Function Generator

GFG-3015

USER MANUAL

GW INSTEK PART NO. 82FG-30150MC1

Good Will Instrument Co., Ltd.
No. 7-1, Jhongsing Rd., Tucheng City, Taipei County 236, Taiwan.

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EC Declaration of Conformity

We

GOOD WILL INSTRUMENT CO., LTD.

No. 7-1, Jhongsing Rd, Tucheng City,Taipei County 236, Taiwan

GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.

No. 69, Lushan Road, Suzhou New District Jiangsu, China

declares that the below mentioned product

GFG-3015

is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Law of Member States relating to Electromagnetic Compatibility (2004/108/EC) and Low Voltage Equipment Directive (73/23/EEC & 93/68/EEC). For the evaluation regarding the Electromagnetic Compatibility and Low Voltage Equipment Directive, the following standards were applied:

◎ EMC

EN 61326-1 : **EN 61326-2-1:**	Electrical equipment for measurement, control and laboratory use—EMC requirements
Conducted and Radiated Emissions CISPR11: 2003+A1: 2004+A2: 2006	Electrostatic Discharge IEC 61000-4-2: 2001
Current Harmonic EN 61000-3-2: 2006	Radiated Immunity IEC 61000-4-3: 2006+A1: 2007
Voltage Fluctuation EN 61000-3-3: 1995+A1: 2001+A2 : 2005	Electrical Fast Transients IEC 61000-4-4: 2004+Corr.1 : 2006+Corr.2 : 2007
----------	Surge Immunity IEC 61000-4-5: 2005
----------	Conducted Susceptibility IEC 61000-4-6: 2003+A1: 2004+A2: 2006
----------	Power Frequency Magnetic Field IEC 61000-4-8: 2001
----------	Voltage Dips/ Interrupts IEC 61000-4-11: 2004

◎ Safety

Low Voltage Equipment Directive 73/23/EEC & amended by 93/68/EEC
Safety Requirements **IEC/EN 61010-1: 2001**

1. Precautions

GFG-3015 is specially designed for safety operation. It has passed through rigorous tests of inclement environment to ensure its reliability and good condition.

The following precautions are recommended to insure your safety and keep the best condition of the equipment.

(1) Safety Terms and Symbols

The following terms and symbols may appear in this manual:

WARNING This statement identifies conditions or practices that could result in injury or loss of life.

CAUTION This statement identifies conditions or practices that could result in damage to this product or other properties.

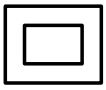
The following terms and symbols may appear on the product:

DANGER	This term indicates an immediately accessible injury hazard.
WARNING	This term indicates that an injury hazard may occur, but is not immediately accessible.
CAUTION	This term indicates potential damage to this product or other properties.

DANGER
High voltage

Protective
Conductor
Terminal

ATTENTION
refer to manual



Double
Insulated

DANGER
Hot surface

Earth
Ground
Terminal

(2) Do not place any heavy objects on the instrument under any circumstances.

(3) Disassembling the instrument

Due to the precision of this instrument, all the procedures of disassembling, adjusting, and maintenance should be performed by a professional technician. If the instrument has to be opened or adjusted under some unavoidable conditions, and to be managed by a technician who is familiar with GFG-3015. Once there is any abnormality, please contact our company or our distributor near you.

(4) Power Supply

AC input should be within the range of line voltage±15%, 50/60Hz. To prevent the instrument from burning up, be sure to check the line voltage before turning on power.

(5) Grounding

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

GFG-3015 can be operated only with an earth grounded AC power cord that connects the case and ground well. This is to protect the user and the instrument from the risk of shock hazard.

(6) Fuse Replacement

WARNING For continued fire protection, replace fuse only with the specific type and rating by qualified personnel. Disconnect the power cord before replacing fuse.

The fuse blows only when there is any wrong on the instrument, which will stop working under this situation. Please find out the cause, then open the outside case **(Please see the Figure (A), Figure (B) on below)** and replace a proper fuse as listed below. Be sure to use the correct fuse before changing the applying location.

F101 : T 0.8A/250V
F100 : T 0.5A/250V

Check the line voltage setting on the rear panel. If the line voltage setting does not match, Please change the line voltage setting according to the following steps:

1. Remove line cord from AC socket.
2. Switch the “AC line voltage switch” to correct setting with flat-blade screwdriver and reinsert.

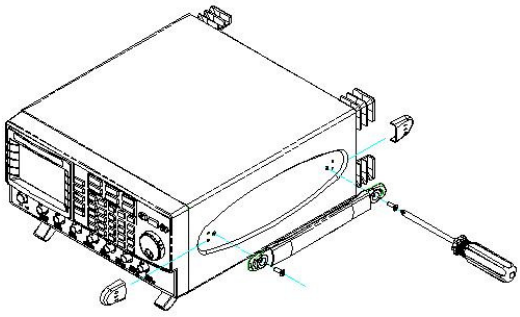


Figure (A)

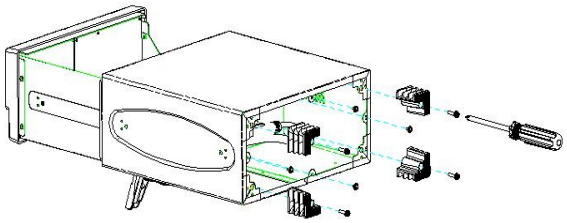


Figure (B)

(7) Cleaning the Cabinet

Disconnect the AC power cord before cleaning the instrument.

Use a soft cloth dampened in a solution of mild detergent and water. Do not spray cleaner directly onto the instrument, since it may leak into the cabinet and cause damage.

Do not use chemicals containing benzing, benzne, toluene, xylene, acetone, or similar solvents.

(8) Operation environment

Indoor use
Altitude up to 2000m
Temperature to satisfy the specification : 18°C ~ 28°C (+64.4°F ~ +82.4°F)
Operating temperature : 0°C ~ 40°C (+32°F ~ +104°F)
Storage temperature : -10°C ~ 70°C (+14°F ~ 158°F)
Relative humidity : up to 90% when 0°C~35°C;
up to 70% when 35°C~40°C
Installation category： CAT Ⅱ(The detail is as Table A)
Pollution degree： 2

Table A

CAT Ⅳ	For measurements performed at the source of the low-voltage installation.
CAT Ⅲ	For measurements performed in the building installation.
CAT Ⅱ	For measurements performed on circuits directly connected to the low-voltage installation.
CAT Ⅰ	For measurements performed on circuits not directly connected to Mains.

(9) Place GFG-3015 in a location with a suitable environment as stated above free from dust, direct exposition of sunlight, and strong effect of magnetic fields.

(10) For United Kingdom

NOTE

This lead/appliance must only be wired by competent persons.

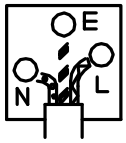
WARNING

THIS APPLIANCE MUST BE EARTHED

IMPORTANT

The wires in this lead are coloured in accordance with the following codes:

Green/Yellow :Earth
Blue :Neutral
Brown :Live (Phase)



As the colours of the wires in mains leads may not correspond with the coloured markings identified in your plug/appliance, proceed as follows:

The wire which is coloured Green and Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⏚ or coloured Green or Green and Yellow.

The wire which is coloured Blue must be connected to the terminal which is marked with the letter N or coloured Blue or Black.

The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.

If in doubt, consult the instructions provided with the equipment or contact the supplier.

This cable/appliance should be protected by a suitably rated and approved HBC mains fuse; refer to the rating information on the equipment and/or user instructions for details. As a guide, cable of 0.75mm^2 should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.

Any moulded mains connector that requires removal/replacement must be destroyed by removal of any fuse and fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if engaged in a live socket. Any re-wiring must be carried out in accordance with the information detailed in this section.

2. Product Introduction

The frequency feedback method applied by GFG-3015 is a new technique that generates stable output frequency with extraordinary accuracy for Function Generator.

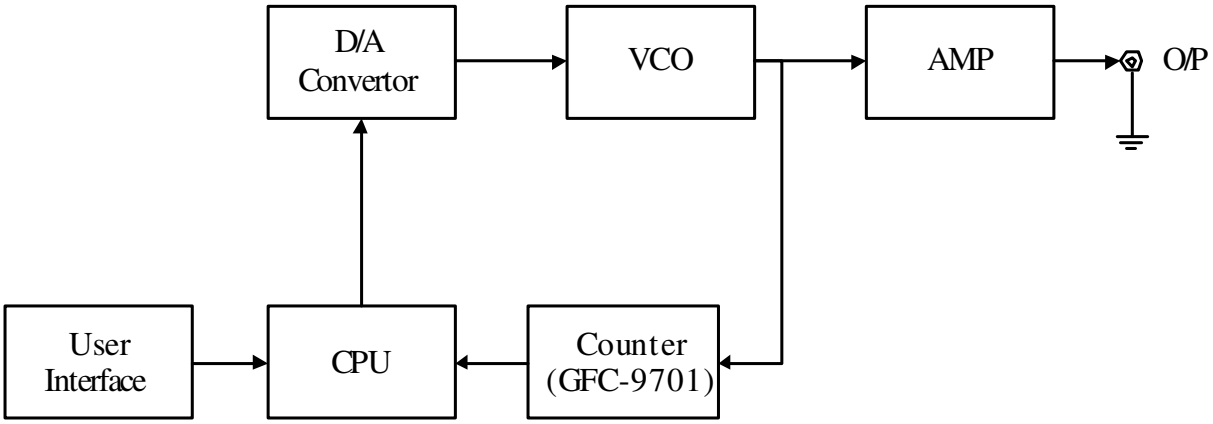
The traditional function generators typically use integrating circuit and constant current circuit techniques that are easily affected by operation temperature or the quality of resistor or capacitor and other key components to occur poor frequency accuracy. The innovative design for GFG-3015 is to get rid of these problems.

The frequency feedback system needs a compatible, powerful frequency counter. GW has designed his own full-function counter chip, GFC-9701, for this system with high frequency test range and full functions, including Period test, Duty test, Ratio test, Time interval, Pulse wide, direct display and direct connect with CPU system.

GFG-3015 uses this Chip to read output frequency value at any time. Then CPU will modify the correct value of D/A converter immediately according to this value, so that the user can get a high accuracy frequency from GFG-3015 Function Generator.

Besides, the GFG-3015 can also generate a high accuracy frequency to provide high frequency resolution.

Graph1 indicates the fundamental construction of a frequency feedback system.



Except the different design from the typical circuit, GFG-3015 system also has micro controller (CPU unit) equipping an additional RS-232 interface functions which will be used on any test system with other instrument or to be controlled by computer.

3. Features

GFG-3015 is a functional Function generator that applies Frequency feedback control system technique and can generate high frequency accuracy with high resolution. Its main signal source can generate waveforms including sine wave, square wave, triangle wave, and ramp wave.

There are additional features listed as follows:

✧ All digitized operation user interface

✧ Output Waveforms of Sine, Square, Triangle, Ramp, Pulse, AM, FM, Sweep, Trigger and Gate or Burst.

✧ Wide output frequency range 0.01Hz ~ 15MHz.

✧ High frequency accuracy 0.02% ± 5 count.

✧ Maximum frequency resolution 10mHz.

✧ Dual displays indicate frequency and amplitude or other necessary information.

✧ Built-in 6-digit INT/EXT Function Counter and up to 150MHz frequency range with high resolution.

✧ INT/EXT AM/FM Modulation with internal modulation signal output.

✧ LIN/LOG Sweep Mode with internal sweep signal output.

✧ VCF of 100:1 EXT Frequency Control.

✧ SYNC Output.

✧ TTL Output.

✧ Synchronization GCV Output.

✧ Variable DC Offset Control

✧ Output Overload Protection

✧ RS232 Interface Standard

4. Specifications

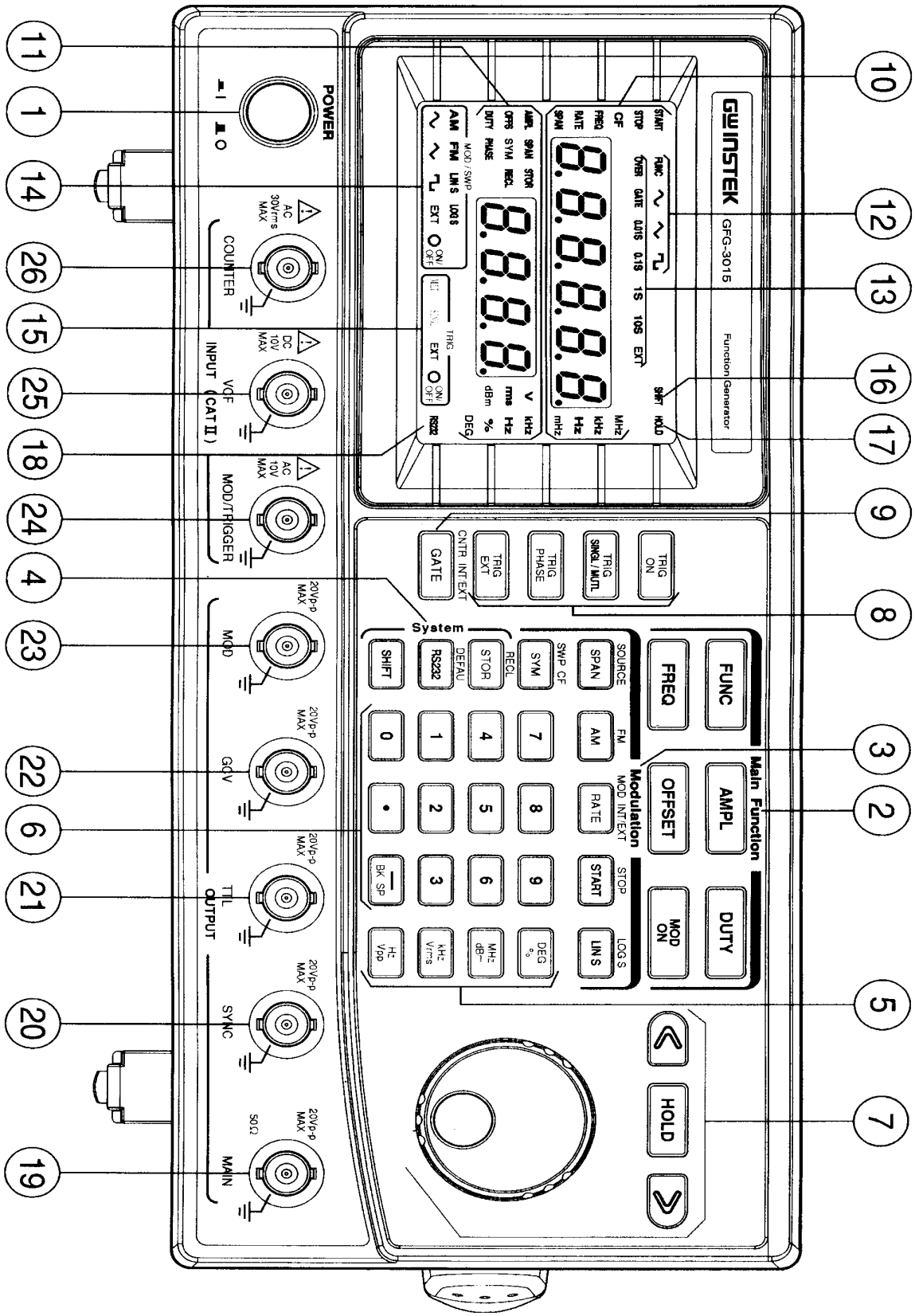
Output Waveforms	Sine, Square, Triangle, ±Ramp, Pulse, AM, FM, Sweep, Trigger, Gate or Burst	
Frequency Range	10mHz~15MHz in 8 Frequency Range (auto switch)	
Frequency Resolution	1.5001MHz ~ 15.0000MHz …(100Hz) 150.01kHz ~ 1.50000MHz…(10Hz) 15.001kHz ~ 150.000kHz…(1Hz) 1.5001kHz ~ 15.0000kHz…(0.1Hz); 150.01Hz ~ 1.50000kHz…(10mHz) 15.01Hz ~ 150.00Hz…(10mHz) 1.51Hz ~ 15.00Hz…(10mHz) 0.01Hz ~ 1.50Hz…(10mHz)	
Frequency Accuracy	0.02% ±5 Count	
Output Impedance	50Ω ± 10%	
Amplitude	Range	10.00V~0.01V (into 50Ω) 4 amplitude ranges | Vac peak | + | Vdc | < 5V
	Resolution	10mV(10.00V~0.01V)
	Accuracy	≤3% ±5count at 10Hz~1MHz ≤10% ±5count at 1MHz~15MHz
	Unit	Vpp, Vrms, dBm
DC Offset	Range	± 5V (into 50Ω) | Vac peak | + | Vdc | < 5V
	Resolution	10mV
	Accuracy	≤3% ±3count at Amplitude Min.
Duty	Control Range	80%:20%:80% to 1MHz
	Resolution	1%
	Accuracy	≤1% to 1MHz at 50% Duty
Sync Output	Impedance	50 Ω ±10%
	Level	>1Vp-p open circuit
Sine	Distortion	≤0.5%(-46dBc) From 10Hz~100kHz ≤-30dBc To 15MHz (Spec. applied form 1Vpp to 10Vpp)
Square	Asymmetry	±1% of period + 3ns
	Rise or Fall Time	<18nSec
Triangle and Ramp	Linearity Error	<1% of full scale output at 100Hz

Sweep	Sweep Mode	Linear or Log sweep
	Sweep Range	150kHz~15MHz 15kHz~1.5MHz 1.5kHz~150kHz 150Hz~15kHz 15Hz~1.5kHz 1.5Hz~150Hz 0.15Hz~15Hz 0.01Hz~1.5Hz
	Width	>100:1(In Same Frequency Range)
	Rate	0.01Hz~10kHz
	Symmetry Control	90:10:90 ; Resolution:1%
	Sweep output	0 to≥-5Vp-p into 10k Ω
Modulation	Types	AM, FM, Sweep, Trigger(int/ext), Gate or Burst (Implement by Trigger Type)
	Waveform	Sine, Square, Triangle, Ramp or Variable Symmetry Pulse
	Rate Frequency Range	10mHz~10KHz in 3 Frequency Range (auto switch)
	Rate Frequency Accuracy	5%±1 count
	Rate Frequency Resolution	10.0kHz~0.1kHz(100Hz) 99Hz~1Hz(1Hz) 0.99Hz~0.01Hz(0.01Hz)
	Symmetry	90%:10%:90%; Resolution:1%
	Symmetry Accuracy	±1 count(≤1%)
	Output Level	≧1Vpp into 10kΩ load
	Sine Wave Distortion	≤2% from 10Hz to 10kHz
	Amplitude Modulation	
	Depth	0~100%
	Modulation Frequency Rate	0.01Hz ~ 10kHz(INT) DC~1MHz(EXT)
	Carries -3dB Bandwidth	<100Hz to >5MHz
	External Sensitivity	≤10Vpp for 100% modulation
	Frequency Modulation	
	Deviation	0~±15%
	Modulation Frequency Rate	0.01Hz ~ 10kHz(INT) DC ~ 50kHz(EXT)
	External Sensitivity	≤5Vpp for 15% deviation

Trigger	Start/Stop Phase Range	-90º ~ +80º
	Rate	0.01Hz~10kHz
	Frequency Range	0.1Hz ~ 1MHz(Useful to 10MHz)
	Ext Trig Frequency Range	DC to 1MHz,TTL compatible input level
	Gate or Burst	Implement by Trigger setting.
VCF	Range	100:1(0 to 10V± 1V) In Same Frequency Range
	Input Linearity	<0.5% to 1MHz,<5% to 10MHz
	Input Impedance	10 k Ω
TTL Output	Level	≧3Vpp
	Fan-out	>10 TTL Load
GCV Output	To set the voltage between 0.2V to 2V as per different Frequency in Same frequency Range	
Frequency Counter	INT/EXT	Switch Selector
	Range	5Hz~150MHz EXT
	Accuracy	Time Base(10MHz) Accuracy ± 1 count
	Time Base	± 20ppm(23ºC ± 5ºC) after 30 minutes warm up
	Resolution	The maximum resolution is 100nHz for 1Hz and 1Hz for 100MHz
	Input Impedance	1MΩ // 150pF
	Sensitivity	≤35mVrms(5Hz~100MHz); ≤45mVrms(100MHz~150MHz)
Interface	RS232	
Accessories	GTL-101 × 2, Instruction Manual × 1, Power cord × 1	
Power Source	115/ 230V AC ±15%, 50/60Hz	
Dimensions	290 (W) × 142 (H) × 346 (D) mm	
Weight	Approx. 5kg	

5. Front and Rear Panels

Front Panel



(1) POWER button : Push the button to turn on the power, and the display is activated. Push again the button to turn off the power.

(2) Main Function keys :

FUNC Key is to set main output waveform in the cycle of Sine, Triangle and Square. When the key is pressed, the related waveform LEDs will light up accordingly.

FREO Key is to set main frequency entry mode. Key in the desired value of frequency by using the number keys or Modify keys and Unit keys.
When the key is pressed, the FREQ LED (on parameter display area A) will be flashing until other mode is set.

AMPL Key is to set main amplitude entry mode. Key in the desired value of voltage by using the number keys or Modify keys and Unit keys.
When the key is pressed, the AMPL LED (on parameter display area B) will be flashing until other mode is set.

OFFSET Key is to set main output offset voltage entry mode. Key in the desired value of voltage by using the number keys or Modify keys and Unit keys.
When the key is pressed, the OFFS LED (on parameter display area B) will be flashing until other mode is set.

DUTY Key is to set main output Duty Cycle entry mode. Key in the desired value of percentage by using the number keys or Modify keys and Unit keys.
When the key is pressed, the DUTY LED (on parameter display area B) will be flashing until other mode is set.

MOD/ON Key is to start performing Amplitude Modulation, Frequency Modulation or Sweep function. When the key is pressed again, the functions will stop.
When the key is pressed, the ON/OFF LED (on MOD/SWP Function LED area) will light up, press again the key, the LED will be off.

(3) Modulation/Sweep Function keys : These keys control the functions of sweep and modulation.

SOURCE
SPAN Key is to set Span of Modulation or Sweep entry mode and choose the source of modulation.
If set to source choose function, must use Secondary Function mode.

FM
AM Key is to choose the type of modulation between AM and FM. If want to set to FM function, must use Secondary Function mode.

INT/EXT
RATE Key is to set Rate of Modulation, Sweep or Trigger entry mode and choose the signal source of Modulation, Sweep or Trigger.
If want to set to signal, must use Secondary Functions mode.

STOP
START Key is to set Start Frequency of Sweep entry mode and Stop Frequency of Sweep entry mode.
If set to Stop Frequency of Sweep entry mode, must use Secondary Functions mode.

LOG S
LIN S Key is to choose the type of Sweep between liner sweep and LOG sweep.
If set to LOG sweep, must use Secondary Function mode.

SWP CF
SYM Key is to set the Duty cycle of Modulation, Sweep or Trigger source entry mode. Key in the desired value of percentage by using number keys or modify keys and Unit keys. If want to set to center frequency of Sweep function that must use Secondary Functions mode.
When the key is pressed, the SYM LED (on parameter display area B) will be flashing until other mode is set.
When you use center frequency entry mode then the CF LED (In parameter display area A) will be flashing until other mode is set.
The detail operation of these keys. Please refer to the instruction in next Chapter.

④ System keys :

RECL
STOR Key is to save or reload the setup parameters of the instrument into or take out from memory; the selected numbers is from 0 to 9, up to 10 groups.

DEFAU
RS232 Key is to start performing RS232 interface. Press the key then use rotational knob to change function states (ON or OFF).
Press the key again then use rotational knob to change the Baud rate. The cycle order is in 300, 600, 1200, 2400, 4800, 9600 and 19200 sequence.
If set the instrument to default state, must use Secondary Function mode.

SHIFT Key is to set the Secondary Functions mode. When the key is pressed, the instrument will choose Secondary Function and the SHIFT LED will light up.

For example, press SHIFT + DEFAU RS232 can recall the default value of the instrument.

⑤ Unit keys : DEG/% MHz/dB KHz/Vrms Hz/VDD In 'Normal' mode, these keys are used to assign the unit and to set the entered value. For example, you can use dBm and Vpp to set the output amplitude. They can be used to set frequency (MHz, kHz, Hz), OFFSET, and PHASE, etc.
In STOR or RECL modes, they are used as 'Enter'.

(6) Entry keys : 0 To 9 and . keys are used to input value. A unit key should be pressed to set the entered value.

-/BK SP key is blank space that used to delete the entered value entirely and the other function is minus key .

(7) Modify keys : ◄ ► Keys are used to change the digit of input value.

User can use the Rotate knob for increasing or decreasing that digit.

HOLD Key to terminate the function of all Modify keys until user press this key again.

When the key is pressed, the HOLD LED will light up until the key is pressed again.

(8) Trigger Function keys : TRIG ON Key is to start performing Trigger function mode. If the key is pressed again, the function will stop.

When the key is pressed, the ON/OFF LED (In Trigger Function LED area) will light up until the key is pressed again (The LED will light off).

SIGL/MUT Key is to choose the type of Trigger, Single-trigger or multi-trigger.

When the key is pressed, the MULT or SINGL LED (In Trigger Function LED area) will light up accordingly.

PHASE Key is to set the phase of trigger function entry mode. Key in the desired value of percentage by using number keys, modify keys and Unit keys.

When the key is pressed, the PHASE LED (In parameter display area B) will be flashing until other mode is set.

TRIG EXT Key is to choose the Trigger signal source, internal or external.

When the key is pressed, the EXT LED (In Trigger Function LED area) will light up accordingly until the key is pressed again (The LED will light off).

INT/EXT

(9) Counter Function key : GATE Key is to set the Gate time of External counter function. The cycle order is according to 0.01s, 0.1s, 1s, and 10s. When the key is pressed, the Gate time LEDs will light up according user's wish.

The other function is to choose input signal source of counter, internal or external, by using Secondary Function mode.

(10) Parameter display Area (A) : The 6-digit Parameter display presents the parameter values and information about the current status and unit.

The START LED light on indicated that the value of display was Start frequency of sweep function right now.

The STOP LED light on indicated that the value of display was Stop frequency of sweep function right now.

The CF LED light on indicated that the value of display was center frequency of sweep function right now.

The FREQ LED light on indicated that the value of display was main output frequency right now.
The RATE LED light on indicated that the value of display was rate frequency of sweep or modulation or trigger function right now.
The SPAN LED light on indicated that the value of display was Span frequency of sweep function right now.
The MHz, kHz, Hz and mHz LED light on indicated that unit according current value of display.

(11) Parameter display Area (B) : This 4-digit Parameter display presents the parameter values and information about the current status and unit.
The AMPL LED light on indicated that the value of display was main output amplitude right now.
The OFFS LED light on indicated that the value of display was main output DC offset voltage right now.
The DUTY LED light on indicated that the value of display was main output duty cycle right now.
The SPAN LED light on indicated that the value of display was span frequency of modulation function right now.
The SYM LED light on indicated that the value of display was modulation signal duty cycle of sweep or modulation or trigger function right now.
The PHASE LED light on indicated that the value of display was phase of trigger function right now.
The STOR LED light on indicated that the value of display was save group number right now.
The RECL LED light on indicated that the value of display was reload group number right now.
The V, rms, dBm kHz, Hz, % and DEG LED light on indicated that unit according current value of display.

(12) Waveform Function LEDs : These LEDs indicate the figure of main output waveform and the current operation functions.

(13) Counter Functions LEDs : These LEDs indicate the GATE TIME of external counter and the current value.

(14) Modulation/Sweep Function LEDs : These LEDs indicate the current status of Sweep and Modulation and the current operation functions.
The AM LED lights on to indicate the setting status of amplitude modulation function.
The FM LED lights on to indicate the setting status of frequency modulation function.
The LIN LED lights on to indicate the setting status of liner sweep function.
The LOG LED lights on to indicate the setting status of LOG sweep function.
The Sine, Triangle and Square LED light on indicated that according Modulation source waveform.
The EXT LED lights on to indicate the external sweep or modulation signal source.
The ON/OFF LED lights on to indicate that the sweep or modulation function is enabled.

(15) Trigger Function LEDs : These LEDs indicate the current status of trigger function on display and the current operation functions.
The MULT LED lights on to indicate the trigger setting status of multi-trigger type.
The SINGL LED lights on to indicate the trigger setting status of Single-trigger type.
The EXT LED lights on to indicate the external trigger signal source.
The ON/OFF LED lights on to indicate that the trigger function is enabled.

(16) Shift mode LED : The SHIFT LED light on indicated that the enter mode is Secondary Functions right now.

(17) Hold mode LED : The HOLD LED lights on to indicate that all modify keys is disabled.

(18) RS-232 Interface LED : The RS232 LED indicates the current operation status with the RS-232 interface bus.

(19) Main Output BNC : This is the BNC connector that outputs all main signals. Output resistance is 50Ω.

(20) Sync Output BNC : This is the BNC connector that outputs sync signals. Output resistance is 50Ω.

(21) TTL Output BNC : This is the BNC connector that outputs TTL level signals.

(22) GCV Output BNC : This is the BNC connector that outputs the voltage between 0.2V and 2V varied with different Frequency

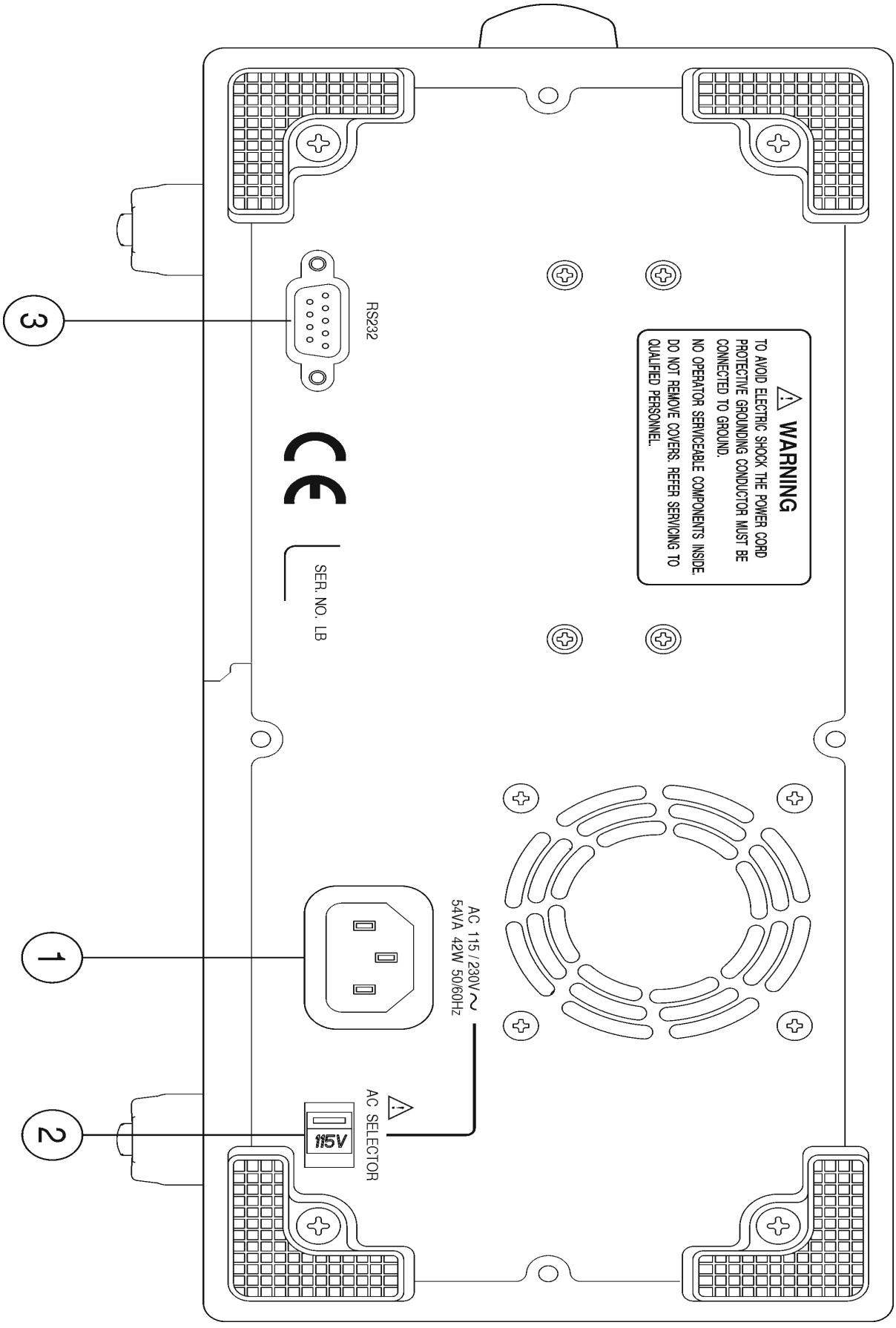
(23) Modulation/Sweep Output BNC : This is the BNC connector that outputs internal Sweep or modulation signals. Output Impedance is 10kΩ.

(24) EXT Modulation/Trigger Input BNC : This is the BNC connector for EXT amplitude/frequency modulation or EXT sweep signal input.
The amplitude modulation index is 100% when ≤10Vpp is input.
The frequency modulation index is 15% when ≤5Vpp is input.
The trigger mode input signal is compatible with TTL level.

(25) VCF Input BNC : This is the BNC connector for VCF signal input.
The frequency variation width index is 100:1 when 10V± 1V is input. Input Impedance is 10kΩ.

(26) EXT Counter Input BNC : This is the BNC connector for external counter signal input. The Input Impedance is 1MΩ // 150pF

Rear Panel


WARNING
TO AVOID ELECTRIC SHOCK THE POWER CORD PROTECTIVE GROUNDING CONDUCTOR MUST BE CONNECTED TO GROUND.
NO OPERATOR SERVICEABLE COMPONENTS INSIDE.
DO NOT REMOVE COVERS. REFER SERVICING TO QUALIFIED PERSONNEL.
RS232
SER. NO. LB
AC 115 / 230V ~
54VA 42W 50/60Hz
AC SELECTOR
115V
1
2
3

(1) Power Entry model	:	This is the AC power input terminal. AC input should be within the range of line voltage±15%, 50/60Hz.
(2) Line Voltage Selector	:	This switch can choose the current line voltage between 115V and 230V
(3) RS232 connector	:	This is the port of serial RS232 interface. The DCE and Baud rate is among 300 ~ 19.2k.

6. Operation

6.1 The First Step Setup For Instrument

❶ Ensure that the voltage of main supply is compatible with this instrument. The selector on the rear panel states the required AC line voltage.
❷ Connect the instrument to main supply with the power cord.
❸ Press the Power Switch, all control functions will be shown on the parameter display area.
❹ Press SHIFT + DEFAU RS232 can recall the default value of this instrument.

6.2 The Setup of Output Function

❶ Press FUNC key to select main output waveform. The Waveform will change when you press this key each time. The cycle order is according to Sine, Triangle, Square.
When the key is pressed, the waveform LEDs will light up according to the mentioned cycle order of output waveform.
❷ Set different duty cycle ratio (not 50%) for Triangle or Square waveform to get ±Ramp or different Pulse width square waveform.

6.3 The Setup of Frequency

❶ Set to Frequency Entry mode by pressing FREO button, the FREQ LED (In parameter display area A) will be flashing.
❷ Key in the desired value of frequency.
❸ Select a proper unit-button to specify the value.
❹ In addition, you can use ◄ ► and the Rotate Knob to adjust the main frequency value you need.

Note: The frequency range of this instrument is from 10mHz to 15MHz in 8 Frequency Range. The details and resolution is as below. But those ranges will auto switch according to the enter value.

Frequency Range	10mHz~15MHz in 8 Frequency Range (auto switch)
Frequency Resolution	1.5001MHz ~ 15.0000MHz …(100Hz) 150.01kHz ~ 1.50000MHz…(10Hz) 15.001kHz ~ 150.000kHz…(1Hz) 1.5001kHz ~ 15.0000kHz…(0.1Hz); 150.01Hz ~ 1.50000kHz…(10mHz) 15.01Hz ~ 150.00Hz…(10mHz) 1.51Hz ~ 15.00Hz…(10mHz) 0.01Hz ~ 1.50Hz…(10mHz)

❖ *Example of the Setup Frequency*

1. To set frequency at 250Hz
Press FREO first, then key in 2 5 0 and press Hz/VDD .

2. To modify the frequency to 850Hz.

Press ◄ or ► to move flash digit to " 2 " position.
Then turn the Rotate Knob clockwise until the digit become to " 8 ".

6.4 The Setup of Amplitude

❶ Set to Main Amplitude entry mode by pressing AMPL button to, now the AMPL LED (In parameter display area B) will be flashing.
❷ Key in the desired value of Amplitude.
❸ Select a proper unit-button to specify the value.
❹ In addition, you can use ◄ or ► and the Rotate Knob to modify the main Amplitude value you need.

❖ *Example of the Setup Amplitude*

1. To set Amplitude at 8 Vpp.

Press AMPL first, then key in 8 and press Hz/Vpp .

2. To modify the Amplitude to 5 Vpp.

Press ◄ or ► to move flash digit to " 8 " position.
Then turn the Rotate Knob anti-clockwise until the digit become to " 5 ".

The input limit : (1) Amplitude should be among 0.01 ~ 10Vpp.
(2) Offset should be among ±5Vpp.
(3) AMPL + |2 × OFFSET| ≤ 10Vpp.

6.5 The Setup of Offset

❶ Set to main DC offset Voltage entry mode by pressing OFFSET button, now the OFFS LED (In parameter display area B) will be flashing.
❷ Key in the desired value of DC offset voltage.
❸ Select a proper unit-button to specify the value.
❹ In addition, you can use ◄ ► and the Rotate Knob to modify the main DC offset voltage value you need.

❖ *Example of the Setup Offset*

1. To set DC offset voltage at 1 Vpp.

Press OFFSET first, then key in 1 and press Hz/Vpp.

2. To modify offset voltage to 2 Vpp.

Press ◄ or ► to move flash digit to " 1 " position.
Then turn the Rotate Knob clockwise until the digit become to " 2 ".

The input limit : (1) Amplitude should be among 0.01 ~ 10Vpp.
(2) Offset should be among ±5Vpp.
(3) AMPL + |2 × OFFSET| ≤ 10Vpp.

6.6 The Setup of Duty

❶ Set Duty cycle of Main output entry mode by pressing DUTY button, the DUTY LED (In parameter display area B) will be flashing.
❷ Key in the desired value of Duty cycle.
❸ Key in the specific value by using Unit button.
❹ In addition, you can use ◄ ► and the Rotate Knob to modify the Duty cycle of Main output value you need.

❖ *Example of the Setup Duty*

1. To set Duty cycle at 60%.
Press DUTY first, then key in 6 0 and press DEG/%.
2. To modify Duty cycle to 30%.
Press ◄ or ► to move flash digit to " 6 " position.
Then turn the Rotate Knob anti-clockwise until the digit become to " 3 ".
The input limit: 80%**:**20%**:**80% at 1MHz.

6.7 The Setting of STORE

The Store button is used to save the setup parameters of the instrument into its memory with the stored group number from 0 to 9, up to 10 groups totally.

❶ Push RECL STOR button.
❷ Key in the group number from 0 to 9.
❸ Press any button from DEG/% MHz/dB kHz/Vms or Hz/Vpp to complete the setting.

❖ *Example of the Setup STOR*

To save a parameter to the RAM of group #5.
Press RECL STOR first, then key in 5 and press Hz/Vpp.

6.8 The Setting of RECALL

The Recall button can retrieve the parameters saved in the RAM.

❶ Push SHIFT and RECL STOR button.
❷ Key in the group number from 0 to 9.
❸ Press any button from DEG/% MHz/dB kHz/Vms or Hz/Vpp to complete the setting.

❖ *Example of the Setup RECALL*

To retrieve a parameters from the RAM of group #6.
Press SHIFT and RECL STOR first, then key in 6 and press Hz/Vpp

6.9 The SHIFT Key and Function Keys

The SHIFT button is used to enable the secondary function of certain function keys with blue printed letters. After pressing the SHIFT button, The SHIFT LED will light up, only the buttons with blue printed letters are working. To release the secondary function by pressing SHIFT again.

❖ **The Secondary Functions**

1. SHIFT + DEFAU / RS232 Return to the default status of GFG-3015.
2. SHIFT + RECL / STOR Retrieve the setup parameters from memory;
3. SHIFT + SWP CF / SYM Display sweep center frequency and get into enter mode.
4. SHIFT + SOURCE / SPAN Change the Modulation source.
5. SHIFT + FM / AM Set Frequency modulation function.
6. SHIFT + INT/EXT / RATE Choose the Modulation type.
7. SHIFT + STOP / START Display Sweep stop frequency and get into enter mode.
8. SHIFT + LOG S / LIN S Set LOG sweep function.
9. SHIFT + INT/EXT / GATE Choose the Counter signal source.

6.10 Setup of LIN or LOG Sweep

GFG-3015 can adopt frequency to sweep its function output for triangle and ramp waves. The type of sweep can be set as linear or log sweep.

❶ Select a main waveform by using FUNC button.

❷ Select a main output amplitude by using AMPL button.

❸ Select the sweep mode by using LOG S / LIN S button.

❹ Press INT/EXT / RATE to set up sweep RATE value (Range from 0.01Hz to 10kHz).

❺ Set the starting frequency by pressing STOP START button and terminate sweep frequency by pressing SHIFT + STOP START .

The start and stop frequency must be at the same sweep frequency range. Please refer to the Note 2 for the details.

The sweep can also be done by enter Center frequency or Span frequency.

Press SHIFT + SWP CF SYM for center frequency entry mode (Note 3).

Press SOURCE SPAN for span frequency entry mode (Note 3).

❻ Press SWP CF SYM to set the Duty of sweep signal (Range 90%:10%:90%).

❼ Press MOD/ON to initiate sweeping.

Note: 1. Please refer to the setup of LIN and LOG Sweep as the sample below.

2. Because all frequency range (0.01Hz ~ 15MHz) of GFG-3015 are composed of 8 frequency ranges (The details as below), So the value of start and stop frequency must be at the same sweep range.

Sweep Range	150kHz ~15MHz 15kHz ~1.5MHz 1.5kHz ~150kHz 150Hz ~15kHz 15Hz ~1.5kHz 1.5Hz ~150Hz 0.15Hz ~15Hz 0.01Hz ~1.5Hz

3. The bandwidth [SPAN] = stop frequency - start frequency
The center frequency = [(stop frequency + start frequency)/2]
The start frequency = center frequency of the sweep - bandwidth/2
The stop frequency = center frequency of the sweep + bandwidth/2
The start and stop frequencies can be freely set according to the users' preference.

4. It won't make any change on execution and result by taking different step sequence.

5. GFG-3015 can output waveform synchronizing with its sweep function. In the example of setting up LIN sweep, the Modulation output terminal will output the waveform of triangle at 1Hz.

❖ *Example of the Setup of LIN Sweep*

To set the following conditions:

- Output function : Sine Wave.
- Output Amplitude : 10Vpp.
- Sweep mode : LIN.
- Speed :1 second.
- Start frequency : 1kHz.
- Stop frequency : 10kHz.
- Sweep signal symmetry: 50%.

Procedure:

❶ Press FUNC to select SINE wave for main output.

❷ Press AMPL 1 0 Hz/Vpp in sequence.

❸ Then press LOG S / LIN S to select linear sweep mode.

❹ Press INT/EXT / RATE 1 Hz/Vpp in sequence.

❺ Press STOP / START 1 KHz/Vrms in sequence.

❻ Press SHIFT STOP / START 1 0 KHz/Vrms in sequence.

❼ Press SWP CF / SYM 5 0 DEG/% in sequence.

❽ Press MOD/ON

❾ The Modulation/Sweep Output BNC will output 1Hz Triangle wave.

In addition, you can use ◄ ► and the Rotate Knob to modify the value you need.

❖ *Example of the Setup of LOG Sweep*

To set the following conditions:

- Output function: Triangle Wave.
- Output amplitude: 10Vpp.
- Sweep mode: LOG.
- Speed: 0.1 second.
- Start frequency: 10kHz.
- Stop frequency: 100kHz.
- Sweep signal symmetry: 90%.

Procedure:

❶ Press FUNC to select TRIANGLE wave for main output.

❷ Press AMPL 1 0 Hz/Vpp in sequence.

❸ Then press SHIFT LOG S / LIN S to select LOG sweep mode.

❹ Press INT/EXT / RATE 1 0 Hz/Vpp in sequence.

❺ Press STOP / START 1 0 KHz/Vrms in sequence.

❻ Press SHIFT STOP / START 1 0 0 KHz/Vrms in sequence.

❼ Press SWP CF / SYM 9 0 DEG/% in sequence.

❽ Press MOD/ON .

❾ The Modulation/Sweep Output BNC will output the 10Hz LOG wave.

In addition, you can use ◄ ► and the Rotate Knob to modify the value you need.

❖ *Error message for Sweep Function*

Because all frequency range (0.01Hz ~ 15MHz) of GFG-3015 are composed of 8 frequency ranges, So the Sweep function has specific restriction on the start and stop frequency. If the value of start and stop frequency not at the same sweep range, then the instrument will show the message to user.
Basically, The message is a suggestion that remind user of selecting a proper sweep frequency range and amend the start or stop frequency.
Please refer to the sample below:

To set the following conditions:

- Start frequency: 100Hz.
- Stop frequency: 1MHz.

Procedure:

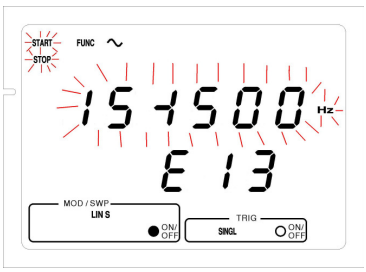
❶ Press LOG S / LIN S to select linear sweep mode.

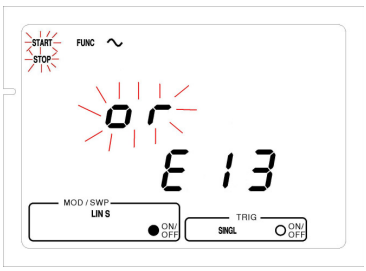
❷ Press STOP / START 1 0 0 Hz/Vpp in sequence.

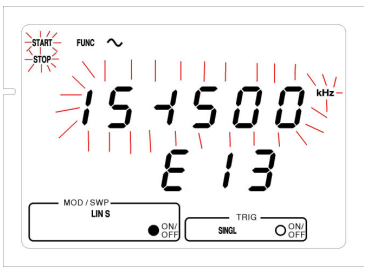
❸ Press SHIFT STOP / START 1 MHz/dB in sequence.

❹ Press MOD/ON.

When the MOD/ON key is pressed, The Display area will show reminding message (The detail as below) If the input sweep ranges out of correct range, The instrument will according to start and stop frequency to suggest possible sweep range.
In this sample, The message of "**15Hz – 1500Hz or 15kHz – 1500kHz**" range will be provided. Because the input start frequency is at 100Hz, so "15Hz – 1.5kHz" can match up the requirement. Besides, the stop frequency is at 1MHz, so "15kHz – 1.5MHz" is close to range requirement. After show the message, The Display area will back to original state (Before press the button).







6.11 Setup of AM Modulation

The AM modulation function offers internal sine, square, and triangle (ramp) signals. Besides, You can select the modulation signal from external (Modulation/Trigger Input BNC).

❶ Set the main output function by using FUNC button .

❷ Set the main output frequency by using FREQ button and number keys.

❸ Set the main output Amplitude by using AMPL button and number keys.

❹ Select the modulation mode by using FM / AM button.

❺ Select the modulation signal source by using SHIFT + INT/EXT / RATE.

❻ Press INT/EXT / RATE to set up modulation RATE value (Range 0.01Hz ~ 10kHz).

❼ Select the modulation signal by pressing SHIFT + SOURCE / SPAN buttons.

GFG-3015 offers sine, square, and triangle (ramp) signals for internal modulation.

❽ Select the amplitude modulation depth by pressing SOURCE / SPAN buttons (Range 100%).

❾Press SWP CF / SYM to set the Duty of modulation signal (Range 90%:10%:90%).

❿Press MOD/ON to start performing amplitude modulation.

Note: 1. Please refer to the setup of amplitude modulation as the example below.

2. When the modulation signal sources from external are selected, the Rate, Span (Depth), Symmetry and source selection will disable as these functions are operated on internal source mode only.

3. It won't make any change on execution and result by taking different step sequence.

4. GFG-3015 can output waveform synchronizing with its modulation function. In the example of setting up amplitude modulation, the Modulation output terminal will output the waveform of sine at 100Hz.

❖ *Example of the Setup of AM Modulation*

To set the following conditions:

- Main function: Sine Wave.
- Main Frequency: 10kHz.
- Main Output Amplitude:10Vpp
- Modulation Mode: Amplitude
- Modulation Source: INT
- Modulation rate: 100Hz.
- Modulation Signal Source: Sine.
- Modulation Depth: 80%.
- Modulation Signal Symmetry: 50%.

Procedure:

❶ Press FUNC to select SINE wave for main output.

❷ Press AMPL 1 0 Hz/Vpp in sequence.

❸ Then press FREO 1 0 KHz/Vrms in sequence. .

❹ Press FM AM to set AM mode.

❺ Press SHIFT INT/EXT RATE to select the source from internal signal.

❻ Press INT/EXT RATE 1 0 0 Hz/Vpp in sequence.

❼ Press SHIFT SOURCE SPAN to select the modulation signal on SINE wave.

❽ Press SOURCE SPAN 8 0 DEG/% in sequence.

❾ Press SWP CF SYM 5 0 DEG/% in sequence.

❿ Press MOD/ON .
The MOD Output BNC will output 100Hz sine wave.

In addition, you can use ◄ ► and the Rotate Knob to modify the value you need.

6.12 Setup of FM Modulation

The FM modulation function offers internal sine, square, and triangle (Ramp) signals. Besides, you can select the modulation signal from external (Modulation/Trigger Input BNC).

❶ Set the main output function by pressing FUNC button.

❷ Set the main output Amplitude by pressing AMPL button and number keys.

❸ Set the main output frequency by pressing FREO button and number keys.

❹ Select the modulation mode by pressing SHIFT + FM AM buttons.

❺ Select the modulation signal source by pressing SHIFT + INT/EXT RATE buttons.

❻ Press INT/EXT RATE to set up modulation RATE value (Range 0.01Hz ~ 10kHz).

❼To select the modulation signal by pressing SHIFT and SOURCE SPAN buttons.
GFG-3015 offers sine, square, and triangle (ramp) signals for internal modulation.

❽ To select the Frequency modulation deviation by pressing SOURCE SPAN buttons. (Range ±15%).

❾Press SWP CF SYM to set the Duty of modulation signal (Range 90%:10%:90%).

❿Press MOD/ON to start performing frequency modulation.

Note: 1. As all frequency range (0.01Hz ~ 15MHz) of GFG-3015 are composed of 8 frequency ranges (The details as below), When the main frequency in FM function is set, a reasonable Span must be considered.
For example, If set the main frequency at 1.4MHz (Range 7) and set Span at 10%, the corrected frequency vibration is from 1.26MHz to 1.54MHz and it will be over Range 7. Therefore, the FM result is faults now, the Span must be reduced in order to get a reasonable result.

Number of Range	Main Setting Frequency	FM variation Range
8	1.5001MHz ~ 15.0000MHz	150kHz~15MHz
7	150.01kHz ~ 1.50000MHz	15kHz~1.5MHz
6	15.001kHz ~ 150.000kHz	1.5kHz~150kHz
5	1.5001kHz ~ 15.0000kHz	150Hz~15kHz
4	150.01Hz ~ 1.50000kHz	15Hz~1.5kHz
3	15.01Hz ~ 150.00Hz	1.5Hz~150Hz
2	1.51Hz ~ 15.00Hz	0.15Hz~15Hz
1	0.01Hz ~ 1.50Hz	0.01Hz~1.5Hz

2. Please refer to the setup of frequency modulation as the example below.
3. When the modulation signal source external is selected, the Rate, Span (Deviation), Symmetry and source selection will disable as those functions are workable on internal source mode only.
4. It won't make any change on execution and result by taking different step sequence.
5. GFG-3015 can output waveform synchronizing with its modulation function. In the example of setting up frequency modulation, the "Modulation output terminal" will output the waveform of sine at 1kHz.

❖ *Example of the Setup of FM Modulation*

To set the following conditions:

- Main function: Sine Wave.
- Main Frequency: 100kHz.
- Main Output Amplitude: 10Vpp.
- Modulation Mode: Frequency
- Modulation Source: INT
- Modulation rate: 1kHz.
- Modulation Signal Source: Sine.
- Modulation Deviation: 10%.
- Modulation Signal Symmetry: 50%.

Procedure:

❶ Press FUNC to select SINE wave for main output.

❷ Press [AMPL] [1] [0] [Hz/Vpp] in sequence.

❸ Then press [FREO] [1] [0] [0] [KHz/Vrms] in sequence.

❹ Press [SHIFT] [FM / AM] to set FM mode.

❺ Press [SHIFT] [INT/EXT / RATE] to select the source from internal signal.

❻ Press [INT/EXT / RATE] [1] [KHz/Vrms] in sequence.

❼ Press [SHIFT] [SOURCE / SPAN] to select the modulation signal on SINE wave.

❽ Press [SOURCE / SPAN] [1] [0] [DEG/%] in sequence.

❾ Press [SWP CF / SYM] [5] [0] [DEG/%] in sequence.

❿ Press [MOD/ON].
The MOD Output BNC will output the 1kHz sine wave.

In addition, you can use [◄] [►] and the Rotate Knob to modify the value you need.

6.13 Setup of Trigger

The Trigger function offers internal trigger source signals. Besides, You can select the signal from external (From Modulation/Trigger Input BNC).

❶ Set the main output function by pressing [FUNC] button .

❷ Set the main output Amplitude by pressing [AMPL] button and number keys.

❸ Set the main output frequency by pressing [FREO] button and number keys.

❹ Select the Trigger type by pressing [SIGL/MUT] button.

❺ Select the Trigger signal source by pressing [TRIG EXT] button.

❻ Press [INT/EXT / RATE] to set up Trigger signal RATE value (Range 0.01Hz ~ 10kHz).

❼ Press [SWP CF / SYM] to set the Duty of Internal trigger signal (Range 90%:10%:90%).

❽ Select the Trigger start Phase by pressing [PHASE] button and number keys. GFG-3015 offers -90º ~ +80º range for internal trigger mode.

❾Press [TRIG ON] to start performing Trigger function.

Note: 1. Please refer to the setup of Trigger function as the example below.

2. When the Trigger signal source from external is selected, the Rate, Phase, and Symmetry will disable as those functions are workable on internal trigger mode only.

3. It won't make any change on execution and result by taking different step sequence.

4. The Trigger function of GFG-3015 must meet the important setting condition with the Main frequency higher than Trigger rate frequency!

❖ *Example of the Setup of Trigger Function*

To set the following conditions:

- Main function: Sine Wave.
- Main Frequency: 5kHz.
- Main Output Amplitude: 10Vpp.
- Trigger type: Multi-trigger
- Trigger Source: INT
- Trigger Signal rate: 1kHz.
- Trigger Phase: 30º.
- Trigger Signal Symmetry: 50%.

Procedure:

❶ Press [FUNC] to select SINE wave for main output.

❷ Press [AMPL] [1] [0] [Hz/Vpp] in sequence.

❸ Then press [FREQ] [5] [KHz/Vrms] in sequence.

❹ Press [SIGL/MUT] to set Trigger Type on Multi-Trigger .

❺ Press [TRIG EXT] to select the source from internal signal.

❻ Press INT/EXT [RATE] [1] [KHz/Vrms] in sequence.

❼ Press SWP CF [SYM] [5] [0] [DEG/%] in sequence.

❽ Press [PHASE] [3] [0] [DEG/%] in sequence.

❾ Press [TRIG ON].

❿ The Trigger Function will perform on output terminal. Please see **Figure (1)**.

Besides, you can use [◄] [►] and the Rotate Knob to modify the value you need.

❖ *Another Example of the Setup of Trigger Function*

All the setting conditions are the same as above mentioned examples except the one set "Single-trigger" of the Trigger Type.

- Trigger type: Single-Trigger

Procedure:

❶ Press [SIGL/MUT] to set Trigger Type to Single-Trigger .

❷ The Trigger Function will perform on output terminal. Please see **Figure (2)**.

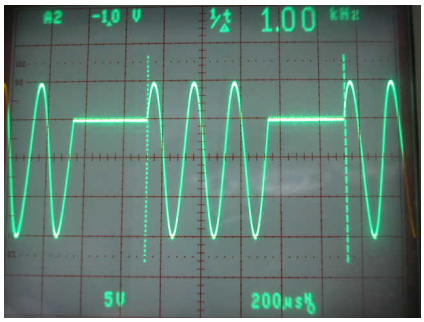


Figure (1)

Figure (2)

6.14 Setup of GATE and BURST

The GFG-3015 provides GATE or BURST function performed with different Trigger settings. If want to set to GATE or BURST function, just proceed some simple calculation and some Trigger setting.
Please refer the setup of GATE or BURST function as the example below.

❖ *Example of the Setup of BURST*

- The detailed calculated formula for BURST as below:
  1. Trigger Rate period = Burst period.
  2. Symmetry of Trigger signal =100% - {{[Burst period – (Burst count × Main Frequency period)]/ Burst period }×100%}
- The Burst period > Burst Count × Main Frequency period.
- Set the Trigger Type to Multi-Trigger type.
- Because the Frequency and Symmetry of Trigger signal have their own accuracy that is different than main frequency, therefore, when the above formula is used to calculate the Symmetry, the value might have to be modified to match the Burst count as desired.

To set the following conditions for BURST function example:

- Main function: Sine Wave.
- Main Frequency: 1kHz(1mS).
- Main Output Amplitude: 10Vpp.
- Burst period: 10ms
- Burst count: 3.

Procedure:

❶ The calculation of setting:
1. Trigger Rate = Burst period = **10mS**(100Hz)
2. Symmetry of Trigger signal =100% - {{[10mS – (3 × 1mS)]/10mS}×100%}= **30%**

❷ Press FUNC to select Sine wave for main output.

❸ Press AMPL 1 0 Hz/Vpp in sequence.

❹ Then press FREQ 1 KHz/Vrms in sequence.

❺ Press SIGL/MUT to set Trigger Type on Multi-Trigger .

❻ Press TRIG EXT to select the source from internal signal.

❼ Press INT/EXT RATE 1 0 0 Hz/Vpp in sequence.

❽ Press SWP CF SYM 3 0 DEG/% in sequence.

❾ Press PHASE 0 DEG/% in sequence.

❿ Press TRIG ON .
The BURST Function will perform on output terminal. Please see **Figure (3)**.

In addition, you can use ◄ ► and the Rotate Knob to modify the value of Trigger signal Symmetry and set the Burst count you need.

Note: 1. It won't make any change on execution and result by taking different step sequence.
2. Use suitable external signal to set the BURST function you need.

❖ *Example of the Setup of GATE*

- The detailed calculate formula of GATE function as below:
  1.Trigger Rate period = Gate period.
  2.Symmetry of Trigger signal = 100% - {[(Gate period – Open Gate time)/ Gate period] ×100%}
- The Gate period > Open Gate time.
- Set the Trigger Type to Multi-Trigger type.
- Because the Frequency and Symmetry of Trigger signal have their own accuracy that is different than main frequency, therefore, when the above formula is used to calculate the Open Gate time, the value might have to be modified to close your desire. It's a normal phenomenon that the Open Gate time may have less accuracy than your wish.

To set the following conditions for Gate function Example:
- Main function: Triangle Wave.
- Main Frequency: 1kHz(1mS).
- Main Output Amplitude: 10Vpp.
- Gate period: 10mS
- Open Gate Time: 6mS.

Procedure:

❶ The calculation of setting:
1. Trigger Rate = Gate period = 10ms(100Hz)
2. Symmetry of Trigger signal =100% - {[(10mS – 6mS)/10mS]×100%}= **60%**

❷ Press FUNC to select Triangle wave for main output.

❸ Press AMPL 1 0 Hz/Vpp in sequence.

❹ Then press FREO 1 KHz/Vrms in sequence.

❺ Press SIGL/MUT to set Trigger Type to Multi-Trigger.

❻ Press TRIG EXT to select the source from internal signal.

❼ Press INT/EXT [RATE] [1] [0] [0] [Hz/Vpp] in sequence.

❽ Press SWP CF [SYM] [6] [0] [DEG/%] in sequence.

❾ Press [PHASE] [0] [DEG/%] in sequence.

❿ Press [TRIG ON].
The GATE Function will perform on output terminal. Please see **Figure (4)**.

In addition, you can use [◄] [►] and the Rotate Knob to modify the value of Trigger signal Symmetry and set the Open Gate Time you need.

Note: 1. It won't make any change on execution and result by taking different step sequence.
2. Use suitable external signal to set the GATE function you need.

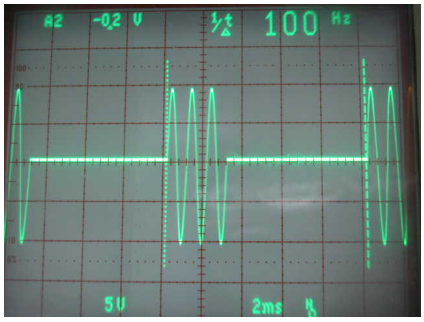


Figure (3)

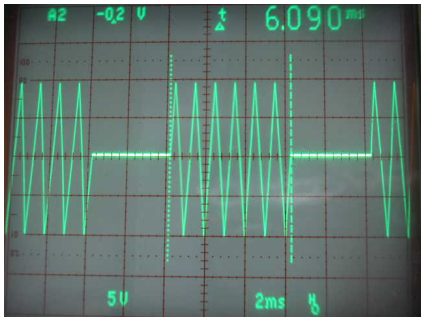


Figure (4)

6.15 Setup of External Counter

The GFG-3015 provides a high performance external frequency counter and with 6 digits counter and up to 150MHz high frequency range with high resolution.

❶ Press [SHIFT] INT/EXT [GATE] button, the EXT and one of the Gate time indicated LEDs will light up, also, the GATE will be flashing according to the Gate time of Counter (In Counter Functions LEDs area). Now, the external counter is in enabling status.

❷ When the INT/EXT [GATE] is pressed, the Gate time LEDs will be according to the cycle of 0.01S, 0.1S, 1S, and 10S to display. The Different Gate time will provide different resolution of counter. So users can use the key to choose whatever the resolution they need.
The detailed relation among the Test frequency, the Gate time, the State LEDs and minimum resolution is as below:

Input Test Frequency	Gate Time	Display Value	State of LEDs	Resolution
1Hz	0.01 Sec	1.0000	Hz	100 μ Hz
	0.1 Sec	1.00000	Hz	10 μ Hz

	1 Sec	1.00000	Hz	10 μ Hz
	10 Sec	000.000	mHz, OVER	1 μ Hz
10Hz	0.01 Sec	10.000	Hz	1mHz
	0.1 Sec	10.0000	Hz	100 μ Hz
	1 Sec	10.0000	Hz	100 μ Hz
	10 Sec	0.00000	Hz, OVER	10 μ Hz
100Hz	0.01 Sec	100.00	Hz	10mHz
	0.1 Sec	100.000	Hz	1mHz
	1 Sec	100.000	Hz	1mHz
	10 Sec	00.0000	Hz, OVER	100 μ Hz
1kHz	0.01 Sec	1.0000	kHz	100mHz
	0.1 Sec	1.00000	kHz	10mHz
	1 Sec	1.00000	kHz	10mHz
	10 Sec	000.000	Hz, OVER	1mHz
1MHz	0.01 Sec	1.0000	MHz	100Hz
	0.1 Sec	1.00000	MHz	10Hz
	1 Sec	1.00000	MHz	10Hz
	10 Sec	000.000	kHz, OVER	1Hz
10MHz	0.01 Sec	10.0000	MHz	100Hz
	0.1 Sec	0.00000	MHz, OVER	10Hz
	1 Sec	0.00000	MHz, OVER	10Hz
	10 Sec	000.000	kHz, OVER	1Hz
100M Hz	0.01 Sec	100.000	MHz	1kHz
	0.1 Sec	00.0000	MHz, OVER	100Hz
	1 Sec	0.00000	MHz, OVER	10Hz
	10 Sec	000.000	kHz, OVER	1Hz

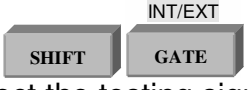
Note: When OVER LED is light on, The means that there are still more values than 6 digits on the Display. User can set more high Gate time to check it.

❖ *Example of the External Counter*

To set the following conditions:

- Counter mode: External.

Procedure:

❶ Press 

to select External source for Counter mode.

❷ Connect the testing signal with “Counter Input BNC connector”.

❸ Press 

to select the Gate time of you need.

❹ The correct frequency will be displayed. (Parameter display Area (A))

6.16 THE VCF Function

The GFG-3015 also provides the function of Voltage control frequency (VCF). Input a voltage from 0 to 10V to the instrument can change the main output frequency. In other word, put a different input voltage will get a different main frequency.

Basically, If user put a voltage that from 0 to 10V to instrument then the variation of main frequency will over 100 times. But that just appear in Same "Frequency variation Range". Because whole frequency range (0.01Hz ~ 15MHz) of GFG-3015 is composed of 8 frequency range (The detail is as below). So User's voltage just can control at same frequency range.

For example, User can't make the main frequency to 10kHz on range 7 by VCF input voltage. It must change to range 6 or 5.

Number of Range	Setting Frequency Range	VCF Frequency variation Range
8	1.5001MHz~15.0000MHz	150kHz~15MHz
7	150.01kHz~1.50000MHz	15kHz~1.5MHz
6	15.001kHz~150.000kHz	1.5kHz~150kHz
5	1.5001kHz~15.0000kHz	150Hz~15kHz
4	150.01Hz~1.50000kHz	15Hz~1.5kHz
3	15.01Hz~150.00Hz	1.5Hz~150Hz
2	1.51Hz~15.00Hz	0.15Hz~15Hz
1	0.01Hz~1.50Hz	0.01Hz~1.5Hz

The input voltage must be input with VCF BNC connector. If need to change **"The frequency variation range"**, proceed 6.3 The Setup of Frequency to modify the main setting frequency.

❖ *Example of the Setup of VCF*

To set the following conditions:

- Main function: Sine Wave.
- Main Output Amplitude: 10Vpp.
- Hope that Main output will output 10kHz on External VCF function.

Procedure:

❶ Press FUNC to select SINE wave for main output.

❷ Press AMPL 1 0 Hz/Vpp in sequence.

❸ Then press FREQ 1 5 0 KHz/Vrms in sequence to choose suitable main output frequency for corresponding "**VCF Frequency variation Range".**

❹ Input about DC 9V to "VCF input BNC connector".

❺ You will get about 10kHz sine signal from Main Output connector.
Also, you can get 10kHz from VCF frequency variation range with the same procedure as above description by setting different value of input VCF voltage.
Please refer to the following:

1) Press FREO 1 5 KHz/Vrms in sequence to choose suitable main output frequency for corresponding "**VCF Frequency variation Range".**
2) Input about **DC 3.3V** to "VCF input BNC connector".
3) You will get about 10kHz Sine signal from Main Output connector.

Note: 1. It won't make any change on execution and result by taking different step sequence.
2. If need to change difference frequency variation range in order to get maximum variation (more than 100 times) at the same range, it is to be suggested to set the main frequency on the top of each frequency range.

6.17 THE GCV Output Function

The GFG-3015 provides the function of Generate control Voltage (GCV). User can get a voltage from 0.2V to 2V from the instrument and the voltage changes following the different main output frequency setting. In other words, if change the setting of the main frequency, the voltage got from GCV output BNC connector will be changed.
Basically, If user set any main frequency then It will get a relative voltage from instrument. But that just appear in same "Frequency Range". Because whole frequency range (0.01Hz ~ 15MHz) of GFG-3015 are composed of 8 frequency range (The detail is as below). So the GCV output voltage (0.2 to 2V) just appear on each same frequency range.

Setting Frequency Range	GCV Output Voltage
15.0000MHz ~ 1.5001MHz	2 ~ 0.2V
1.50000MHz ~ 150.01kHz	2 ~ 0.2V
150.000kHz ~ 15.001kHz	2 ~ 0.2V
15.0000kHz ~ 1.5001kHz	2 ~ 0.2V
1.50000kHz ~ 150.01Hz	2 ~ 0.2V
150.00Hz ~ 15.01Hz	2 ~ 0.2V
15.00Hz ~ 1.51Hz	2 ~ 0.2V
1.50Hz ~ 0.01Hz	2 ~ 0.2V

❖ ***Example of the Setup of GCV***

To set the following conditions:
- Get 2V from GCV output BNC connector.

Procedure:

❶ Press FREO 1 5 0 KHz/Vrms in sequence.
❷ You will get about 2V from GCV output BNC connector.
Also, you can get 2V from another frequency ranges with the same procedure as above description by setting different frequency value.
Please refer to the following:

1) Press FREO 1 5 KHz/Vrms in sequence.

2) You will get about 2V from GCV output BNC connector.

Note: It won't make any change on execution and result by taking different step sequence.

6.18 THE TTL Signal Output Function

The GFG-3015 provides a compatible TTL level signal from TTL Output BNC connector. The frequency of TTL signal output depends on the main output frequency. If need to modify the frequency of the signal, please refer to the procedure of 6.3 The Setup of Frequency.
The amplitude of the signal is fixed at ≧3Vpp which can not be changed.

❖ *Example of the Setup of TTL Output*

To set the following conditions:

- Main Frequency: 5kHz.
- Signal Type: TTL Level.

Procedure:

❶ Set the main frequency to 5kHz(refer to 6.3 The Setup of Frequency).
❷ Connect with "TTL output BNC connector".
❸ You will get a 5kHz/TTL Level signal from the connector.

6.19 THE SYNC Signal Output Function

The GFG-3015 provides a synchronous signal with main output from SYNC Output BNC connector. The frequency of SYNC signal output synchronizes with main output. If need to modify the frequency of the signal, please refer to the procedure of 6.3 The Setup of Frequency.
The amplitude of the signal is fixed at >1Vp-p open circuit which can not be changed.

❖ *Example of the Setup of Sync Output*

To set the following conditions:

- Main Frequency: 10kHz.
- Signal Type: Synchronize with main output.

Procedure:

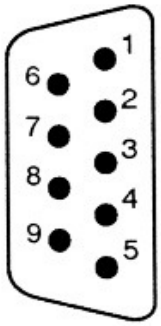
❶ Set the main frequency to 10kHz(refer to 6.3 The Setup of Frequency).
❷ Connect with "SYNC output BNC connector".
❸ You will get a 10kHz signal synchronized with main output from the connector.

6.20 Remote Control - RS232 Interface

The GFG3015 contains a DB 9-pin, male RS-232 connector for serial communication with a computer or terminal. The GFG-3015's RS-232 interface is configured as an RS-232 "Data Terminal Equipment" so that data is sent from pin 3 and received on pin 2. For remote controls, the RS-232 interface has to be connected with a computer or terminal.

❖ Pin Assignments

The Pin assignments of the RS232 connector on the rear panel for DB-9-D.The details are listed below.



1 No connection
2 Receive Data (RxD) (input)
3 Transmit Data (TxD) (output)
4 No connection
5 Signal Ground (GND)
6 No connection
7 No connection
8 No connection
9 No connection

❖ DB9 to DB9 Wiring

The wiring configuration is used for computer with DB9 connectors that configured as Data Terminal Equipment.

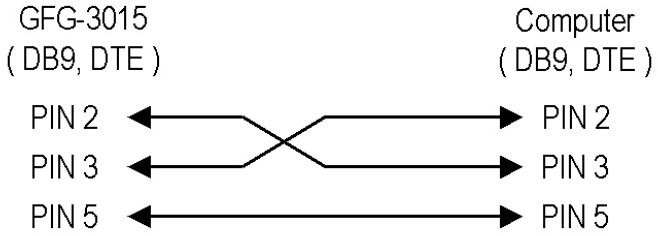


Figure 6.20.1 DB9 to DB9 wiring

When the GFG-3015 is set up with a RS232 interface, please check the following points:

- Do not connect the output line of one DTE device to the output line of the other.
- Many devices require a constant high signal on one or more input pins.
- Ensure that the signal ground of the equipment is connected to the signal ground of the external device.
- Ensure that the chassis ground of the equipment is connected to the chassis ground of the external device.
- Do not use more than 15m of cable to connect devices to a PC.
- Ensure the same configurations are used on the device as the one used on PC terminal.
- Ensure the connector for the both side of cable and the internal connected line are met the demand of the instrument.

❖ Communication Mode

The same baud rate and data format must be set to the instrument and the computer.
The baud rate of the RS-232 interface can be set as listed in the following table.

300	Baud	600	Baud	1200	Baud
2400	Baud	4800	Baud	9600	Baud
19200	Baud				

The data transmission format is N-8-1 (no parity bit, 8 data bits, 1 stop bits).

❖ **Computer's Connection**

A personal computer with a COM port is the essential facility in order to operate the instruction via RS232 interface.

The connections between GFG-3015 and computer are as follows:

- Connect one end of a RS232 cable to the computer.
- Connect the other end of the cable to the RS232 port on the GFG-3015.
- Turn on the GFG-3015.
- Turn on the computer.

❖ **The RS232 connection testing**

If you want to test whether the RS232 connection is working or not, you can send a command from computer. For instance, using a terminal program send the query command (uppercase)
*IDN?

Should return the Manufacturer, model number and firmware version in the following format:
GW,GFG3015,V.1.00

If you do not receive a proper response from the GFG-3015, please check if the power is on, the RS232 configurations are the same on both sides, and all cable connections are active.

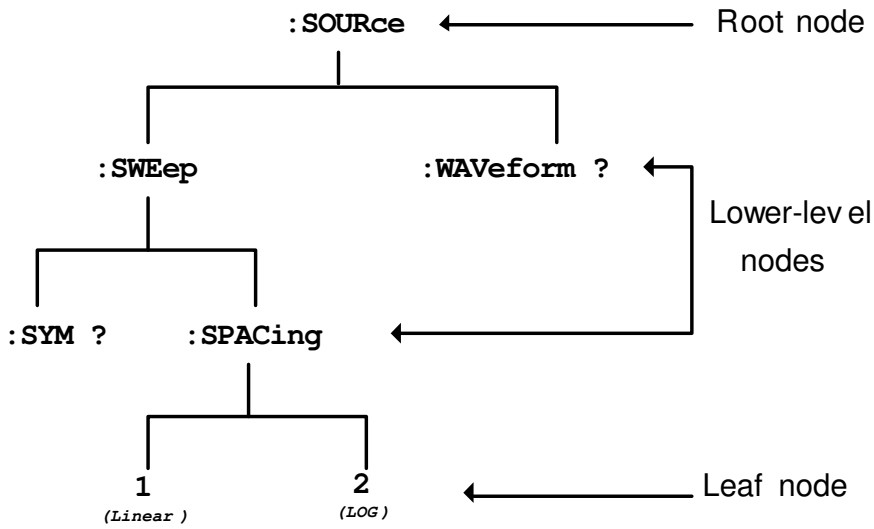
6.21 Commands Syntax

If you want to transfer any of the instructions to an instrument, there are three basic elements must be included.

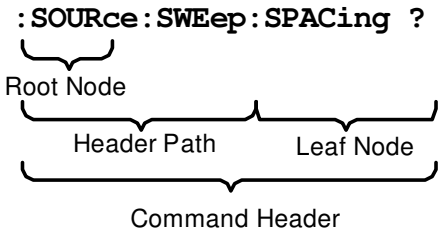
- **Command header**
- **Parameter (if required)**
- **Message terminator or separator**

❖ **Command Header**

The command header has a hierarchical structure that can be represented by a command tree.



The top level of the tree is the root level. A root node is located at the root level. A root node and one or more lower-level nodes form a header path to the last node called the leaf node.
The command header is configured by header path and leaf node. The below Figure shows the command header for the leaf node indicated.



❖ Parameter

If the command has parameters, the values have to be included. In this manual, when we express the syntax of the command, the < > symbols are used for enclosing the parameter type. For instance, the syntax of the command in the following Figure includes the Boolean parameter type

NOTE: Do not include the <, >, or | symbols when entering the actual value for a parameter.

Command Header with Parameter

The following Table defines the Boolean and other parameter types for the GFG-3015.

Parameter Type	Description	Example
Boolean	Boolean numbers or values	1 0
NR1	Integers	0, 1, 18
NR2	Decimal numbers	1.5, 3.141, 8.4
NR3	Floating point numbers	4.5E-1, 8.25E+1
NRf	NR1, NR2, or NR3	1, 1.5, 4.5E-1

Parameter Types for Syntax Descriptions

For the actual value of the parameter type <Boolean>, you have to enter 0 instead of “OFF” or enter 1 instead of “ON”.
The following example includes both the header and a value for the parameter type:

:SOURce:TRIGger:STATe 0

The parameter values which appear in this manual are often separated by a vertical line. This vertical line means the word "or". For example, values for the parameter <Boolean> are
0|1
This means "0 (off) or 1 (on)", any single value is a valid parameter.

❖ Message Terminator

As there is no signal of end message on RS232 bus, therefore use **LF** (Line Feed, 0×0A, or ASCII ‘\n’) as message of terminator. When a series of commands are sent to the instrument, they must add a LF to be a judgment for message terminator. As for query command, the return message of the instrument is also added a LF for PC to judge message terminator.

❖ Entering Commands

The standard, which governs the commands setting for the GFG-3015, is allowed a certain amount of flexibility when you enter commands. For instance, you can abbreviate many commands or combine commands into one message to send to the GFG-3015. This flexibility, called friendly listening, saves programming time and makes the command setting easier to be remembered and used.

❖ Command Characters

The GFG-3015 is not sensitive to the command characters. You can enter commands in either uppercase or lowercase.
You can precede any command with white space characters. You must, however, use at least one space between the parameter and the command header.

❖ **Abbreviating Commands**

Most commands have both long form and short form. The list for each command in this section shows the abbreviations in upper case. For instance, you can enter the query

:SOURce:TRIGger:STATe ?
simply as:

:SOUR:TRIG:STAT ?

6.22 The Commands of RS-232 Serial Interface

❖ **Common commands**

Command	Function	Parameter	Arguments
*CLS	Clear status command		None
*IDN?	Identification query		None
*RCL	Recall command	<NR1>	<0~9>
*SAV	Save command	<NR1>	<0-9>
*RST	Default setting		

❖ **Commands of the instrument**

Command	Function	Parameter	Arguments
:SYSTem:ERR ?	Check the type of error messages		None
:FUNCtion:WAVeform	Set the waveform of main frequency	<NR1>	<1>Sinusoid <2>Triangle <3>Square
:FUNCtion:WAVeform ?	Check the present waveform of main frequency		None
:FREQuency	Set the main frequency	<NRf>	Numeric data
:FREQeency ?	Check the main frequency		None
:AMPLitude:VOLTage	Set the value of output amplitude	<NRf>	Numeric data
:AMPLitude:VOLTage ?	Check the value of output amplitude		None
:AMPLitude:UNIT	Set the unit of amplitude	<NR1>	<1>Vpp <2>Vrms <3>dBm
:AMPLitude:UNIT ?	Check the unit of amplitude		None
:OFFSet	Set the voltage of offset	<NRf>	Numeric data
:OFFSet ?	Check the voltage of offset		None
:DUTY	Set the value of duty	<NR1>	Numeric data
:DUTY ?	Check the value of duty		None
:SOURce:WAVeform	Set the waveform of modulation mode	<NR1>	<1>Sinusoid <2>Triangle <3>Square

Command	Function	Parameter	Arguments
:SOURce:WAVeform ?	Check the present waveform of modulation mode		None
:SOURce:STATe	Set the modulation function	<NR1>	<0>OFF <1>AM <2>FM <3>Sweep
:SOURce:STATe ?	Check the modulation function		None
:SOURce:SOURce	Set the modulation source	<NR1>	<0>Internal <1>External
:SOURce:SOURce ?	Check the modulation source		None
:SOURce:MODAM:RATe	Set the value of AM Rate	<NRf>	Numeric data
:SOURce:MODAM:RATe ?	Check the value of AM Rate		None
:SOURce: MODAM:SPAN	Set the value of AM span	<NR1>	Numeric data
:SOURce: MODAM:SPAN ?	Check the value of AM span		None
:SOURce: MODAM:SYM	Set the value of AM SYM	<NR1>	Numeric data
:SOURce: MODAM:SYM ?	Check the value of AM SYM		None
:SOURce: MODFM:RATe	Set the value of FM Rate	<NRf>	Numeric data
:SOURce: MODFM:RATe ?	Check the value of FM Rate		None
:SOURce: MODFM:SPAN	Set the value of FM span	<NR1>	Numeric data
:SOURce: MODFM:SPAN ?	Check the value of FM span		None
:SOURce: MODFM:SYM	Set the value of FM SYM	<NR1>	Numeric data
:SOURce: MODFM:SYM ?	Check the value of FM SYM		None
:SOURce:SWEep:STARt	Set the value of sweep start frequency	<NRf>	Numeric data
:SOURce:SWEep:STARt ?	Check the value of sweep start frequency		None
:SOURce:SWEep:STOP	Set the value of sweep stop frequency	<NRf>	Numeric data
:SOURce:SWEep:STOP ?	Check the value of sweep stop frequency		None
:SOURce:SWEep:CENTer	Set the value of sweep center frequency	<NRf>	Numeric data
:SOURce:SWEep:CENTer ?	Check the value of sweep center frequency		None
:SOURce:SWEep:SPAN	Set the value of sweep span	<NRf>	Numeric data
:SOURce:SWEep:SPAN ?	Check the value of sweep span		None
:SOURce:SWEep:RATe	Set the value of sweep rate	<NRf>	Numeric data
:SOURce:SWEep:RATe ?	Check the value of sweep rate		None
:SOURce:SWEep:SYM	Set the value of sweep SYM	<NR1>	Numeric data
:SOURce:SWEep:SYM ?	Check the value of sweep SYM		None

Command	Function	Parameter	Arguments
:SOURce:SWEep:SPACing	Set the method of sweep	<NR1>	<0>Linear <1>LOG
:SOURce:SWEep:SPACing ?	Check the method of sweep		None
:SOURce:TRIGger:RATe	Set the value of trigger rate	<NRf>	Numeric data
:SOURce:TRIGger:RATe ?	Check the value of trigger rate		None
:SOURce:TRIGger:STATe	Set the trigger state	<NR1>	<1>ON <0>OFF
:SOURce:TRIGger:STATe ?	Check the trigger state		None
:SOURce:TRIGger:PHASe	Set the value of trigger phase	<NR1>	Numeric data
:SOURce:TRIGger:PHASe ?	Check the value of trigger phase		None
:SOURce:TRIGger:MODe	Set the trigger mode	<NR1>	<0>Single <1>Mutiple
:SOURce:TRIGger:MODe ?	Check the trigger mode		None
:SOURce:TRIGger:SOURce	Set the trigger source	<NR1>	<0> Internal <1> External
:SOURce:TRIGger:SOURce ?	Check the trigger source		None
:SOURce:TRIGger: SYM	Set the value of trigger SYM	<NR1>	Numeric data
:SOURce:TRIGger: SYM ?	Check the value of trigger SYM		None
:SOURce:COUNter:GATe	Set the gate time of counter	<NR1>	<0>001sec <1>01sec <2>1sec <3>10sec
:SOURce:COUNter:GATe ?	Check the gate time of counter		None
:SOURce:COUNter:SOURce	Set the counter source	<NR1>	<0> Internal <1> External
:SOURce:COUNter:SOURce ?	Check the counter source		

❖ **Error Messages**

- **Command Error**

Error Code	SCPI Error Code／Explanation
-100	Command error
-102	Syntax error

- **Execution Error**

Error Code	SCPI Error Code／Explanation
-220	Parameter error
-221	Settings conflict
-222	Data out of range

6.23 The Examples of the Communication Interface Software

```
/*
********************************************************************************
* Microsoft Visual C++ 6.0 for RS-232
*
* This programming example shows how to communicate
* PC and instrument via RS232.
*
*        "*IDN?\n"                    : Ask the Manufacturer, model number
*                                              and firmware
*    ":FREQuency 1000.0\n" : Set Frequency=1000Hz
*
********************************************************************************
*/

#include <stdio.h>
#include <windows.h>

HANDLE InitCom (int Error_Value);

char *Error_Message[6]={
                "Error Create File\n",
                "Error SetCommTimeous\n",
                "Error SetCommState\n",
                "Error SetupComm\n",
                "Error GetCommState\n",
                "Error EscapeCommFunction\n"
};



void main()
{
        char            command_line[100];
        char            Receive_Data[100];
        char            Read_Machine_Number[10] ={"*IDN?\n"};
        DWORD           dwcommand_len=0,dwWritten=0,dwRead=0;
        int             i,error_value=0;
        HANDLE          hComm;
```

```
        /*---------------- initial Data ---------------*/
        for(i = 0; i<100;i++) command_line[i]=0;
        for(i = 0; i<100;i++) Receive_Data[i]=0;

        /*---------------- Create Comm_port -----------*/
         hComm = InitCom(error_value);

        /*---------------- Send *IDN? ------------------*/

        dwcommand_len =sprintf( command_line,"*IDN?\n"); // '\n' is message
                                                                    // terminator
        WriteFile(hComm,command_line,dwcommand_len,&dwWritten,NULL);

        Sleep(1000); // delay 1 sec for instrument response

        ReadFile(hComm,Receive_Data,100,&dwRead,NULL);

        Receive_Data[strlen(Receive_Data)] = 0x00;
        printf("\nReceive_Data = %s\n",Receive_Data);

        /*-------------- Send FRQuency = 1000Hz -----------*/

        dwcommand_len =sprintf( command_line,":FREQuency %3.0f\n",1000.0);
        // '\n' is message terminator
        WriteFile(hComm,command_line,dwcommand_len,&dwWritten,NULL);

        CloseHandle(hComm);
}


/*-----------------------------------------------*/
/*                  Initial RS-232                                  */
/*-----------------------------------------------*/
HANDLE InitCom(int Error_Value)
{
        HANDLE                  hComm;
        COMMTIMEOUTS    CommTimeOuts;

        hComm = CreateFile("COM1",
                GENERIC_READ | GENERIC_WRITE, 0, NULL, OPEN_EXISTING,NULL, NULL );


        if (hComm == INVALID_HANDLE_VALUE)
        {
                printf("%s",Error_Message[0]);
                return FALSE;
        }

        /*----------------- Timeout -------------------*/
        CommTimeOuts.ReadIntervalTimeout = 1;
        CommTimeOuts.ReadTotalTimeoutMultiplier = 0;
        CommTimeOuts.ReadTotalTimeoutConstant = 1000;
        CommTimeOuts.WriteTotalTimeoutMultiplier = 0;
        CommTimeOuts.WriteTotalTimeoutConstant = 5000;
        if(!SetCommTimeouts(hComm, &CommTimeOuts ))
        {
                printf("%s",Error_Message[1]);
                return FALSE;
        }
```

```
        /*-----------------------------------------------*/
        /*                  set baud rate                */
        /*                  ByteSize                     */
        /*                  parity                       */
        /*                  StopBits                     */
        /*-----------------------------------------------*/

        DCB dcb = {0};

        dcb.DCBlength = sizeof(dcb);
        if (!GetCommState(hComm, &dcb))
        {
                printf("%s",Error_Message[2]);
                return FALSE;
        }

        dcb.BaudRate = CBR_9600;    // current baud rate
        dcb.ByteSize = 8;               // number of bits/byte, 4-8
        dcb.Parity = 0;                 // 0-4=no,odd,even,mark,space
        dcb.StopBits=0;                 // 0,1,2 = 1, 1.5, 2

        if (!SetCommState(hComm, &dcb))
        {
                printf("%s",Error_Message[3]);
                return FALSE;
        }

        /*---------------- Set In,Out Queue -----------*/
        if(!SetupComm(hComm, 8196,8196))
        {
                printf("%s",Error_Message[4]);
                return FALSE;
        }

        if (!EscapeCommFunction(hComm, SETDTR))
        {
                printf("%s",Error_Message[5]);
                return FALSE;
        }

        return hComm;

}
```

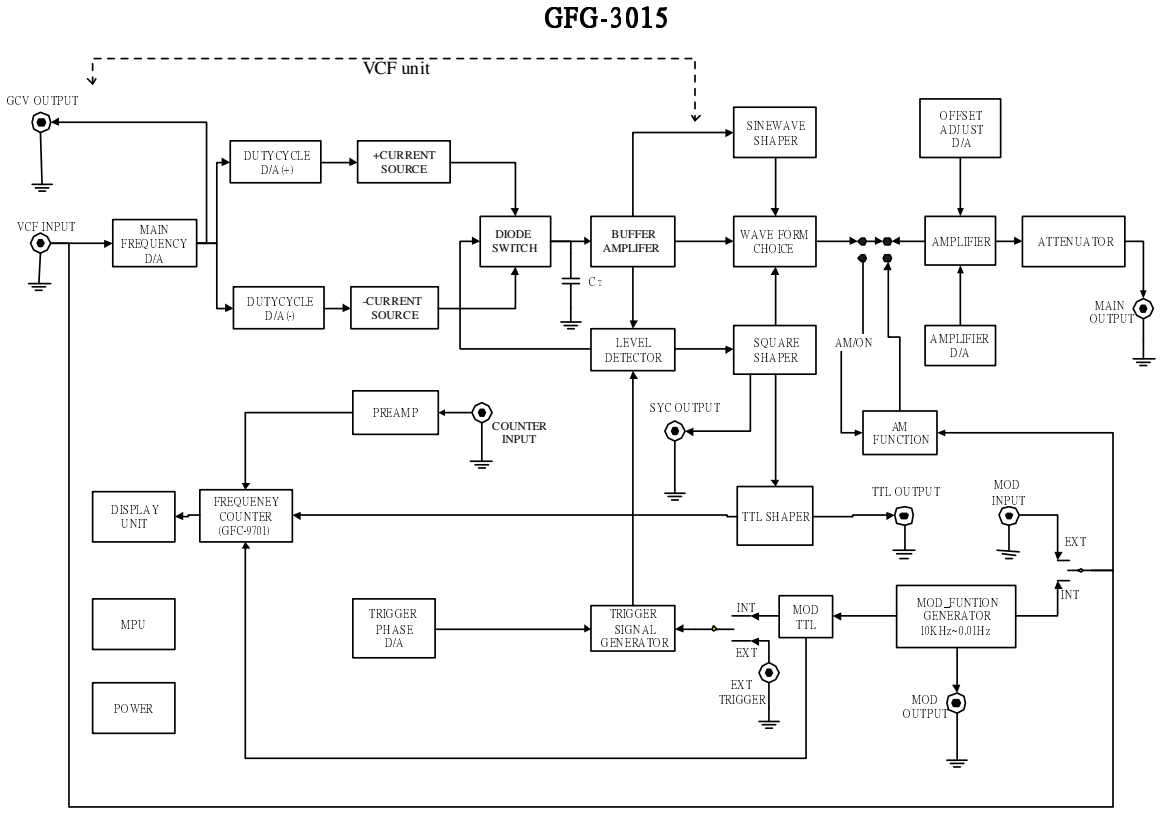
6.24 The Error message of instrument

The operation of GFG-3015 is a whole digitizing operation user interface. Every parameter will be showing by numerically and every input value keyed in with numerical keys. So when key in the value to instrument, it might cause some mistake, now the GFG-3015 will show a corresponding error code on the Display a few seconds later for User to correct the data. (Please refer to the specification or Operation ways). The detailed explanation is as following table:

Error Code	Explanation
E01	Frequency over range
E02	Frequency over Resolution
E03	Amplitude over range
E04	Amplitude over resolution
E05	Offset over range
E06	Offset over resolution
E07	Duty over range
E08	Duty over resolution
E09	Mod rate over range
E10	Mod rate over resolution
E11	Mod sym over range
E12	Mod sym over resolution
E13	Sweep freq over range
E14	Sweep freq over resolution
E15	AM span over range
E16	AM span over resolution
E17	FM span over range
E18	FM span over resolution
E19	Trigger phase over range
E20	Trigger phase resolution
E21	Store setting over settng numbers range
E22	Recall setting over settng numbers range
E23	Recall set is no data

7. The Block Diagram and Description of the System

The block diagram of GFG-3015 consists of a micro processor unit (MPU), a Voltage control Frequency (VCF), many digital to analog converters (D/A) for corresponding block, a square and sine waveform Shaper, a modulation function generator, a Trigger signal generator, a Frequency Counter(GFC-9701), an output amplifier, an attenuator (ATT), and etc. The principles of generating waveforms and Function are shown as follows:



(1) Power

Provide many kind of DC power for every block of the instrument including ± 18V, ±15V and ±5V.

(2) MPU

The Micro Processor Unit is a powerful control center of the instrument that can control many key blocks through D/A converter including the Output waveform, the Frequency, Amplitude, the DC offset, the Duty and the setting the parameters of Sweep or modulation, even the Trigger function. It creates a friendly operation environment.

In addition, it can read the output frequency through the powerful Counter (GFC-9701) and modify the output frequency value at the real time. Therefore, it also provides high accurate signal.

(3) V.C.F

Basically, the Voltage Control Frequency unit is to transform voltage into frequency. It consists of a main frequency D/A, a duty cycle D/A, a positive/negative constant current source, a diode switch unit, a buffer, a level detector and an integral capacitor, and etc.

The MPU puts a specific value to the main frequency D/A which will generate a corresponding voltage for the reference of the duty cycle D/A, then two different polar voltages for current source unit will be generated by the duty cycle D/A, one is a positive voltage from the positive duty cycle D/A and the other is a negative voltage from the negative duty cycle D/A.

The current source block will transform two different polar voltages of the duty cycle D/A output into two different polar correspond constant current. These currents will be charged or discharged by the diode switch unit to the integral capacitor C_T, and the voltage of the C_T will become a continuous symmetrical triangle waveform.

The diode switch movement is controlled by the level detector and the voltage of level detector from the triangle waveform, so does the triangle wave oscillator.

If the positive and negative duty cycle D/A has different values, then the current of charge and discharge will be different. Therefore, the triangle waveform should have unsymmetrical duty.

(4) Frequency setting

The same status as the VCF above, the MPU puts a specific value to the main frequency D/A, the VCF unit will generate a correspond frequency (Symmetrical triangle wave), then, input a desire frequency value to the instrument, the MPU will set the frequency accordingly.

(5) Description of every kind of Waveform

The GFG-3015 provides many kinds of waveforms including Sine, Triangle, Square, Ramp and Pulse. Please refer to the following for details:

1. **Triangle and Ramp Waveform**

   The same status as the VCF above, the output voltage of the VCF unit is a symmetrical triangle wave which can pass the waveform choice, the output amplifier, the ATT, and the output through the Main Output terminal.

   Regarding the Ramp wave, if the positive and negative duty cycle D/A has different value, then the triangle waveform should have unsymmetrical duty, that is the positive and negative Ramp waveform.

2. **Sine Waveform**

   The procedure of generating triangle waveforms is similar to that of generating the sine waveforms, except that the triangle signal can pass a sine wave shaper circuit between the VCF unit and the output amplifier, and the shaper circuit can change the waveform type from triangle to sine.

3. **Square and Pulse Waveform**

   The procedure of generating the triangle waveforms is similar to that of generating the square waveforms. except that the triangle signal can pass a square wave shaper circuit (Comparator circuit) between the VCF unit and the output amplifier.

   Regarding the Pulse waveform, if the positive and negative duty cycle D/A has different value, then the square waveform should have unsymmetrical duty, that is the positive and negative Pulse waveform.

(6) Amplitude and DC offset

The Amplifier of GFG-3015 is similar to lineally multiplier (EL4451). The amplitude of this amplifier varies with the different control voltage.

The control voltage comes from the Amplitude of the D/A converter. The MPU puts a specific value to the D/A converter which will generate a corresponding voltage to main output Amplifier, from which, user will get different output amplitude.

The procedure of the amplitude setting is similar to that of DC offset setting, except that there is another D/A converter (Offset adjust D/A) to change the DC offset of output amplifier.

(7) Modulation Function

The GFG-3015 provides two different kinds of modulation functions, one is Amplitude modulation and the other is Frequency modulation.

The instrument has another internal independent function generator which can generate Sine, Triangle, and Square waveform with the frequency range from 0.01Hz to 10kHz, and the symmetry and amplitude of waveform are adjustable. The full function generator is used to make the source for modulation even trigger function.

The detailed principles of modulation is as follows:

1. Amplitude Modulation

The AM function block is for general purpose of the Amplitude modulation circuit (MC1496), including a carrier signal input, an audio signal input and a modulation output. The output amplitude of carrier signal is decided by the audio signal.

The carrier signal is obtained from the main waveform (can select Sine, Triangle and Square), and the audio signal is obtained from a internal independent of function generator.

Set all the parameters of Amplitude modulation by selecting the Waveform (modulation source), the Amplitude (Span), the Frequency (Rate) and the Duty (Symmetry) of the generator.

The output of AM function block is to correct AM waveform and pass the output amplifier, the ATT, and the output through the Main Output terminal. The function includes the internal modulation and the external modulation with the same operation procedure, except that the modulation signal source is obtained from the external MOD input terminal.

2. Frequency Modulation

The principles of the VCF have been described previously, the voltage varies with the different frequency, and the signal obtained from the internal independent function generator is put to the main frequency D/A, then the frequency of the VCF will be according to this signal.

Set all the parameters of the Frequency modulation by selecting the Waveform (modulation source), the Amplitude (Span), the Frequency (Rate) and the Duty (Symmetry) of the generator.

The output of VCF will become FM function waveform and pass the waveform choice, the output amplifier, the ATT, and the output through the Main Out terminal.

This function includes internal modulation and external modulation with the same operation procedure. The only difference with external modulation is that the modulation signal source will come from external MOD input terminal.

(8) Sweep Function

1. **LIN Sweep**

   The procedure of generating the LIN Sweep functions is similar to that of generating the FM function, except that the Ramp waveform is the only signal source.

2. **LOG Sweep**

   The procedure of generating the LOG Sweep functions is similar to that of generating the LIN Sweep functions, except that the signal source will pass a LOG wave shaper circuit (This circuit be included MOD function generator block).

(9) Trigger Function

The Trigger Signal Generator will generate special signal that can instruct the VCF unit to generate/stop waveform.

The Signal obtained from the internal independent function generator must go through a TTL level shaper, as this block only accepts TTL compatible level. So can use the Frequency (Rate) and the Duty (Symmetry) of this generator to set the trigger phase and other parameters of Trigger Function.

The output of VCF is to correct Trigger waveform and pass the waveform choice, the output amplifier, the ATT, and the output through the Main Out terminal.

This function includes the internal and external Trigger with the same operation procedure, except that the Trigger signal will be obtained from the external Trigger input terminal.

(10) Frequency Counter

GW has designed its own full function counter chip, GFC-9701, with high frequency test range for the system.

The counter has the internal and external counter mode for GFG-3015. The most important function for the internal counter mode is to show the main frequency (VCF) on the display. So we take a square signal from Square shaper and change the level to TTL compatible level by TTL shaper block, then the signal will connect with the counter (GFC-9701). Because the counter directly connects with the MPU system, so the MPU can get the correct frequency and show it on the Display.

In addition, as the MPU can get the correct frequency anytime, so it can monitor the output frequency at all the time to keep the accuracy of output frequency.

This function includes the internal and external counter mode with the same operation procedure, except that the external test signal has to pass a preamplifier circuit and change it to TTL compatible level.