

# Electronics Function Generators

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Function generator (or signal generator)

Output resistance

Inputs

Connector characteristics

Waveform characteristics

Special characteristics of pulse waveforms

# Function generator (or signal generator)

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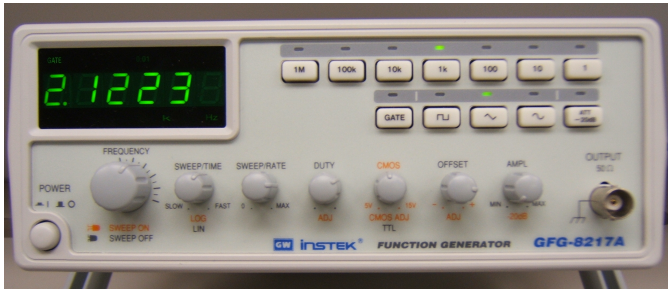
- used when you want a known time-varying signal to feed into a circuit

# Typical function generator

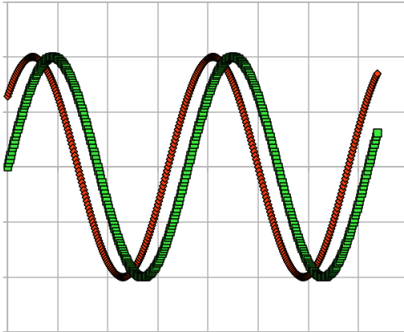
Function generator (or signal generator)  
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Special characteristics of pulse waveforms

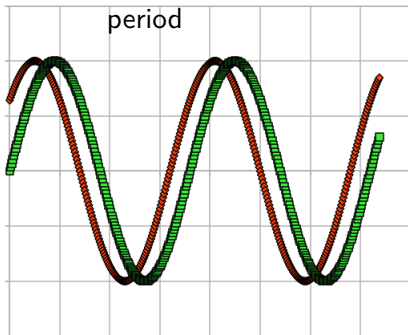
# Typical function generator



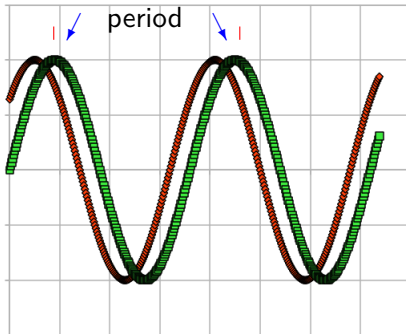
## Waveform characteristics



## Waveform characteristics

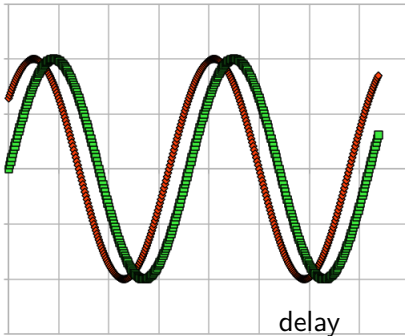


## Waveform characteristics

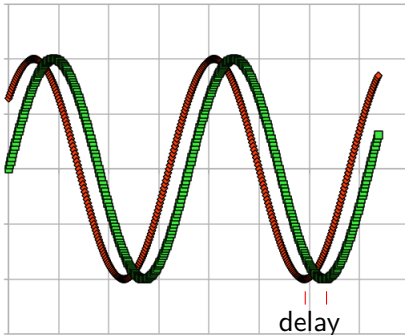




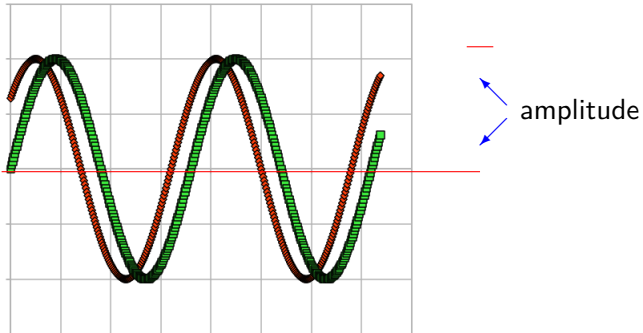
## Waveform characteristics



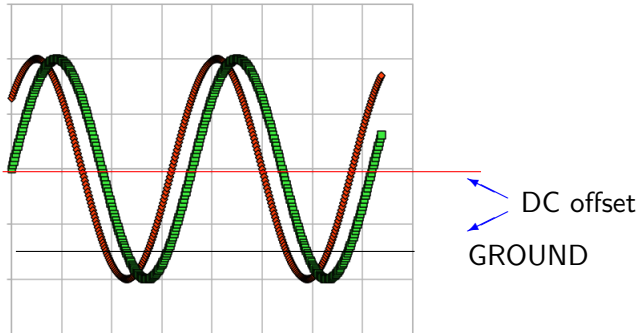
## Waveform characteristics



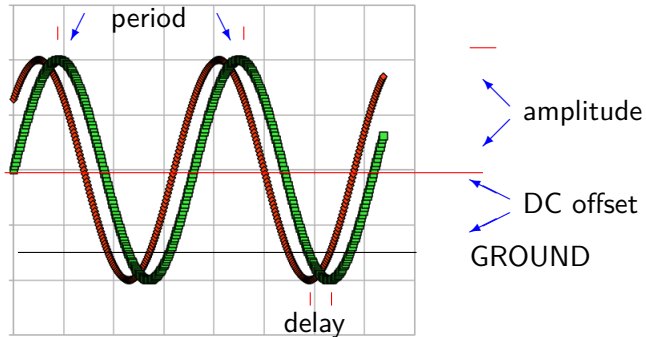
## Waveform characteristics



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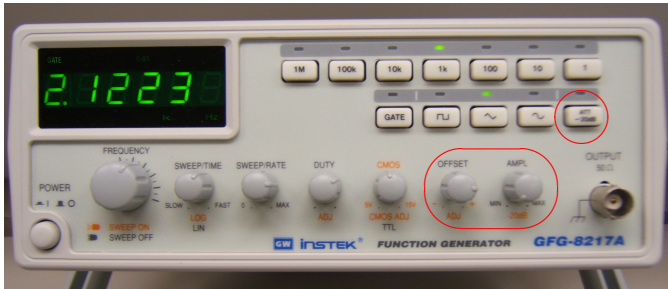


## Waveform characteristics



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

Function generator (or signal generator)

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# Shape

# Shape

- Depends on application



# Shape

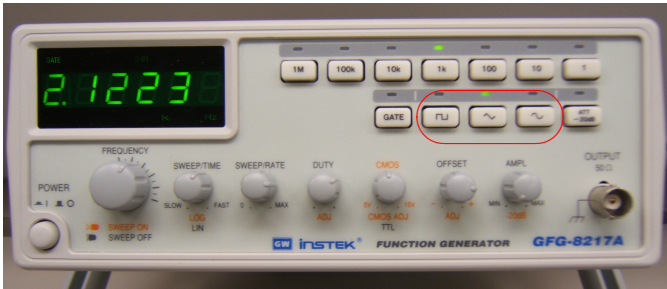
- Depends on application
- Usually square, sine, triangle available

# Shape

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

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Shape controls

Function generator (or signal generator)

Output resistance

Inputs

Connector characteristics

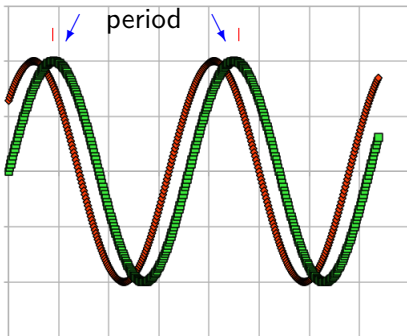
Waveform characteristics

Special characteristics of pulse waveforms

# Frequency

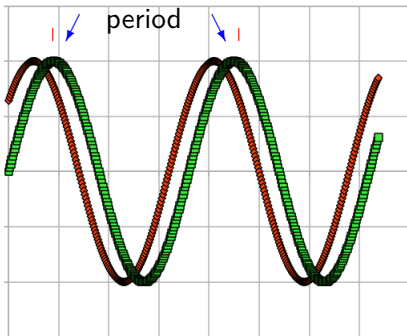
# Frequency

- Measured in Hz



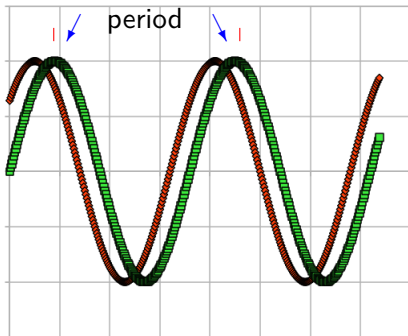
# Frequency

- Measured in Hz
- Rate of full cycle



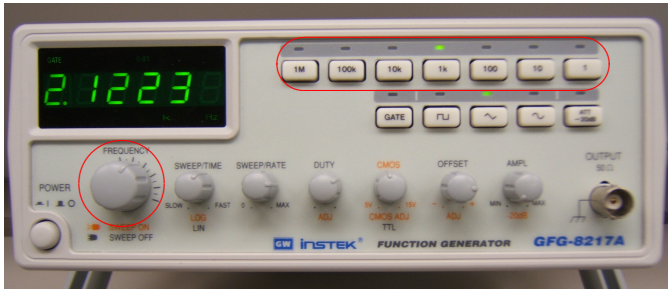
# Frequency

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



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Frequency controls



Function generator (or signal generator)

Output resistance

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Waveform characteristics

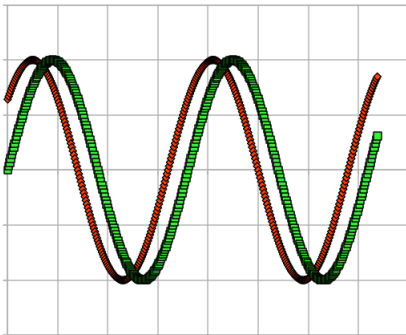
Special characteristics of pulse waveforms

# Amplitude



# Amplitude

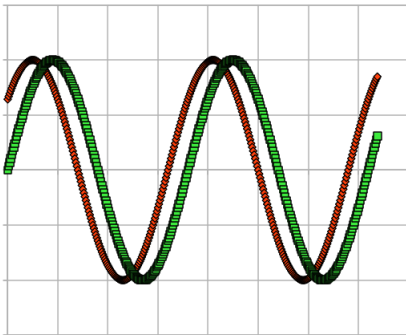
- Measured in volts or mV
- Can be given as peak-to-peak or as amplitude



—  
↔ amplitude  
↔

# Amplitude

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



—  
↕  
↕  
amplitude

Function generator (or signal generator)

Output resistance

Inputs

Connector characteristics

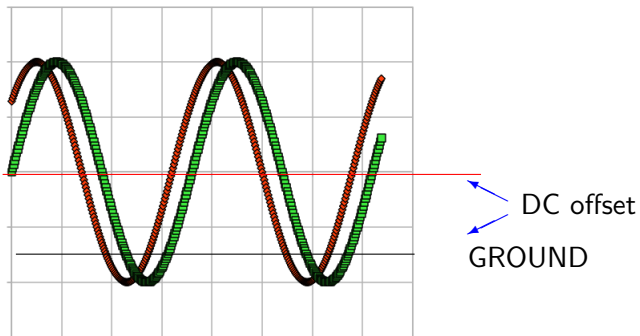
Waveform characteristics

Special characteristics of pulse waveforms

# Offset

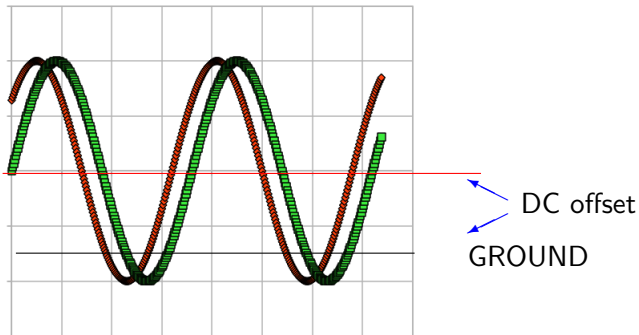
# Offset

- Measured in volts or mV



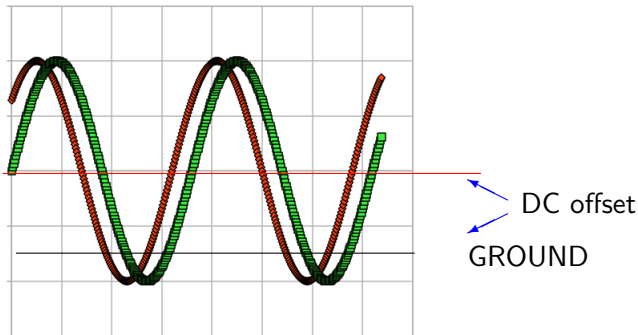
# Offset

- 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)





Function generator (or signal generator)

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# Offset

# Offset

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

Function generator (or signal generator)

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Connector characteristics

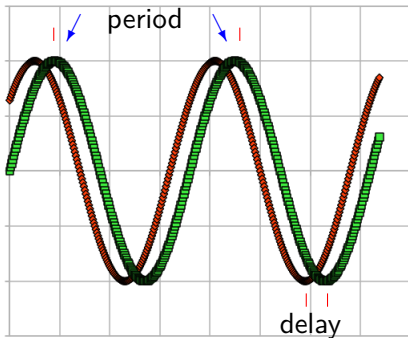
Waveform characteristics

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# Phase

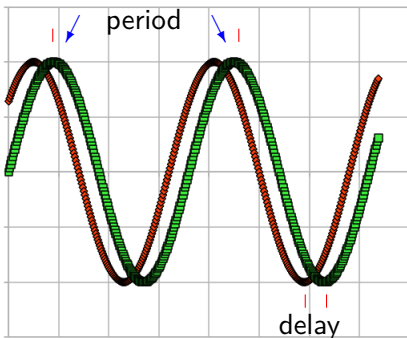
# Phase

- Measured in degrees



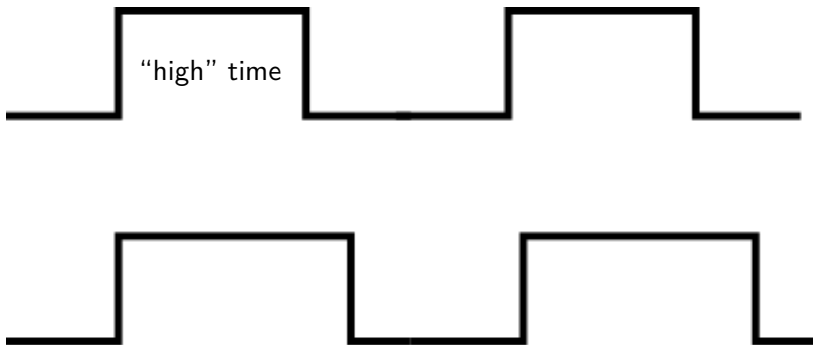
# Phase

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

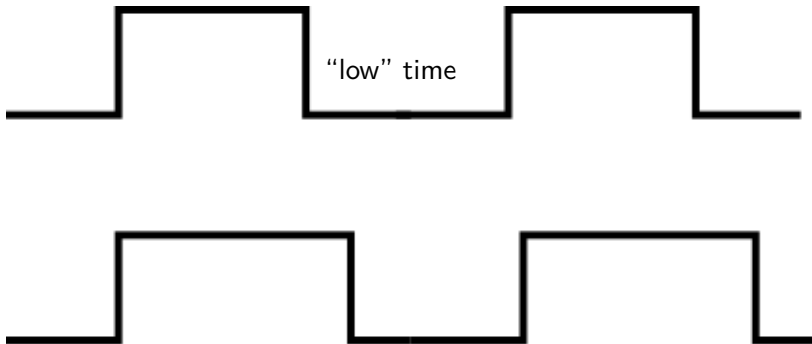


## Special characteristics of pulse waveforms

## Duty cycle

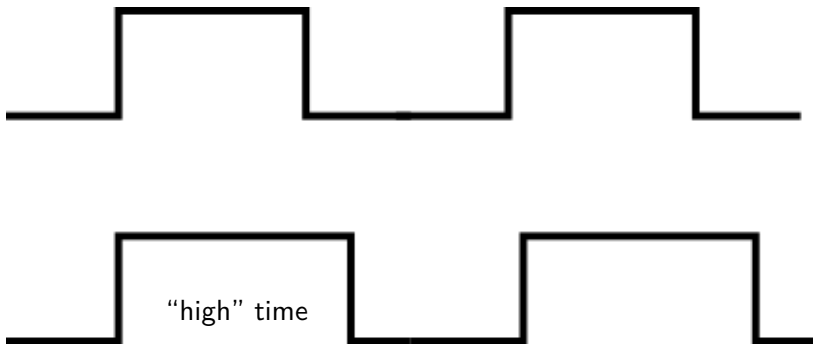


## Duty cycle

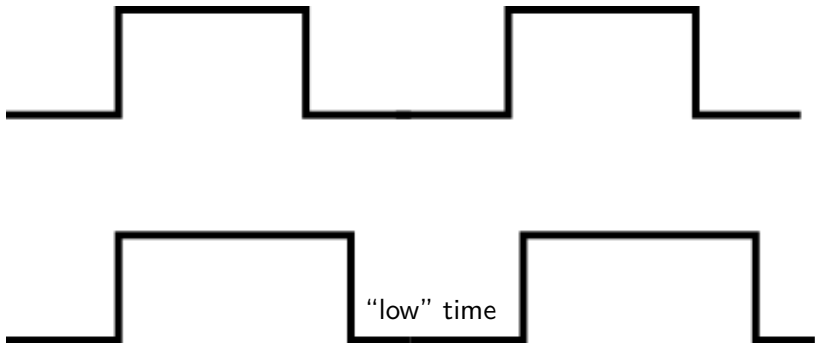




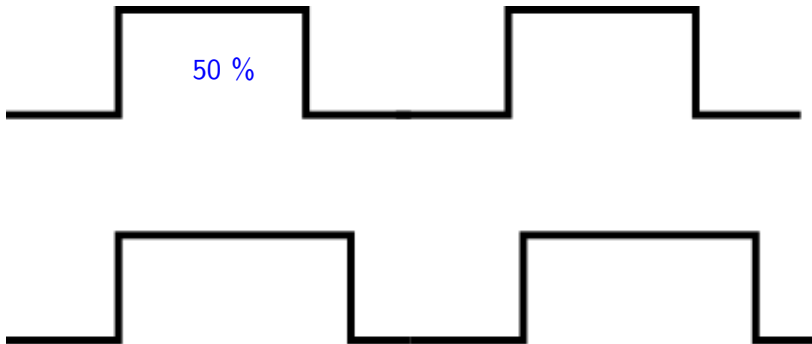
## Duty cycle



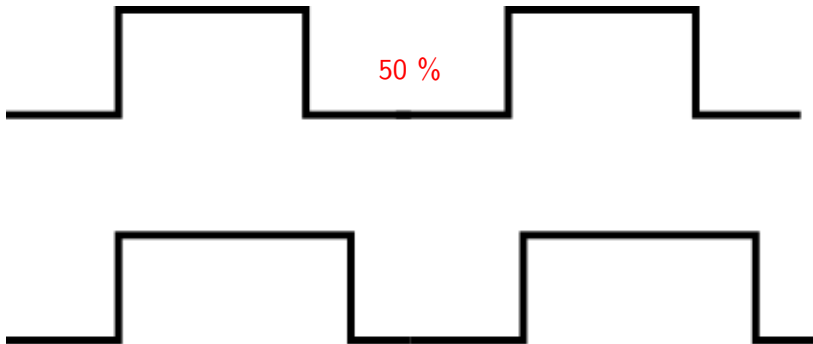
## Duty cycle



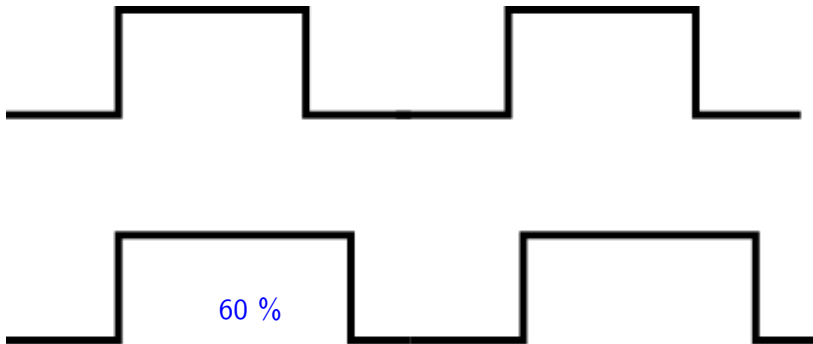
## Duty cycle



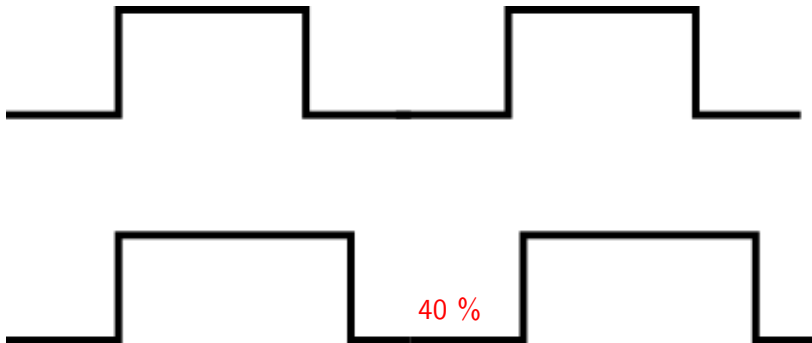
## Duty cycle



## Duty cycle



## Duty cycle



# Duty cycle

# Duty cycle

- Measured in percent



# Duty cycle

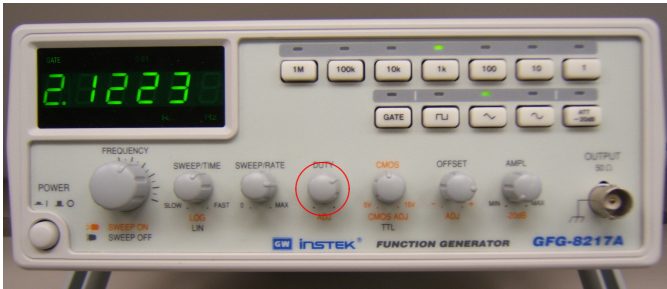
- Measured in percent
- Sometimes you don't want the high and low parts equal

# 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.

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- 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

Function generator (or signal generator)

**Output resistance**

Inputs

Connector characteristics

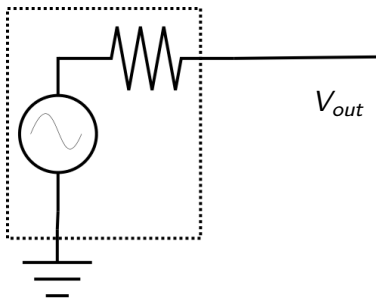
# Output resistance

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

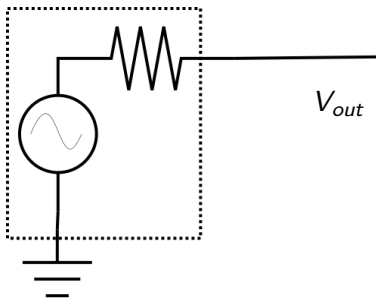


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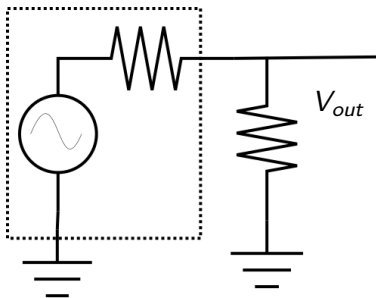
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# Output resistance



- 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?*

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

# Inputs

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- 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

## Connector types

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

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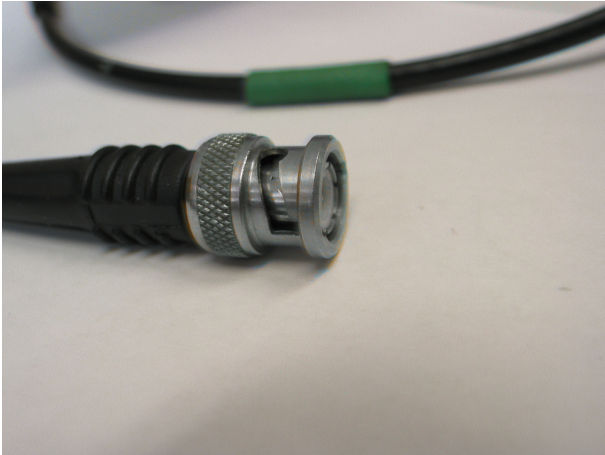
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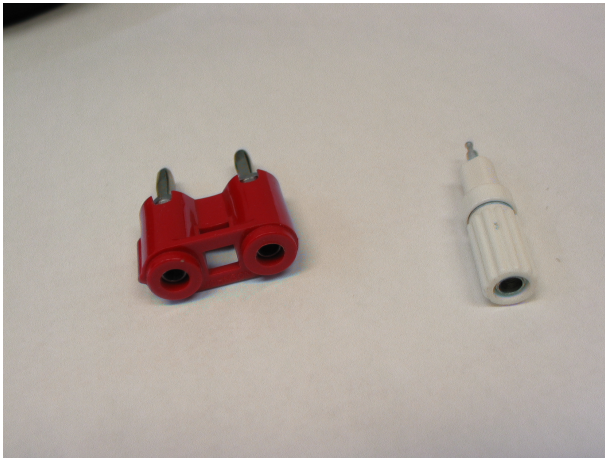
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- Sometimes there are different ones for signals that can only be square or pulse for use in logic circuits
- **BNC connectors are polarized for a reason; usually the outside connector is grounded**
- BNC connectors are *coaxial* to shield them from electrical noise



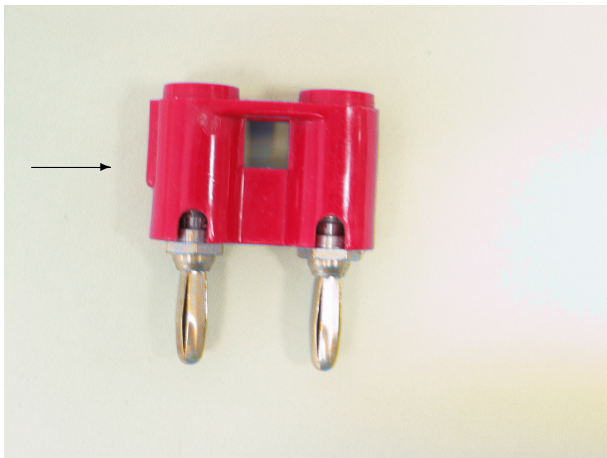
BNC connector



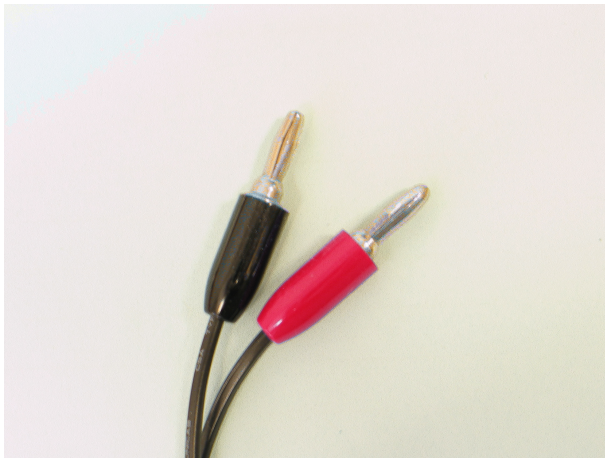
BNC connector - side view



Banana plugs - dual and single



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



Banana plugs - unrestricted spacing