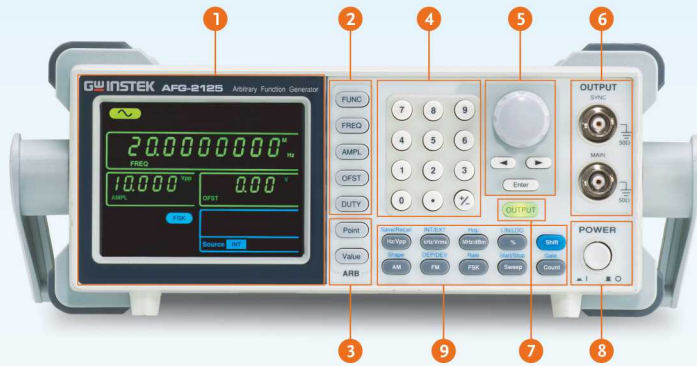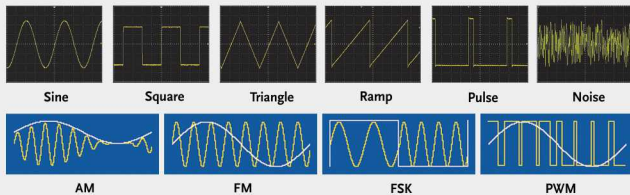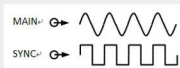# Function Generator

1. **3 Color LCD Panel :**
   3.5 inch, 3 color LCD display

2. **General Function Keys :**
   Set different output waveform type, frequency, amplitude, DC offset and duty cycle value

3. **Arbitrary Function Keys :**
   Set the ARB point numbers and the amplitude value of the selected points

4. **Number Pad :**
   The digital keypad is used to enter values and parameters.

5. **Scroll knob & Selection Key :**
   It is used to edit values and parameters.

6. **Output Terminals :**
   SYNC output & main output port fixed at 50 Ohm output impedance

7. **Main Output Switch :**
   Turns the output on/off. When it combines with shift key, the display can show the high-Z output impedance value

8. **Power Switch :**
   Turns the instrument power on/off

9. **Operation Keys :**
   Select the AM, FM, FSK modulation and frequency sweep function

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A — An Introduction to Function Generator

1. A Function Generator is used to generate function waveforms like sine, square, triangle, pulse, noise, AM, FM, Sweep... etc.
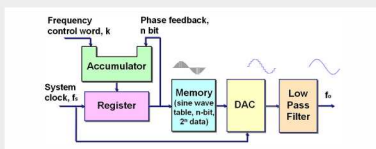
Sine	Square	Triangle	Ramp	Pulse	Noise

AM	FM	FSK	PWM

2. The SYNC output generates a TTL signal of is synchronized with the main output.

MAIN⌐→
SYNC⌐→

3. External Counter Function can measure the signal frequency fed into the counter input.

→ Ext Counter in→
200000000ˢ
FREQ

4. **Function Generator Category**

※ DDS (Direct-Digital-Synthesized) Function Generator is a digital based design which provides signal with stable frequency and low distortion. The block diagram illustrates as below.

Frequency control word, k
Phase feedback, n bit
Accumulator
System clock, fs
Register
Memory (sine wave table, n-bit, 2^n data)
DAC
Low Pass Filter
f_o

Assume the memory storing the SINE wave table is n-bit, the system clock frequency is fs , with the frequency control work k (ranges from $0 - 2^n$), the output frequency fo is derived by the equation as :

$$f_o = \frac{k \cdot fs}{2^n}$$

※ Arbitrary Waveform/ Function Generator is the upgraded version of DDS FG. In the waveform data memory, not only the standard waveform but also the arbitrary waveform data can be loaded. The signals like medical, vehicle, physical etc. are usually not in regular form. With arbitrary waveform and an editing tool (usual a PC program), these signals can be created and generated.

※ The conventional function generator is mostly the analog circuit design, which consists of positive-and-negative current source and integrator. The charging polarity alters when the charging voltage reaches the threshold. Firstly, the periodic triangle waveform is formed while the sine and the square waveforms are formed by shaping circuits.

Current source 2
Current Source 1
Integrator
Square
Triangle
Sine
—— :Charging   —— :Discharging
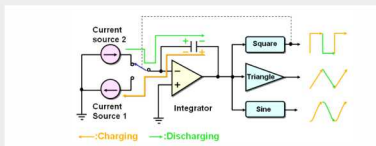
B — Definitions of Operation Parameters of Function Generator

1. The parameter settings a waveform are as follows.
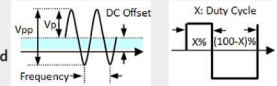
   Frequency : Number of times occurred during one second, unit : Hz
   Amplitude : Strength of the signal. Vpp, Vrms and dBm are usually used as unit.
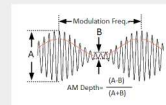   DC Offset : The DC component in a signal.
   Duty Cycle : Mostly used in square wave, defining the percentage of high level presence.
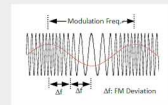
   Vpp   Vp   DC Offset
   Frequency→
   X: Duty Cycle
   X%   (100-X)%

2. The conversion equation of Vrms, Vp and dBm is as below.

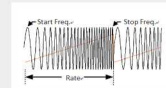$$Vrms = \sqrt{\frac{\int_0^T Vp(t)^2 dt}{T}} \qquad dBm = 10 \cdot log\left(\frac{Vrms^2}{R \cdot mW}\right)$$
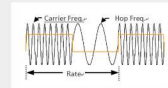
3. **AM waveform parameters**

   Modulation Freq.
   B
   A
   AM Depth= $\frac{(A-B)}{(A+B)}$

4. **FM waveform parameter**

   Modulation Freq.
   ΔF   ΔF   ΔF: FM Deviation

5. **Sweep waveform parameters**

   Start Freq.   Stop Freq.
   Rate

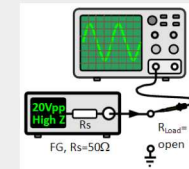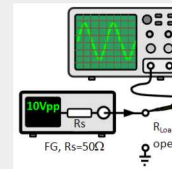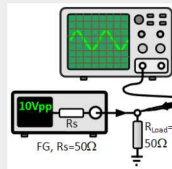6. **FSK waveform parameters**

   Carrier Freq.   Hop Freq.
   Rate

C — Function Generator Applications

1. **Relationship between Output Amplitude and Load.**

   The output impedance of FG is fixed at 50. The output amplitude is set under the assumption of 50 load. For example, if 10Vpp is set, 10Vpp can be measured on 50 load by scope. If the FG output is not connected with the scope within 50 load, 20Vpp will be displayed on the scope. In this case, the output can be set to High Z (high load impedance) mode, the amplitude should be equivalently set at 20Vpp.

   10Vpp   Rs $R_{Load}= 50\Omega$ FG, Rs=50Ω
   10Vpp   Rs $R_{Load}=$ open   FG, Rs=50Ω
   20Vpp High Z   Rs $R_{Load}=$ open   FG, Rs=50Ω

2. **Amplifier Test**

   FG can be used as a signal source to test the amplifier. In the hi-fi equipment test system, a sweep signal is generated from FG to test the frequency response of the amplifier and speaker.

   1kHz Swp   Amp.