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**EC Declaration of Conformity**

We
**GOOD WILL INSTRUMENT CO., LTD.**
**No. 95-11, Pao-Chung Rd., Hsin-Tien City, Taipei Hsien, Taiwan**
**GOOD WILL INSTRUMENT (SUZHOU) CO., LTD.**
**No. 69, Lushan Road, Suzhou New District Jiangsu, China**
declares that the below mentioned product

**SFG-2110/2107/2104/2010/2007/2004**

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 (89/336/EEC, 92/31/EEC, 93/68/EEC) 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:** Electrical equipment for measurement, control and laboratory use — EMC requirements **(1997+A1: 1998+A3: 2003)** | |
|---|---|
| Conducted and Radiated Emissions<br>EN 55011: 1998+A1:1999+A2:2002 class A | Electrostatic Discharge<br>EN 61000-4-2: 1995+A1:1998+A2:2001 |
| Current Harmonic<br>EN 61000-3-2: 2000 | Radiated Immunity<br>EN 61000-4-3: 2002+A1:2002 |
| Voltage Fluctuation<br>EN 61000-3-3: 1995+A1:2001 | Electrical Fast Transients<br>EN 61000-4-4: 1995+A1:2001+A2:2001 |
| ---------- | Surge Immunity<br>EN 61000-4-5: 1995+A1:2001 |
| ---------- | Conducted Susceptibility<br>EN 61000-4-6: 1996+A1:2001 |
| ---------- | Power Frequency Magnetic Field<br>EN 61000-4-8: 1993+A1:2001 |
| ---------- | Voltage Dips/ Interrupts<br>EN 61000-4-11: 2004 |

◎ **Safety**

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



# 1. PRECAUTIONS

The SFG-2000/2100 series are specially designed for safety operation by passing 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 the 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.

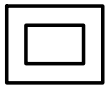
**WARNING** This term indicates that an injury hazard may occur, but is not immediately accessible.

**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



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**(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 SFG-2000/2100 series. 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 +10%, -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.

The SFG-2000/2100 series can't be operated until they are well-grounded by connecting an earth grounded AC power cord to the case in order 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 anything going wrong on the instrument. Please find out the cause before open the outside case (Please see the Figure (A) on below) to replace a proper fuse as listed below. Before connecting the instrument to the line voltage, ensure that the correct operating voltage and fuse have been selected.

| MODEL | FUSE Rating and Type | | Rating Input | |
|---|---|---|---|---|
| | F502 | F503 | Watts | VA |
| SFG-2000 Series | T0.125A/250V | T0.125A/250V | 17 | 21 |
| SFG-2100 Series | | | 23 | 27 |

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.

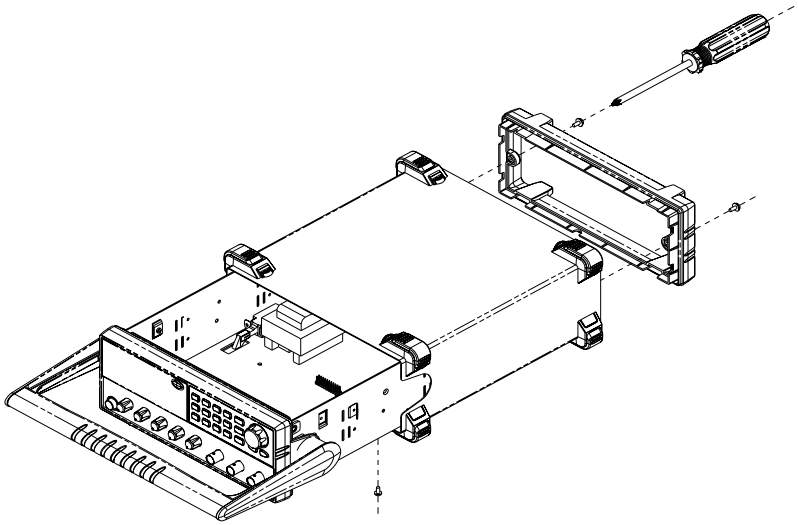


**Figure (A)**



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**(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 to 28°C (+64.4°F to +82.4°F)

Operating temperature: 0°C to 40°C (+32°F to +104°F)

Storage temperature: -10°C to 70°C (+14°F to 158°F)

Relative humidity: up to 80% at 0°C to 40°C, up to 70% at 35°C to 40°C

Installation category：CAT Ⅱ(Please refer to Table A for the details.)

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 the SFG-2000/2100 Series 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**<br>This lead/appliance must only be wired by competent persons.<br><br>**WARNING**<br>THIS APPLIANCE MUST BE EARTHED<br><br>**IMPORTANT**<br>The wires in this lead are coloured in accordance with the following codes: | As the colours of the wires in main leads may not correspond with the colours marking identified in your plug/appliance, proceed as follows:<br>The wire which is coloured Green & Yellow must be connected to the Earth terminal marked with the letter E or by the earth symbol ⏚ or coloured Green or Green & Yellow.<br>The wire which is coloured Blue must be connected to the<br>terminal which is marked with the letter N or coloured Blue or Black.<br>The wire which is coloured Brown must be connected to the terminal marked with the letter L or P or coloured Brown or Red.<br>If in doubt, consult the instructions provided with the equipment or contact the supplier.<br>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<br>of 0.75mm² should be protected by a 3A or 5A fuse. Larger conductors would normally require 13A types, depending on the connection method used.<br>Any moulded mains connector that requires removal /replacement must be destroyed by removal of any fuse & fuse carrier and disposed of immediately, as a plug with bared wires is hazardous if a engaged in live socket. Any re-wiring must be carried out in accordance with the information detailed on this label. |
| **Green/ Yellow: Earth**<br>**Blue: Neutral**<br>**Brown: Live (Phase)** | |



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## 2. PRODUCT INTRODUCTION

The SFG-2000/2100 Series Synthesized Function Generator apply Direct Digital Synthesis (DDS), a new technique of frequency synthesis that generates a stable output frequency with extraordinary resolution.

The innovative design of the SFG-2000/2100 Series is exempted from the problems occurred on the traditional function generators:

a) The typical integrating circuit and constant current source circuit technique is easily affected by the operation temperature, since the change of the temperature will change the value of resistors, capacitors and the other components, that will certainly cause change on the frequency. So the analog type of function generator has poor characteristics like stability and accuracy.

b) The traditional frequency synthesized function generators typically use Phase Locked Loop (PLL) techniques to generate waveform demanding much higher resolution (up to $1:10^6$ in general) and stable reference frequency, when the PLL system is running, the problem of phase jitter and frequency switching response may occur due to the dynamic loop filter is in use.

c) The PLL system needs a wave-shaping circuit with an address counter that is controlled by a variable frequency clock. The counter addresses memory locations in a waveform RAM, and the RAM output is converted into an analog output signal by a high-speed digital-to-analog converter (DAC) and followed a low pass filter. The Problems of the poor phase jitter and transient response could be occurred here too.



d) DDS Function Generator generates analog waveform by the waveform RAM, high speed DAC and low pass filter, but it can avoid the problems occurred on the PLL due to the fixed frequency clock (fs) in use. Besides, the resolution of DDS is higher than that of PLL's. DDS's resolution is $fs/2^k$ where K is the control frequency word, which is more than 28 bits in general. Therefore, the DDS frequency resolution can be much better than the other types.

e) Figure 1 is the basic block diagram of a DDS frequency synthesizer.

f) DDS frequency synthesizer consists of Phase Accumulator, lookout table (ROM or RAM), Digital-to-Analog Converter (DAC), and Low Pass Filter (LPF). The phase accumulator is to accumulate K by adding K with its output for every clock cycle, fs. The output of the accumulator is used to position the data in the Table ROM (or RAM). The DAC will convert the digital data into analog waveform with step-shape generated from the digital data. The following LPF smoothes the step shape by filtering out the clock frequency to form the pure sinewave.



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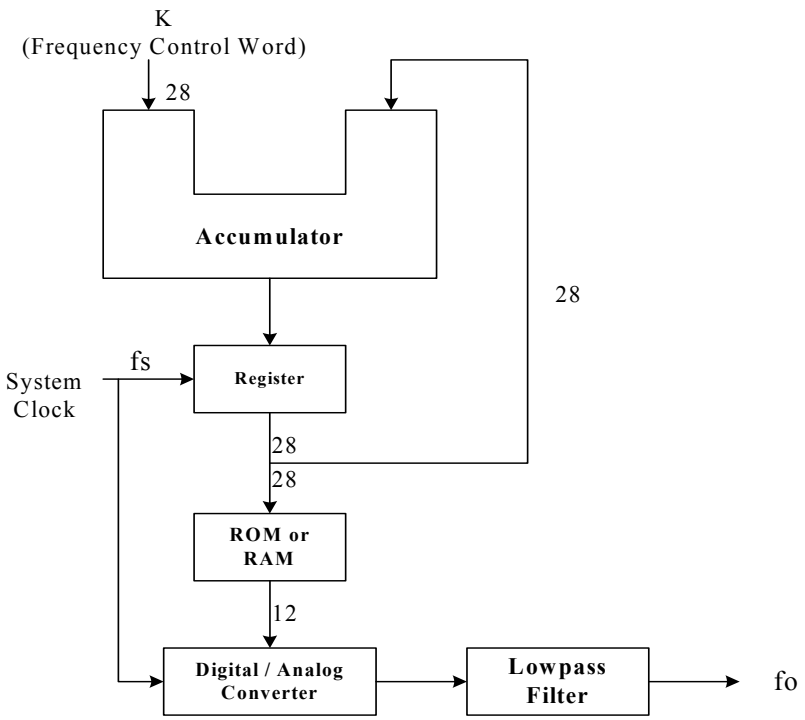



**Figure 1**



## 3. FEATURES

The SFG-2000/2100 Series are Synthesized Function Generators which apply Direct Digital Synthesis (DDS) technique and can generate accurate and stable frequency with high resolution. The main signal source generate waveform including Sine wave, Square wave and Triangle wave.

The main features are listed as follows:

- ✧ The design of DDS and FPGA technology provide high quality waveforms.
- ✧ High frequency stability and accuracy: 20ppm.
- ✧ Low Distortion at -55dBc.
- ✧ Wide output frequency range: 4MHz, 7MHz, and 10MHz
- ✧ Digital operation user interface
- ✧ Output Waveforms of Sine, Square, Triangle, Pulse, AM, FM and Sweep.
- ✧ Maximum frequency resolution of full range: 100MHz.
- ✧ TTL/CMOS output
- ✧ Variable DC offset control
- ✧ Output overload protection
- ✧ Store/Recall function
- ✧ Built-in 9-digit INT/EXT function counter and up to 150MHz frequency range with high resolution.
- ✧ INT/EXT AM/FM modulation.



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✧ Internal LIN/LOG sweep mode.

✧ Features Comparison Table for models:

| MODEL / FEATURE | SFG-2004 | SFG-2007 | SFG-2010 | SFG-2104 | SFG-2107 | SFG-2110 |
|---|---|---|---|---|---|---|
| Frequency | 4MHz | 7MHz | 10MHz | 4MHz | 7MHz | 10MHz |
| Duty Cycle Control | ● | ● | ● | ● | ● | ● |
| TTL/CMOS | ● | ● | ● | ● | ● | ● |
| DC Offset | ● | ● | ● | ● | ● | ● |
| AM/FM | | | | ● | ● | ● |
| Sweep | | | | ● | ● | ● |
| Counter | | | | ● | ● | ● |



## 4. SPECIFICATIONS

| MODEL | SFG-2000 SERIES | | | SFG-2100 SERIES | | |
|---|---|---|---|---|---|---|
| | **2004** | **2007** | **2010** | **2104** | **2107** | **2110** |
| **1. Main** | | | | | | |
| Output Function | Sine, Square, Triangle | | | | | |
| Frequency Range (For Sine, Square) | 0.1Hz \| 4MHz | 0.1Hz \| 7MHz | 0.1Hz \| 10MHz | 0.1Hz \| 4MHz | 0.1Hz \| 7MHz | 0.1Hz \| 10MHz |
| Frequency Range (For Triangle) | 0.1Hz \| 1MHz | | | | | |
| Resolution | 0.1Hz | | | | | |
| Stability | ±20ppm | | | | | |
| Accuracy | ±20ppm | | | | | |
| Aging | ±5ppm/year | | | | | |
| Amplitude Range | 10Vp-p (into 50Ω load) | | | | | |
| Impedance | 50Ω±10% | | | | | |
| Attenuator | -20dB±1dB×2 | | | | | |
| DC Offset | ＜-5V to ＞5V (into 50Ω load) | | | | | |
| Duty Control Range | 20% to 80% below 1MHz (for square wave only) | | | | | |
| Resolution | 1% | | | | | |
| Display | 9-digit LED display | | | | | |
| **2. Sine Wave** | | | | | | |
| Harmonics Distortion | From Amplitude control at maximum position without any attenuation to its 1/10 of any combination setting, TTL/COMS off.<br>≧-55dBc, 0.1Hz to 200kHz<br>≧-40dBc, 0.2MHz to 4MHz<br>≧-30dBc, 4MHz to 10MHz | | | | | |



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| | | |
|---|---|---|
| Flatness (relative to 1kHz) | ＜±0.3dB, 0.1Hz to 1MHz<br>＜±0.5dB, 1MHz to 4MHz<br>＜±2dB, 4MHz to 10MHz | |
| **3. Triangle Wave** | | |
| Linear | ≧98%, 0.1Hz to 100kHz<br>≧95%, 100kHz to 1MHz | |
| **4. Square Wave** | | |
| Symmetry | ±1% of period + 4ns to 0.1Hz to 100kHz | |
| Rise or Fall Time | ≦25ns at maximum output.<br>(into 50Ω load) | |
| **5. CMOS Output** | | |
| Level | 4 ± 1Vp-p to 14.5 ± 0.5Vp-p, adjustable | |
| Rise or Fall Time | ≦120ns | |
| **6. TTL Output** | | |
| Level | ≧3Vp-p | |
| Fan Out | 20 TTL load | |
| Rise or Fall Time | ≦25ns | |
| **7. Sweep Operation** | | |
| Sweep Rate | ---------- | 100:1 ratio maximum adjustable |
| Sweep Time | ---------- | 1 to 30 seconds adjustable |
| Sweep Mode | ---------- | Linear and Logarithmic mode selector |
| **8. Amplitude Modulation** | | |
| Depth | ---------- | 0 to 100% |
| Modulating Frequency | ---------- | 400Hz (internal),<br>DC to 1MHz (external) |
| Carrier BW | ---------- | 100Hz to 5MHz (-3dB) |
| External Modulating Sensitivity | ---------- | ≦10Vp-p for 100% modulation |
| **9. Frequency Modulation** | | |
| Deviation | ---------- | 0 to ±5% (center at 1MHz) |
| Modulating Frequency | ---------- | 400Hz (internal),<br>1kHz (external) |



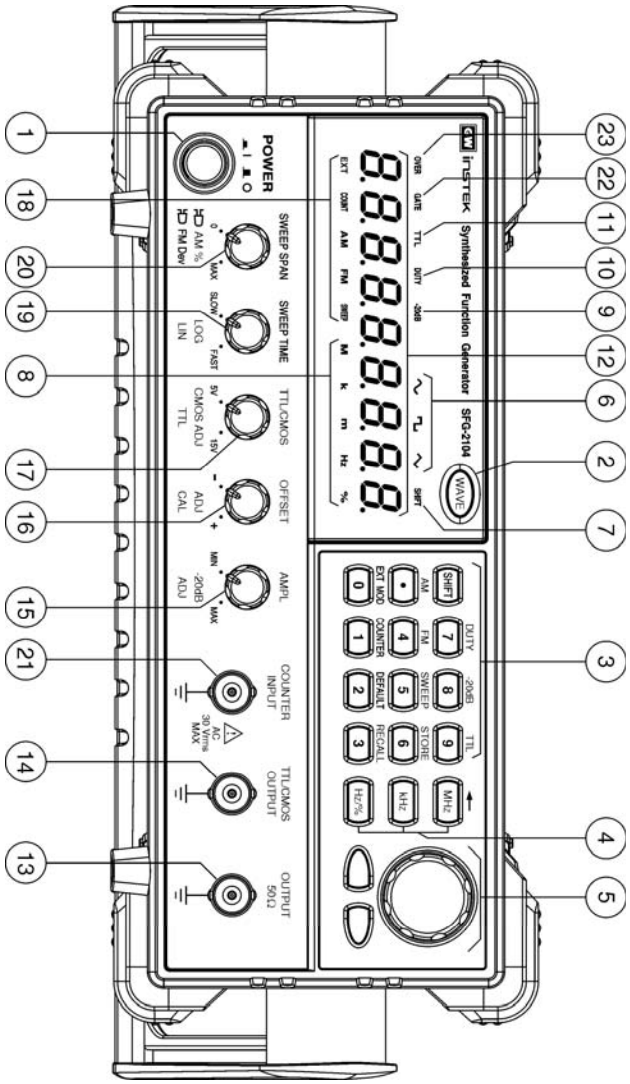
| | | |
|---|---|---|
| External Modulating Sensitivity | ---------- | ≦10Vp-p, for 10% modulation (center at 1MHz) |
| **10.Frequency Counter** | | |
| Range | ---------- | 5Hz to 150MHz |
| Accuracy | ---------- | Time base accuracy<br>±1count |
| Time base | ---------- | ±20ppm (23℃ ± 5℃) after 30 minutes warm up |
| Resolution | ---------- | The maximum resolution is:<br>100nHz for 1Hz,<br>0.1Hz for 100MHz. |
| Input Impedance | ---------- | 1MΩ/150pf |
| Sensitivity | ---------- | ≦35mVrms<br>(5Hz to 100MHz)<br>≦45mVrms<br>(100MHz to 150MHz) |
| **11. Store/Recall Function** | | |
| Size | 10 groups of setting memories | |
| **12. General** | | |
| Power Source | AC115V, 230V + 10%, -15%, 50/60Hz | |
| Operation Environment | Indoor use, altitude up to 2000m.<br>Ambient Temperature 0℃ to 40℃<br>Relative Humidity: Up to 80% at 0℃ to 40℃<br>Up to 70% at 35℃ to 40℃<br>Installation category II<br>Pollution Degree 2 | |
| Storage Temperature & Humidity | -10℃ to 70℃.<br>70% (Maximum). | |
| Accessories | GTL-101×1<br>Instruction manual×1 | GTL-101×2<br>Instruction manual×1 |
| Dimension | 107(W)×266(H)×293(D) mm | |
| Weigh | Approx. 3.1kg | Approx. 3.2kg |



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## 5. FRONT AND REAR PANELS

**Front Panel**




**1** **POWER button:**

Power on/off the instrument by pressing the button with the display on/off.

**2** **Main Function keys:**

Press WAVE key to select main output waveform in the sequence of Sine, Triangle and Square. When the key is pressed, the corresponding waveform LED will light.

**3** **Entry keys:**

Press 0 to 9 and . keys to input value, then press a valid Units key to complete the setting.

**Secondary Function keys:**

The secondary function keys are activated by the combinations of SHIFT key and numerical keys labeled in blue.

- DEFAULT ( SHIFT + 2 ) will set this instrument to the default setup.
- STORE ( SHIFT + 6 ) allows to store frequency and duty setting up to 10 memories.
- RECALL ( SHIFT + 3 ) can recall the setup stored in this instrument.
- DUTY ( SHIFT + 7 ) allows to edit the duty cycle of square wave.

Note: The other functions are toggled between ON and OFF by repeating the same key combination operation.

For example, press SHIFT 2 (DEFAULT) keys can recall the default value of the instrument.





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④ **Units keys:**

Select one of the valid Units keys (MHz, kHz, Hz) [MHz] [KHz] [Hz/%] for the entered value of frequency and Duty Cycle (Hz/%).

⑤ **Modify keys:**

Press [◄] [►] keys to shift the digit of input value.
Rotate the knob for increasing or decreasing that digit.

⑥ **Waveform LEDs:**

To indicate the current waveform of the main output.

⑦ **SHIFT key Status LED:**

To indicate the SHIFT key status. When this LED is on, the following numerical keys will be activated as the secondary function keys.

⑧ **Units LEDs:**

To indicate the units of frequency or duty cycle.

⑨ **Attenuator LED:**

When the –20dB LED is on, the –20dB attenuator is controlled by the SHIFT and 8 keys are on.

⑩ **DUTY LED:**

When the DUTY LED is on, the parameter display will show the duty cycle and wait for editing (for square wave only).



⑪ **TTL/CMOS LED:**

When the TTL LED is on, that means the TTL/CMOS is enabled.

⑫ **Parameter display:**

The 9 digits parameter display presents the parameter values and information, like counter frequency, duty cycle, external frequency and save/recall.

⑬ **Main Output**

Main output with 50Ω output resistance.

⑭ **TTL/CMOS Output**

Press [SHIFT] [9 TTL] keys, a TTL compatible waveform will be obtained from the output by pushing back and rotating the TTL/CMOS knob⑰, and a CMOS compatible waveform (5-15Vp-p) will be obtained from the output while the TTL/CMOS KNOB is pulled out and rotated.

⑮ **Output Amplitude Control with Attenuation operation**

Turn the knob clockwise for increasing output level and invert for decreasing. Pull the knob out for an additional 20dB output attenuation. This attenuation will not change the LED status.



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⑯ **DC Offset Control**

Pull out the knob to turn the DC offset of the waveform between –5V to +5VC(into 50Ω load), turn the knob clockwise to set a positive going DC level waveform and turn reversely for a negative going DC level waveform.

⑰ **TTL/CMOS Selector**

When the TTL/CMOS output is turn on, push back this knob to select the TTL as the output and pull out this knob to select CMOS. When the CMOS is selected, rotate the knob to set the CMOS level.

⑱ **The LEDs of External Counter, Modulation and Sweep**

EXT, COUNT : To indicate the external counter is working. The number displayed on the parameter display area is the external frequency reading.

AM : To indicate the AM mode is working.

EXT, AM : To indicate the external AM is working.

FM : To indicate the FM mode is working.

EXT, FM : To indicate the external FM is working.

SWEEP : To indicate the SWEEP mode is working.

⑲ **Sweep Time Control and LIN/LOG Selector**

In sweep mode, pull up to select linear sweep and push back to select logarithmic sweep mode. Rotate the knob clockwise to adjust the sweep time from slow to fast.



⑳ **Sweep Span Adjustment and AM/FM Selector**

In Sweep mode, rotate the knob clockwise to increase sweep span, or invert for decreasing.

In modulation mode, pull out this knob for AM depth control, and push back for FM deviation control. Rotate the knob to change the AM depth or FM deviation.

㉑ **EXT Counter Input**

The input terminal for external counter signal input. The Input Impedance is 1MΩ // 150pF.

㉒ **Gate Time LED**

When the external counter function is activated, the LED will be flashing according to the sequence of 0.01s, 0.1s, 1s, and 10s.

Choose 0.01s, 0.1s, 1s, or 10s in sequence by rotating the knob ⑤.

㉓ **Over LED**

In the external counter mode, the Over LED will be on when the input frequency is greater than the range selected.

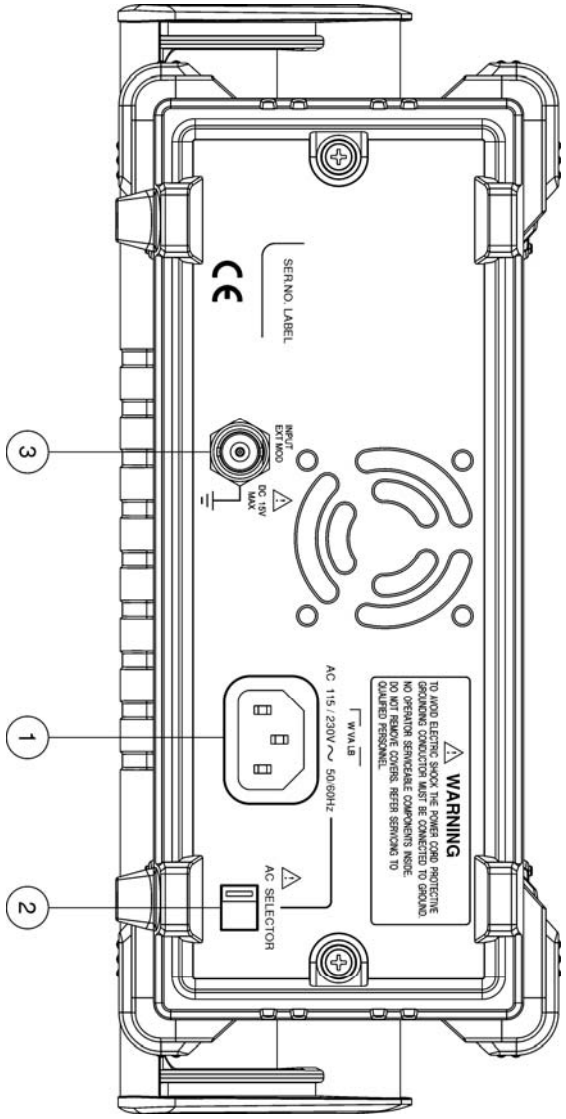
**Remark:**

The functions from item 18 to 23 can not be applied to model SFG-2000 series.



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**Rear Panel**






① **Power Entry Socket**

AC input should be within the range of line voltage +10%, -15%, 50/60Hz.

② **Line Voltage Selector**

To switch the power line voltage between 115V and 230V.

③ **EXT. Modulation Input BNC**

Modulating signal input of external modulation.
The amplitude modulation index is at 100% when ≤ 10Vp-p is input.
The frequency Modulating index is at 10% when ≤ 10Vp-p is input.



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# 6. OPERATION

## 6.1 The first time setup for the Instrument

1) Ensure that the voltage of main supply is compatible with this instrument. The selector on the rear panel states the required AC line voltage.
2) Connect the instrument to main supply with the power cord.
3) Turn on the instrument, the model number will show up on the parameter display area first, then, the factory setting will appear.
4) Press SHIFT + DEFAU 2 can recall the default value of this instrument.

## 6.2 Output Setting

1) Press WAVE key to select main output waveform. The waveform will be changed in the sequence of Sine, Square and Triangle waveform every time when the key is pressed, and the corresponding waveform LED ⑥ will light.
2) Set different duty cycle ratio (not 50%) for Square waveform to get different Pulse width of the waveform (Please refer to 6.6).

## 6.3 Frequency Setting

1) Ensure that the Parameter display ⑫ is not in the DUTY mode, the duty LED is off.
2) Key in the desired value of frequency.
3) Select a valid Unit key for the value.
4) In addition, you can use ◄ ► keys and rotating the knob⑤ to adjust the desired main frequency value.



❖ ***Example of the Frequency Setting***

1) Set the frequency to 250Hz.
   Press 2 5 0 and Hz/%.
2) Change the frequency to 850Hz.
   Press ◄ or ► to shift the flashing digit to "2" position, then change the digit to "8" by rotating the knob ⑤ clockwise.

## 6.4 Amplitude and Attenuation Setting

1) Rotate AMPL ⑮ to control demanded output level.
2) Pull out AMPL ⑮ knob to get 20dB attenuation and press SHIFT -20dB 8 keys can obtain an additional 20dB attenuation. Now, the –20dB LED will light.

Note: 1) –20dB LED ⑨ is responding to SHIFT 8 attenuator only.

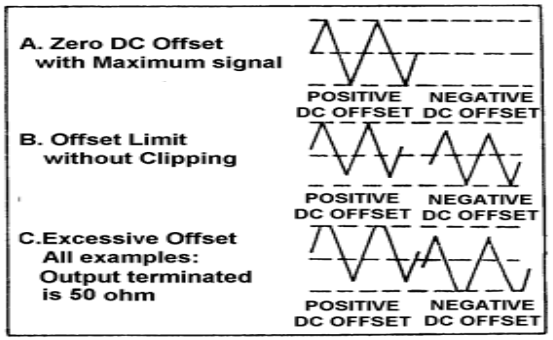
2) The functions are toggled between ON and OFF by repeating the SHIFT 8 keys operation.

## 6.5 Offset Setting

1) Pull out the OFFSET ⑯ knob to activate the DC offset function, which allows to adjust the DC level of the waveform between -5V to +5v.
2) Rotate the knob clockwise to set a positive going DC level waveform and invert for a negative going DC level waveform.
3) However, signal added DC level is still limited to ±20V (no load) or ±10V (50Ω load). In case of over-voltage, the clip of waveform will appear as shown below.



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## 6.6 Duty Setting (for square wave only)

1) Press SHIFT, DUTY (7) keys until the duty LED ⑩ is on.
2) Key in the desired value of DUTY cycle, then press Hz/% key to specify the value. Then the parameter display will return to display frequency.
3) In addition, you can use ◄ or ► keys and rotate the knob ⑤ to change the desired Duty cycle as well.

Note: Any incomplete entry of the duty cycle will last for 5 seconds, then return to previous setting.

### ❖ *Example of the Duty Setting*

1) Set the Square wave Duty cycle to 60%.

   Press SHIFT, DUTY (7) keys, Duty LED is on, then press 6, 0, Hz/%.



2) Change the Duty cycle to 30%.

   Use ◄ or ► key to shift the flashing digit to "6" position, then change the digit to "3" by rotating the knob ⑤ counterclockwise.

Note: The duty cycle limit : 80%:20%:80% at 1MHz.
The frequency range: up to 1MHz.

## 6.7 TTL/CMOS Signal Output Function

The SFG-2000/2100 series provide a TTL/CMOS signal from Output ⑭. The frequency of TTL/CMOS output is identical to the main output frequency. If the frequency needs to be modified, please refer to Section 6.3 The Frequency Setting.

1) Press SHIFT, TTL (9) button, The TTL LED ⑪ will light to indicate that the TTL output function is activated and a compatible TTL level signal will be obtained from TTL/CMOS Output BNC connector ⑭.
2) Pull out TTL/COMS knob ⑰, the CMOS output function is activated, then a compatible CMOS level signal will be obtained from TTL/CMOS Output BNC connector ⑭. Turn the TTL/COMS knob ⑰ to adjust to the desired CMOS signal level.

Note: 1) The main output waveform (Sine and Triangle wave) quality will be affected when TTL/CMOS is activated. So when a high quality Sine or Triangle wave is required, please turn off this function.
2) When you choose square wave, the TTL/CMOS function will always be activated.



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❖ ***Example of the TTL Output***

1) To set the instrument:
   - Frequency: 5kHz
   - Signal type: TTL output

2) Proceed the following steps:
   (1) Set the main frequency to 5kHz (refer to the Setup of Frequency).
   (2) Press SHIFT + 9 (TTL) keys to set TTL/CMOS output mode. The TTL LED ⑪ is on now.
   (3) A 5kHz/TTL Level signal will be obtained from the connector ⑭.

Note: 1) Now the TTL/CMOS knob ⑰ is in the push back status.
2) The functions are toggled between TTL and CMOS by repeating the TTL/CMOS knob operation.

❖ ***Example of the Setting of the CMOS Output***

1) To set the instrument:
   - Frequency: 10kHz
   - Signal type: 10Vp-p CMOS output

2) Proceed the following steps:
   (1) Set the main frequency to 10kHz (refer to the Setup of Frequency).
   (2) Press SHIFT + 9 (TTL) keys to set TTL/CMOS output mode. The TTL LED ⑪ is on now.
   (3) Pull out and turn the TTL/COMS knob ⑰ to adjust the CMOS signal level to 10Vp-p.
   (4) A 10kHz/TTL Level signal will be obtained from the connector ⑭.



## 6.8 STORE Setting

The Store function allows to save the setup parameters (Frequency value and Duty cycle for square wave) of the instrument into its nonvolatile memory with the stored group number from 0 to 9, up to 10 groups totally.

1) Press SHIFT + 6 (STORE) keys, the message of "Store 0" will present on the parameter display ⑫.
2) Key in the group number from 0 to 9. The message of "DONE" will present to complete the store function.

❖ ***Example of the STORE Setting***

1) To save the parameters to the group 5.
2) Press SHIFT + 6 (STORE) keys first, then key in 5.

## 6.9 RECALL Setting

The Recall function allows to retrieve the parameters (Frequency value and Duty cycle for square wave) saved in the nonvolatile memory.



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1) Press SHIFT + RECALL 3 keys, the message of "Recall 0" will present on the parameter display ⑫.

2) Key in the group number from 0 to 9. The message of "DONE" will present to complete the recall function. The setting should be changed accordingly.

❖ ***Example of the Setting of the RECALL***

1) To retrieve the parameters from the group 6.

2) Press SHIFT + RECALL 3 keys first, then key in 6 .

## 6.10 SHIFT Key and Function Keys

The SHIFT key is used to enable the secondary functions of certain function keys with blue printed letters. After pressing the button, The SHIFT LED will light, only the keys labeled in blue are activated. Press SHIFT key again to release the secondary function.

❖ **The Secondary Functions**

1) SHIFT + DEFAULT 2 Recall the default state of the instrument.

Note: The default state is defined as sine wave and 10kHz, all other functions are off.



2) SHIFT + STORE 6 Store the parameters (Frequency and Square wave duty cycle) to memory.

3) SHIFT + RECALL 3 Retrieve the parameters (Frequency and Square wave duty cycle) from memory.

4) SHIFT + DUTY 7 To get into Square wave Duty cycle enter mode.

5) SHIFT + -20dB 8 The 20dB attenuation is activated.

6) SHIFT + TTL 9 The TTL or CMOS level signal will output from the BNC ⑭.

7) SHIFT + AM . Set Amplitude Modulating function.

8) SHIFT + FM 4 Set Frequency modulating function.

9) SHIFT + SWEEP 5 Set Frequency Sweep function.

10) SHIFT + EXT MOD 0 The modulating signal source from rear panel external Input BNC③.

11) SHIFT + COUNTER 1 Set External Frequency Counter function.

12) SHIFT + ← MHz Backspace.



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## 6.11 Linear or Logarithmic Sweep Setting

SFG-2100 series can adopt frequency to sweep. The type of sweep can be set as linear or logarithmic sweep.

1) The current main output frequency is the Start frequency of sweep when the frequency sweep mode is on.
2) Press SHIFT (SWEEP) 5 keys to set instrument to the frequency sweep mode. The Sweep LED ⑱ is on.
3) Rotate SWEEP SPAN knob ⑳ and SWEEP TIME knob ⑲ to adjust sweep time and span.
4) Pull out (push back) SWEEP TIME knob ⑲ to select logarithmic (linear) sweep mode.

Note: 1) When the sweep time is too long or the sweep span is too large, the stop frequency will stay on the maximum frequency value (4MHz, 7MHz or 10MHz) until the end of the sweep and restart from the starting frequency at the next sweep. In this case, adjust the SWEEP TIME knob⑲ or SWEEP SPAN knob⑳ to adapt to the sweep.

2) The sweep functions is toggled between on and off by repeating the same key operation.

3) When the sweep function is activated, the duty of the square is at 50:50.

### ❖ *Example of the LIN. Sweep Setting*

1) To set the instrument:
   - Output function: Sine Wave
   - Sweep mode: Linear
   - Start frequency: 1kHz



2) Proceed the following steps:
   (1) Press WAVE to select SINE wave for main output.
   (2) Press 1 KHz keys.
   (3) Push back the SWEEP TIME knob ⑲ to select linear sweep mode.
   (4) Press SHIFT (SWEEP) 5 to start the frequency sweep mode.
   (5) Rotate the SWEEP SPAN knob ⑳ or SWEEP TIME knob ⑲ to adjust sweep span or time.

### ❖ *Example of the Logarithmic Sweep Setting*

1) To set the instrument:
   - Output function: Triangle Wave
   - Sweep mode: Logarithmic
   - Start frequency: 10kHz

2) Proceed the following steps:
   (1) Press WAVE to select Triangle wave for main output.
   (2) Press 1 0 KHz keys.
   (3) Pull out SWEEP TIME knob ⑲ to select LOG sweep mode.
   (4) Press SHIFT (SWEEP) 5 to start the frequency sweep mode.
   (5) Rotate SWEEP SPAN knob ⑳ or SWEEP TIME knob ⑲ to adjust sweep span or time.



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## 6.12 AM Modulation Setting

The AM modulation function provides a 400Hz sine signal as internally modulating signal. Besides, you can select the modulating signal from external Input BNC③ on the rear panel.

1) Press SHIFT, AM (.) to activate the Amplitude Modulation mode.

2) Pull out SWEEP SPAN knob ⑳ to select Amplitude Modulation mode.

3) Rotate SWEEP SPAN knob ⑳ to adjust AM depth.

4) Press SHIFT, EXT MOD (0), the modulating signal source will be switched to the rear panel external Input BNC ③.

Note: The AM/EXT AM functions are toggled between on and off by repeating the same key operation.

### ❖ *Example of the AM Modulation Setting*

(1) To set the instrument:

- Main function: Sine Wave
- Modulation Source : INT
- Main Frequency : 10kHz.

(2) Proceed the following steps:

(1) Press WAVE to select SINE wave for main output.

(2) Press 1, 0, kHz keys.

(3) Press SHIFT, AM (.) to start the Amplitude Modulation mode.



(4) Pull out SWEEP SPAN knob ⑳ to select the Amplitude Modulation mode.

(5) Rotate the SWEEP SPAN knob ⑳ clockwise to adjust AM Depth.

## 6.13 FM Modulation Setting

The FM modulation function provides a 1kHz sine signal as internally modulation signal. Besides, You can select the modulating signal the external Input BNC ③ on the rear panel.

1) The main output frequency is always the Center frequency of the frequency modulation mode.

2) Press SHIFT, FM (4) keys to activate the frequency modulation mode.

3) Push SWEEP SPAN knob ⑳ to select the frequency modulation mode.

4) Rotate SWEEP SPAN knob ⑳ to adjust modulation deviation.

5) Press SHIFT, EXT MOD (0), the modulating signal source will be switched to the rear panel external Input BNC③.

Note: 1) If the FM signal frequency (from Center - Deviation to Center + Deviation) exceeds the range of the instrument (4MHz, 7MHz or 10MHz), the error message “Freq-Error 3” will show up.

2) The center frequency range is from 300kHz to 3.7MHz for SFG-2104, 300kHz to 6.7MHz for SFG-2107 and 300kHz to 9.7MHz for SFG-2110 when FM modulation is activated.



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3) The FM/EXT FM functions are toggled between on and off by repeating the same key operation.

4) When the FM modulation is activated, the duty of the square wave is at 50:50.

❖ ***Example of the FM Modulation Setting***

1) To set the instrument:
   - Waveform: Sine Wave
   - Modulation Source: INT
   - Main Frequency: 1MHz

2) Proceed the following steps:
   (1) Press WAVE to select SINE wave for main output.
   (2) Press 1 MHz keys.
   (3) Press SHIFT FM 4 to start the frequency modulation mode.
   (4) Push SWEEP SPAN knob ⑳ to select the frequency modulation mode.
   (5) Rotate the SWEEP SPAN knob ⑳ clockwise to adjust the modulation deviation.

## 6.14 External Counter Setting

The SFG-2100 series provide a 9 digits external frequency counter with high performance and resolution up to 150MHz frequency range.



1) Press SHIFT COUNTER 1 keys, the LED of the EXT, COUNT and the GATE time will light, and the GATE time LED will be flashing according to the Gate time of Counter. Now, the external counter is activated.

2) The GATE time LED will be flashing in the sequence of 0.01, 0.1, 1, and 10 seconds.

   The Different Gate time will provide different resolution of counter. So users can use the knob ⑤ to choose the desired resolution.

   Turn the Rotate knob⑤ clockwise by changing the steps in the sequence of 0.01, 0.1, 1, and 10 seconds.

   The detailed relation among the Test frequency, every GATE time, State LED and 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 | 1.000000 | Hz | 1 μ Hz |
| | 10 Sec | 1.0000000 | Hz | 100nHz |
| 10Hz | 0.01 Sec | 10.0000 | Hz | 100 μ Hz |
| | 0.1 Sec | 10.00000 | Hz | 10 μ Hz |
| | 1 Sec | 10.000000 | Hz | 1 μ Hz |
| | 10 Sec | 10.0000000 | Hz | 100nHz |



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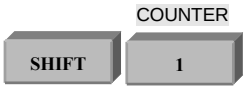
| | | | | |
|---|---|---|---|---|
| 100Hz | 0.01 Sec | 100.000 | Hz | 1mHz |
| | 0.1 Sec | 100.0000 | Hz | 100 μ Hz |
| | 1 Sec | 100.00000 | Hz | 10 μ Hz |
| | 10 Sec | 100.000000 | Hz | 1 μ Hz |
| 1kHz | 0.01 Sec | 1.00000 | k, Hz | 10mHz |
| | 0.1 Sec | 1.000000 | k, Hz | 1mHz |
| | 1 Sec | 1.0000000 | k, Hz | 100 μ Hz |
| | 10 Sec | 1.00000000 | k, Hz | 10 μ Hz |
| 1MHz | 0.01 Sec | 1.00000 | M, Hz | 10Hz |
| | 0.1 Sec | 1.000000 | M, Hz | 1Hz |
| | 1 Sec | 1.0000000 | M, Hz | 100mHz |
| | 10 Sec | 1.00000000 | M, Hz | 10mHz |
| 10MHz | 0.01 Sec | 10.0000 | M, Hz | 100Hz |
| | 0.1 Sec | 10.00000 | M, Hz | 10Hz |
| | 1 Sec | 10.000000 | M, Hz | 1Hz |
| | 10 Sec | 10.0000000 | M, Hz | 100mHz |
| 100M Hz | 0.01 Sec | 100.0000 | M, Hz | 100Hz |
| | 0.1 Sec | 100.00000 | M, Hz | 10Hz |
| | 1 Sec | 100.000000 | M, Hz | 1Hz |
| | 10 Sec | 00.0000000 | M, Hz, OVER | 100mHz |

Note: 1) When the OVER LED lights, that means there are still more values than 9 digits of the Display. User can set less Gate time to check it.

2) The EXT counter is toggled between on and off by repeating the same keys operation.



❖ ***Example of the External Counter Setting***




(1) Press SHIFT + 1 to set to the external counter mode.

(2) Connect the testing signal with "EXT Counter Input BNC"㉑.

(3) Turn the Rotate knob⑤ to select the desired Gate time.

(4) The parameter display ⑫ will display the measured frequency.

## 6.15 Error message of the instrument

The error message shows up when the illegal entry is performed. The categories of the error message is listed as the following table:

| Error Code | Explanation (Limitation) |
|---|---|
| FrEq- Err1 | Sine and Square wave Frequency over range. |
| FrEq- Err2 | Triangle wave Frequency over range (1MHz). |
| FrEq- Err3 | FM Center Frequency over range. |
| FrEq- Err4 | Frequency over Resolution |
| duty- Err1 | Not Square Waveform. |
| duty- Err2 | Square wave Frequency over range when duty cycle is not 50:50 (1MHz) |
| duty- Err3 | Duty over range (80:20) |
| duty- Err4 | Duty over resolution (1%) |



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## 7. APPLICATION NOTES

This instruction introduces some typical applications and the brief descriptions with block diagrams.

**(A) Reference signal of PLL, phase-locked loop**

Connect the main output (with sine wave) or TTL/CMOS output into PLL system directly. It is the most cost-effective solution for finding PLL reference signal source.

**(B) Signal source for trouble-shooting**

When a sub-circuit in a system is suspected to fail, an effective trouble shooting approach is to isolate the suspect and test it solely. The SFG2000/2100 series are ideal signal sources to generate the stimulus signal to feed into the circuit under test. By observing the output waveform on an oscilloscope, the functionality of circuit under test is judged accordingly.

**(C) Transistor DC bias characteristics test**

Connect the transistor with DC voltage source and SFG2000/2100 series as shown in figure 4. Adjust the DC voltage and observe input and output waveforms of transistor on the oscilloscope. The best DC bias condition will make the maximum output waveform without distortion.



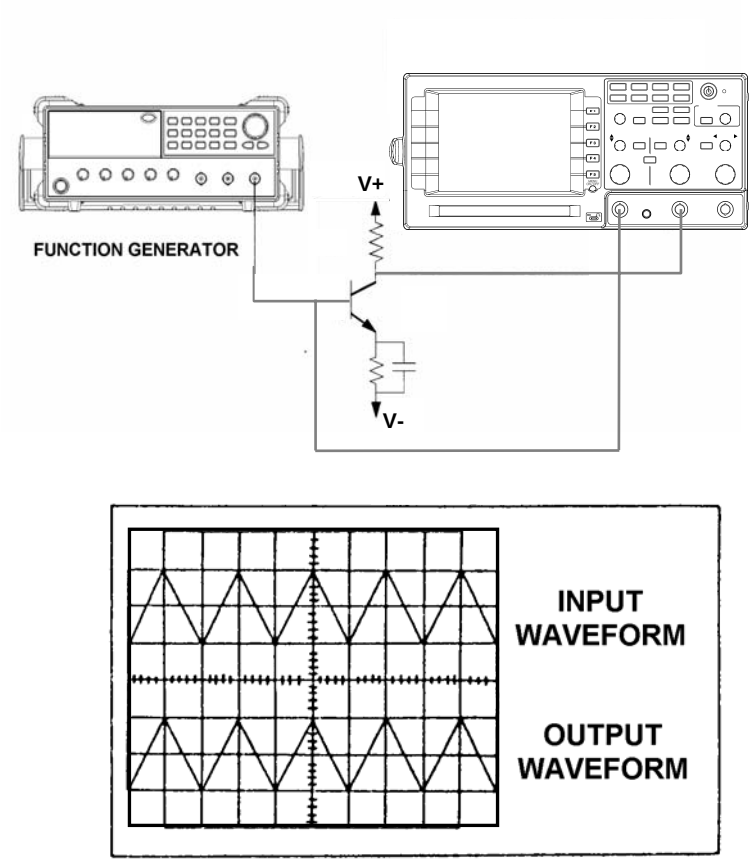



**Figure 4**

**(D) Amplifier over-load characteristic test**

When an amplifier is over-loaded, it will distort the signal. However, in many cases, the sine wave is difficult to examine the distortion situation, here the triangle wave is more suitable for this sort of case. By observing the triangle linearity on the oscilloscope, the maximum undistorted range of an amplifier can be measured accordingly..



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**(E) Amplifier transient characteristic test**

For the frequency response observation, to display the Square waveform from the oscilloscope instead of the Sine wave, which can't actually explain the transient response of amplifier, can show up many characteristics of amplifier.

(a) Connect SFG2000/2100 series, amplifier under test, load (RL) and oscilloscope according to the following figure.

(b) Select Triangle wave for the SFG2000/2100 output. Adjust its amplitude until there is no clipping occurred on the applied signal.

(c) Select Square wave and adjust its frequency to watch the waveform of the middle of amplifier pass band, like 20Hz, 1kHz, 10kHz, … etc.

(d) Due to varying in step (c), the output waveform may behave differently. The following figure shows some possible phenomena with the explanations below.

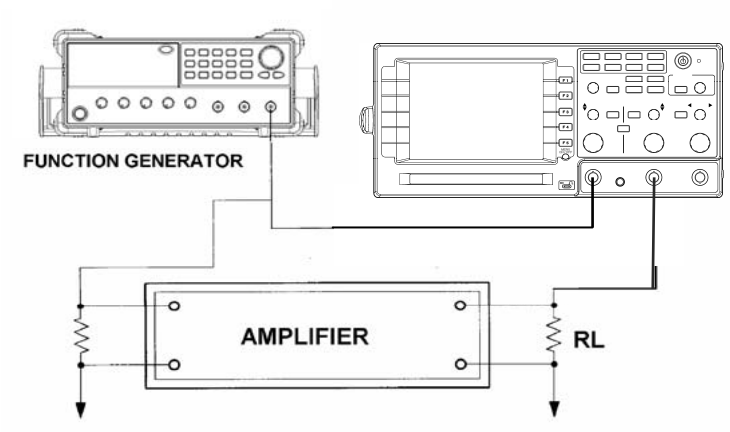



**Figure 5**



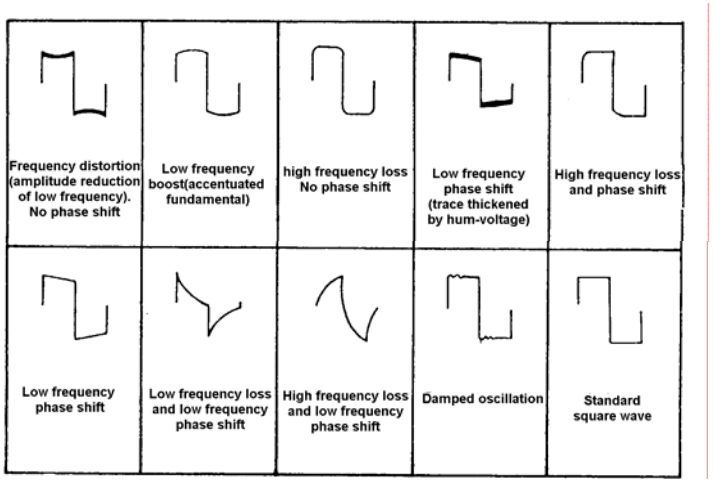



**Figure 6**

**CAUTION: The Square wave may not be suitable for narrow band amplifier testing.**

**(F) Logic circuit test**

The SFG2000/2100 series are suitable for logic circuit testing. Use TTL/CMOS output as the clock or data string to test the digital circuit under test. The dual-trace oscilloscope can be used to measure if the input-output timing relation is correct. The following figure 7 shows the connection.

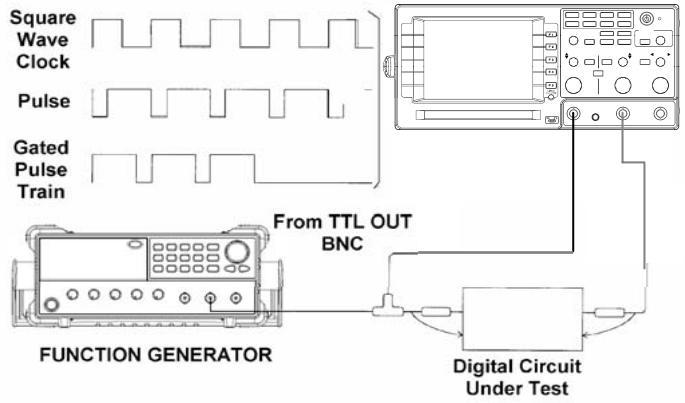



**Figure 7**



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**(G) Speaker Driver and impedance network test**

SFG2000/2100 series can be used to test the frequency characteristics of audio speaker driver or any impedance network. It also can get the resonant frequency of network.

(a) Connect the DUT (device under test) as figure 8 shows. Oscilloscope can be used as well as voltmeter.

(b) When the voltmeter is in use, adjust the SFG frequency and record the voltmeter voltage readings versus SFG frequency.

(c) For speaker testing, the peak voltage value occurs on the resonant frequency of the speaker as Figure 9 illustrated.

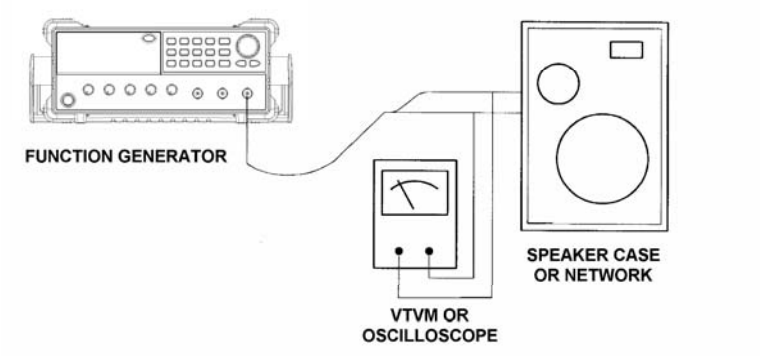



**Figure 8**



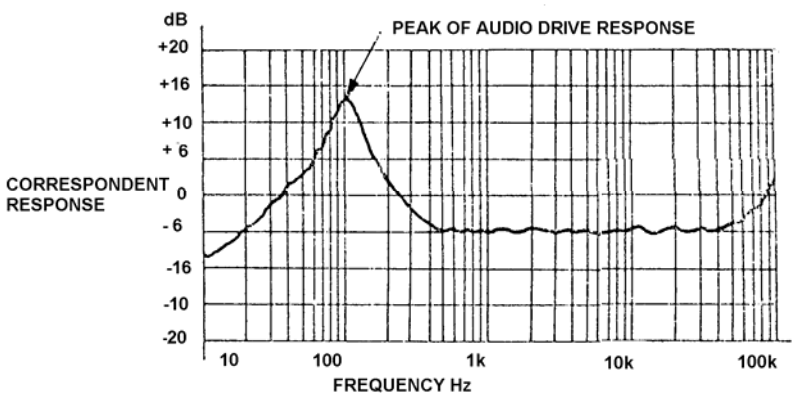



**Figure 9**

(d) When the impedance matching network is under test, proceed the following steps:

(1) Connect the setup as figure 10, where R1 is the potentiometer to find out the impedance of DUT. E1 and E2 are voltmeters used to monitor the voltages of the source and the DUT.

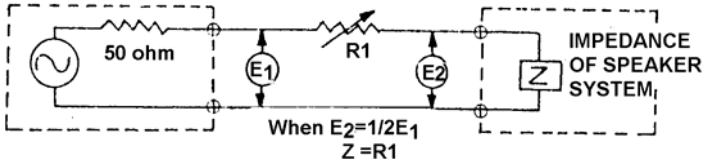



**Figure 10**

(2) Get voltage readings in E1, E2, adjust R1 until E2 is half of E1.

(3) For the current frequency, the network impedance is identical to R1.



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**(H) Sweep functions for speaker test**

SFG2100 series provide sweep feature that the output can drive the amplifier to test the frequency response of speaker. Please refer to figure 11 for the setup.

(a) Select SFG waveform to Sine wave.

(b) Set the start frequency of sweep at 20Hz.

(c) Activate Sweep mode (LIN, LOG), and set sweep width, sweep time as desired. The speaker will sound and churr as the sweep going.

(d) Change the frequency if another frequency bands are required to test.

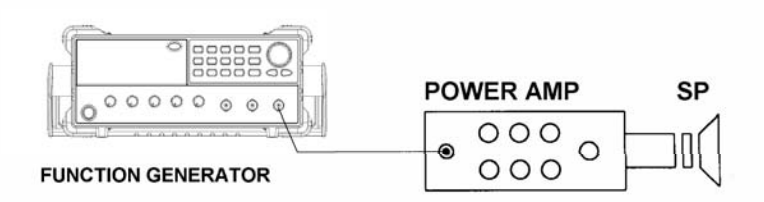



**Figure 11**



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