

Electronics Function Generators

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January 20, 2020

Function generator (or signal generator)

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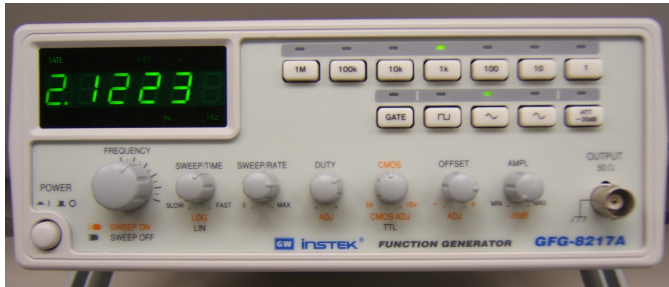
- used when you want a known time-varying signal to feed into a circuit

Typical function generator

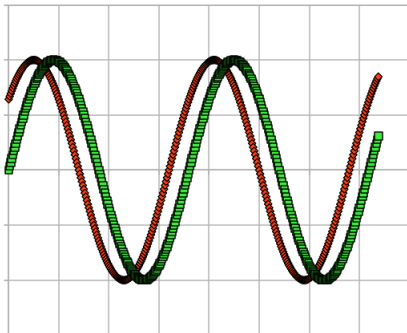
Function generator (or signal generator)
Output resistance
Inputs
Connector characteristics

Waveform characteristics
Special characteristics of pulse waveforms

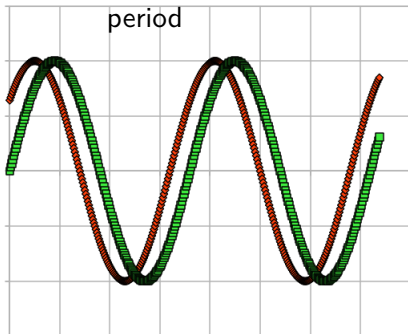
Typical function generator



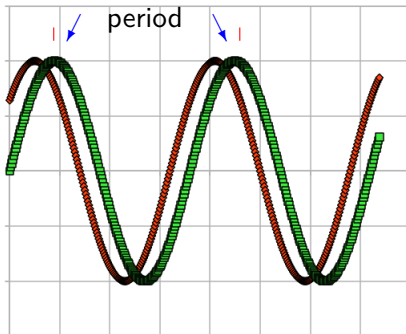
Waveform characteristics



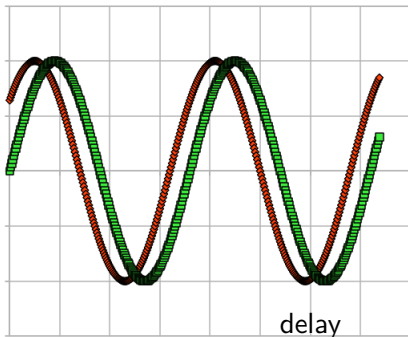
Waveform characteristics



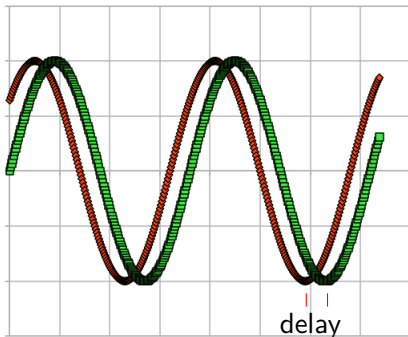
Waveform characteristics



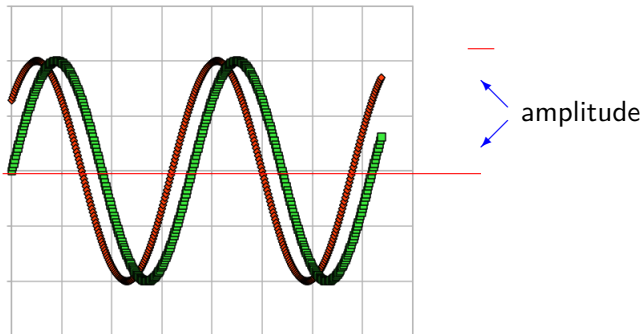
Waveform characteristics



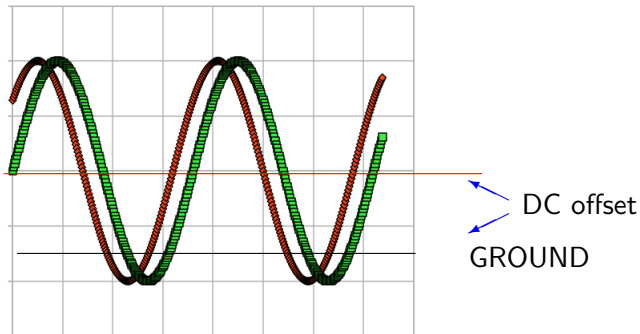
Waveform characteristics



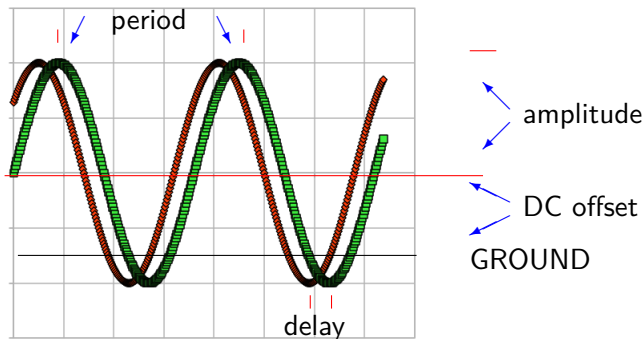
Waveform characteristics



Waveform characteristics

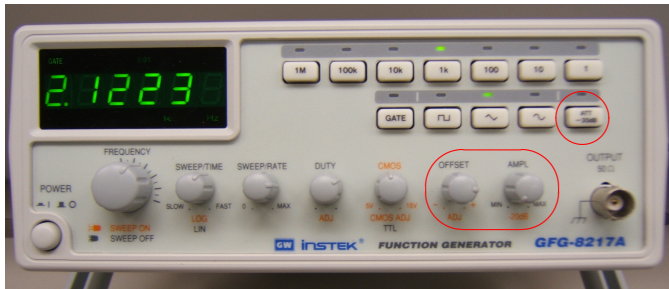


Waveform characteristics



Function generator (or signal generator)
Output resistance
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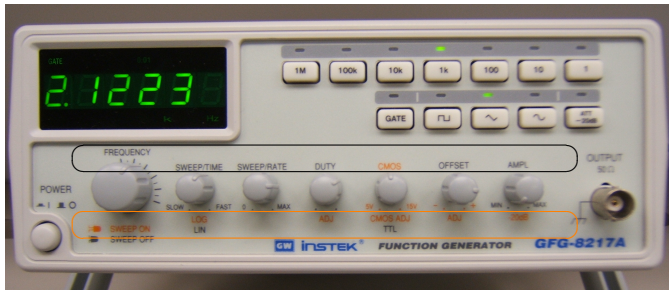
Amplitude and DC offset controls

Important note!

Function generator (or signal generator)
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Important note!



pressed in - black function; pulled out - orange function

Shape

Shape

- Depends on application

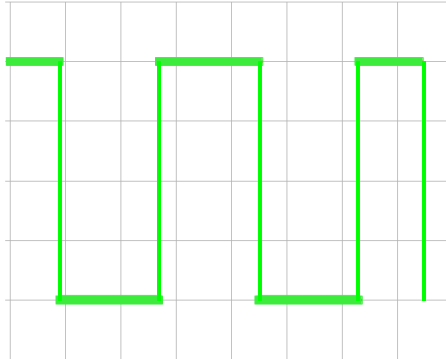
Shape

- Depends on application
- Usually square, sine, triangle available

Shape

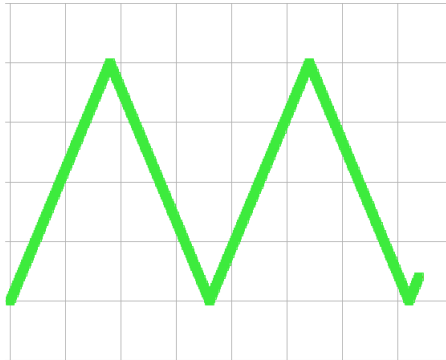
- Depends on application
- Usually square, sine, triangle available
- Other possibilities are ramp and pulse (see below)

Waveform characteristics



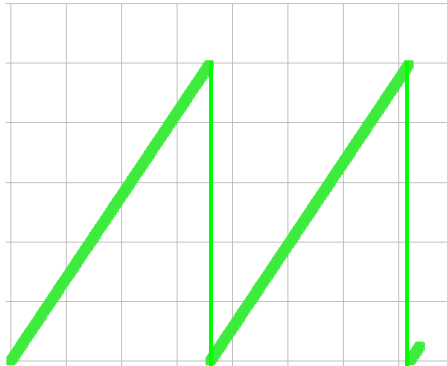
Square

Waveform characteristics



Triangle

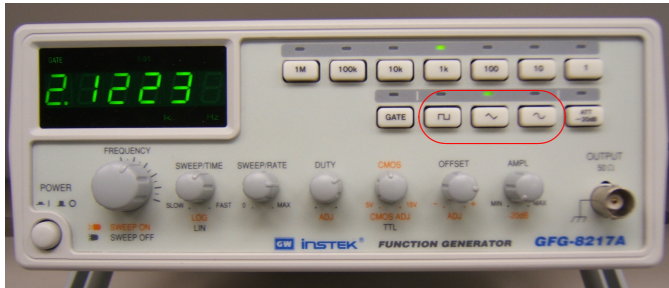
Waveform characteristics



Ramp (or sawtooth)

Function generator (or signal generator)
Output resistance
Inputs
Connector characteristics

Waveform characteristics
Special characteristics of pulse waveforms

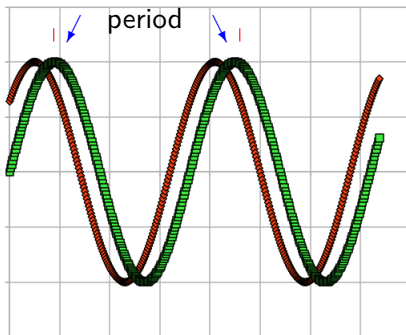


Shape controls

Frequency

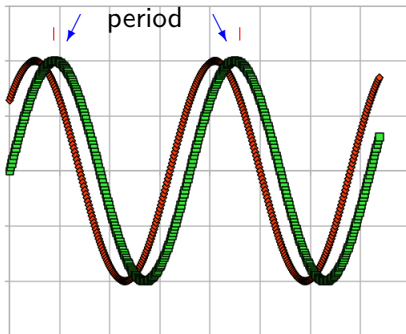
Frequency

- Measured in Hz



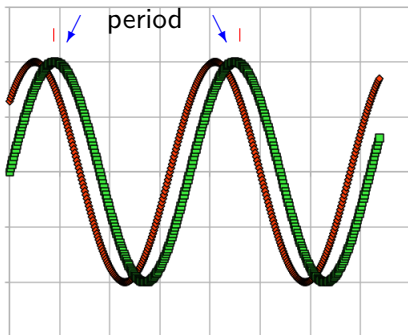
Frequency

- Measured in Hz
- Rate of full cycle



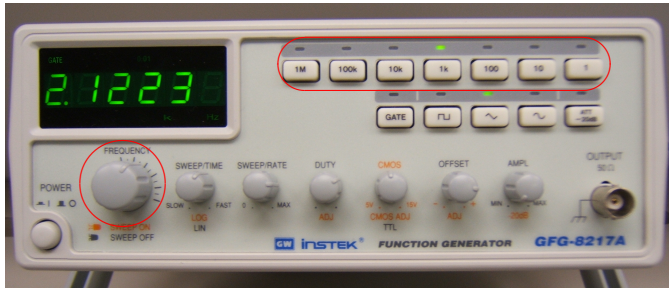
Frequency

- Measured in Hz
- Rate of full cycle
- $Frequency = \frac{1}{period}$



Function generator (or signal generator)
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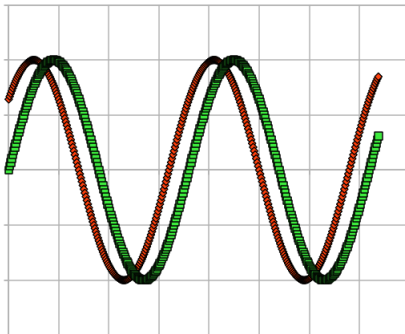


Frequency controls

Amplitude

Amplitude

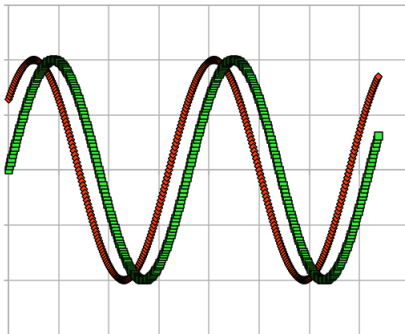
- Measured in volts or mV



—
↙ ↘
amplitude

Amplitude

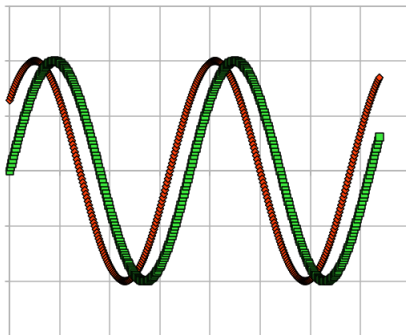
- Measured in volts or mV
- Can be given as peak-to-peak (2x amplitude)



amplitude

Amplitude

- Measured in volts or mV
- Can be given as peak-to-peak (2x amplitude)
- AC component of a signal (see below)

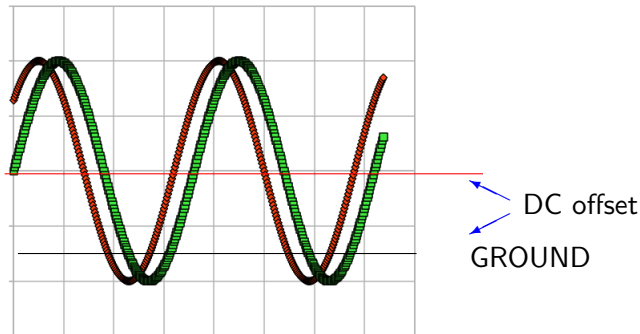


amplitude

Offset

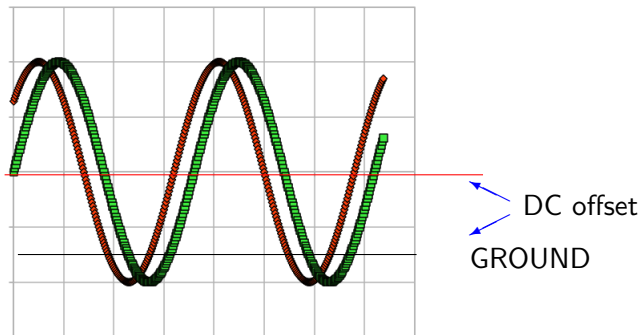
Offset

- Measured in volts or mV



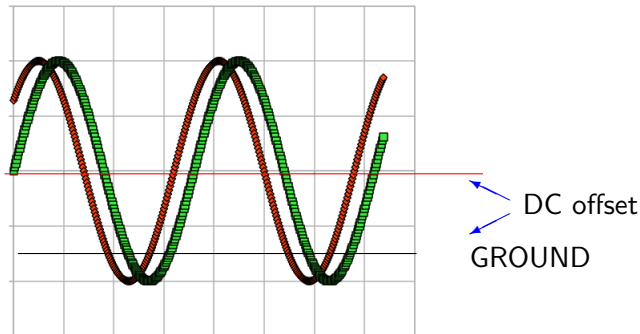
Offset

- Measured in volts or mV
- Sometimes you don't want a signal centred around zero volts.



Offset

- Measured in volts or mV
- Sometimes you don't want a signal centred around zero volts.
- *DC* component of a signal (see above)



Offset

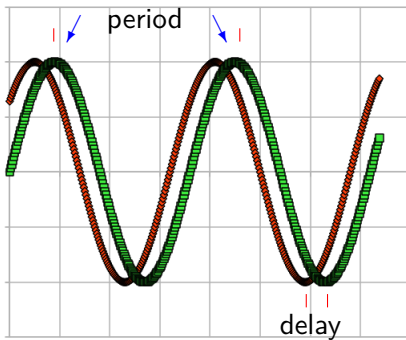
Offset

Warning: Different signal generators handle switching from zero DC offset to adjustable DC offset differently!

Phase

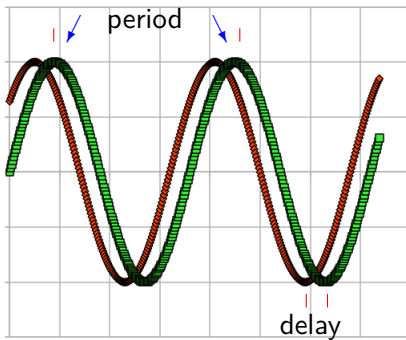
Phase

- Measured in degrees



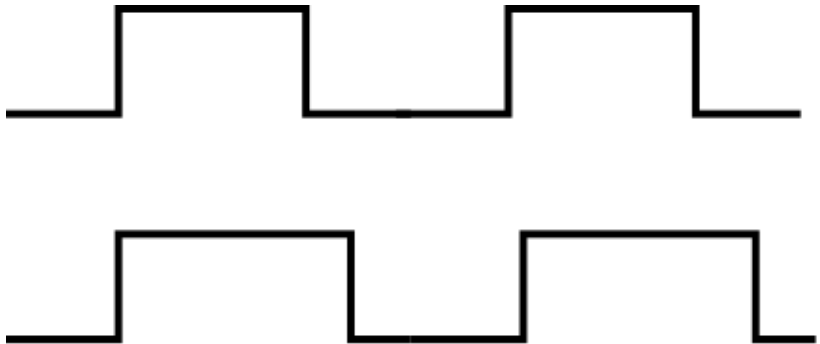
Phase

- Measured in degrees
- Compares the time difference between two signals



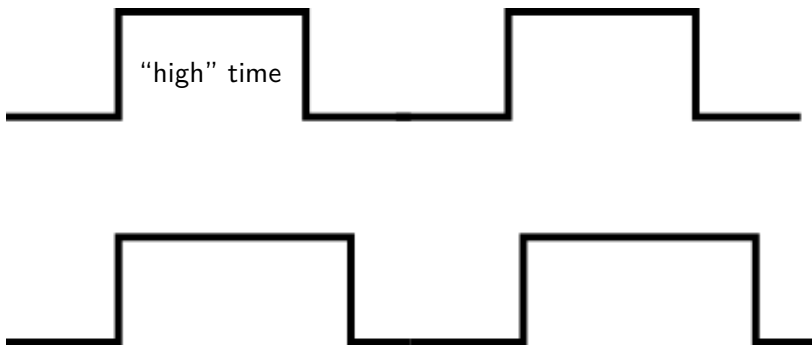
Special characteristics of pulse waveforms

Duty cycle



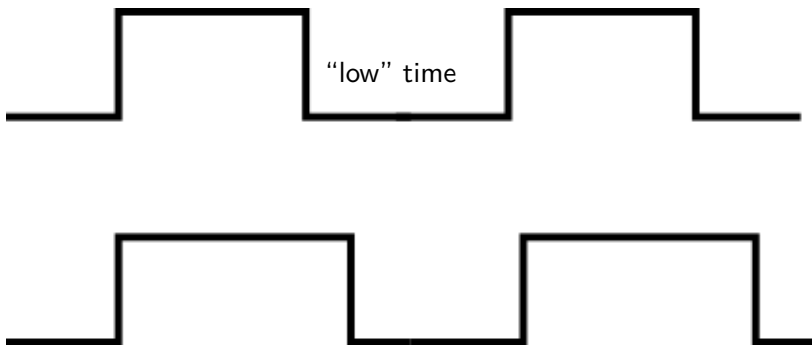
Special characteristics of pulse waveforms

Duty cycle



Special characteristics of pulse waveforms

Duty cycle



Special characteristics of pulse waveforms

Duty cycle

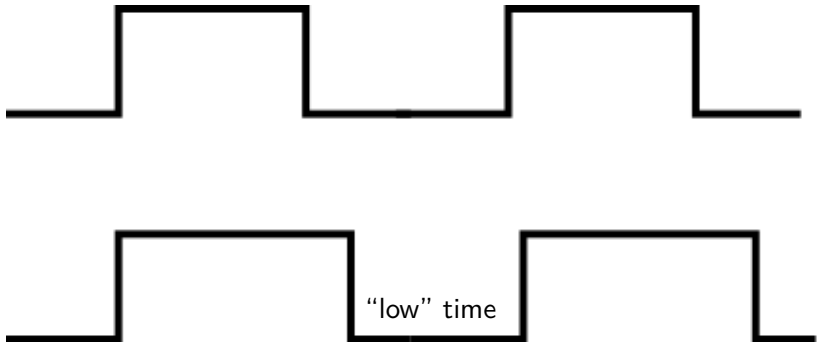


“high” time



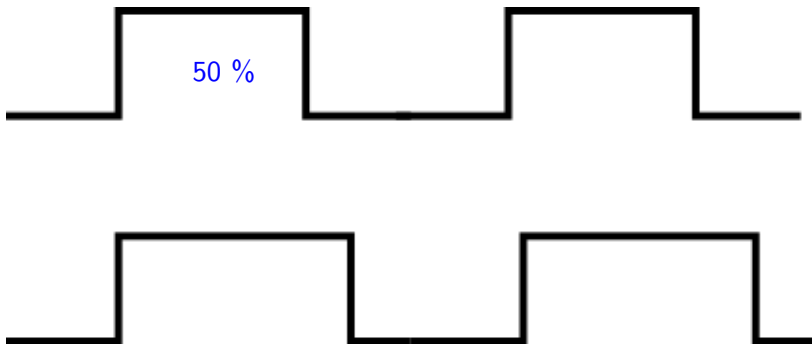
Special characteristics of pulse waveforms

Duty cycle



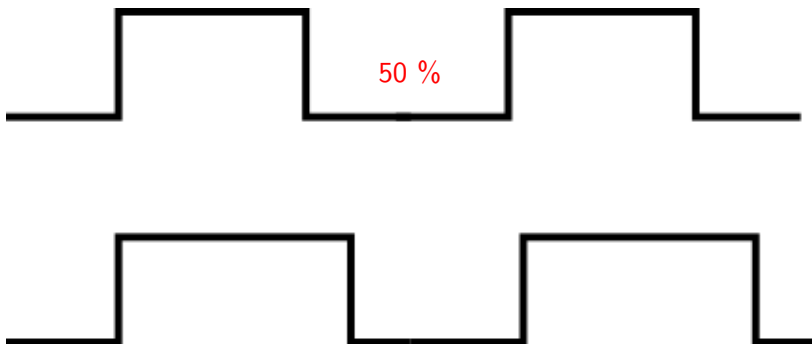
Special characteristics of pulse waveforms

Duty cycle



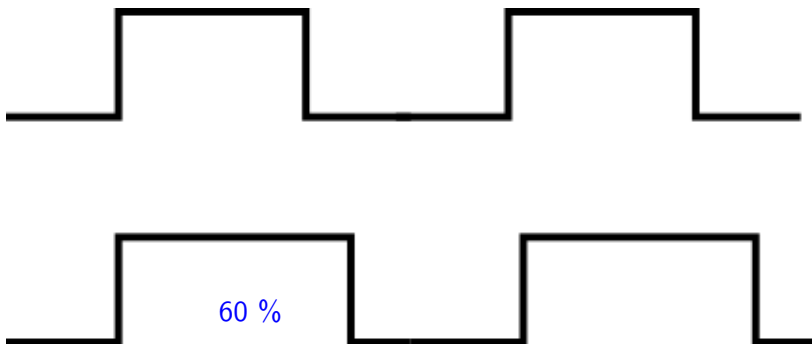
Special characteristics of pulse waveforms

Duty cycle



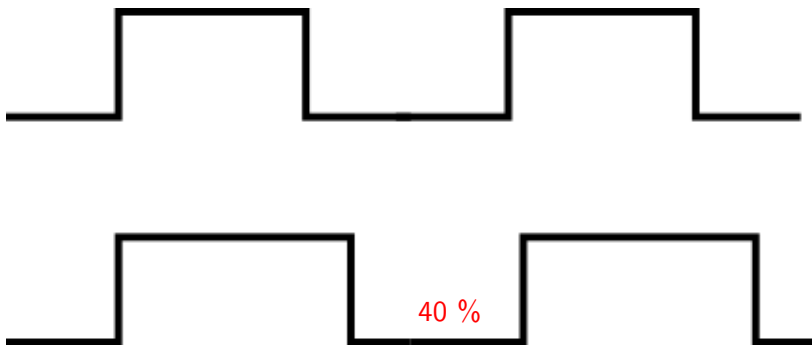
Special characteristics of pulse waveforms

Duty cycle



Special characteristics of pulse waveforms

Duty cycle



Duty cycle

Duty cycle

- Measured in percent

Duty cycle

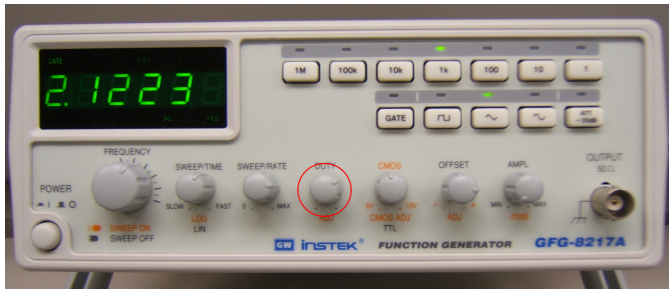
- Measured in percent
- Sometimes you don't want the high and low parts equal

Duty cycle

- Measured in percent
- Sometimes you don't want the high and low parts equal
- Usually referred to like this: "60-40" which means 60% of the time it will be high; 40% of the time it will be low

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Duty cycle control

Rise time/Fall time

Rise time/Fall time

- Measured in ms, ns, etc.

Rise time/Fall time

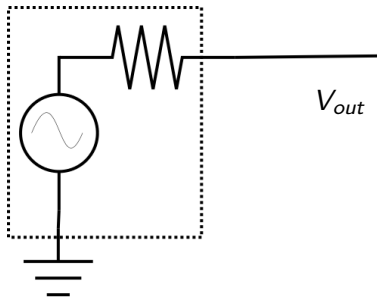
- Measured in ms, ns, etc.
- Sometimes you don't want the edges of the signal to be vertical; you want the changes to be ramps rather than vertical

Output resistance

Output resistance

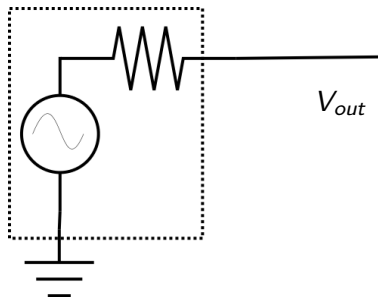
- Think of the output as a voltage followed by a series resistor

Output resistance



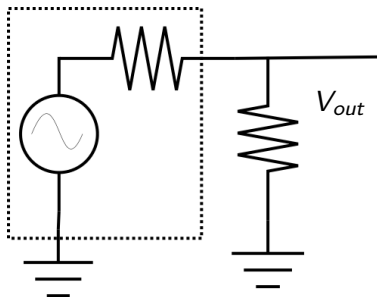
- Think of the output as a voltage followed by a series resistor

Output resistance



- Think of the output as a voltage followed by a series resistor
- Output voltage will start to drop if enough current is drawn

Output resistance



- *If you put a resistor from the output to ground, what value of R would drop the output voltage to half of what it would be otherwise?*

Inputs

Inputs

- Some function generators will have inputs to allow control of the output signals (such as a TTL signal to turn the output ON or OFF)

Connector types

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- Usually BNC (bayonet Neil-Concelman) or banana plugs

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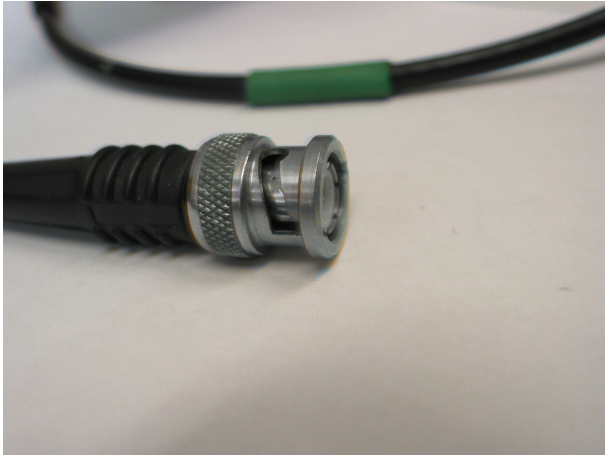
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- **BNC connectors are polarized for a reason; usually the outside connector is grounded**

Connector types

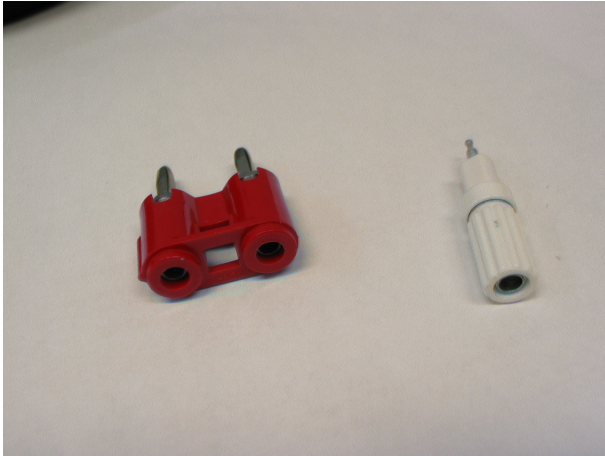
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- BNC connectors are *coaxial* to shield them from electrical noise



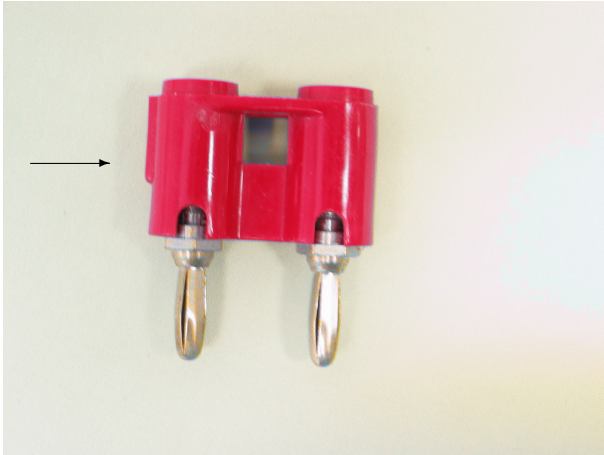
BNC connector



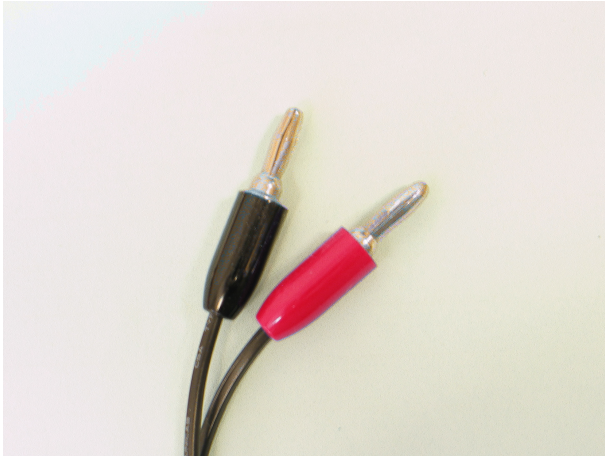
BNC connector - side view



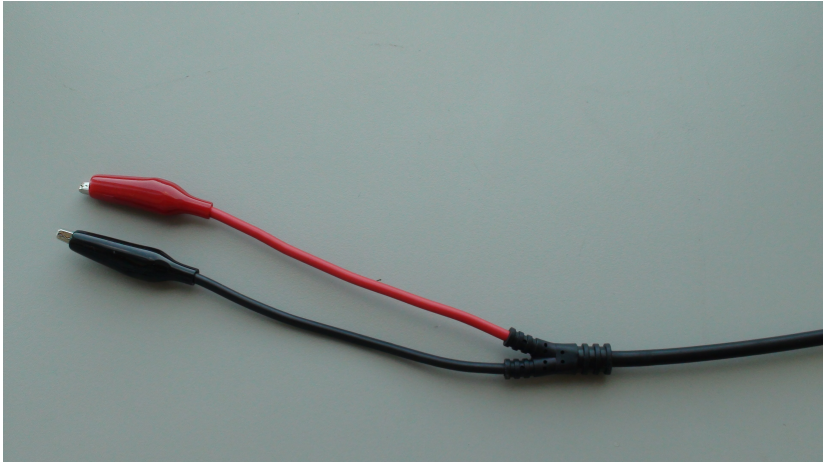
Banana plugs - dual and single



Banana plugs - tab on one side shows polarity (usually GROUND)



Banana plugs - unrestricted spacing



Alligator clips