User's Guide

TFG3860

RF Signal Generator

Introduction

Output frequency ranging 9kHz~6.5GHz, TFG3860 RF Signal Generator provides all-round modulation plans, including standard AM/FM/ØM/Pulse Modulate functions and all support external and internal mode. It can be widely used in fields of communication, R&D, computer, education, Test & Measurement instruments, production, repair and so on.

Main Features:

Frequency Range: 9kHz~6.5GHz

Output frequency resolution: 0.01Hz

Max output power:-130dBm~+20dBm

Amplitude accuracy: ≤0.5dB (typ.)

High signal purity, phase noise<-110dBc/Hz @20kHz (typ.)

Pulse Modulation: on/off ratio up to 70dBc

7 inch capacitive touch screen to provide better experience of human-machine interaction

Abundant interfaces: standard USB HOST, USB DEVICE and LAN

Packing List

TFG3860 RF Signal Generator	1
Power cord	1
CD (User's Guide + PC software)	1
N-BNC connector	1

Overview

Main content in this Manual

Chapter 1 Quick Start

This chapter introduces the front panel, rear panel and user interface of the RF signal generator as well as the precautions when using the instrument for the first time.

Chapter 2 Operating Instruction

This chapter introduces the functions of the keys at the front panel of the RF signal generator as well as the menu functions under the keys in details, and the interfaces function at the rear panel.

Chapter 3 Remote Control

This chapter introduces how to control the RF signal generator remotely.

Chapter 4 Service and Support

This chapter introduces the service and support we can provide to the RF signal generator.

Chapter 5 Specifications

This chapter introduces the main parameters of the RF signal generator.

Note: This document may include technical inaccuracy, and it is only a usage guide for the instrument. Suin Instruments Co., Ltd. will not make any promise to this document, including but not limit to the promise for some special sales and usage. It will not be notified if there were any modification in this documentation.

Chapter 1 Quick Start

This chapter guides users to quickly get familiar with the front panel, rear panel, operation and function of TFG3860.

Main content in this chapter:

1. Preparation for usage
2. Front panel and rear panel
3. Display interface

1. Preparation for usage

1.1 Check the list of supplied items

If the packaging has been damaged, do not dispose the damaged packaging or cushioning materials until the shipment has been checked for completeness and has passed both electrical and mechanical tests.

1.2 Connect the power

Turn on the instrument only the following conditions are met,

Voltage: AC 100~240V

Frequency: 50/60Hz

Power consumption: <60VA

Temperature: 0~40℃

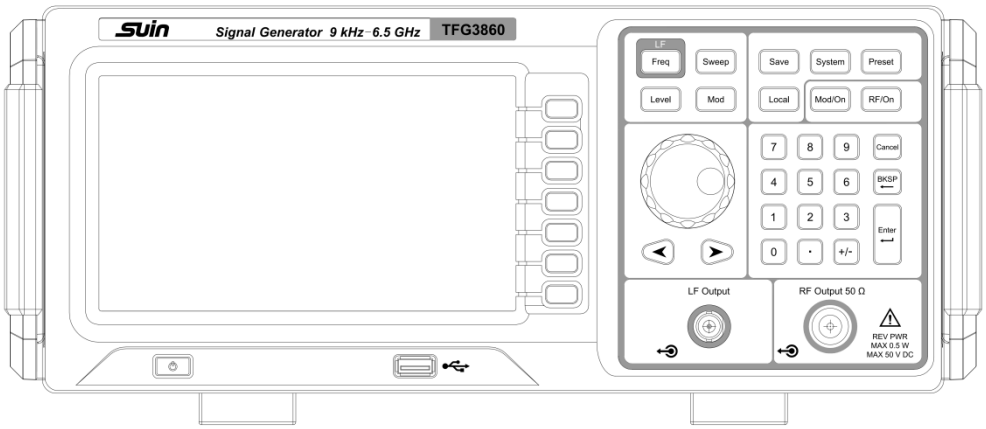
Humidity: <80%

Plug the power cord into an AC220V socket with ground wire and press On /Off switch at the rear panel. Then blinking power button at the front panel indicates the generator well connected with power but still in off state. Only press power button, the backlight of it will light on and the screen will light on too, then please wait until the generator enter the normal working state.

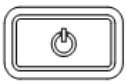
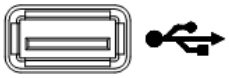
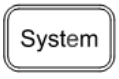
Warning: In order to ensure the security of the operator, use triple- core power socket with ground wire.

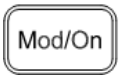
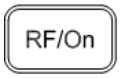
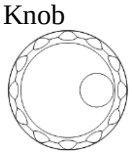
2. Front Panel and Rear Panel

2.1 Front Panel Overview and the keys function introduction



Front panel Diagram

Display screen	7 inch colorful LCD touch screen to show the current main setting and state, and support operating the generator by touching relevant functions.
Power Key 	It is used to turn on or off the RF signal generator.
USB HOST 	This interface is used to connect the USB storage device to update the system or store the system states and etc.
Menu Softkey 	Menu softkeys corresponding to the menus displayed at the left of the softkeys respectively. Pressing the softkey will activate the corresponding menu.
Frequency Key 	Set the frequency parameters of the RF output signal as well as the related parameters of LF output. For the detailed information, refer to "**To Set the Frequency/LF Parameters**".
Amplitude Key 	Set the amplitude parameters of the RF output signal and provide the flatness calibration function. For the detailed information, refer to "**To Set the Amplitude Parameters**".
Sweep Key 	Set the sweep type, sweep manner, sweep mode and etc. For the detailed information, refer to "**Sweep**".
Save and Recall Key 	Save and recall various types of files (such as the instrument state). For the detailed information, refer to "**Store and Recall**".
System Key 	Set the system-related parameters. For the detailed information, refer to "**To Set the System Parameters**".

Restore to Preset Key 	Restore the instrument to the preset state (the factory default state or user-stored state). For the detailed information, refer to "**Reset**". It will switch to screenshot function automatically when a USB flash drive is inserted.
Return to Local Key 	When the instrument is working in the remote mode, you can press this key to return to the local mode.
Modulate Key 	Set the related parameters of amplitude modulation (AM), frequency modulation (FM), phase modulation (ØM), pulse modulation and pulse generator. For the detailed information, refer to "**Modulation**".
Modulate output control Key 	It is used to turn on or off the RF modulation output. When a modulation function (AM, FM, ØM, Pulse Mod) is turned on, press this key, the backlight of the key and the Mod label in the function status area in the user interface are illuminated. At this point, the RF modulation output is turned on and the **[RF Output 50Ω]** connector outputs the modulated RF signal according to the current configuration (the backlight of **RF/on** must be illuminated). Press this key again and the backlight of the key turns off. At this point, the RF modulation output is turned off.
Output control Key 	It is used to turn on or off the RF output. Press this key, the backlight of the key and the RF label in the function status area in the user interface are illuminated. At this point, the RF output is turned on and the **[RF Output 50Ω]** connector outputs RF signal according to the current configuration. Press this key again, the backlight of the key turns off and the RF label in the function status area in the user interface is grayed out. At this point, the RF output is turned off.
Knob 	When setting a parameter, the knob is used to modify the value at the cursor or modify the parameter value at the current step. When editing a filename, it is used to select the desired character. For the storage function, it is used to select the current directory or file. In the parameter information display interface, it is used to switch the parameter tabs.
Arrow Key 	When setting a parameter, the arrow keys are used to enter the parameter editing state and move the cursor to the specified digit. For the storage function, the arrow keys are used to collapse and expand the directory currently selected. When editing a filename, the arrow keys are used to select the desired character. In the parameter information display interface, the arrow keys are used to switch the parameter tabs.

Numeric Keyboard


It is used to input the desired numbers.

Exit Key


When setting a parameter, it is used to exit the parameter input state.

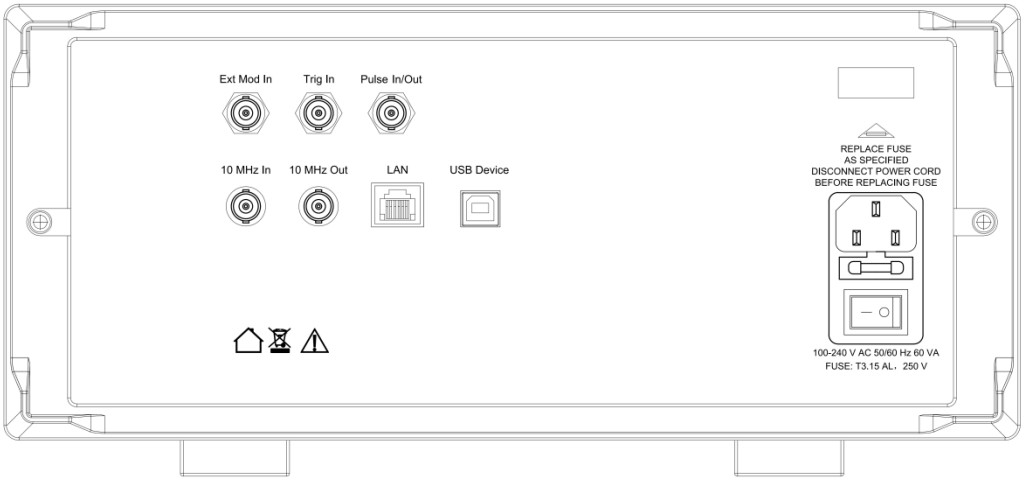
Backspace Key


When setting a parameter, it is used to clear the number in the editing window.

Enter Key


When setting a parameter, it is used to confirm the number in the editing window, and exit the parameter input state.

2.2 Rear Panel Overview and the Interfaces introduction



Rear Panel Diagram

External Modulation Input Connector


When the modulation source of AM or FM/ØM is set to "Ext", this connector is used to input the external modulating signal.

External Trigger Input Connector


When the trigger mode of **Sweep** is 'Ext', this connector is used to input the external trigger signal. You can press **Trig Slope** to set the polarity of the trigger signal to 'Pos' or 'Neg'.
When the pulse modulation source is 'Int' and the trigger mode is 'Ext Trig', it is used to input the external trigger signal.
When the pulse modulation source is 'Int' and the trigger mode is 'Ext Gate', it is used to input the external gated signal.

Pulse Signal Input/Output Connector

The function of this connector is determined by the current working mode of pulse modulation.
Pulse In: When the pulse modulation source is 'Ext', this connector is used to input the external pulse signal.
Pulse Out: When the pulse modulation source is 'Int' and the pulse modulation is turned on, this connector is used to output the pulse signal generated by the internal generator. This output signal is related to the pulse 'Mode' and can be set to 'Single' or 'Multipulse'.

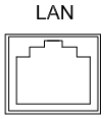
Reference Signal Input Connector

It is used to input the external 10 MHz reference clock signal which is used to synchronize the generator with other instruments.

Reference Signal Output Connector

It is used to output the internal 10 MHz reference clock signal which is used to synchronize the generator with other instruments.

LAN

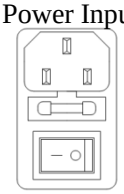


This interface is used to connect the RF signal generator to the PC or network for remote control.

USB DEVICE

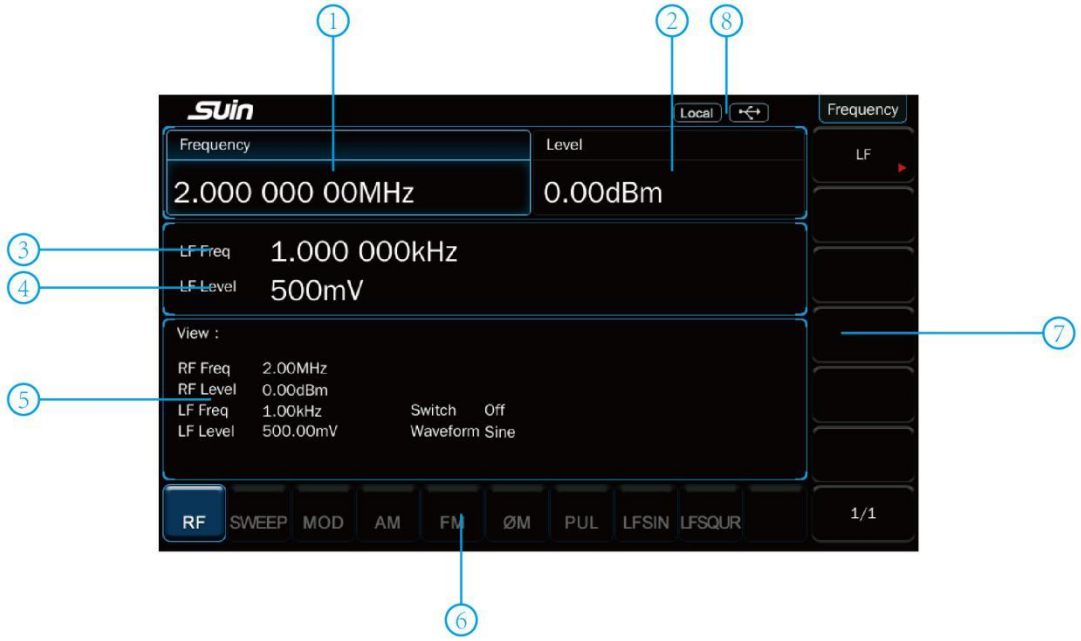
This interface is used to connect the PC for remote control.

Power Input Connector



This RF signal generator can accept 100V-240V, 50/60 Hz AC power supplies.
When the switch is '0', the AC power supply is switched off.
When the switch is '1', the AC power supply is switched on.

3. Display Interface



①	RF Frequency Area	Display the current RF frequency of the RF signal generator.
②	RF Amplitude Area	Display the current RF level of the RF signal generator.
③	LF Frequency Area	Display the current LF frequency of the RF signal generator.
④	LF Amplitude Area	Display the current LF level of the RF signal generator.
⑤	Status Area	Display the current status of the RF signal generator.
⑥	Function Status Area	Display the current states of the functions of the RF signal generator.
⑦	Menu Display Area	The menu items displayed in this area correspond to the soft keys at the right of the screen respectively. Pressing any soft key can enable the corresponding menu function.
⑧	Status Display Area	
		It will display when a USB disk is detected.
	Local	The RF signal generator is working in the local operation mode.
	Remote	the RF signal generator is working in the remote control mode (alternately displaying with Local)

Icon display for function status area

	The RF output is turned on.		The RF output is turned off.
	The RF modulation output is turned on.		The RF modulation output is turned off.
	The ØM modulation output is turned on.		The ØM modulation output is turned off.
	Sweep is turned on.		Sweep is turned off.
	Amplitude modulation is turned on.		Amplitude modulation is turned off.
	Frequency modulation is turned on.		Frequency modulation is turned off.
	LF Sine is turned on.		LF Sine is turned off.
	LF Square is turned on.		LF Square is turned off.
	Pulse modulation is turned on.		Pulse modulation is turned off.

Chapter 2 Operating Instruction

Main content is as below:

1. To Set the Frequency/LF Parameters
2. To Set the Amplitude Parameters
3. Sweep
4. Modulation
5. Save and Recall
6. To Set the System Parameters

1. To Set the Frequency/LF Parameters

1.1 RF Frequency

Set the RF Frequency

Press 

key or touch the frequency in the screen, use the numeric keyboard to input the frequency value and select the desired unit from the pop-up unit menu.

- The frequency units available are GHz, MHz, kHz and Hz.
- You can press Backspace softkey or 

key to delete the number at the left of the cursor.
- You can press the left/right arrow key to enter the parameter editing state and move the cursor to the specified digit; then, rotate the knob to modify the value.
- After the frequency is set, you can rotate the knob to modify the frequency at the current step.

1.2 LF Output

LF output denotes the output of the low-frequency signal generated by the internal generator of the RF signal generator. The LF output can be one of the two commonly used waveforms (sine or square). You can set the frequency and amplitude of the low-frequency signal.

Press 

→ LF to enter the LF output parameter setting menu.

1.2.1 To turn on the LF Output

Press 

→LF →Switch to turn "On" or "Off" the LF output. When "On" is selected, the LF label and the label of the waveform currently selected (Sine or Square) in the function status area of the user interface are illuminated. At this point, the **[LF Output]** connector outputs the LF signal according to the current configuration.

1.2.2 To Select the LF Waveform

Press 

→LF →Waveform to set the waveform of the LF output signal to "Sine" or "Square". The default is "Sine".

1.2.3 To Set the LF Amplitude

Press 

→LF →Level to set the amplitude of the LF signal.

- Use the numeric keyboard to input the amplitude value and select the desired unit from the pop-up unit menu.
- The amplitude units available are V, mV, uV, nV and dBm.
- You can press Backspace softkey or 

to delete the number at the left of the cursor.
- You can press the left/right arrow key to enter the parameter editing state and move the cursor to the specified digit; then, rotate the knob to modify the value.
- You can also rotate the knob to modify the amplitude at the current step.
- The settable ranges of the amplitudes of sine and square are both from 0 V to 3V.

Note: when the frequency is 0 Hz, the LF output is DC signal with the settable amplitude range from -3 V to 3 V.

1.2.4 To Set the LF Frequency

Press 

→ LF→ Freq to set the frequency of the LF signal.

- Use the numeric keyboard to input the frequency value and select the desired unit from the pop-up unit menu. Units GHz, MHz, kHz and Hz are available to select.

- You can press Backspace softkey or 

to delete the number at the left of the cursor.
- You can press the left/right arrow key to enter the parameter editing state and move the cursor to the specified digit; then, rotate the knob to modify the value.
- After the frequency is set, you can rotate the knob to modify the frequency at the current step.

Note:

The settable range of sine frequency is from 0 Hz to 200 kHz.

The settable range of square frequency is from 0 Hz to 20 kHz.

2. To Set the Amplitude Parameters

2.1 Amplitude

Set the RF output amplitude.

Press Level key or touch the level menu in the screen, use the numeric keyboard to input the amplitude value and select the desired unit from the pop-up unit menu.

- The amplitude units available are dBm, -dBm, mV, μV and nV.
- Press Backspace or BKSP to delete the number at the left of the cursor.
- You can press the left/right arrow key to enter the parameter editing state and move the cursor to the specified digit; then, rotate the knob to modify the value.
- You can also rotate the knob to modify the amplitude at the current step.

2.2 Amplitude Unit

Set the unit of the RF output amplitude.

Press Level →Level Unit and select the desired unit from the pop-up unit menu. The output amplitude units available are dBm, dBmV, dBμV, Volts and Watts. Wherein, dBm, dBmV and dBμV are logarithmic units; Volts and Watts are linear units. The default is dBm.

3. Sweep

When the sweep function is turned on, the RF signal generator outputs RF sweep signal from the **[RF Output 50Ω]** connector at the front panel (at this point, the RF output should be turned on).

3.1 Sweep Type

TFG3860 RF signal generator provides three sweep types ("Freq", "Level" and "Freq & Lev"). The sweep function is turned on when any of the sweep types is selected and the Sweep label in the function status area of the user interface is illuminated. By default, the sweep function is turned off. Status Area shows the current specified status.

Press Sweep → Swp type to select the desired sweep type.

- Off: the default state. Turn off the sweep function
- Freq: turn on the frequency sweep function. At this point, the frequency sweep status is displayed in the frequency area in the user interface.

- Level: turn on the amplitude sweep function. At this point, the amplitude sweep status is displayed in the amplitude area in the user interface.
- Freq&Level: turn on the frequency and amplitude sweep functions at the same time. At this point, the frequency and amplitude sweep status are displayed in the frequency and amplitude areas in the user interface respectively.

3.2 Sweep Direction

Press Sweep and use 1/2 softkey to open the 2/2 page of the menu; then, press Direct to select "Fwd" or "Down" and the default is "Fwd".

1) Fwd: the RF signal generator sweeps from the start frequency or start level to the stop frequency or stop level. The display values in the frequency area and amplitude area in the user interface sweep from low to high.

2) Down: the RF signal generator sweeps from the stop frequency or stop level to the start frequency or start level. The display values in the frequency area and amplitude area in the user interface sweep from high to low.

3.3 Sweep Type

TFG3860 provides two sweep types ("List" and "Step") and the default is "Step".

3.3.1 List Sweep

1) Select the list sweep mode

Press Sweep →Type to select "List". At this point, the RF signal generator sweeps according to the sweep list currently loaded.

2）Sweep List

Press Sweep and use 1/2 softkey to open 2/2 page of the menu, then press List Swp softkey to enter the sweep list menu.

- Load List

Press Load softkey to open the Save and Recall interface. At this point, you can select and read the sweep list files saved. For the detailed operations, refer to "**Save and Recall**". After a list is loaded, the storage directory of the file loaded is displayed in View.

- View List

You can press View to view the information of the sweep list currently loaded. Pressing any key (except the arrow keys and knob) at the front panel will return to the sweep list menu.

Note: This menu is only valid after a list file is loaded.

3.3.2 Step Sweep

1) Select the step sweep mode

Press Sweep →Type to select "Step". At this point, the RF signal generator performs step sweep according to the current settings.

2) Set the sweep parameters

Press Sweep and then press Step softkey to set the sweep parameters, such as the start frequency, stop frequency, start level, stop level and number of sweep points.

- Start Frequency

Press Start Freq, use the numeric keyboard to input the start frequency value and select the desired unit from the pop-up unit menu. You can press Backspace or BKSP to delete the number at the left of the cursor.

- Stop Frequency

Press Stop Freq, use the numeric keyboard to input the stop frequency value and select the desired unit from the pop-up unit menu. You can press Backspace or BKSP to delete the number at the left of the cursor.

Note: When the "Start Freq" or "Stop Freq" is modified, the RF signal generator will restart the sweep and output from the specified "Start Freq" or "Stop Freq".

- Start Level

Press Start Level, use the numeric keyboard to input the start level value and select the desired unit from the pop-up unit menu. You can press Backspace or BKSP to delete the number at the left of the cursor.

- Stop Level

Press Stop Level, use the numeric keyboard to input the stop level value and select the desired unit from the pop-up unit menu. You can press Backspace or BKSP to delete the number at the left of the cursor.

Note: When the "Start Level" or "Stop Level" is modified, the RF signal generator will restart the sweep and output from the specified "Start Level" or "Stop Level".

- Sweep Points

Press Points, use the numeric keyboard to input the number of sweep points and then press Confirm. You can press Backspace or BKSP to delete the number at the left of the cursor.

- Dwell Time

The dwell time denotes the duration of a sweep step.

Press Dwell Time, use the numeric keyboard to input the time value and select the desired unit from the pop-up unit menu. You can press Backspace or BKSP to delete the number at the left of the cursor.

- Sweep Space

The sweep space denotes the mode in which the instrument changes from one frequency or amplitude to another within one step.

Press Swp Space to select "Log" or "Lin" sweep space.

Note: Level sweep only supports "Lin" sweep space.

- Sweep Shape

The sweep shape denotes the cycle mode of multiple sweeps.

Press Shape to select "Ramp" or "Triangle" sweep shape.

Ramp: the sweep period always starts from the start frequency or start level to the stop frequency or stop level and the sweep sequence is similar to a ramp waveform.

Triangle: the sweep period always starts from the start frequency or start level to the stop frequency or stop level and then returns back to the start frequency or start level. The sweep sequence is similar to a triangle waveform.

3.4 Sweep Mode

Press Sweep →Mode to select "Cont" or "Single" sweep and the default is "Cont".

- Cont: when continuous sweep is selected, the continuous sweep label is displayed in the frequency or amplitude area in the user interface. When the trigger condition is met, the instrument sweeps continuously according to the current setting.

- Single: when single sweep is selected, the single sweep label is displayed in the frequency or amplitude area in the user interface. When the trigger condition is met, the instrument performs a single sweep according to the current setting and then stops.

Note: If the current sweep mode is "Cont", press Single to switch the sweep mode to "Single" and the instrument will perform a single sweep if the trigger condition is met. If the current sweep mode is "Single", press Single and the instrument will perform a single sweep if the trigger condition is met.

3.5 To Reset the Sweep

If the current sweep direction is "Fwd", press Reset Swp, the instrument stops the current sweep and restarts the sweep from the start frequency or start level.

If the current sweep direction is "Down", press Reset Swp, the instrument stops the current sweep and restarts the sweep from the stop frequency or stop level.

3.6 Trigger Mode

1. Trigger Mode

Select the trigger mode of the whole sweep period.

Press Sweep and use menu softkey 1/2 to open 2/2 page of menu, then, press Trig Mode to select "Auto", "Key", "Bus" or "Ext" trigger.

Note: The following descriptions are valid when the trigger mode of each sweep point in the sweep period is met.

- Auto Trigger

The default mode is auto. If the sweep mode is set to "Cont", the instrument will start sweeping once a sweep type is selected. If the sweep mode is set to "Single", you need to press Single to meet the single sweep condition; after that, the instrument will start a sweep and then stops and wait for next trigger.

- Key Trigger

When "Key" trigger is selected, if the sweep mode is set to "Cont", the instrument starts a sweep each time Key Trig is pressed; if the sweep mode is set to "Single", you need to press Single to meet the single sweep condition and after that, the instrument starts a sweep and then stops each time Key Trig is pressed.

- Bus Trigger

When "Bus" trigger is selected, if the sweep mode is set to "Cont", the instrument starts a sweep each time the "*TRG" command is sent; if the sweep mode is set to "Single", you need to press Single to meet the single sweep condition and after that, the instrument starts a sweep and then stops each time the "*TRG" command is sent.

- External Trigger

In external trigger, the RF signal generator receives the trigger signal input from the **[Trig In]** connector at the rear panel. If the sweep mode is set to "Cont", the instrument starts a sweep each time a TTL pulse signal with the specified polarity is received. If the sweep mode is set to "Single", you need to press Single to meet the single sweep condition; after that, the instrument starts a sweep and then stops each time a TTL pulse signal with the specified polarity is received. To specify the polarity of the TTL pulse signal, press Trig Slope to select "Pos" or "Neg" and the default is "Pos".

2. Point Trigger Mode

Select the trigger mode of each sweep point in a sweep period.

Press Sweep and use menu softkey 1/2 to open 2/2 page of menu, then, press Point Trig to select "Auto", "Key", "Bus" or "Ext" trigger.

Note: The following descriptions are valid when the trigger mode of the corresponding sweep period is met.

- Auto Trigger

The default mode is auto. If the sweep mode is set to "Cont", the instrument will start sweeping each sweep point continuously within a sweep period once a sweep type is selected. If the sweep mode is set to "Single", you need to press Single to meet the single sweep condition; after that, the instrument starts to sweep and then stops after the sweep period expires.

- Key Trigger

When "Key" trigger is selected, if the sweep mode is set to "Cont", the instrument starts to sweep a point each time Key Trig is pressed; if the sweep mode is set to "Single", you need to press Single to meet the single sweep condition and after that, the instrument starts to sweep a point and then stops after the sweep period expires each time Key Trig is pressed.

- Bus Trigger

When "Bus" trigger is selected, if the sweep mode is set to "Cont", the instrument starts to sweep a point each time the "*TRG" command is sent; if the sweep mode is set to "Single", you need to press Single to meet the single sweep condition and after that, the instrument starts to sweep a point and then stops after the sweep period expires each time the "*TRG" command is sent.

Note: When executing the sweep operation, the priority order of the conditions is from high to low: Single Sweep → Trigger Mode→Point Trigger Mode. For example, when both the trigger mode and point trigger mode are set to "Key" trigger:

- **In "Cont" sweep mode, you need to press Key Trig to meet the trigger mode of the whole period and then press Key Trig again to meet the trigger mode of the points within the sweep period; then, the instrument starts to sweep.**
- **In "Single" sweep mode, you need to press Single to meet the single sweep condition and then press Key Trig twice to meet the sweep period trigger mode and point trigger mode respectively; then, the instrument starts to sweep.**

4. Modulation

4.1 Amplitude Modulation (AM)

During amplitude modulation (AM), the modulating signal changes the amplitude of the RF carrier waveform linearly.

4.1.1 To enter AM

Press Mod → AM to enter the amplitude modulation parameter setting menu.

4.1.2 To Turn on Amplitude Modulation

Press Switch to select "On" or "Off".

- On: turn on the AM function. The AM label in the function status area in the user interface is illuminated.
- Off: turn off the AM function and this is the default state.

Note: If a sweep type is selected and the step sweep time is lower than 30 ms, "You can turn on the AM when sweep time is greater than 30ms" will be displayed in the user interface when amplitude modulation is turned on.

4.1.3 To Select the Modulation Source

Press Source to select "Int" or "Ext" modulation source.

1) Internal Source

When "Int" is selected, the internal modulation source is turned on. At this point, the instrument provides the modulating signal and you can set the modulation frequency and modulation waveform of the modulating signal.

2) External Source

When "Ext" is selected, Freq and Waveform are grayed out and disabled. The RF signal generator receives the external modulating signal input from the **[Ext Mod In]** connector at the rear panel. This modulating signal can be any waveform.

Note: To ensure the modulation performance, the input amplitude of the external modulating signal should be less than 1 Vpp.

4.1.4 To Set the Modulation Depth

The modulation depth denotes the extent of output amplitude variation and is expressed as a percentage. The range of AM modulation depth is from 0% to 100%.

Press Depth to set the AM modulation depth.

1) When "Int" modulation source is selected

The AM modulation depth (m_a) and the amplitude difference (ΔP_{sb}) between the carrier and sidebands satisfy the following relation.

$$\Delta P_{sb} = 6 - 20\lg m_a$$

2) When "Ext" modulation source is selected

- 100% modulation depth refers to the modulation depth corresponding to 1 Vpp input amplitude of the external modulation source.
- When the input amplitude of the external modulation source is 0.5 Vpp, the modulation depth actually measured is 50%.

4.1.5 To Select the Modulation Waveform

Press Source to select "Int" modulation source; press Waveform to select "Sine" or "Square" and the default is "Sine".

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.1.6 To Set the Modulation Frequency

Press Source to select "Int" modulation source; press Freq to set the modulation frequency.

- For Sine waveforms, the range of the modulation frequency is from 10 Hz to 100 kHz.
- For Square waveforms, the range of the modulation frequency is from 10 Hz to 20 kHz.

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.1.7 External Coupling

Press EXT Coup to select "AC" or "DC" coupling and the default is "AC".

- When "AC" is selected: the DC components of the external signal input from the **[Ext Mod In]** connector at the rear panel of the instrument will be blocked and the AC components can pass through the connector. The external modulation input port is similar to a high-pass filter which low cutoff frequency is less than 5 Hz.
- When "DC" is selected: all the AC components and DC components of the external input signal can pass through the connector.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.1.8 Input impedance

Press Impedance to select "50ohm", "600ohm" or "100kohm ". You can set the impedance of the **[Ext Mod In]** input channel.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.2 Frequency Modulation (FM)

During frequency modulation (FM), the modulating signal changes the frequency of the RF carrier waveform.

Press Mod → FM/ØM to enter the frequency/phase modulation parameter setting menu.

4.2.1 To Turn on Frequency Modulation

Press FM/ØM to select "FM" and then press Switch to select "On" or "Off".

On: turn on the FM function. The FM label in the function status area in the user interface is illuminated.

Off: turn off the FM function and this is the default state.

Note: The frequency modulation and phase modulation cannot be turned on at the same time. In addition, if a sweep type is selected and the step sweep time is lower than 200 ms, "You can turn on the FM or ØM when sweep time is greater than 200ms" will be displayed in the user interface when frequency modulation is turned on.

4.2.2 To Select the Modulation Source

Press Source to select "Int" or "Ext" modulation source.

- Internal Source

When "Int" is selected, the internal modulation source is turned on. At this point, the instrument provides the modulating signal and you can set the modulation rate and modulation waveform.

- External Source

When "Ext" is selected, Rate and Waveform are grayed out and disabled. The RF signal generator receives the external modulating signal input from the **[Ext Mod In]** connector at the rear panel. This modulating signal can be any waveform.

Note: To ensure the modulation performance, the input amplitude of the external modulating signal should be less than 1 Vpp.

4.2.3 To Set the Frequency Deviation

The frequency deviation is the deviation of the frequency of the modulating waveform relative to that of the carrier waveform and the unit is Hz.

Press Deviation to set the FM frequency deviation.

- For different carrier frequencies, the maximum frequency deviations are different.

4.2.4 To Select the Modulation Waveform

Press Source to select "Int" modulation source; press Waveform to select "Sine" or "Square" and the default is "Sine".

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.2.5 To Set the Modulation Frequency

Press Source to select "Int" modulation source; press Rate to set the modulation frequency.

Use the numeric keyboard or knob to input the desired frequency value.

For sine waveforms, the range of the modulation frequency is from 10 Hz to 100 kHz.

For square waveforms, the range of the modulation frequency is from 10 Hz to 20 kHz.

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.2.6 External Coupling

Press EXT Coup to select "AC" or "DC" coupling and the default is "AC".

- When "AC" is selected: the DC components of the external signal input from the **[Ext Mod In]** connector at the rear panel of the instrument will be blocked and the AC components can pass through the connector. The external modulation input port is similar to a high-pass filter which low cutoff frequency is less than 5 Hz.
- When "DC" is selected: all the AC components and DC components of the external input signal can pass through the connector.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.2.7 Input Impedance

Press Impedance to select "50ohm", "600ohm" or "100kohm ". You can set the impedance of the **[Ext Mod In]** input channel.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.3 Phase Modulation (ØM)

During phase modulation (ØM), the modulating signal changes the phase of the RF carrier waveform.

Press Mod →FM/ØM to enter the frequency/phase modulation parameter setting menu.

4.3.1 To Turn on Phase Modulation

Press FM/ØM to select "ØM" and then press Switch to select "On" or "Off".

- On: On: turn on the ØM function. The ØM label in the function status area in the user interface is illuminated.
- Off: turn off the ØM function and this is the default state.

Note: The frequency modulation and phase modulation cannot be turned on at the same time. In addition, if a sweep manner is selected and the step sweep time is lower than 200 ms, "You can turn on the FM or ØM when sweep time is greater than 200ms" will be displayed in the user interface when phase modulation is turned on.

4.3.2 To Select the Modulation Source

Press Source to select "Int" or "Ext" modulation source.

- Internal source

When "Int" is selected, the internal modulation source is turned on. At this point, the instrument provides the modulating signal and you can set the modulation rate and modulation waveform of the modulating signal.

- External source

When "Ext" is selected, Rate and Waveform are grayed out and disabled. The RF signal generator receives the external modulating signal input from the **[Ext Mod In]** connector at the rear panel. This modulating signal can be any waveform.

Note: To ensure the modulation performance, the input amplitude of the external modulating signal should be less than 1 Vpp.

4.3.3 To Set the Phase Deviation

The phase deviation is the deviation of the phase of the modulating waveform relative to that of the carrier waveform and the unit is rad.

Press Deviation to set the ØM phase deviation.

- For different carrier frequencies, the maximum phase deviations are different.

4.3.4 To Select the Modulation Waveform

Press Source to select "Int" modulation source; press Waveform to select "Sine" or "Square" and the default is "Sine".

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.3.5 To Set the Modulation Frequency

Press Source to select "Int" modulation source; press Rate to set the modulation frequency.

For sine waveforms, the range of the modulation frequency is from 10 Hz to 100 kHz.

For square waveforms, the range of the modulation frequency is from 10 Hz to 20 kHz.

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.3.6 External Coupling

Press EXT Coup to select "AC" or "DC" coupling and the default is "AC"

- When "AC" is selected: The DC component of the external signal input from the **[Ext Mod In]** connector at the rear panel of the instrument is blocked and the AC component can pass through the connector. The external modulation input port is similar to a high-pass filter which low cutoff frequency is less than 5 Hz.
- When "DC" is selected: all the AC components and DC components of the external input signal can pass through the connector.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.3.7 Input Impedance

Press Impedance to select "50ohm", "600ohm" or "100kohm ". You can set the impedance of the **[Ext Mod In]** input channel.

Note: When "Int" modulation source is selected, this menu is grayed out and disabled.

4.4 Pulse Modulation

During pulse modulation, the RF carrier waveform is modulated by the pulse signal.

Press Mod → to enter pulse modulation parameter setting menu.

4.4.1 To Turn on Pulse Modulation

Press Switch to select "On" or "Off".

- On: turn on the pulse modulation function. The PUL label in the function status area in the user interface is illuminated.
- Off: turn off the pulse modulation function and this is the default state.

Note: If a sweep manner is selected and the step sweep time is lower than 50 ms, "You can turn on the PUL when sweep time is greater than 50ms" will be displayed in the user interface when pulse modulation is turned on.

4.4.2 To Select the Modulation Source

Press Source to select "Ext" or "Int" modulation source.

- Internal source

When "Int" is selected, the internal modulation source is turned on. At this point, the internal pulse generator of the instrument provides the modulating signal and you can set the pulse mode, pulse period and pulse width of the modulating signal.

- External source

When "Ext" is selected, Mode, Period, Width, Trig Mode and Pulse Out are grayed out and disabled. The RF signal generator receives the external pulse signal input from the **[Pulse In/Out]** connector at the rear panel as the modulating signal.

4.4.3 To Select the Pulse Mode

Press Source to select "Int" modulation source; press Mode to select "Single" or "Train"

- Single: only a single pulse signal is generated for a pulse period. This is the default pulse mode.
- Train: multiple pulse signals are generated for a pulse period. At this point, Period and Width are grayed out and disabled.

Note: When "Ext" modulation source is selected, this menu is grayed out and disabled.

4.4.4 To Set the Pulse Period

The pulse period is the time interval between two neighboring pulses in periodically-repetitive pulse train.

Press Source to select "Int" modulation source; press Period to set the period of the "Single" pulse modulating signal.

- The range of the pulse period is from 40 ns to 170 s.
- The pulse period determines the repeating frequency of the internal pulse modulating signal.

Note: When "Ext" modulation source or "Train" pulse mode is selected, this menu is grayed out and disabled.

4.4.5 To Set the Pulse Width

Press Source to select "Int" modulation source; press Mode to select "Single". Press Width to set the width of the single-pulse modulating signal.

- The range of the pulse width is from 10 ns to (170 s - 10 ns).
- The pulse width is limited by the minimum pulse width and the pulse period.
- Pulse width ≥ minimum pulse width
- Pulse width ≤ pulse period - 10 ns

Note: When "Ext" modulation source or "Train" pulse mode is selected, this menu is grayed out and disabled.

4.4.6 To Select the Trigger Mode

Press Source to select "Int" modulation source; press Trig Mode to select "Auto, Ext, Ext gate, Key" or "Bus" trigger mode.

- Auto

The default mode is auto. The RF signal generator meets the trigger condition at any time and will start the pulse modulation once the pulse modulation function is turned on.

- External Trigger

In external trigger, the RF signal generator receives the external trigger signal input from the **[Trig In]** connector at the rear panel. The instrument starts a pulse modulation each time a TTL pulse with the specified polarity is received.

To specify the polarity of the TTL pulse, press Trig Slope to select "Pos" or "Neg" and the default is "Pos".

- External Gate Trigger

In external gate mode, the RF signal generator receives the external gated signal input from the **[Trig In]** connector at the rear panel. The instrument starts a pulse modulation within the valid level range each time a gated signal with the specified polarity is received. To specify the polarity of the external gated signal, press Gate Polar to select "Pos " or "Neg", the default is "Pos "

- Key Trigger

In key trigger mode, the instrument starts a pulse modulation each time Key Trig is pressed.

- Bus Trigger

In bus trigger mode, the instrument starts a pulse modulation each time the "*TRG" command is sent.

Note: When "Ext" modulation source is selected, the above-mentioned menus are grayed out and disabled.

4.4.7 Pulse Output

Press Source to select "Int" modulation source; press Switch to select "on", the RF signal source can output a pulse signal generated by the internal pulse generator from the **[Pulse In/Out]** connector at the rear panel.

4.4.8 Trigger Delay

Press Source to select "Int" modulation source and select "Ext Trig" mode; press Trig Delay to set the delay from when the pulse modulating signal receives the external trigger signal.

5. Store and Recall

TFG3860 allows users to store various types of files to the internal or external memory and recall them when required.

TFG3860 provides a local memory (C disk) and an external memory (U disk).

C Disk: provide storage location for state file, flatness csv file, sweep csv file and etc.

U disk: available when a USB storage device is detected at USB Host at front panel.

Press 

at the front panel to enter the store and recall interface.

Note: TFG3860 can recognize files with filenames consisting of English characters and numbers. If other characters are used in the file or folder name, the file or folder name might not be displayed normally in the store and recall interface.

File Type

In the store and recall interface, rotate the knob to select the current storage directory (available when a USB storage device is detected; it is used to switch between C disk and U disk); then, press the right arrow key to unfold the current directory. Press File Type to select the desired file type.

The file types available are "All", "State", "Flat csv", "Swp csv". The default is "All". The description of each file type is as shown in the table below.

File Type	Format	Suffix	Explanation
State	BIN	.STA	Stores the current system status in binary format.
Flat csv	CSV	.CSV	The flatness list file stored in csv format. You can open the file using Excel on PC to view the list information.
Swp csv	CSV	.CSV	The sweep list file stored in csv format. You can open the file using Excel on your PC to view the list information.

Notes: You can generate csv format files using Excel on the PC. Then, you can open the file, edit the required parameter values according to the corresponding file format requirements directly in the Excel table and save it to a USB storage device. In addition, you can also load the file to the RF signal generator when required.

6. To Set the System Parameter

6.1 Language

Press System →Language to select the desired language (Chinese or English).

6.2 Reset

Press System →Reset to set to perform "Power On", "Preset Type" and "Save Preset".

6.2.1. Power On

Press Power on soft key to select "Last" or "Preset".

When "Last" is selected, the system setting before the last power-off will be loaded automatically at power-on.

When "Preset" is selected, the setting defined in Preset Type will be loaded automatically at power-on.

6.2.2 Preset Type

Press Preset type soft key to select "Factory" or "User".

When Power On is set to "Preset", the specified preset type will be loaded at power-on.

After the instruments **starts**, press Preset at the front panel under any operation interface to recall factory settings or user settings.

6.2.3 Save Preset

Press Save Preset to store the current system configuration as user-defined setting in the internal non-volatile memory.When Preset Type is set to "User", the configuration will be loaded when you recall the " Preset " configuration.

Note: When Preset Type is set to "Factory", this menu is grayed out and disabled.

Chapter 3 Remote Control

1. Remote Control Overview

TFG3860 supports to build communication with the PC via the USB or LAN interface to realize remote control. The remote control is realized on the basis of the SCPI (Standard Commands for Programmable Instruments) command set. The remote control is realized in the following two modes.

1.1 User-defined programming

Users can program and control the RF signal generator using the SCPI commands on the basis of NI-VISA (National Instrument-Virtual Instrument Software Architecture) library. For the detailed information of the commands and programming, refer to TFG3860 Programming Guide.

1.2 Use PC software

Users can use the common PC software provided by Suin to send SCPI commands to control the RF signal generator remotely. The software is available on the attached CD.

2. Remote Control Via USB

2.1 Connect the device

Connect the RF signal generator (USB DEVICE) and PC (USB HOST) using a USB cable.

2.2 To set the programmable interface

Press System →I/O Config→Remote I/O→USB to finish.

3. Remote Control Via LAN

3.1 Connect the device

Connect the RF signal source to PC with a LAN cable.

3.2 To set programmable interface

Press System →I/O Config→Remote I/O→LAN to finish.

3.3 Configure the LAN parameters

Automatic configuration (default)

Press System →I/O Config→LAN

Manual configuration

Press System →I/O Config →LAN→ manual →open →IP, set IP Address, Sub Mask, and Gateway

Chapter 4 Service and Support

Warranty

For the technical and material's defects of the products that Suin Instruments Co., Ltd produced and sold, we promise one year warranty since the shipment day. During the warranty, as to the defective products which are proved, we will regroup or replace these defective ones based on the detailed provisions of the warranty.

Except guarantees of this outline and warranty, we factory make no any other forms of expressed or implied guarantees at all. In any case, we factory bear no responsibility with those direct, indirect or any other consequential loss.

Contact

If you have any inconvenience during the use of this product, please contact us directly.

Working time: 8:30am~17:15pm Monday to Friday, Beijing Time

Sales: 0086-0311-83897147

Fax: 0086-0311-83897040

Email: export@suintest.com

Website: www.suindigital.com

Chapter 5 Specifications

This chapter lists the instrument's technical specifications and general technical specifications. Technical specifications are valid when he instrument is stored at least 2 hours in 0℃ to 50℃ and warm up for 40 minutes. Unless otherwise note, the specifications in this manual include the measurement uncertainty.

Typical Value (typ.): the typical performance that 80 percent of the measurement results can meet at room temperature (approximately 25℃). This data is not warranted and does not include the measurement uncertainty.

Nominal Value (nom.): the expected average performance or the designed performance attribute, such as the 50 Ω connector. This data is not warranted and is measured at room temperature (approximately 25℃).

Measured Value (meas.): the performance attribute measured during the design phase used to be compared with the expected performance, such as the variation of the amplitude drift with time. This data is not warranted and is measured at room temperature (approximately 25℃)

Note: Unless otherwise noted, all the values in this manual are the measurement results of multiple instruments at room temperature. (approximately 25℃).

1. Frequency

	TFG3860
Range	9KHz~6.5GHz
Resolution	0.01Hz
Setting time [1]	<10ms(typ.)

Internal Reference Frequency		
Reference frequency	10MHz	
Temperature stability	Temperature range 0℃ to 50℃, reference 25 ℃	＜5×10^{-6}
	OCXO (option)	＜5×10^{-7}
Aging rate		＜5×10^{-6}/year
	OCXO (option)	＜5×10^{-6}/year
Internal reference frequency output	Frequency	10MHz
	Level	+5 dBm to +10 dBm
External reference frequency input	Frequency	10MHz

	Level	0dBm to +10 dBm

[1] Time from receipt of SCPI command or trigger signal to within 0.1 ppm of final frequency (final frequency > 200 MHz) or within 100 Hz (final frequency ≤ 200 MHz).

Frequency Sweep		
Sweep type	Step sweep (equally or logarithmically spaced frequency steps)	
	List sweep (list with arbitrary frequency steps)	
Sweep mode	Single, continuous	
Sweep range	Full frequency range	
Sweep shape	Triangle, ramp	
Step change	Linear or logarithmic	
Number of points	Step sweep	2 to 65535
	List sweep	1 to 6001
Dwell time	20 ms to 100 s	
Trigger mode	Auto, key, external, bus (USB, LAN)	

Spectrum Purity			
Harmonic	CW mode, 100kHz≤f≤6.5GHz， level≤+13 dBm	＜ -30dBc	
Non-harmonics	CW mode, level＞-10 dBm，carrier offset＞10 kHz		
	100kHz≤f≤1.6GHz	<-64dBc	<-70dBc(typ.)
	1.6GHz≤f≤3.6GHz	<-60dBc	<-64dBc (typ.)
	3.6GHz＜f≤6.5GHz	<-55dBc	<-60dBc(typ.)
SSB phase noise	CW mode, carrier offset=20kHz,1Hz measurement bandwidth		
	100kHz≤f<1.6GHz	＜-110dBc/Hz(typ.)	
	1.6GHz≤f≤3.6GHz	＜-107dBc/Hz(typ.)	
	3.6GHz＜f≤6.5GHz	＜-105dBc/Hz(typ.)	
Residential FM	CW mode, f = 1 GHz，RMS		
	0.3 kHz to 3 kHz	＜10 Hz rms, ＜5 Hz rms (typ.)	
	0.03 kHz to 20 kHz		

2. Amplitude

Setting Range			
		Specification level range	Setting range
Max. output level[1]	9kHz ≤f≤6.5GHz	+13 dBm	+20 dBm
Min. output level	9kHz≤f<100 kHz	-110 dBm	-130 dBm
	100kHz≤f≤4GHz	-120 dBm	-130 dBm
	4GHz＜f≤6.5GHz	-110 dBm	-130 dBm
Resolution	0.01dB		

Absolute level uncertainty				
level uncertainty	Temperature range 20℃ to 30℃			
		+13dBm to -60 dBm	-60dBm to -90dBm	-90dBm to Minimum
	9kHz≤f<100kHz	≤0.7dB， ≤0.5dB(typ.)	≤0.7dB， ≤0.5dB (typ.)	≤0.7 dB， ≤0.5dB (typ.)
	100kHz≤f≤4GHz	≤0.7dB， ≤0.5dB(typ.)	≤0.9dB， ≤0.5dB(typ.)	≤1dB， ≤0.5dB(typ.)
	4GHz＜f≤6.5GHz	≤0.7dB， ≤0.5dB(typ.)	≤1dB， ≤0.5dB(typ.)	≤1.3dB， ≤0.7dB(typ.)
VSWR[2]	1MHz≤f≤6.5GHz	＜ 1.8 (typ.)		

Level setting		
Setting time[3]	Fixed frequency, temperature range 20 ℃ to 30 ℃	≤5 ms (typ.)

Max. Reverse Power		
Max. reverse power	Max. DC voltage	50V
	1MHz＜f≤6.5GHz	0.5W

[1] Typical maximum output level up to +20 dBm (±1 dB) when output frequency ≥ 10 MHz

[2] In 50 measurement system, typical, output level ≤ -10dbm.

[3] Time from receipt of SCPI command or trigger signal to within 0.1 dB of final level.

Level sweep		
Sweep type	Step sweep (equally spaced level steps)	
	List sweep (list with arbitrary level steps)	
Sweep mode	single, continuous	
Sweep range	full level range	
Sweep shape	Triangle, ramp	
Step change	Linear	
Number of points	Step sweep	2 to 65535
	List sweep	1 to 6001
Dwell time	20 ms to 100 s	
Trigger mode	Auto, key, external, bus (USB, LAN)	

3. Internal Modulation Generator (LF)

Internal modulation generator (LF)		
Waveform	Sine, square	
Frequency range	Sine	DC to 200 kHz
	Square	DC to 20 kHz
Resolution	0.01Hz	
Frequency error	Same as RF reference generator	
Voltage range	AC	0 to 3Vp
	DC	-3V to 3V
Voltage resolution	2mV	

4. Modulation[1]

Simultaneous modulation				
	AM	FM	ØM	Pulse modulation
AM		●	●	○
FM	●		×	●
ØM	●	×		●
Pulse modulation	○	●	●	

Note: ●: compatible; ×: Incompatible; ○: compatible, but the AM performance will decrease when pulse modulation is turned on.

[1] Unless otherwise noted, the modulation source is sine. The temperature range is from 20℃ to 30℃, carrier frequency ≥ 1 MHz.

AM		
Modulation source	Internal, external	
Modulation depth[1]	0% to 100%	
Resolution	0.1%	
Setting uncertainty	f_{mod} = 1 kHz	<setting×4% +1%
Distortion	f_{mod}=1kHz m <30% level=0dBm	<3%(typ.)
Modulation frequency response	m <80%, DC/10 Hz to 100 kHz	<3dB (nom.)

FM		
Modulation source	Internal, external	
Max. deviation	N[2] × 1 MHz(nom.)	
Resolution	< 0.1% of deviation or 1 Hz, take the greater one (nom.)	
Setting uncertainty	f_{mod} = 1 kHz, internal modulation	<setting×2% +20Hz
Distortion	f_{mod}=1kHz deviation=N[2]×50kHz	<2%(typ)
Modulated frequency response[3]	DC/10 Hz to 100 kHz	<3dB (nom.)

ØM		
Modulation source	Internal, external	
Max. deviation	N[2] × 5rad(nom.)	
Resolution	< 0.1% of deviation or 0.01 rad, take the greater one (nom.)	
Setting uncertainty	f_{mod} = 1 kHz, internal modulation	<setting×1% +0.1rad
Distortion	f_{mod}=1kHz deviation =N[2]×5rad	<1%(typ.)
Modulated frequency response[4]	DC/10 Hz to 100 kHz	<3dB (nom.)

[1] The peak envelope power is not greater than the maximum value of the specification output range.

[2] In this paper, N represents the factor that helps define the determined specification.

N=1 1600 MHz ≤f≤3600 MHz

N=0.5 800 MHz ≤f<1800 MHz

N=0.25 400 MHz ≤f<900 MHz; f<200 MHz

N=0.125 200 MHz ≤f<450 MHz

[3] External modulation, measured at 100 kHz deviation.

[4] External modulation, measured at 5 rad deviation.

Pulse modulation		
Modulation source	Internal, external	
On/off ratio	100 kHz ≤ f＜6.5 GHz	＞70 dB(typ.)
Rise/fall time (10%/90%)	＜ 50 ns，10 ns(typ.)	
Pulse repetition frequency	DC to 1 MHz	
Pulse mode	Single pulses, pulse train	
Pulse period	Setting range	40ns to 170s
	Resolution	10ns
Pulse width	Setting range	10ns to (170s-10ns)
	Resolution	10ns
Trigger delay	Setting range	10ns to 170s
	Resolution	10ns
Trigger mode	Auto, external trigger, external gate, key, bus (USB, LAN)	
Pulse train generator	Number of pulses	1 to 2047
	On/off time range	20ns to 170s
	Number of repetitions per pattern	1 to 256

5. Input and Output

Front panel connector		
RF output	Impedance	50Ω (nom.)
	Connector	N female
LF output	Impedance	50Ω (nom.)
	Connector	BNC female
USB master	Connector	A type

Rear panel connector		
External trigger input	Impedance	1 kΩ (nom.)
	Connector	BNC femal
	Trigger voltage	3.3 V TTL level

Pulse input/output	Impedance	50Ω (nom.)
	Input /output voltage	0V/3.3V (nom.)
External modulation signal input	Impedance	100 kΩ/600 Ω/50 Ω(nom.)
	coupling	AC/DC
	Sensitivity	1 V peak-peak for indicated modulation depth or deviation (nom .)
	Connector	BNC female
10MHz input	Impedance	50Ω (nom)
	Connector	BNC female
10MHz output	Impedance	50Ω (nominal)
	Connector	BNC female
USB device	Connector	B plug
LAN	Network port	RJ-45

6. General characteristic

General characteristic		
Dimension	W ×H ×L	364×154×388mm
Weight		Approx.8kg
Power	Input voltage range	100V to 240V,nominal AC
	Consumption	60VA Max.
	AC range	50/60Hz（1±10%）