuracy:** the output waveform consists of the computation value of functions with higher waveform accuracy and less distortion.
- **Multi-waveform:** 4 basic function waveforms and 4 fixed arbitrary waveforms
- **Pulse characteristics**: accurate pulse width can be output.
- **Sweep characteristics:** with the function of frequency sweep. Start point and stop point can be set arbitrarily.

- **Modulation characteristics:** FM, AM, PSK and FSK modulation signal can be output.
- **Burst characteristics:** the signal of burst count can be output with set quantity.
- **Frequency Counter:** 8digits/s, the upper limit range of measured frequency can be reach to 2.5GHz.(option, only for TFG3605)
- **Storage characteristics:** 4 groups of working state can be stored and recalled at any time.
- **Math function:** frequency, period, amplitude peak-to-peak, virtual value and power level can be used.
- **Operation mode:** key operation, TFT-LCD interface, direct digital setting, continuous adjustment by knob.
- **High reliability:** large scale integrated circuit, SMT, high reliability and long service life.
- **Communication port:** USB device and RS232.

Synthesized Signal Generators and Accessories (Packing List)

- ◆ TFG36××Synthesized Signal Generator 1
- ◆ Power cord 1
- ◆ BNC testing cable 1
- ◆ CD 1

Table of Contents

Chapter 1 Quick Start

If this is your first time to use the generator or you have no time to read the guide carefully, you only need to master the simple method of using and quickly output continuous standard waveform signal through chapter 1. If you need more complicated functions, please refer to chapter 2 "basic operation". And if you have difficulties in using, please go on to chapter 3 "advanced application".

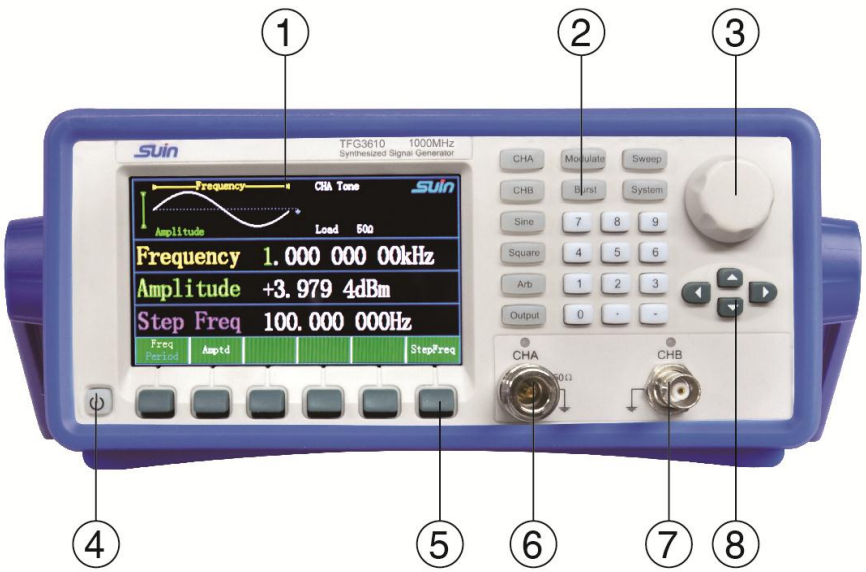
1.1 To prepare for use

1.1.1 Check the list of supplied items

Please check the instrument along with following parts. If you find package damaged badly, leave it until the instrument passes performance test. If any missing, please contact the seller.

1.1.2 Front /Rear panel

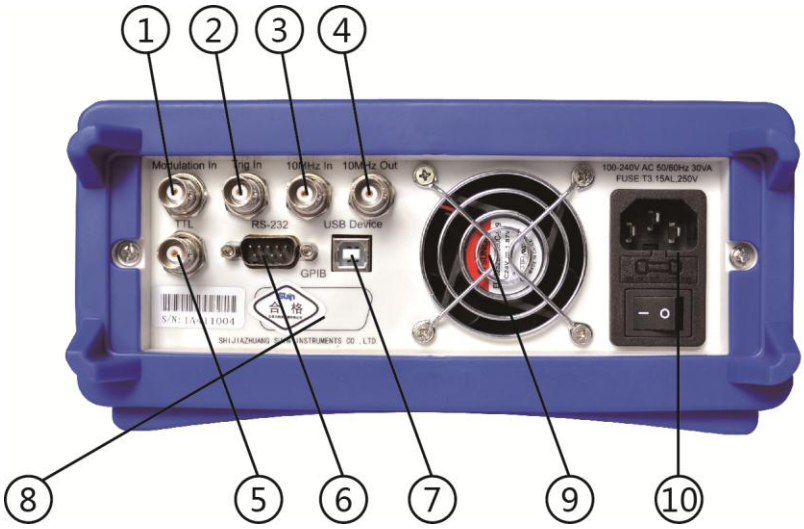
The front panel at a glance



1. Display screen
2. Function keys
3. Digital adjusting knob
4. Power
5. Unit keys
6. CHA output
7. CHB output
8. Direction keys

Keyboard description: there are 22 named keys on the panel with certain definition, which are embraced with【 】. There are 6 blank keys named optional softkeys at the bottom, whose definitions varies with different use, embraced with〖 〗. There are 4 arrow keys under the knob indicated with【↑】, 【↓】, 【←】 and 【→】. 12 of instrument keys with LED, which lighted indicates current function, waveforms and output status.

The rear panel at a glance



1. External modulation input

2. External Trigger In

3. External clock in

4. Internal clock out

5. TTL

6. RS232 interface

7. USB device

8. GPIB interface (option)

9. Fan

10. Power outlet

1.1.3 Working condition and Storage

WARNIG: To prevent electrical shock, connect the power cord to a properly grounded power source.

Working condition

Make sure of the following conditions before operation.

Power: AC 100V-240V 50(1±5%) Hz

Temperature: -20℃～60℃ Humidity: ≤80％RH

Do not operate in an explosive atmosphere.

To avoid damage to instrument or personal injuries, never operate instrument in an explosive environment.

Keep instrument surface clean and dry.

To avoid dust or moisture from affecting the performance of instrument, keep the surface of instrument clean and dry.

Prevent Electrostatic Impact.

Operate the instrument in an electrostatic discharge protective environment to avoid damage induced by static discharges. Always ground both the internal and external conductors of cables to release static before making connections.

Do Not Operate in Wet Conditions.

To avoid short circuit inside the instrument or electric shock, never operate the instrument in a humid environment.

Insert the power plug into the protective earth lead of the power cord.

Press the On/Off button in front panel to connect the instrument from power source. All the indicating lamp lights, then lights out, initialization begins. Instrument and manufacturer names are displayed

first, and then recall all the power-on parameters to normal working status. CHA output sine wave with frequency 1 kHz, amplitude +3.9794 dBm. CHB output sine wave with frequency 1 kHz, amplitude 1 Vpp and offset 0 Vdc.

Storage Conditions

If the instrument not be used for a long time, please store it in a ventilated and dry place. Do not store or leave the instrument where it may be exposed to direct sunlight for long periods of time. Make sure of the following storage conditions,

Temperature:-40℃～60℃ Relative Humidity≤80％

Cleaning

Clean the instrument regularly according to its operating conditions.

1. Disconnect the instrument from all power sources.

2. Clean the external surfaces of the instrument with a soft cloth dampened with mild detergent or water. When cleaning the LCD, take care to avoid scarifying it.

1.2 The method of data input

Input data before setting working parameters. There are two methods of input:

1.2.1 Keypad input: Use numeric keys, decimal key and negative key to input data. If input wrong, press【←】key to delete it by backspace. To make the input data come into effect you must end with unit key. Using numeric keys can make parameter settings successful by one-step.

1.2.2 Knob input: Use 【←】and 【→】keys to move green numeric

cursor. Turn knob right to adjust the cursor digit increase 1 continuously or turn left to adjust the cursor digit decrease 1. Data come into effect the instant digit changes without need for pressing unit key. Using knob can adjust the parameter continuously and make a coarse or sharp adjustment with cursor shift keys.

1.3 To set the output frequency

If you want to change the frequency to 2.5 kHz, follow the steps:

1.3.1 Press〖Freq〗softkey to select "frequency" option, which displays green with value **1.000 000 00 kHz**.

1.3.2 Press the numeric keys【2】, 【•】 and【5】, displaying **2.5**.

1.3.3 Press the〖kHz〗softkey, displaying **2.500 000 00 kHz**.

The moment you press the unit softkeys, generator changes the frequency of output waveform with the new setting.

1.3.4 You can also change the frequency continuously by knob or arrow keys【←】 and 【→】.

1.3.5 Press the〖Freq〗softkey to select the "period" and set it.

1.4 To set the output amplitude

If you want to change the amplitude to 3dBm, follow the steps:

1.4.1 Press the〖Amptd〗softkey to select "amplitude" option, which displays green with default value **+3.9794 dBm**.

1.4.2 Press the numeric key【3】, displaying **3**.

1.4.3 Press the〖dBm〗softkey to enter unit, displaying **+3.000 0dBm**

The moment you press the unit softkeys, generator changes the amplitude of output waveform with the new setting.

1.4.4 You can also change the frequency continuously by using the knob or arrow keys【←】and 【→】.

1.4.5 For CHB, you can set high level for output waveform. Press 〖Amptd〗key to select "High Lev", which displays green and can be set its value.

It is convenient for user to convert the format of amplitude, no need to input number, press 【.】key then press relevant unit softkey. For example，press 〖Vpp〗or 〖mVpp〗softkey to display peak-to-peak value; press 〖Vrms〗or 〖mVrms〗softkey to display virtual value. For CHA Sine wave with load 50 ohms, press〖dBm〗to display power level.

1.5 To set DC offset

Instrument allows DC offset setting for only CHB. If you want to change the DC offset to -25mVdc, follow the steps:

1.5.1 Press the〖Offset〗softkey to select "offset", which displays green with default value **+ 0.000 Vdc**.

1.5.2 Press the numeric keys【-】, 【2】 and 【5】, displaying **"**-25".

1.5.3 Press the〖mVdc〗softkey to enter the unit, displaying **-0.025 Vdc**. The moment you press the unit softkeys, generator changes the DC offset of output waveform with the new setting.

1.5.4 You also can change the offset by using the knob and arrow keys 【←】 and 【→】. It can switch sign automatically once pass the zero.

1.5.5 For CHB, you can set low level. Press〖Offset〗key to select "Low Lev", which displays green and can be set its value.

1.6 To set the frequency step

Press 〖StepFreq〗softkey to select it, which displays green. For example, set a step frequency as 2.5 kHz. Then press 〖Freq〗again to select "Frequency". After that, each time you press 【↑】, frequency increases 2.5 kHz. Press 【↓】key to decrease. By this method, user can easily output series of frequency sequence by step increase or decrease.

1.7 To set the square waveform

At power-on, the generator outputs a sine waveform. Press【Square】key, whose indicator lights while the sine LED lights off, generator outputs square waveform with fixed duty cycle 50% of CHA. It is allowed to change the duty cycle for CHB square.

CHA only has sine and square waveforms. Besides these two, CHB has 6 more waveforms, like Ramp, Pulse, Exponential, SINC, Noise and DC.

1.8 To set the ramp waveform

Press【Arb】key, whose indicator lights and display waveform list. The waveform with green name is output at the same time. Press〖Ramp〗to output ramp waveform. The symmetry of ramp waveform stands for the ratio of rising time and falling time with adjustable range from 0% to 100%.

You can set ramp waveform symmetry by numeric keys and unit keys, or adjust it continuously by knob or cursor shift key. After setting, the ramp waveform displays on the screen.

1.9 To set the pulse waveform

Press【Arb】key, whose indicator lights and display waveform list. The waveform with green name is output at the same time. Press〖Pulse〗to output pulse waveform. Pulse width stands for the time when output high level.

You can set ramp waveform symmetry by numeric keys and unit keys, or adjust it continuously by knob and cursor shift key. After setting, the ramp waveform displays on the screen.

1.10 To set other waveforms

Same as ramp and pulse waveform settings, Press【Arb】key to set other waveforms. Press relevant softkey to select the wave and display it on screen.

1.11 Start/Stop sweep function

Press 【Sweep】key. Indicator lights, that stands for current sweep status of instrument. It outputs continuous frequency sweep waveform along with the default parameters. Press【Sweep】key again to stop sweep function, lights off and returns to tone status.

1.12 Start/Stop modulation function

Press【Mod】key. Indicator lights, that stands for current modulation status of instrument. It outputs continuous modulation waveform along with the default parameters. Press【Mod】key again to stop modulation function, lights off and returns to tone status.

1.13 Start/Stop burst function

Press【Burst】key. Indicator lights, that stands for current burst function status of instrument. It outputs continuous burst count along with the default parameters. Press【Burst】key again to stop burst function, lights off and returns to tone status.

Chapter 2 Basic Operation

You have known how to set basic function and output continuous waveform through chapter 1. By this chapter, you will know more basic functions of the generator and please refer to chapter 3 "advanced application" for detailed description.

2.1 To set the output terminal

The waveform signals are output from the CHA and CHB terminal on front panel, the series output impedance is fixed to be 50Ω.

Press【Output】key repeatedly to start or stop output signal by turns.

2.2 To set the frequency sweep

Only CHA has frequency sweep function.

The output frequency changes from start frequency to the stop frequency at a sweep rate which you set. You can sweep up or down, with either linear or logarithmic spacing. Follow the steps to set a logarithmic frequency sweep waveform with 50 Hz start frequency, 5 kHz stop frequency, 1vpp amplitude and 1s sweep time and internal trigger source.

2.2.1 Press【CHA】key to enter into the tone menu.

2.2.2 press 〖Amptd〗key to select amplitude option . Set it to be 1 Vpp by numeric keys or knob.

2.2.3 Press【Sweep】key to enter into the sweep menu.

2.2.4 Select〖Start〗option. Set the start frequency to be 50 Hz by numeric keys or knob.

2.2.5 Select〖Stop〗option. Set the stop frequency to be 5 kHz by numeric keys or knob.

2.2.6 Select〖Time〗option. Set the sweep time to be 1s by numeric keys or knob.

2.2.7 Select〖Mode〗option to enter into sweep mode menu.

2.2.8 Press〖Log〗softkey and select logarithm sweep mode.

2.2.9 Press〖Back〗key to return to sweep menu.

2.2.10 Press〖Source〗option to display trigger source menu.

2.2.11 Press〖Int〗key to select internal trigger.

After setting, generator outputs continuous sweep waveform with new settings.

To sweep up in frequency, set the stop frequency lower than start frequency. To sweep down in frequency, set the stop frequency higher than start frequency. Press〖Source〗key to select trigger mode, Int, Ext or Manual.

2.3 To set the frequency modulation (FM)

Only CHA has frequency modulate function.

In FM, the carrier frequency varies with the instantaneous voltage of the modulating waveform. Follow the steps to set a FM waveform with 1MHz carrier frequency, 800 Hz modulating frequency, 10 kHz frequency deviation, 1 Vpp amplitude, Sine modulating wave, and internal trigger source.

2.3.1 Press【CHA】key to enter into the tone menu.

2.3.2 Press 〖Freq〗key to select frequency option . Set it to be 1 MHz by numeric keys or knob.

2.3.3 Press 〖Amptd〗key to select amplitude option . Set it to be 1 Vpp by numeric keys or knob.

2.3.4 Press【Mod】key to enter into the modulate menu. Press 〖Type〗softkey to enter type menu and then press〖FM〗softkey to select FM, generator enters into FM modulation mode. Press〖Back〗key to return to modulate menu.

2.3.5 Press〖FM Freq〗softkey to select "modulate frequency" and set it to 800 Hz by using numeric keys or knob.

2.3.6 Press〖FM Devia〗softkey to select "modulate deviation" and set it to be 10 kHz by using numeric keys or knob.

2.3.7 Press 〖Shape〗softkey to enter into waveform menu. Press〖Sine〗key to select sine. Press〖Back〗key to return to modulate menu.

2.3.8 Press 〖Source〗key to enter into modulation source menu. Press 〖INT〗key to select INT.

After setting, generator outputs FM modulating waveform with the new settings.

2.4 To set the amplitude modulation (AM)

Only CHA has amplitude modulation function.

In AM, carrier amplitude is varied by the instantaneous voltage of the modulating waveform. Follow the steps to set an AM waveform with 5 kHz carrier frequency, 200 Hz modulating frequency and 80%

modulation depth, waveform amplitude 1Vpp, Sine wave and internal trigger source.

2.4.1 Press【CHA】key to enter into the tone menu.

2.4.2 Press〖Freq〗key to select frequency option . Set it to be 5 kHz by numeric keys or knob.

2.4.3 Press 〖Amptd〗key to select amplitude option . Set it to be 1 Vpp by numeric keys or knob.

2.4.4 Press【Mod】key to enter into the modulate menu. Press 〖Type〗softkey to enter into type menu and then press〖AM〗softkey to select AM, generator enters into AM modulation mode. Press 〖Back〗key to return to modulate menu.

2.4.5 Press〖AM Freq〗softkey to select "modulate frequency" and set it to 200 Hz by using numeric keys or knob.

2.4.6 Press〖AM Depth〗softkey to select "modulate depth" and set it to be 80% by using numeric keys or knob.

2.4.7 Press 〖Shape〗softkey to enter into waveform menu. Press〖Sine〗key to select sine. Press〖Exit〗key to return to modulate menu.

2.4.8 Press〖Source〗key to enter into source menu. Press 〖INT〗key to select INT.

After setting, generator outputs AM modulating waveform with the new settings.

2.5 To set the frequency-shift keying (FSK)

Only CHA has frequency-shift keying function.

In FSK, output frequency shifts repeatedly between the carrier frequency and hop frequency, the changed frequency is called FSK rate. Follow the steps to set a FSK waveform with 3 kHz carrier frequency, 500 Hz hop frequency, 100 Hz FSK rate, 1Vpp amplitude and internal source.

2.5.1 Press【CHA】key to enter into the tone menu.

2.5.2 Press〖Freq〗key to select frequency option . Set it to be 3 kHz by numeric keys or knob.

2.5.3 Press 〖Amptd〗key to select amplitude option . Set it to be 1 Vpp by numeric keys or knob.

2.5.4 Press【Mod】key to enter into the modulate menu. Press 〖Type〗softkey to enter into type menu and then press〖FSK〗softkey to select FSK, generator enters into FSK modulation. Press〖Back〗key to return to modulate menu.

2.5.5 Press〖Hop Freq〗softkey to select "hop frequency" and set it to 500 Hz by using numeric keys or knob.

2.5.6 Press 〖FSK Rate〗softkey to select "FSK rate" and set it to 100 Hz by using numeric keys or knob.

2.5.7 Press〖Source〗key to source menu. Press 〖INT〗key to select INT. After setting, generator outputs PSK modulating waveform with the new settings.

2.6 To set the phase-shift keying (PSK)

Only CHA has phase-shift keying function.

In PSK, phase of output signal shifts repeatedly between set phase 1 and 2 at a certain frequency, which is called PSK rate. Follow the steps to set a PSK waveform with 10 kHz carrier frequency, 20 Hz PSK rate, 90°phase 1，270°phase 2, 1Vpp amplitude and internal source.

2.6.1 Press【CHA】key to enter into the tone menu.

2.6.2 Press〖Freq〗key to select frequency option . Set it to be 10 kHz by numeric keys or knob.

2.6.3 Press 〖Amptd〗key to select amplitude option . Set it to be 1 Vpp by numeric keys or knob.

2.6.4 Press【Mod】key to enter into the modulate menu. Press〖Type〗softkey to enter into type menu and then press〖PSK〗softkey to select PSK, generator enters into PSK modulation. Press〖Back〗key to return to modulate menu.

2.6.5 Press〖Phase 1〗softkey to select "phase 1" and set it to be 90°by using numeric keys or knob.

2.6.6 Press〖Phase 2〗softkey to select "phase 2" and set it to be 270° by using numeric keys or knob.

2.6.7 Press 〖PSK Rate〗softkey to select "PSK rate" and set it to be 20 Hz by using numeric keys or knob.

2.6.8 Press〖Source〗key to enter into source menu. Press 〖INT〗key to select INT.

After setting, generator outputs FSK modulating waveform with the new settings.

2.7 To set the burst output

Only CHA has burst function.

In burst mode, you can set the burst cycle, number, start phase of each burst and burst source. Follow the steps to set a burst waveform with 3 kHz frequency, 20ms burst cycle, 10 pulses burst count, 180° start phase, 1Vpp amplitude and internal source.

2.7.1 Press【CHA】key to enter into the tone menu.

2.7.2 Press〖Freq〗key to select frequency option . Set it to be 3 kHz by numeric keys or knob.

2.7.3 Press 〖Amptd〗key to select amplitude option . Set it to be 1Vpp by numeric keys or knob.

2.7.4 Press【Burst】key to enter into the burst menu.

2.7.5 Press〖Period〗softkey to select the burst cycle option. Set it to be 20 ms by numeric keys or knob.

2.7.6 Press 〖Phase1〗softkey to select start phase option. Set it to be 180°by numeric keys or knob.

2.7.7 Press〖N cycle〗softkey to select N cycle and set it to be 10 by using numeric keys or knob.

2.7.8 Press〖Source〗key to enter into source menu. Press〖INT〗key to select INT.

After setting, generator outputs FSK modulating waveform with the new settings.

Pressing〖Source〗softkey can select trigger mode from Internal, External, Manual and Gate.

2.8 Reset

Press 【System】key then 〖Reset〗softkey to reset instrument, status after resetting is determined by power-on setting. If default setting is selected for power-on states, instrument will initialize with default status. If status before power-off is selected for power-on setting, instrument will initialize as the status before power off.

Chapter 3 Advanced Applications

This chapter will specify the functions characteristics and operating methods of this instrument in detail, so before reading this chapter, if you haven't mastered its basic operation, please read contents of the former two chapters and make practical operation exercise in advance. In this chapter, those contents about basic operation will not be repeated, moreover, only those people who has practical operation experience can understand the contents of this chapter better.

Note: CHA has 2 output frequency range, 1μHz to 80MHz, 80.000001MHz to 500MHz. The first range is specified as low frequency range and the second range is specified as high frequency range. The following description will not mention the frequency range again just use low frequency and high frequency to express.

3.1 Output Function

CHA has sine and square waveform output. CHB has sine, square, ramp and pulse waveform output, also other 4 built-in waveforms.

3.1.1 Sine wave: press 【Sine】key to output sine waveform, which is the most used waveform with best spectral purity, and it is also used as carrier signals in various modulation applications. When switch on the machine, default output waveform is sine.

3.1.2 Square wave: press 【Square】key to output square waveform, which the duty cycle is fixed 50%.

Sine and Square of CHA are used as continuous waveforms, also can be used in sweeping, FM，AM，PM，FSK and burst as well.

3.2 Output frequency

When waveforms changes, if the present frequency exceeds waveform's highest frequency, the instrument will modify frequency value to confine it within the limit of waveform's highest frequency value automatically. Except sine wave, as the rising of frequency, the distortion of other signals will increase gradually. In practical application, you can limit the highest frequency according to the requirement for distortion. The lowest output frequencies of all the waveforms are 1 μHz.

3.3 Output amplitude

3.3.1 Amplitude value: the amplitude displayed is based on 50Ω load input, if without input load, the tested value from output terminal is double displayed value. By setting high impedance, the tested amplitude will be same as displayed value.

3.3.2 Amplitude value limitations: offset could be set for CHB, so maximum amplitude and dc offset should conform to the regulations of below formula, if the amplitude setting exceeds the limitation, instrument will modify the input value automatically to make it confined within the allowable maximum amplitude.

$$Vpp \leq 2 \times (5 - |V_{offset}|)$$

Default load impedance is 50Ω for all the description of amplitude, offset and dc level as following.

3.3.3 Amplitude units: all waveforms can be labeled as peak-to-peak amplitude (Vpp). As to sine, square, ramp and pulse waves, the

amplitude can also be shown as root mean square value (Vrms). If the actual load impedance is 50Ω, the amplitude can be power level (dBm) as well for sine wave.

$$dBm = 10 \times \log (P \div 0.001) \qquad \text{where } P = (Vrms)^2 \div 50$$

Except sine and square wave, others signals cannot be shown as rms value.

If the signal is not sine wave or the actual load impedance is not 50Ω, the power level (dBm) unit is invalid.

3.3.4 Amplitude displaying: As for sine wave of tone frequency, with limitation to flatness calibration and maximum amplitude, actual output amplitude accords with displayed value. But when in sweep and modulate function, frequency more than 10 MHz and amplitude more than 10 Vpp, maybe actual amplitude differ from the displayed value.

3.4 DC offset

CHB has DC offset function. The maximum DC offset value and amplitude should conform to rule of following formula, if the offset setting exceeds the range, the instrument will modify it to the maximum offset value allowed.

$$|\text{offset}| \leq 5 - Vpp \div 2 \qquad \text{(Load Impedance is 50Ω)}$$

3.5 Pulse waveform

Pulse width stands for the time interval from the middle of rising edge to that of falling edge and must be less than pulse cycle, if the setting value exceeds the current pulse cycle, the instrument will modify it to the maximum pulse width allowed.

3.6 Arbitrary waveforms

The memory location stores four fixed arbitrary waveforms, exp, sinc, noise and dc, which can be outputted by selecting from arbitrary waveform menu.

3.7 Frequency sweep

In Frequency sweep mode, the output frequency changes from start frequency to stop frequency within set sweep time. Sweep cannot be valid within the whole frequency range, but only within the four frequency ranges. In the process of sweep, the phase of output signal is continuous. Sine and square can be used for frequency sweep. But for square, the maximum sweep frequency should be limited to 80MHz, so high frequency range is invalid for square sweep.

3.7.1 Start/Stop frequency: press softkey of 〖Start〗 and 〖Stop〗 to select "start frequency" and "stop frequency", you can set the start and stop frequencies respectively. If the stop frequency is higher than the start frequency, the generator begins at the start low frequency and sweeps to the stop high frequency in an up direction, and then resets back to the start frequency. If the stop frequency is lower than the start frequency, the generator begins at the start high frequency and sweeps to the stop low frequency in a down direction, and then resets back to the start frequency. Start frequency can be set arbitrarily without frequency range limitation, but stop frequency should be within the same range as start frequency.

3.7.2 Sweep time: when sweep within the low frequency range, it represents the time required to sweep from the start frequency to the stop frequency. The time interval to sweep from one frequency to next one is constant, so more sweep time results in more sweep frequency points and finer sweep step, vice visa. When sweep within the high frequency range, user can set the step time, which represents the pause interval of sweep signal at each step frequency, so sweep time = step time×(|start frequency-stop frequency|/step frequency), for long step time, low step frequency, the sweep time will be long.

3.7.3 Sweep mode: when sweep within low frequency range, press 〖Mode〗 softkey to select linear sweep mode or logarithmic sweep mode.

In the linear sweep mode, frequency step is fixed. For wide sweep range, fixed frequency step has bad affect, which lead to high sweep resolution at top, slow change and fine sweep. But at bottom, the sweep resolution is low with fast change and coarse sweep. So the linear sweep mode is only suitable for narrow sweep frequency range.

In logarithmic sweep, frequency step is not fixed but varies in logarithmic fashion, which is high at frequency top and low at frequency bottom. For wide sweep range, the variation is average, so this mode is suite for wide sweep frequency range.

3.7.4 Trigger: press 〖Source〗 softkey to select trigger mode.

When select internal trigger, the sweep runs repeatedly with internal trigger source.

When select external trigger, the trigger signal with TTL level can be inputted from the rear panel "Trig In" connector. rising and falling edge are both OK for trigger, for rising edge trigger, the sweep process on detecting the trigger signal's rising edge, which the principle is same as falling edge. Sweep runs once it trigger and output signal returns to start frequency after sweep finished. And the cycle of trigger signal should be longer than the sweep time setting value.

When select manual trigger, once you press the〖ManuTrig〗softkey, one sweep runs and output signal return to start frequency after sweep finished.

3.8 Frequency modulation (FM)

In Frequency modulation, the carrier frequency is varied by the instantaneous voltage of modulating waveform; the carrier shape is sine or square.

3.8.1 Carrier setting: carrier waveform can be set with tone frequency menu, you can first set the frequency and amplitude of carrier to enter into the modulation function, also you can press 【CHA】in modulation mode to enter into the tone frequency menu and set its frequency or amplitude. Now the instrument is still at the modulation working and the preset carrier frequency and amplitude comes to affect instantly.

3.8.2 Modulation frequency: in frequency modulation, the modulation frequency is always much lower than the carrier frequency. If internal modulating signal is used, you can set the modulating frequency. If

external modulating signal is used, the modulating frequency setting is ignored.

3.8.3 Modulation Frequency deviation: it represents the variation of carrier frequency when modulated waveform at full amplitude scale. When the amplitude of the modulating waveform is at positive peak value, the frequency of the modulated signal is equal to the frequency of the carrier plus the frequency deviation, and when it is at the negative peak value, the frequency is equal to the carrier frequency minus the frequency deviation. Therefore, the frequency deviation setting must conform to the following two conditions:

Frequency deviation < carrier frequency

Frequency deviation + carrier frequency < maximum frequency of the selected signal

3.8.4 Modulating waveform shape: Press〖Shape〗softkey to select sine, square or ramp. Modulating waveform shape setting would be ignored if external modulating signal is used.

3.8.5 Modulating source: Press 〖Source〗 softkey to select modulation source. When selecting internal modulation, it will run modulation as setting. When selecting external modulation, the modulating signal is inputted from the rear panel "Modulation In" connector. If the amplitude of the external modulating signal is ± 2.5V, the frequency deviation setting and the display value accord with the real frequency offset. Otherwise, the frequency deviation setting and display value are not accurate.

3.9 Amplitude modulation (AM)

In AM, the amplitude of the carrier is varied by the instantaneous voltage of the modulating waveform; the carrier shape is sine or square.

3.9.1 Carrier setting: carrier waveform can be set with tone frequency menu, you can first set the frequency and amplitude of carrier to enter into the modulation function, also you can press 【CHA】in modulation mode to enter into the tone frequency menu and set its frequency or amplitude. Now the instrument is still at the modulation working and the preset carrier frequency and amplitude comes to affect instantly.

3.9.2 Modulating waveform frequency: in frequency modulation, the modulation frequency is always much lower than the carrier frequency. If internal modulating signal is used, you can set the modulating frequency. If external modulating signal is used, the modulating frequency setting is ignored.

3.9.3 Modulation depth: it represents the maximum variation in the amplitude of the carrier wave in amplitude modulation. If the maximum amplitude of the modulated waveform is called as Amax, the minimum amplitude as Amin, then the modulation depth can be expressed as the following formula:

$$\text{Modulation depth } \% = (\text{Amax} - \text{Amin}) / \text{A}$$

If Amax=A，Amin=0, the modulation depth setting will be up to 100%. If Amax=0.8A, Amin=0.2A, the modulation depth setting will be up to 60%. If Amax=0.5A, Amin=0.5A, the modulation depth setting will be

up to 0%. That is to say, when modulation depth is 0, carrier amplitude is half of the amplitude setting.

3.9.4 Modulating waveform shape: Press〖Shape〗softkey to select sine, square or ramp. Modulating waveform shape setting would be ignored if external modulating signal is used.

3.9.5 Modulating source: Press 〖Source〗 softkey to select modulation source. When selecting internal modulation, it will run modulation as setting. When selecting external modulation, the modulating signal is inputted from the rear panel "Modulation In" connector. If the amplitude of the external modulating signal is ± 2.5V, the frequency deviation setting and the display value accord with the real frequency offset. Otherwise, the frequency deviation setting and display value are not accurate.

When selecting internal modulation and modulation signal of CHB, it can't be set for CHB. So【CHB】isn't available when pressing.

3.10 Frequency-shift keying (FSK)

In FSK, the frequency of the carrier shifts between "carrier frequency" and "hop frequency" alternately, the rate at which the output shifts is determined by FSK rate, the carrier shape is sine or square.

3.10.1 Carrier setting: carrier waveform can be set with tone frequency menu, you can first set the frequency and amplitude of carrier to enter into the modulation function, also you can press【CHA】in modulation mode to enter into the tone frequency menu and set its frequency or amplitude. Now the instrument is still at the

modulation working and the preset carrier frequency and amplitude comes to affect instantly.

3.10.2 Shift frequency: for internal modulation, modulated waveform should be fixed as square with duty cycle 50%, the frequency of which is shift frequency. For external modulation, the shift frequency setting can be ignored.

3.10.3 Hop frequency: FSK is similar as FM modulation of square and hop frequency is similar as the modulating frequency deviation, the difference between them is just that the reference with carrier frequency, modulating frequency deviation is the offset value based on carrier frequency and setting range relates with it, but hop frequency not.

3.10.4 Modulating source: Press 〖Source〗 softkey to select modulating source. When selecting the internal modulating, instrument start modulating as setting. When selecting external modulation, the trigger signal with TTL level is inputted from the rear panel "Trig In" connector for FSK. If the level of the trigger signal is logic low level, the frequency of the FSK signal is that of the carrier, if the level of the trigger signal is logic high level, the frequency of the FSK signal is the hop frequency.

3.11 Phase-shift keying (PSK)

In PSK, the phase of output signal shifts alternately between preset phase 1 and 2 on a frequency, the changed frequency is called as shift frequency. The carrier shape is sine or square.

3.11.1 Carrier setting: carrier waveform can be set with tone frequency menu, you can first set the frequency and amplitude of carrier to enter into the modulation function, also you can press 【CHA】in modulation mode to enter into the tone frequency menu and set its frequency or amplitude. Now the instrument is still at the modulation working and the preset carrier frequency and amplitude comes to affect instantly.

3.11.2 Phase 1: start phase 1 of PSK output signal during alternating.

3.11.3 Phase 2: start phase 2 of PSK output signal during alternating.

3.11.4 Shift frequency: for internal modulation, modulated waveform should be fixed as square with duty cycle 50%, the frequency of which is shift frequency. For external modulation, the shift frequency setting can be ignored.

3.11.5 Modulating source: Press 〖Source〗 softkey to select modulating source. When selecting the internal modulating, instrument start modulating as setting. When selecting external modulation, the trigger signal with TTL level is inputted from the rear panel "Trig In" connector for FSK. If the level of input signal is logic low, the start phase of PSK signal is Phase 1. If the level of the input signal is logic high, the start phase of PSK signal is Phase 2.

3.12 Burst output

It is explained that in burst mode, the word "burst" means the cycle of any waveform, not the pulse. In burst output, instrument outputs numbers of waveform or single waveform as specified number of cycles,

specified period and specified start phase. The burst signal is sine or square.

3.12.1 Burst period: it represents time from the start of one burst to start of the next one and must be big enough in order to output the specified number of cycles, as the following formula shows:

Burst period＞burst count N ÷signal frequency

If the burst period was too short, the instrument will modify it to the allowable minimum value.

3.12.2 N Cycle: it represents the number of cycles to be outputted per burst. It must be small enough in order to be outputted in one burst, as following formula shows:

N Cycle＜burst period ×signal frequency

If the N cycle was too large, the instrument will modify it to the allowable maximum value.

3.12.3 Start phase: the start time of one burst should be same phase as the stop time on the waveform, that calls start phase, the setting range of which is 0 °~360 °, not available for square wave.

3.12.4 Trigger Source: press〖Trigger〗softkey to select trigger mode of burst by "Internal", "External" or "Manual" and "Gate".

When selecting internal trigger, instrument uses internal continuous trigger source to output continuous bursts according to burst period and burst N cycle set in advance.

When selecting external trigger, instrument uses external trigger source, input TTL trigger signal from the instrument rear panel "Trig In" connector. The generator outputs a burst at the rising edge of the trigger

signal and resets back to the starting phase to wait the next rising edge. Of course, the trigger signal cycle should conform to the restricted conditions of burst period.

When selecting manual trigger, once you press 〖Manual〗 softkey, the current waveform will be outputted continuously (not burst), press 〖Manual〗 again, the output will stop, then the instrument resets back to the starting phase point to wait the next keystroke.

When selecting gated output, instruments uses external trigger source, a TTL gated signal is inputted from the instrument rear panel "Trig In" connector. When the gated signal is at logic high level, the waveform is outputted continuously (not burst), when gated signal is at logic low level, the output stops, then the instrument resets back to the starting phase point. In the gated burst mode, both burst period and burst count settings are ignored.

3.13 Parameters setting

Generally, you can use the default parameters. But you can take more function and make instrument suitable for different operation environments and habits through system setting. Enter into system setting interface by pressing【System】key then〖Utility〗softkey.

3.13.1 Storage setting: Users can set the storage function for instrument. There are four locations in memory to store the current settings, including CHA and CHB and other states, such as the buzzer, the boot state, separators and so on. Users can store the settings of common use in the four locations, which can be directly recalled. Press

〖save〗after setting location, the instrument will prompt "Save succeed", if the storage fails, the instrument will prompt "Save failed", please contact the supplier. Press〖Recall〗key after setting storage location to recall stored settings and click here to set up initialization of instrument, and exit the storage menu. If the selected memory location has no memory contents, the prompt 'Setup has not been stored' will pop up. The storage area of equipment also retained the factory's default settings, when users operate mistakenly or make a chaos parameter in the calibration, it can restore the outgoing settings. After pressing the softkey of〖outgoing settings〗, the instrument will prompt "Do you want to recall the default setup?", confirming by pressing the softkey 〖Yes〗, the instrument prompt "Default setup recalled!" cancelling by pressing the softkey by〖No〗, the instrument prompt "Default setup un-recalled!".

3.13.2 Output settings: Users can set the output characteristics of the instrument, including the CHA resistance, CHB impedance, TTL output. CHA impedance refers to the value of load impedance connected by the CHA output port, when the setting is 50Ω, the setting value of the output amplitude is the value measured on the 50Ω load, when the setting is high impedance, the setting value of the output amplitude is the value measured on the high impedance load. The meaning of CHB impedance is as same as CHA impedance. TTL output is used to set "TTL" terminal in the front panel whether to allow the output TTL signal, when set to be allowed, there are TTL signal output, when set to be prohibited, there is no TTL signal output, but when the CHA output

square wave, TTL signal continuously output, when the CHA frequency is at high frequency, TTL signal continuously close, TTL setting does not work.

3.13.3 Interface settings: Users can set the programmable interface characteristics of the instrument. Instrument are standard with a RS232 interface and USB device interface, when select RS232 interface, user can set the interface of baud rate and interface address. Baud rate has 7 choices ---115200, 57600, 38400, 19200, 9600, 4800 and 2400. For further information on the programmable interface, please refer to "Programmable Interface Users Guide."

3.13.4 System settings: Users can set the state of instrument, including the boot state, buzzer state and separator settings.

If the boot state of instrument is set to the default, when the instrument connects to the power or press the softkey of 〖Reset〗, the instrument is initialized in accordance with the default settings, if the boot state of instrument is set to the state before shutting down, when the instrument connects to the power or press the softkey of 〖Reset〗, the instrument will be initialized according to the state before shutting down. Instruments, if for a specific test, the boot status is set to the state before shutting down , the same settings for instrument can be saved after booting. The boot state is default when instrument outgoing.

When the buzzer is set to be allowable, there is a short tone "beep" after pressing the buttons. When the setting be error ,there will be a error tone, sometimes the error tone is two tone "beep .. beep" sometimes is a

long tone "beep ... ...". When the buzzer is set to be prohibited, there is no tone. The buzzer is set to be allowable when instrument outgoing.

3.14 Output Port

The instrument has five output ports, there are 2 in front panel, and there are 3 in rear panel. Output ports used for signal input is strictly prohibited, otherwise, may result in instrument's damage.

3.14.1 The signal output port 'CHA','CHB', 'TTL':

A variety of waveform signals produced by instrument output from the signal output port. The port of 'CHA' and 'CHB' output signal CHA and CHB, these two ports have the protective function. Pressing the key of【Output】in front panel to enable indicator light of【Output】 key on/off, which can circularly open or close output port signal. If inadvertently added a higher-voltage signal to the output port of signal CHA and CHB, instrument will be subject to the danger 'encroachment', at this time the instrument will automatically activate protection function, immediately turn off the signal output port, The indicator light of button extinguish. External loads must be checked at this time, after troubleshooting you can press 【Output】 key to open the signal output port. "TTL" port output TTL signal same as CHA frequency, , the two ports do not have protective function, if there is a high-voltage signal to input ,may damage the instrument. Please note when using.

3.14.2 Internal clock output port "10MHz Out": Output 10MHz internal system clock signal, which can be used clock for other instruments and devices, so make other instruments simultaneous with this instrument.

3.15 Input Port

The instrument has five input ports, which all be in the rear panel. Input port can only be used as an external signal input, can not be used signal output .

3.15.1 Modulation input port "Modulation In": In the FM, AM modulation ,input an external modulation signal.

3.15.2 Trigger input port "Trig In": In the frequency sweep, FSK, PSK and the pulse string , input external trigger signal and TTL compatible levels.

3.15.3 External clock input port "10MHz In": input an external clock signal to synchronize the instrument and other devices, or use a more precise frequency reference.

3.15.4 Counter 1 input: input low frequency signal with specified range 1Hz to 100MHz.

3.15.5 Counter 2 input: input low frequency signal with specified range 100MHz to 2.5GHz.

3.16 Communications Port

3.16.1 USB device port "USB Device": Connecting to the computer through the interface cable can realize to programmable operation for the instrument.

3.16.2 RS232 port "RS-232": Connecting to the computer through the interface cable can realize to programmable operation for the instrument. You can also use the updated software to update operating system of the instrument.

3.16.3 GPIB port "GPIB": Connecting to the computer through the interface cable can realize to programmable operation for the

instrument.

3.17 Calibration

Instruments have been calibrated when outgoing, but after long-term working, some technical parameters may have a bit error. In order to ensure the accuracy of the instrument, calibration should be carried out regularly. For the calibration of the main technical parameters, opening the chassis to adjust the hardware does not need, only through the keyboard; users can restore the instrument accuracy. Pressing the key of【System】then softkey of 〖Cal.〗can enter into the interface of instrument calibration.

In order to prevent some unrelated people's arbitrary calibration, instrument is set to the calibration password. Only enter into the correct calibration password, the calibration can be opened. Otherwise, the calibration is closed, calibration operation does not work. Enter the calibration password, the instrument will prompt "Password is correct!" calibration function is opened, users can carry out calibrate.

Calibration needs professional testing equipment, if the accuracy of testing equipment cannot meet the requirements, please do not calibrate! Please press softkey of 〖Save Data〗to save the calibrating data after finishing calibration. If the calibrating data isn't stored, the instrument will perform task as previous data once power on the instrument. Enter into the calibration function, the instrument will lock the keys except the Key of【Cal.】, and only press the key of【Cal.】again to exit the calibration state, the instrument automatically save the new calibration data when exiting. If still having problems after calibration, users can restore the data be by calling the factory settings, referring to the contents of the parameter settings.

3.17.1 Calibration display area: After entering calibration function, the first line of the display area shows the calibration step, the second line of the display area shows the frequency value corresponding to the

current steps, the third line of the display area shows calibration parameters corresponding to the current calibration step, the fourth line of the display area shows the current measured parameter values. There is no calibration step and the setting frequency value in the function of CHB offset calibration and modulation depth calibration does, so the first two lines are blank.

3.17.2 CHA amplitude calibration: Pressing softkey of 〖CHA Amptd〗 to enter into the menu of CHA amplitude calibration. Instrument default calibration steps 99, and output sinusoidal signal of 1kHz and 1Vrms. Pressing softkey of 〖Para〗, enter into the actual amplitude value measured by the digital voltmeter. Pressing softkey of 〖Enter〗, instrument will enter calibration step 0, and output sinusoidal signal 1MHz and 4dBm, at this time a spectrum analyzer should be used to measure the actual amplitude value of output signal, and then enter, press softkey of 〖Enter〗, instrument enter into the calibration step 1, circular calibration like this, until the calibration is complete. User must input actual amplitude value in calibration step 0 which is the reference of following calibration and press softkey of 〖Enter〗, otherwise, the following calibration steps will not available.

CHA amplitude calibration has a total of 55 steps, users can set the amplitude values setting the frequency point point-by-point in the calibration process, or can also enter into the calibration steps to calibrate directly the amplitude values setting the frequency point, but must ensure that the amplitude values of calibration steps 99,0,9,14,23,29 and 43 have been calibrated. Calibration of the 99step need a digital voltage meter and the spectrum analyzer need to be used in calibration of other steps.

3.17.3 CHB amplitude calibration: Pressing softkey of 〖CHB Amptd〗 to enter into the menu of CHB amplitude calibration. Instrument default calibration steps 0, and output sinusoidal signal

1kHz and 7Vrms. Pressing softkey of 〖Para〗softkey, enter the actual amplitude value measured by the digital voltmeter. Pressing softkey of 〖Enter〗,instrument enter into calibration step 1 and output sinusoidal signal 1MHz and 4dBm, at this time a spectrum analyzer should be used to measure the actual amplitude value of output signal, and then enter, Pressing softkey of 〖Enter〗, instrument enter into the calibration step 2, circular calibration like this, until the calibration is complete. User must input actual amplitude value in calibration step 1 which is the reference of following calibration and press softkey of 〖Enter〗, otherwise, the following calibration steps will not available.

CHB amplitude calibration has a total of 11 steps, users can set the amplitude values setting the frequency point point-by-point in the calibration process, or can also enter into the calibration steps to calibrate directly the amplitude values setting the frequency point, but amplitude value of calibration step 0 and 1 must be calibrated.
Calibration of the 0 step need a digital voltage meter, and the spectrum analyzer need to be used in calibration of other steps.

3.17.4 CHB offset calibration: Pressing softkey of〖CHB offset〗to enter into the menu of CHB offset calibration. Instrument output 0Vdc DC signal ,input the actual voltage values measured by digital voltage meter, pressing softkey of〖Enter〗, instrument enter into the next step, output the 10Vdc DC signal, input the actual voltage values measured by digital voltage meter, pressing softkey of〖Enter〗, instruments will return to the first step.

In the calibration of CHB offset, a calibration cannot be the ideal calibration value, and repeated calibrations maybe required. First the DC 0Vdc calibration should be completed, then recalibrate 10Vdc. CHB offset calibration need to use digital voltmeter.

3.17.5 Modulation depth: Pressing softkey of 〖AM Depth〗to enter into the menu of modulation depth calibration.

The instrument outputs modulation signal of modulation depth 50%, the default calibration step is 0 and frequency of modulation signal is 1kHz. Press softkey of 〖Para〗,input the actual modulation depth value measured by modulation meter, pressing softkey of 〖Enter〗, instrument then enter into the calibration step 1, now frequency of modulation signal is 10kHz, input the actual modulation depth value measured by modulation meter, pressing softkey of 〖Enter〗, instrument then enter into the calibration step 2. Repeat like this, until calibration finish.

The calibration of modulation depth has 6 steps, you can calibrate by point to point, or enter into calibrate steps. Calibration of modulation depth needs to use modulation meter.

3.18 Frequency Counter (option, only for TFG3605)

The frequency counter is used to measure the frequency of external signal input. There are two counter inputs, Counter 1 is used to input low frequency with specified range 1Hz to 100MHz, corresponding to Counter 1 in display interface, while Counter 2 is used to input high frequency with specified range 100MHz to 2.5GHz, corresponding to Counter2 in display interface. User can set gate time, trigger level, coupling mode, bandwidth limitation, input impedance and attenuator for Counter 1, but only gate time for Counter 2.

3.18.1 Gate time

The default setting of gate time is 1s and the maximum setting is 100s. Press 〖Gate Time〗softkey to enter into menu of gate time setting, then input the desired value of gate time by number keys or change the numeric bit through arrow key and increase or decrease this bit through adjusting knob.

3.18.2 Trigger Level

The default setting of trigger level is 0.000V with specified range -5V to +5V and minimum step of 5mV. In menu of Counter 1, press 〖Level〗 softkey to enter into the setting menu of trigger level. User can set or change the trigger level by numeric keys, direction keys or adjusting knob.

3.18.3 Coupling Mode

The coupling model is the setting state of Counter 1 and includes DC coupling and AC coupling and the defaulting setting is AC coupling. In menu of Counter 1, the initial is setting menu for trigger level and gate time, then user can enter into the setting menu of coupling mode, bandwidth limitation, input impedance and attenuator through pressing 〖More〗softkey. Then press 〖Coupling〗softkey to enter into coupling menu, select AC or DC. Press〖Back〗to return previous menu.

3.18.4 Bandwidth Limitation

The bandwidth limitation of Counter 1 is 100kHz, which only allow the signal above 100kHz to be input into the channel of counter. Operation setting is same as coupling mode.

3.18.5 Input Impedance

The input impedance setting of Counter 1 includes 50Ω and 1MΩ, so as to guarantee the channel impedance of counter match to the output impedance of measured signal. Operation setting is same as coupling mode.

3.18.6 Attenuator

For amplitude of input signal beyond of limitation of counter channel, user could turn on the attenuator to give ×10 attenuation for input signal so as to meet the requirement of counter channel. The way of turn on/off attenuator is same as the setting of coupling mode.

3.19 Factory default settings

3.19.1 CHA Output

Waveform: Sine wave Frequency: 1kHz

Amplitude: 3.9794dBm Output port: off

Load Impedance: 50Ω

3.19.2 CHB Output

Waveform: Sine wave Frequency: 1kHz

Amplitude:1Vpp DC offset:0Vdc

Output port: off Load Impedance: 50Ω

3.19.3 Frequency Sweep

Starting frequency :1kHz End frequency:10kHz

Sweeping time: 1s Sweeping mode:linear

Trigger Source: Internal

3.19.4 FM Modulation

Modulation Frequency: 100Hz Modulation waveforms: sine

Frequency Offset: 100Hz Modulation Source: Internal

3.19.5 AM Modulation

Modulation Frequency: 100Hz Modulation waveforms: sine

Modulation Depth: 100% Modulation Source: Internal

3.19.6 FSK Modulation

Hopping Frequency: 10kHz Shift Frequency: 100Hz

Modulation Source: Internal

3.19.7 PSK Modulation

Phase 1:0 ° Phase 2:90 °

Shift Frequency: 100Hz Modulation Source: Internal

3.19.8 Burst

Burst period: 100ms Burst count: 5 N

Start Phase: 0 ° Trigger Source: Internal

3.19.9 Frequency Counter (option, only for TFG3605)

Gate time: 1s Trigger level: 0V

Coupling mode: AC Bandwidth limitation: Off

Input impedance: 1M Ω Attenuator: Off

3.19.10 System

Language selection: English TTL Output: Prohibition

Interface type: RS232 Interface Address: 19

Baud rate: 19200 Boot State: Default

Buzzer: Allow Separator: space

3.19.11 Calibration

Calibration parameters: User's calibration values

Calibration state: off

Chapter 4 Service and Support

4.1 Warranty

Shijiazhuang Suin Instruments Co.,Ltd. will give one year's warranty to maintaining or replacing since consignment for the verified quality problem of the product.

Except for this explanation and the description in the warranty card, the company has no other warranty, in proclamation or in implication. Under no circumstances, the company will responsible for the direct, indirect or other secondary loss.

4.2 Contact us

If you have any questions or inconvenient during the use of our products please do not hesitate to contact us.

Monday to Friday, 8：00-17：00 (Beijing Time)

Tel: +86-311-83897147

Email：export@suintest.com

Website: www.suintest.com

Chapter 5 Specifications

5.1 CHA output frequency

Frequency range: 1μHz~1500MHz (Sine) ***see Note1**

1μHz~80MHz (Setting range of Square)

Resolution: 1μHz (Carrier Frequency≤80MHz)

1Hz (Carrier Frequency >80MHz)

Accuracy: ±1 ppm Frequency ≥1.0kHz 18℃ ~ 28℃

±50ppm Frequency<1.0kHz Min.output 1μHz

5.2 CHA output level (Sine)

Setting Rang: -127dBm~+13dBm

Specification range: -100dBm~+13dBm

Resolution: 0.1dB

Accuracy:

±1.5 dBm of setting value (output level+13dBm~ -100 dBm, Frequency≤300MHz，

Setting value ±1.0 dBm typical value)

±2.2 dBm of setting value (output level+13dBm~ -80 dBm,Frequency≤1500MHz

Setting value ±1.5 dBm typical value)

±2.7 dBm of setting value (output level-100dBm~-80 dBm,Frequency≤1500MHz

Setting value ±2.0 dBm typical value)

Standing Wave Ratio:＜1.8 (output level≤0 dBm)

Output impedance: 50Ω (typical value)

5.3 CHA spectrum purity

Harmonic: ＜-33dBc(output level≤4dBm，typical value)

Non-harmonic: ＜-40dBc(output level≤4dBm，Deviation Carrier Frequency≥5kHz)

Sub-harmonics: ＜-40dBc(output level≤4dBm)

Residual f.m.: ＜100Hz (BW: 0.3~3kHz，RMS, ＜120MHz)

5.4 CHA Square characteristics

Rise/Fall Time:≤15ns

Overshoot: ≤5%

5.5 CHA Modulation

5.5.1 AM modulation

Modulation depth: 1~120%(Carrier Frequency≤80MHz , output level≤4dBm)

1~80%(Carrier Frequency＞80MHz, output level≤4dBm)

Resolution: 1%

Accuracy: ± 10% of setting value

Modulation rate: Internal 1μHz~20kHz

External 20Hz~20kHz

Distortion: ＜2% (Internal 1kHz modulation rate, Modulation depth 30%, BW:0.3~3kHz)

Residual a.m.: ＜0.1%(BW:0.05~15kHz,AVG)

5.5.2 FM modulation

Peak-value frequency offset:

fc/2(Carrier Frequency + Deviation≤80.1MHz, Carrier Frequency≤80MHz)

Peak-value frequency offset:

0~100kHz(Carrier Frequency＞80MHz)

Frequency deviation resolution:

1μHz(Carrier Frequency≤80MHz)

100Hz(Carrier Frequency＞80MHz)

Accuracy: ±5% setting value±50Hz

Modulation rate: Internal 1μHz~20kHz(Carrier Frequency≤80MHz)

Internal 1μHz~1kHz(Carrier Frequency＞80MHz)

External 20Hz~10kHz

External 20Hz~1kHz(Carrier Frequency＞80MHz)

Distortion: ＜2%(Internal 1kHz modulation rate, BW:0.3~3kHz, Peak-value frequency offset＞10kHz)

5.5.3 FSK modulation

Carrier frequency and hopping frequencies are arbitrarily set in the following frequency slicing.

1μHz~80MHz (FSK rate < 10kHz)

Trigger mode:

Internal or external (external control TTL level, low-level carrier frequency, high-level hopping frequency)

5.5.4 PSK modulation

Rang of Phase1 and Phase 2: 0~360°

Resolution: 0.1°

Alternating intervals: 0.1ms~800s

Trigger mode: Internal or external(external control TTL level, low-level phase1, high-level phase2)

5.5.5 External modulation input

Voltage rang: 5V full scale

Input impedance: 10kΩ

Frequency: DC to 10 kHz

5.6 Burst (Carrier Frequency≤80MHz)

Burst count: 1~10000 cycles

Alternating intervals: 0.1ms~800s

Trigger mode: Internal , external, gated(gated TTL pulse, high-level output, low-level is off)or single(Single manual button trigger)

5.7 Frequency sweep

Sweep rate: 1ms~800s Linear (Carrier Frequency≤80MHz)

100ms~800s Logarithm (Carrier Frequency≤80MHz)

Step time: 50ms~10s Linear(Carrier Frequency＞80MHz)

Frequency slicing: 100μHz~80MHz,

80.000001MHz~1500MHz

Sweep mode:

Linear sweep and logarithmic sweep (Carrier requency≤80MHz)

Step sweep (Carrier Frequency＞80MHz)

External trigger signal frequency:

≤1kHz(Linear), ≤10Hz(Logarithm)

$$\leq \frac{1}{Tstep \times (\frac{fstop - fstart}{fstep} + 1)} \text{ (Step sweep)}$$

Trigger mode: Internal, external (rising edge or falling edge trigger) or manual (Single manual button trigger)

5.8 CHB waveform Characteristic

Waveform: Sine wave, Square wave, Ramp wave, Pulse wave, Sinc, Exp, Noise, DC voltage

5.9 CHB frequency Characteristic

Frequency range: 1μHz-10MHz

Resolution: 1μHz

Accuracy: ±1ppm, Frequency≥1.0kHz, 18~28℃

±50ppm, Frequency＜1.0kHz min output 1μHz

5.10 CHB signal Characteristic

Square wave

Time of rising/falling: ≤50ns

Duty Cycle: 0.01%-99.99%

Pulse wave

Time of rising/falling: ≤50ns

Range of pulse width: 20ns~20s

Resolution: 20ns

Ramp wave

Symmetry: 0.0%-100.0%

5.11 CHB output Characteristic

Amplitude: 1mVpp ~ 10Vpp (50Ω)

2mVpp ~ 20Vpp (High impedance)

Offset: ±5Vpk ac + dc (50Ω)

±10Vpk ac + dc (High impedance)

Resolution: 5 mVpp

Accuracy (1 kHz Sine): ±(1% setting value＋10mVpp)

Flatness (Relative to 1MHz Sine, 1Vpp): ± 0.5dB

Output impedance: 50Ω typical value

Protection: short circuit protection, overload relay output is automatically disabled.

5.12 Clock Reference

5.12.1 External clock input

Clock frequency: 10 MHz ±35 kHz

Clock amplitude: 2 Vpp ~ 5 Vpp

Input impedance: 2 kΩ

5.12.2 Internal clock output

Clock frequency: 10 MHz

Clock amplitude:＞2 Vpp

Output impedance: 50Ω typical value

5.13 Frequency Counter (option, only for TFG3605)

5.13.1 Counter 1

Frequency range: DC coupling 1Hz~100MHz

AC coupling 1MHz~100MHz (50Ω open)

AC coupling 30Hz~200 MHz (1MΩ open)

Dynamic range: 50mVrms~1.0Vrms Sine

150mV$_{P-P}$~4.5V$_{P-P}$ Pulse

Input Impedance: 1MΩ//35pF or 50Ω

Coupling mode: AC or DC

Attenuator: ×1 or ×10

Filter: ending frequency is around 100kHz

Trigger level: -5.000V~+5.000V, step value 5mV

5.13.2 Counter 2

Frequency range: 100MHz~2.5GHz

Dynamic range: -15dBm~+13dBm Sine (Frequency: 100MHz~2.0GHz)

-10dBm~+13dBm Sine (Frequency: 2.0GHz~2.5GHz)

Input Impedance: 50Ω

Coupling mode: AC

5.14 Other Characteristics

5.14.1 Function of storage and recall

The instrument has 4 storage locations to store the operating state.

5.14.2Programmable interface

Standard: RS232 interface and USB interface

Option: IEEE488 interface

5.14.3 Power

Voltage: AC 100V-240V

Frequency: 50Hz/60Hz (1±10%)

Power dissipation: 30VA

5.15 General Characteristic

5.15.1 Ambient: Temperature 10 ℃ ~ 40 ℃

Relative Humidity＜ 80 %

5.15.2 Measurement: 254 mm × 103 mm × 374 mm

5.15.3 Weight: 4.2kg

Note 1: Frequency range (for Sine)

TFG3605:1μHz~500MHz

TFG3610: 1μHz~1000MHz

TFG3615: 1μHz~1500MHz