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DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

EE200 CIRCUIT LABORATORY

NOTES ON FUNCTION GENERATOR

2020/2021

FUNCTION GENERATOR

1. Introduction

The AATech AWG 1020A is a voltage waveform generator. It can be used to apply periodic voltage waveforms to a circuit (e.g., sinusoids, square waves, triangle waves, and pulses). You will use the function generators to supply time-varying input to circuits for transient or frequency analysis (e.g., to characterize a filter or an amplifier).

2. Quick Notes

- Make sure the "Output" button is lit (in the lower-right corner).
- Set parameters in Ampl/Offset mode, not in HiLevel/LoLevel mode. If HiLevel/LoLevel mode is selected, push the blue buttons below HiLevel/LoLevel until Ampl/Offset mode is selected instead.
- The Ampl parameter sets the peak-to-peak amplitude, not the peak amplitude. See Figure 1.
- Delivered voltage varies with output load impedance. With an infinite load impedance at the output, the voltage amplitude delivered to the load will be double the panel setting. See Section 3.
- Choose parameters to adjust via the blue buttons that are below the screen. Change the parameter values using the top-right knob as well as the arrow keys; an alternative is to use the numbered keys to input the desired value. If you do use the numbered keys, note that after punching in the numbers, you must select the proper units and order of magnitude using the blue buttons below the screen.
- Offset is the voltage offset for the waveform. You can use it to add a constant voltage (DC component) to the wave (e.g. if you want to have a cosine vary around 2 V).
- The function generator's ground is earth-grounded, i.e. the black lead from the BNC cable is not a floating ground. Since the oscilloscope is earth-grounded as well, the function generator and oscilloscope grounds are connected.

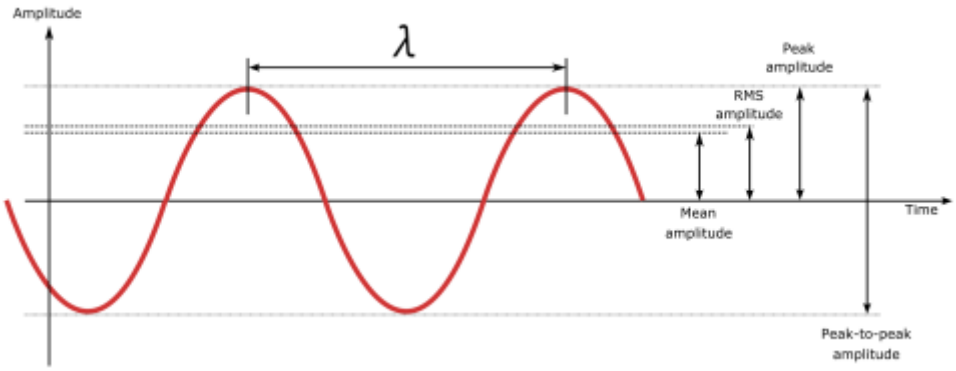


Figure 1: Definitions of various wave parameters

3. Voltage Divider Discussion

When displaying voltage value settings (e.g. the Ampl parameter displaying Vpp), the function generator panel displays the voltage that will be delivered to the load at the output under the assumption that the total load impedance is 50 Ω. The function generator also has an internal impedance of 50 Ω, and so the load impedance forms a voltage divider with the internal impedance of the function generator. The equivalent voltage divider is shown in Figure 2.

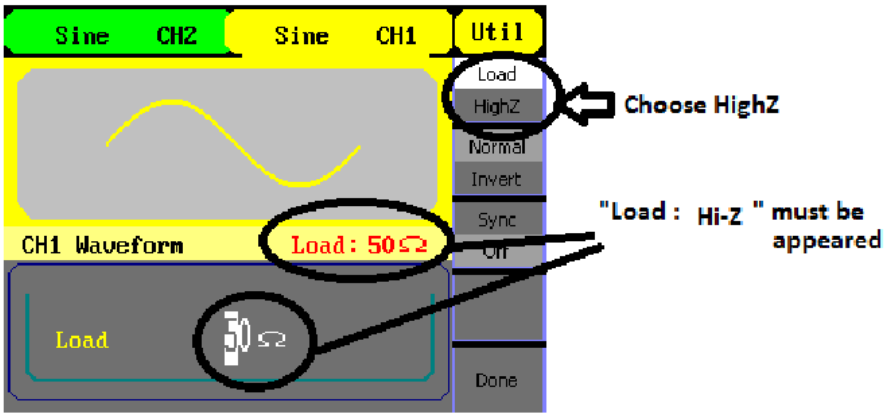


Figure 2: Function generator panel displays voltage values for RL = 50 Ω

Under the assumption that the load impedance is 50 Ω, the voltage delivered to the load (the effective voltage output) is half the generated voltage of vs. Loading the output with an impedance much greater than 50 Ω (such as connecting the output directly to an oscilloscope) will drop the majority of the voltage across the load, and thus the measured output voltage can be up to double the panel setting. Loading the function generator with RL < 50 Ω will cause the voltage delivered to be less than the panel setting.

The function generator is often used to create an input signal to amplifiers. Voltage amplifiers often have a high input impedance (e.g. an effectively infinite input impedance for a MOS amplifier), and so the function generator will often be loaded with an infinite RL. Thus the voltage delivered to the amplifier input will often be double the panel setting.

4. Interface Details

To begin, you should know where the power button and output port are located on the function generator. The power button is in the lower-left corner of the front panel. The output ports are in the lower-right corner and require a special cable. Notice that after turning on the function generator, the display shows the value of the currently selected parameter as well as the units and order of magnitude (e.g. mV V).

The notes below correspond to the button groups shown in Figure 3. They are generally in the order that you would use them to set up an output waveform.

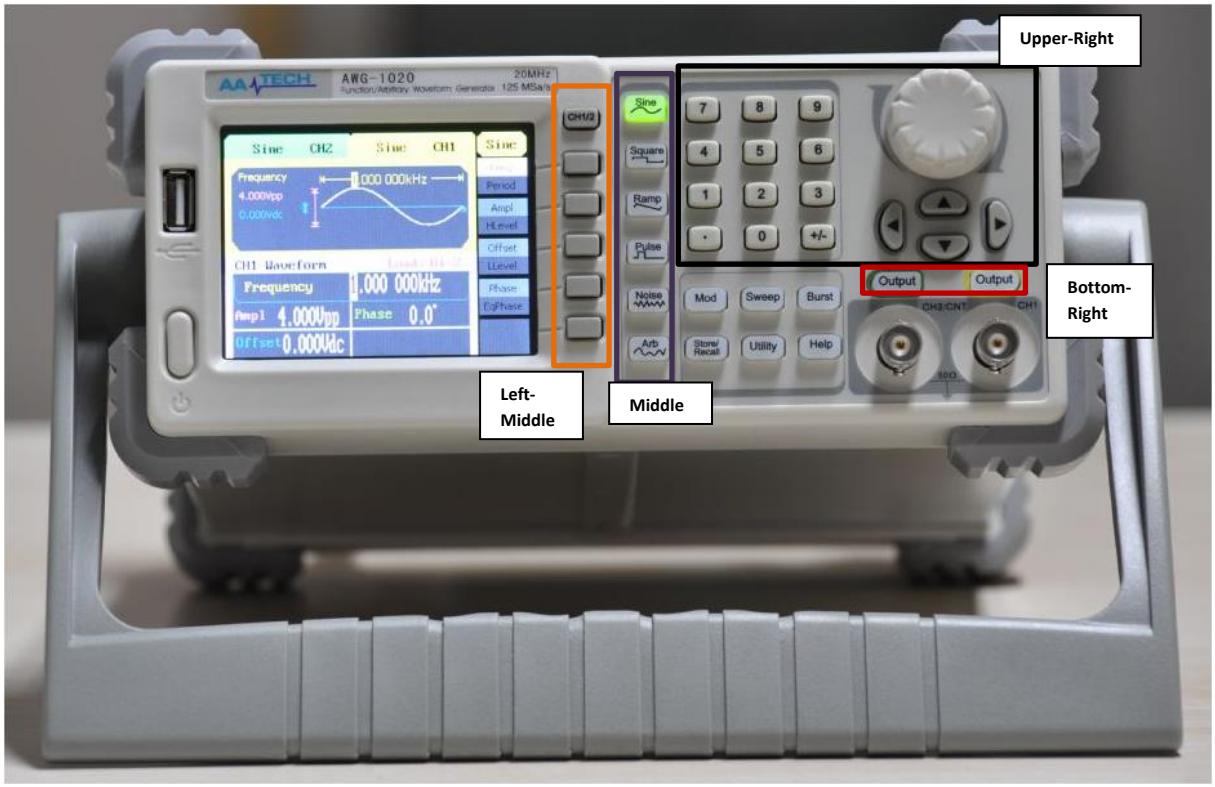


Figure 3: AATech AWG 1020A Front Panel

4.1.Bottom-Right Buttons

The Output buttons turn on the output voltages, which should be off when the function generator is initially turned on. So, press the button once to turn on the output voltage.

4.2.Middle Buttons

These six buttons set the shape of the output waveform:

- Sinusoidal: A sine or cosine wave; function generator will normally have the capability to produce a standard sine wave output. This is the standard waveform that oscillates between two levels with a standard sinusoidal shape.
- Square: It consists of a signal moving directly between high and low levels.
- Ramp: This form of signal produced by the function generator linearly moves between a high and low point. Also known as a "Saw-tooth" wave.
- Pulse: A voltage pulse is sent periodically. The pulse width can be tuned separately from the period (the time interval between repeated pulses).
- Noise: Simulation of voltage noise.
- Arb: Create your own waveform.

4.3.Left-Middle Grey Buttons

First grey button selects the channel (CH1 or CH2) and the other five buttons allow you to select parameters of the output waveform. After selecting a parameter, the parameter value can be adjusted with the numbered keys, arrow buttons, and the knob located in the upper-right corner of the front panel. Depending on the middle button selected, not all of these five left-middle buttons will be active (i.e. not every waveform will require the use of all six buttons).

Each left-middle button has two labels above it, with only one of the two labels lit at any given time. The highlighted label corresponds to the parameter that is currently selected, and its value will be shown on the display. You will only need to adjust the Freq, Ampl, Offset, Width, and/or Duty Cycle parameters. If HiLevel and LoLevel are lit, press the button below LoLevel or HiLevel until Ampl and Offset are selected instead.

Here is a list of the parameter labels and their respective meanings:

- Freq: Frequency in repetitions per second. In the case of a pulse, this parameter corresponds to the frequency at which repeated pulses are sent.
- Ampl: Amplitude (peak-to-peak), defined as the distance between the highest and lowest voltage points of a waveform.
- Offset: DC voltage offset. The time-varying waveform is offseted (“raised”) by the constant offset component (e.g. if you want a sinusoid of amplitude 1 V centered at 3 V, the offset should be 3 V).
- Width: Pulse width (for the pulse waveform).
- Duty Cycle: duration of a pulse. This control on the function generator changes the ratio of high voltage to low voltage time in a square wave signal, i.e. changing the waveform from a square wave with a 1:1 duty cycle to a pulse waveform, or a triangular waveform with equal rise and fall times to a saw-tooth.

4.4.Upper-Right Buttons

In the upper-right corner of the front panel, there is a knob, two arrow buttons, and a set of numbered buttons. Each of these offers a different way of adjusting the displayed parameter value:

- Knob: This can be turned clockwise and counterclockwise to adjust the displayed parameter value. Note that the knob only changes the digit (or number) selected by the blinking cursor.
- Arrow Buttons: Press the left and right arrow buttons to manually move the blinking cursor.
- Numbered Buttons: An alternative to the knob and arrow buttons is the set of numbered keys. Simply punch in the desired value using the numbered key pad, and when prompted, select the proper order of magnitude. Note that the polarity of the output can be changed with the +/− button.