

# ECE 2300

## Electronics Circuits and Electronics Devices Laboratory

Gregg Chapman

# Pre-Lab

## Waveform Basics and Instrumentation Overview

# Lab Format

- PowerPoint Screencast
  - Background
  - Lab Supplies
  - Test Set-up
  - Circuits
  - Measurements
  - Calculations
- Quiz
- Video (Concurrent with Lab)
- Results

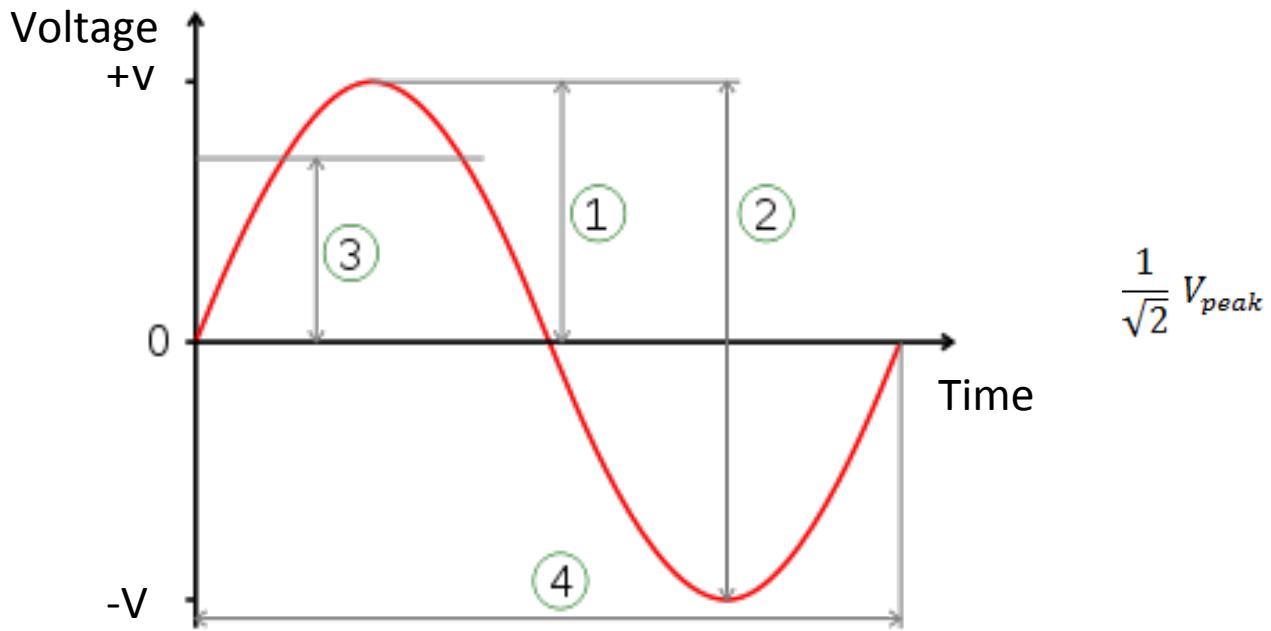
# The Labs

1. Resistor Networks
2. Passive Filters – Transient Response
3. Passive Filters – Frequency Response
4. Operational Amplifiers
5. Op-Amps – Active Filters
6. Diodes

# Pre-Lab

- Periodic Waveforms
- Cables and Connectors
- Instrumentation
  - Function Generator (ARB)
  - Digital Oscilloscope
  - Triple Power Supply
  - Digital Multi-meter

# Periodic Waveforms



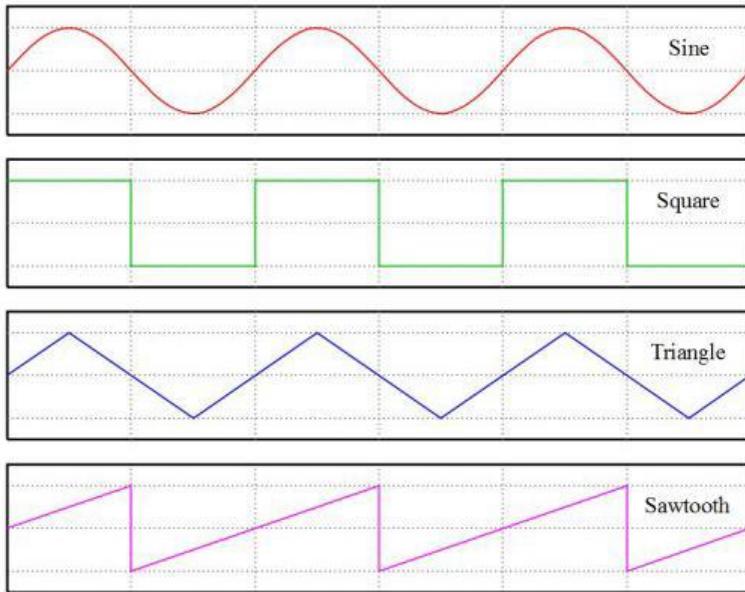
1 = Peak amplitude =  $V$

2 = Peak-to-peak amplitude =  $2V$

3 = RMS amplitude =  $V/\sqrt{2}$

4 = Wave period (or Wavelength,  $\lambda$ ) = 1 / Frequency

# Periodic Waveforms

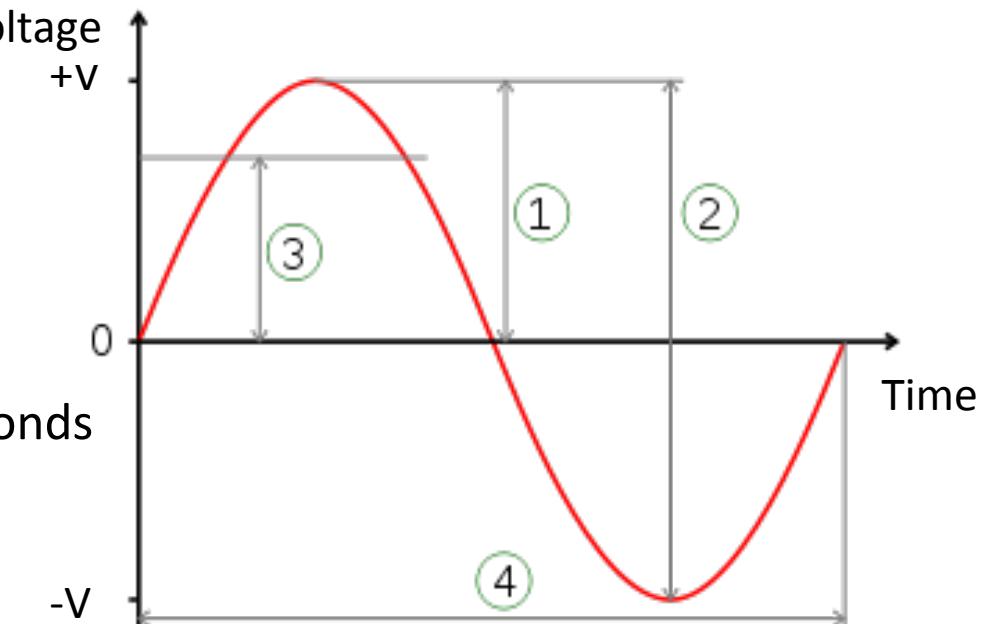


## RMS (AC) Values for Periodic Signals

Sine	$\frac{1}{\sqrt{2}} V_{peak}$
Square	$V_{peak}$
Triangle	$\frac{1}{\sqrt{3}} V_{peak}$
Sawtooth	$\frac{1}{\sqrt{3}} V_{peak}$

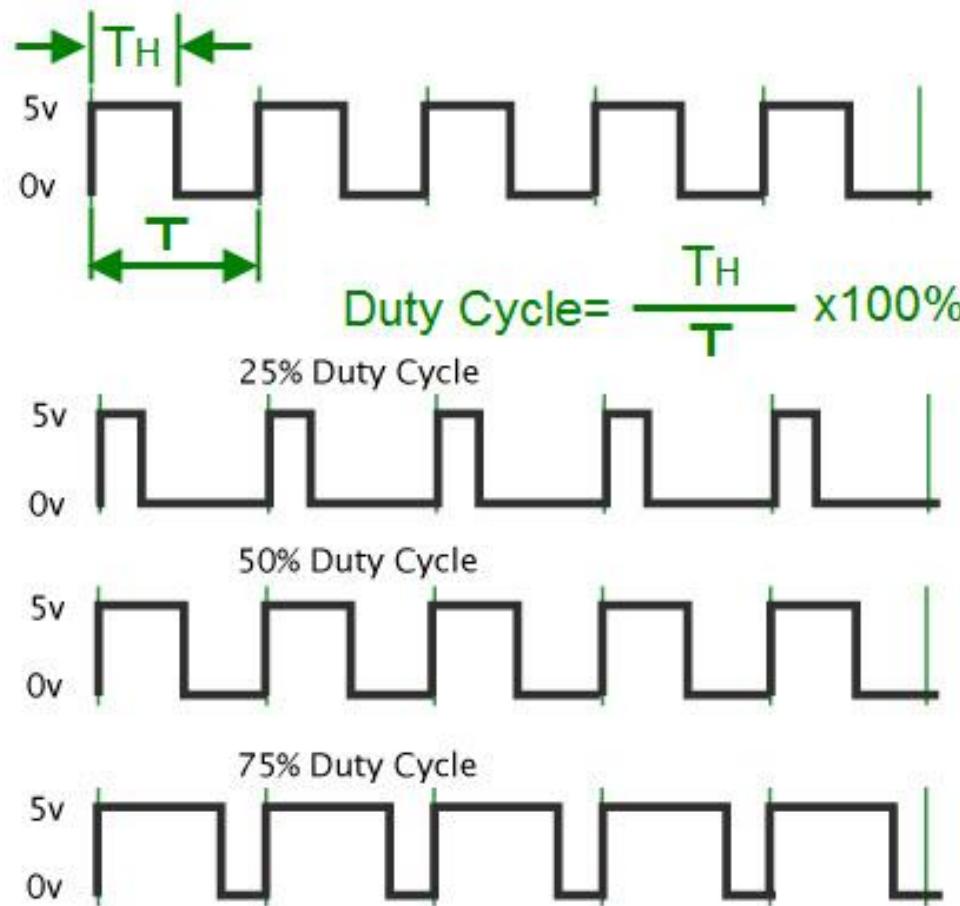
# Frequency

- Is equal to 1 / Period (in seconds)
- Has units of Hertz (Hz)
  - $\text{Hz} = 1 / \text{Seconds}$
- May be expressed in Radians / Seconds
  - $\text{Radians/ Second} = 2\pi \text{ Hz}$
- $\text{Hz} = (\text{Radians/ Second}) / 2\pi$



# Duty Cycle

- The percentage of time during one period that a periodic digital signal is true ( 1 in example).



# Connectors and Cables

Screencast: 5:55

# Connectors and Cables

- BNC Cables
- Banana Cables
- Mini-grabbers (Easy Clips)
- Adapters

# BNC Cables

(Stands for Bayonet - Neill - Concelman connector)



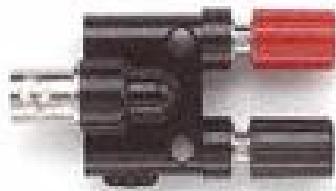
# Banana Cables



# Easy Clips or MiniGrabbers



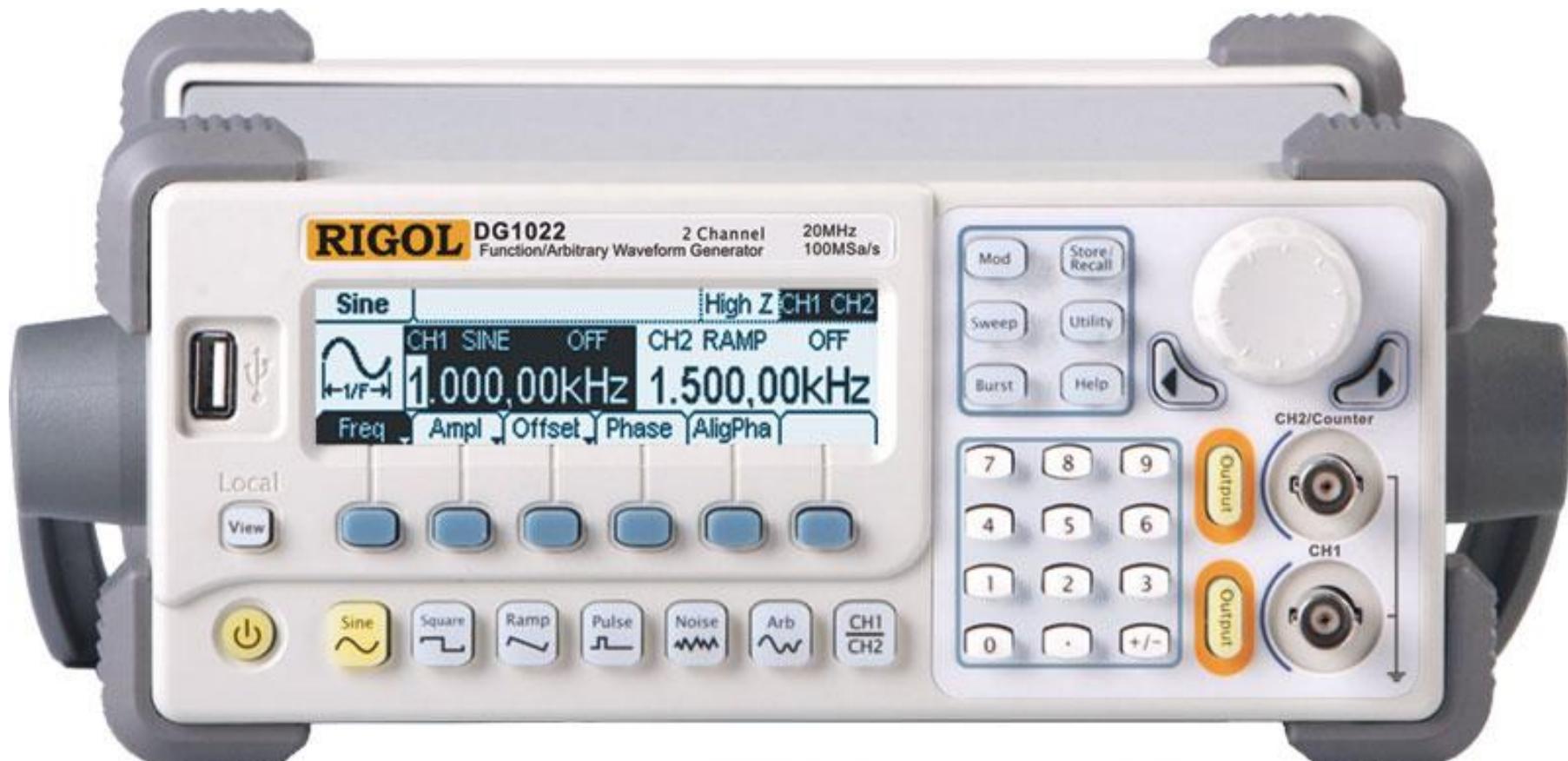
# Adapters



# Laboratory Instruments

# Rigol Model DG1022A

## Arbitrary Waveform Generator



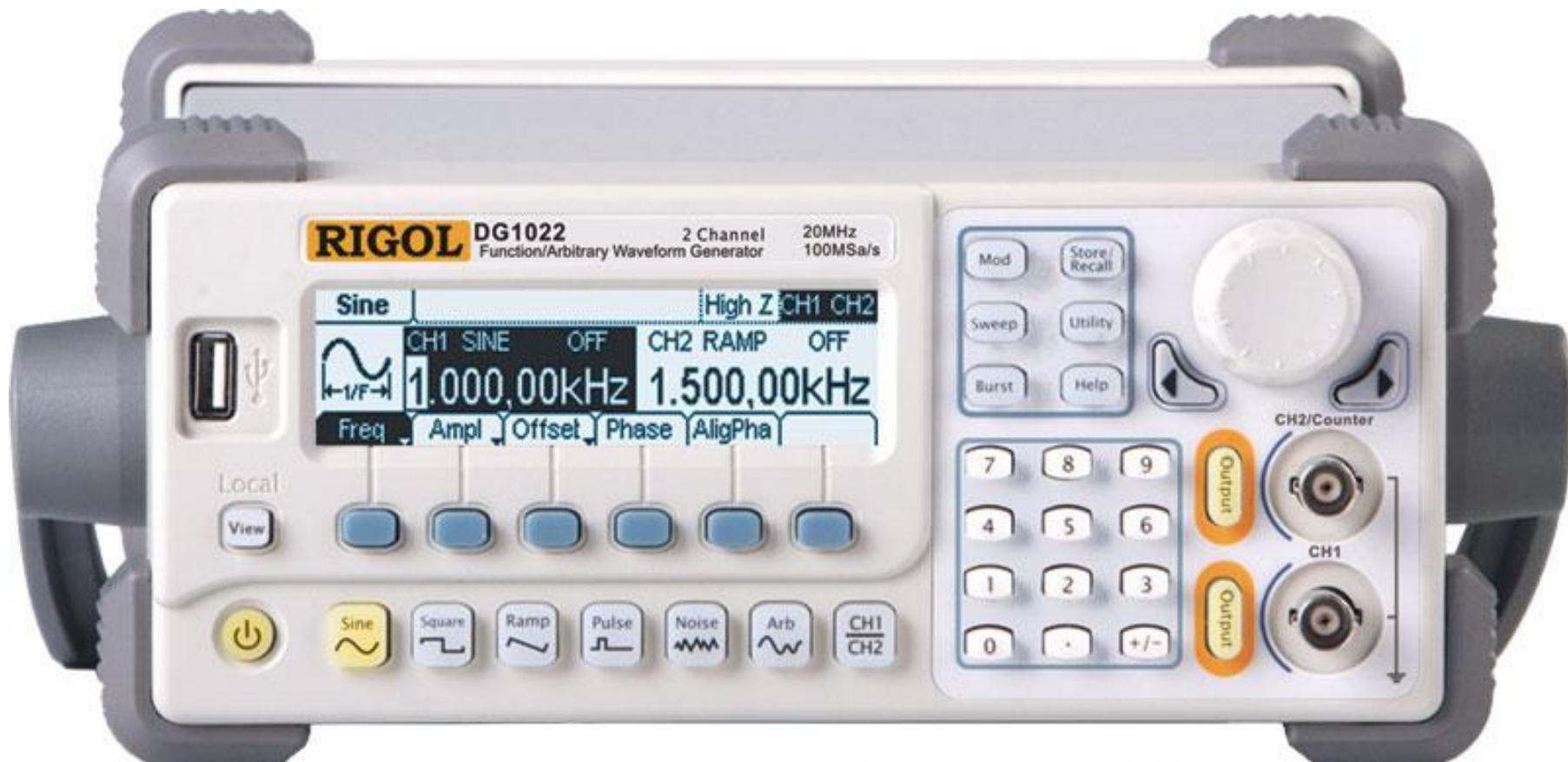
# Rigol Model DG1022A

## Arbitrary Waveform Generator

- Function

# Rigol Model DG1022A

## Arbitrary Waveform Generator



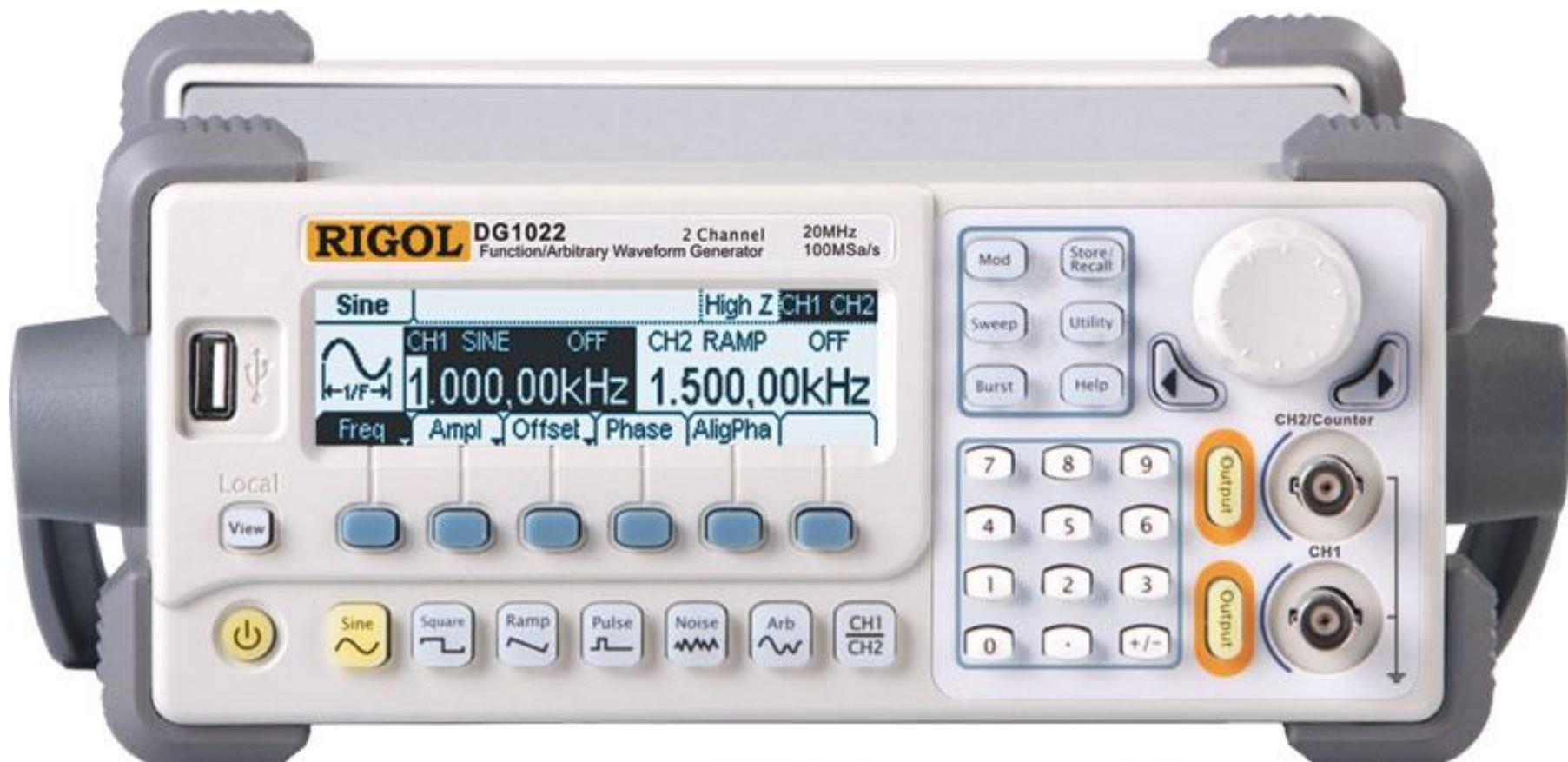
# Rigol Model DG1022A

## Arbitrary Waveform Generator

- Function
- Frequency

# Rigol Model DG1022A

## Arbitrary Waveform Generator



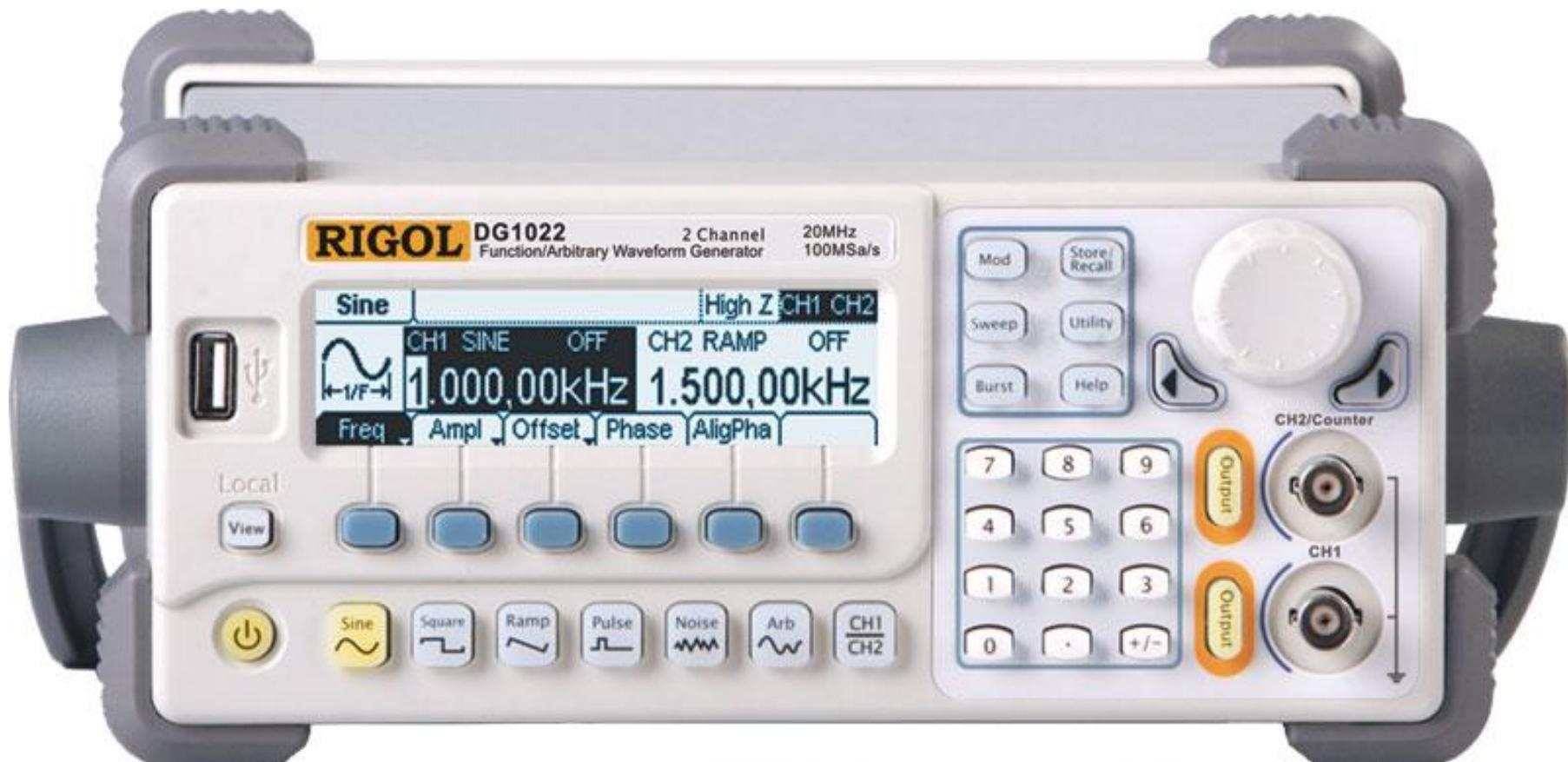
# Rigol Model DG1022A

## Arbitrary Waveform Generator

- Function
- Frequency
- Amplitude

# Rigol Model DG1022A

## Arbitrary Waveform Generator



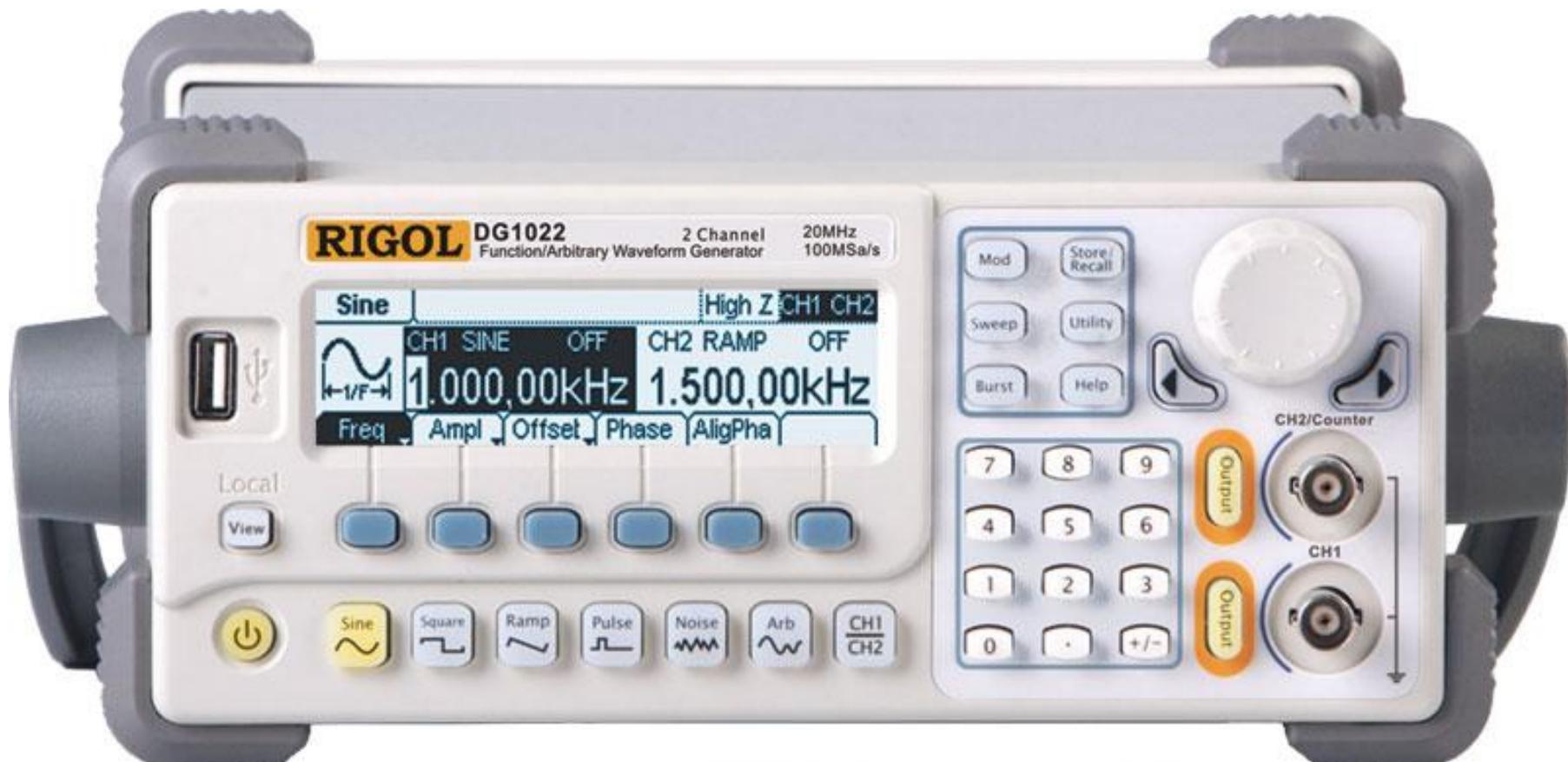
# Rigol Model DG1022A

## Arbitrary Waveform Generator

- Function
- Frequency
- Amplitude
- Offset

# Rigol Model DG1022A

## Arbitrary Waveform Generator



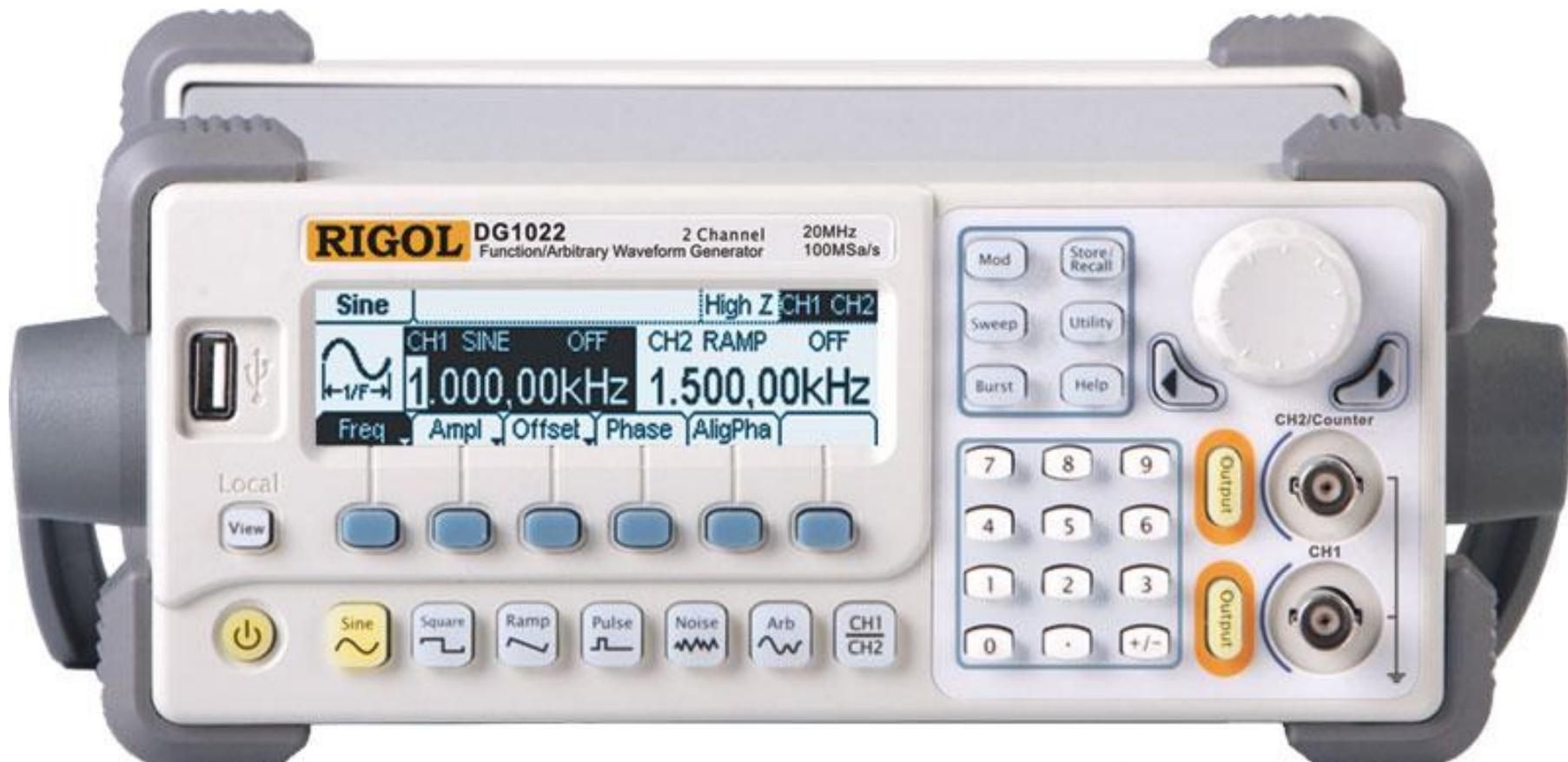
# Rigol Model DG1022A

## Arbitrary Waveform Generator

- Function
- Frequency
- Amplitude
- Offset
- Output Enable

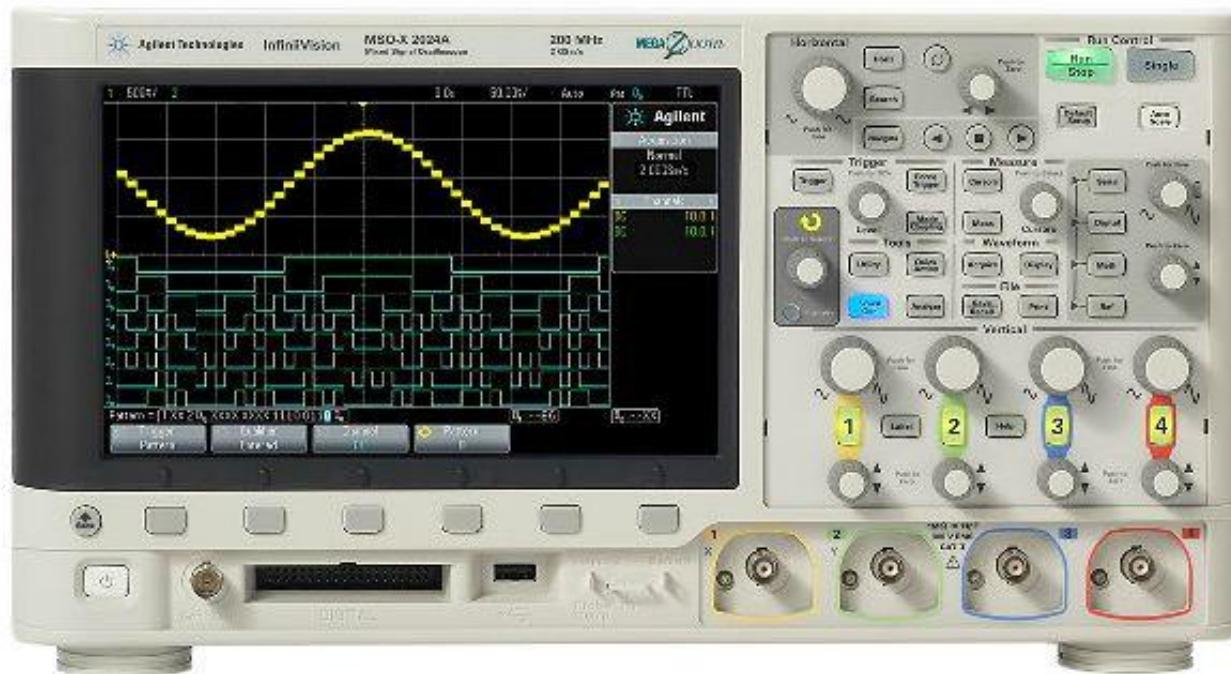
# Rigol Model DG1022A

## Arbitrary Waveform Generator



# Agilent MSO-X 2014A

## 4 Channel 100 MHz Digital Oscilloscope



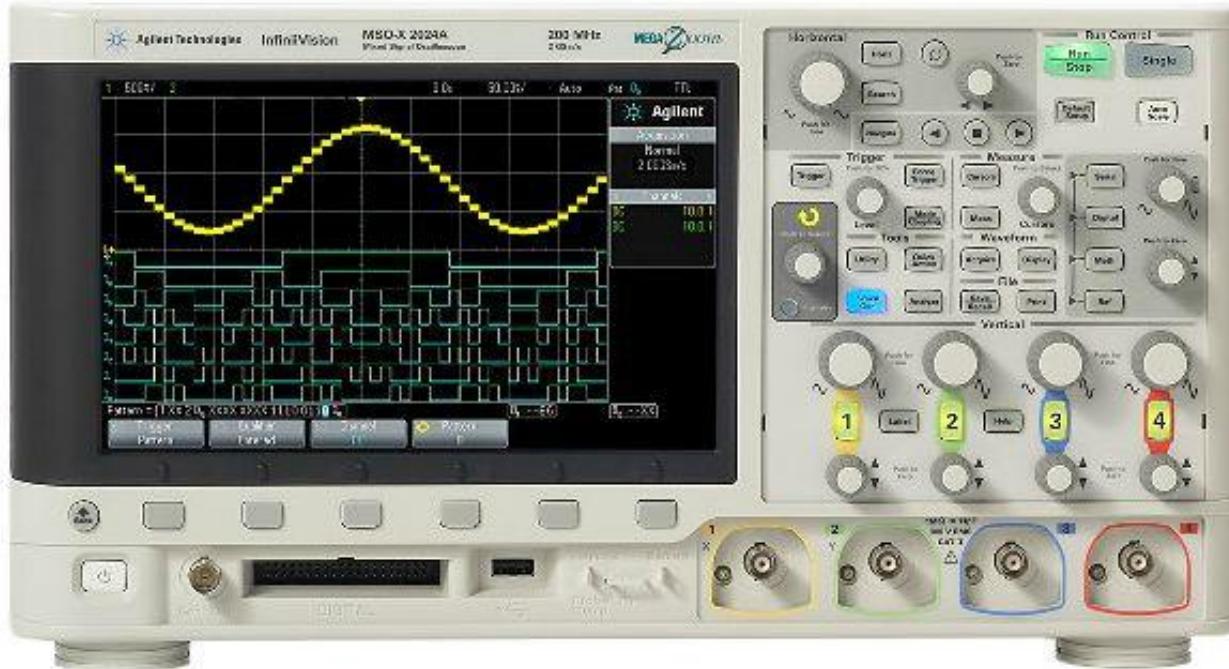
# Agilent MSO-X 2014A

## 4 Channel 100 MHz Digital Oscilloscope

- Vertical amplifiers

# Agilent MSO-X 2014A Oscilloscope

## Vertical Amplifiers



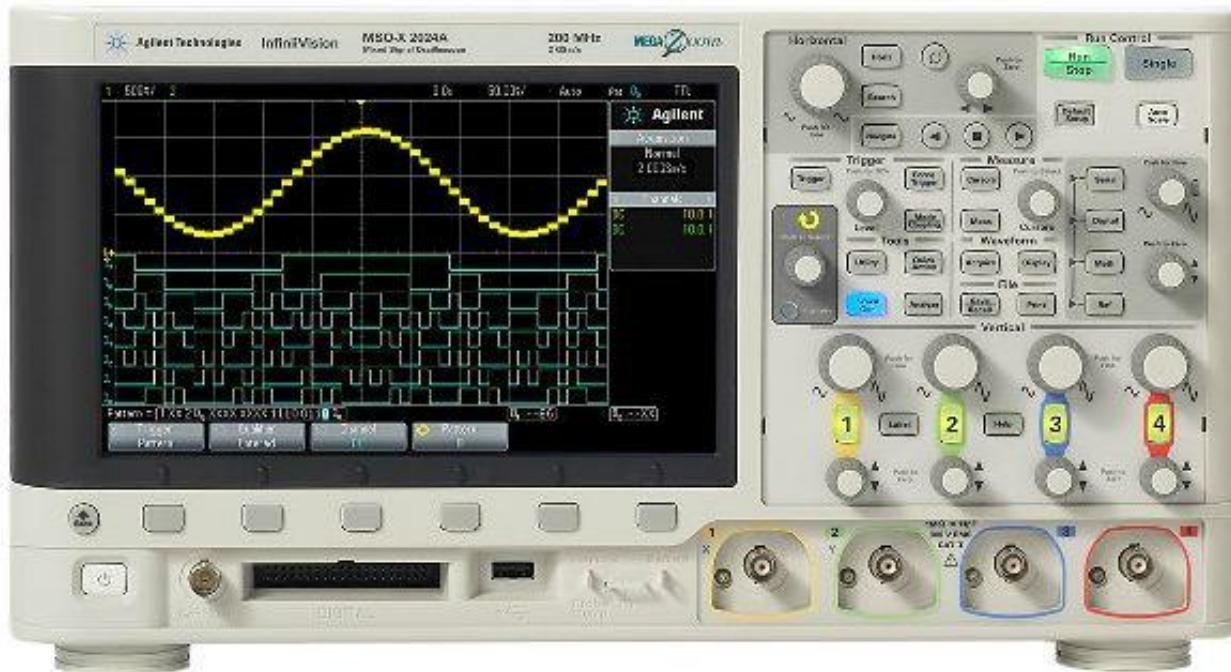
# Agilent MSO-X 2014A

## 4 Channel 100 MHz Digital Oscilloscope

- Vertical amplifiers
- Time scale

# Agilent MSO-X 2014A Oscilloscope

## Time Scale

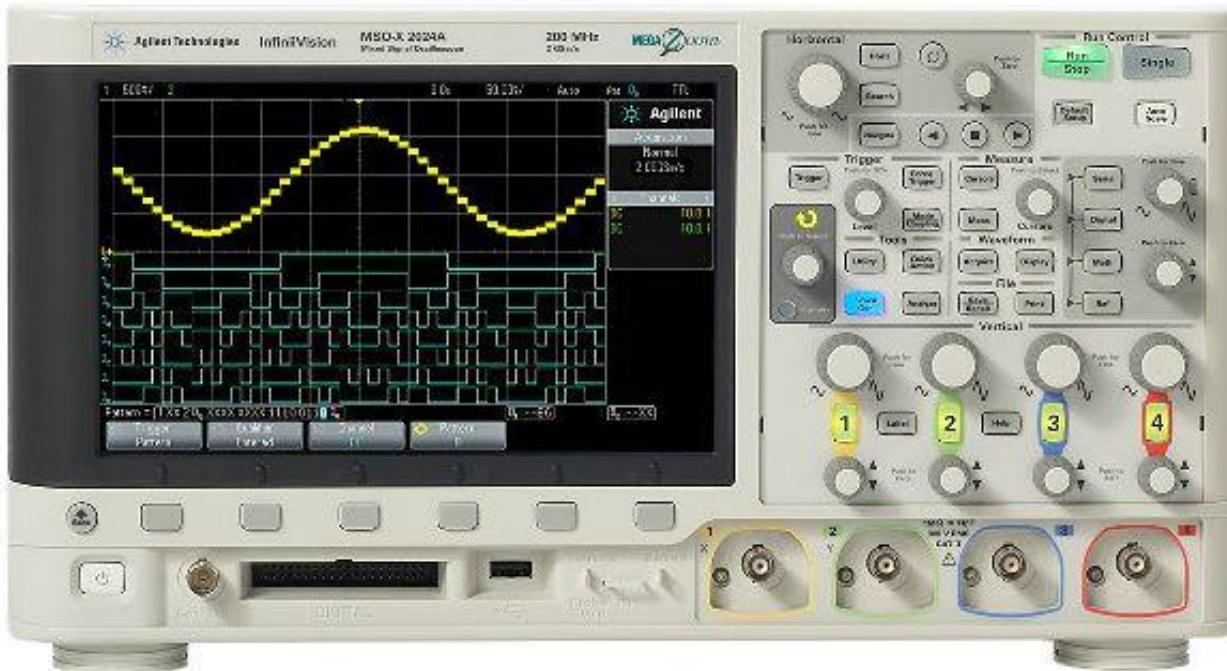


# Agilent MSO-X 2014A

## 4 Channel 100 MHz Digital Oscilloscope

- Vertical amplifiers
- Time scale
- Triggering

# Agilent MSO-X 2014A Oscilloscope Triggering



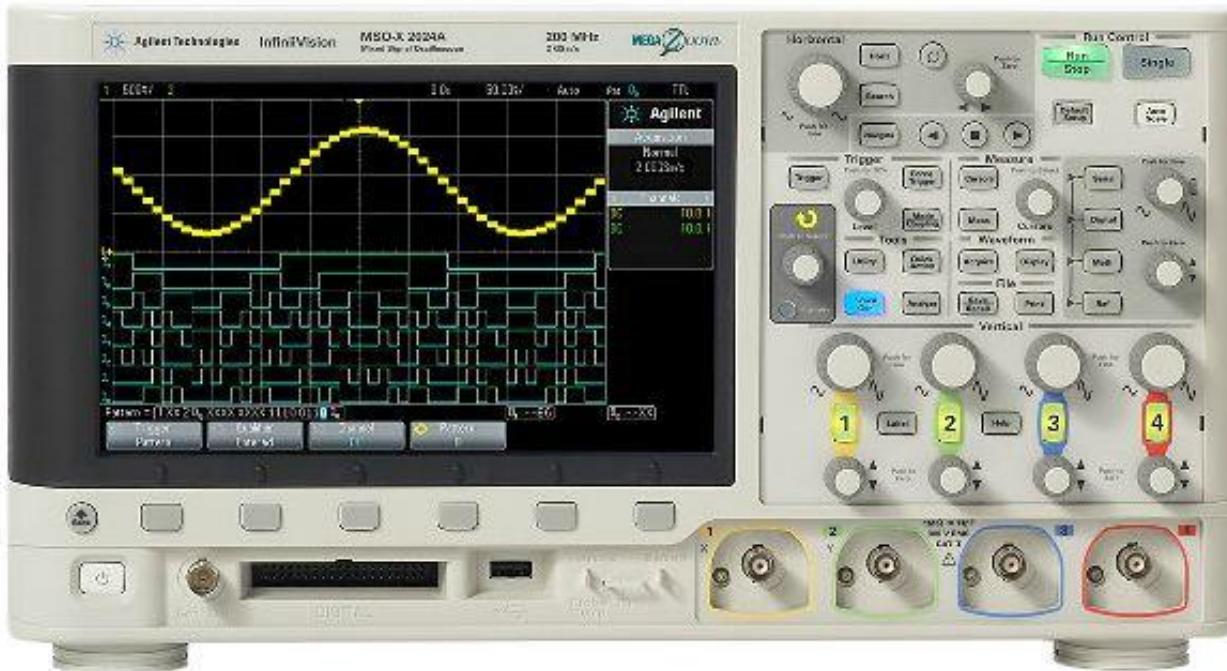
# Agilent MSO-X 2014A

## 4 Channel 100 MHz Digital Oscilloscope

- Vertical amplifiers
- Time scale
- Triggering
- Dual Channel Operation

# Agilent MSO-X 2014A Oscilloscope

## Multiple Channel Operation



# Agilent MSO-X 2014A

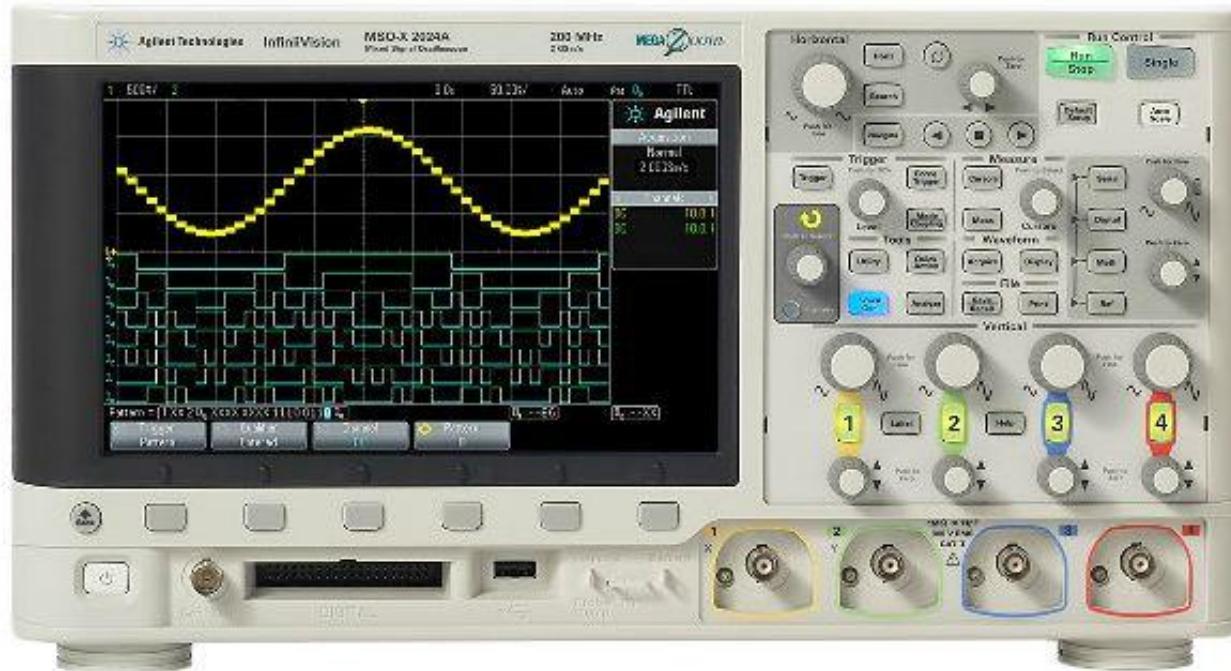
## 4 Channel 100 MHz Digital Oscilloscope

- Vertical amplifiers
- Time scale
- Triggering
- Dual Channel Operation
- Measurements

# Agilent MSO-X 2014A Oscilloscope

- Measurements
  - Cursors
    - Amplitudes
    - Time Base
- Automated Measurements
  - Voltages
  - Frequency
  - Period

# Agilent MSO-X 2014A Oscilloscope Measurements



# Rigol DP1308A Triple Power Supply



# Rigol DP1308A Triple Power Supply

- Supply Selection

# Rigol DP1308A

## Triple Power Supply



# Rigol DP1308A Triple Power Supply

- Supply Selection
- Setting the Voltage

# Rigol DP1308A Triple Power Supply



# Rigol DP1308A Triple Power Supply

- Supply Selection
- Setting the Voltage
- Output Enable

# Rigol DP1308A Triple Power Supply



# Rigol DP1308A Triple Power Supply

- Supply Selection
- Setting the Voltage
- Enabling the Output
- The 0-6 V Single Supply

# Rigol DP1308A Triple Power Supply



# Rigol DP1308A Triple Power Supply

- Supply Selection
- Setting the Voltage
- Enabling the Output
- The 0-6 V Single Supply
- The Dual Supply

# Rigol DP1308A Triple Power Supply



# Fluke 117 Handheld Digital Multimeter



Screencast: 23:57  
In-Lab Video: 25:15

# Handheld Digital Multimeter

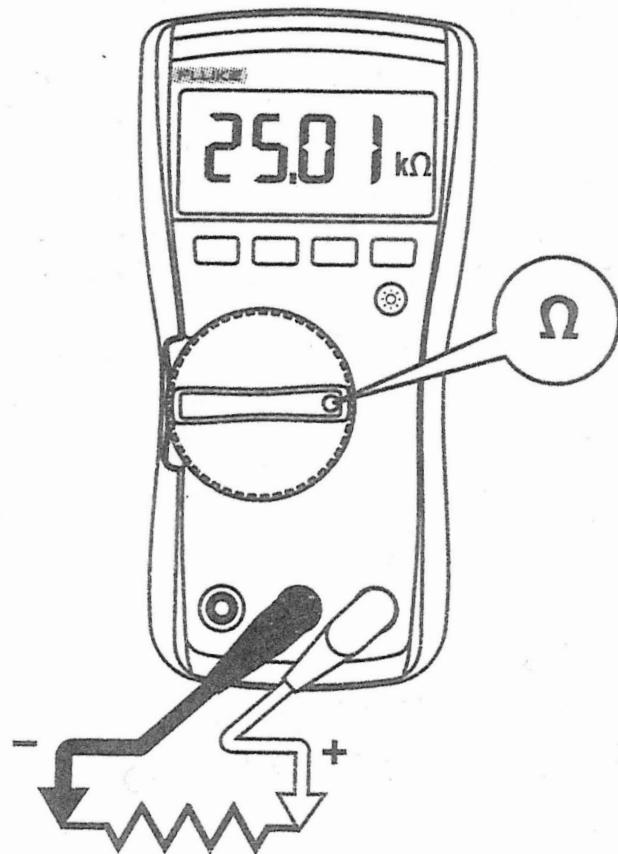
## Fluke Model 117

- Resistance Measurements

# Measurements

- Resistance - measured across resistor  
(in parallel)

## *Measuring Resistance*



# Handheld Digital Multimeter

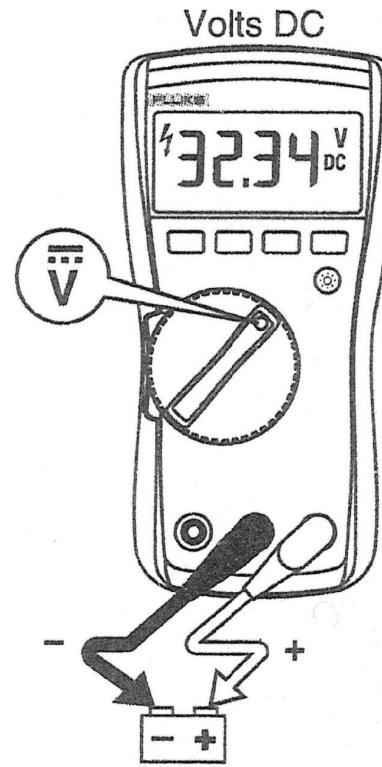
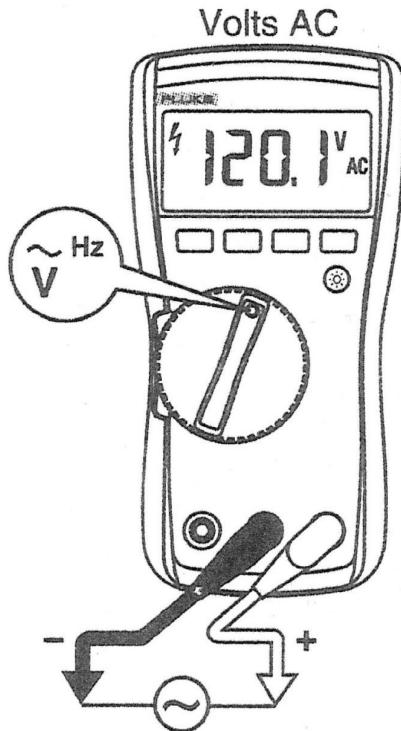
## Fluke Model 117

- Resistance Measurements
- Voltage Measurements

# Measurements

- DC Voltage - measured in parallel

## *Measuring AC and DC Voltage*



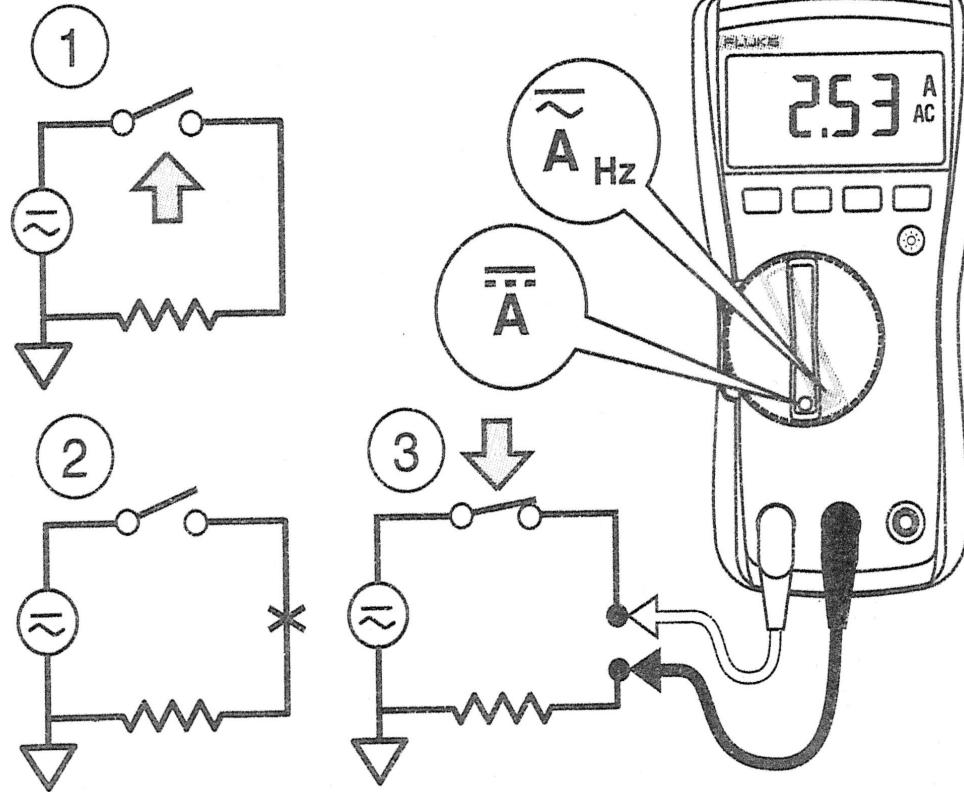
# Handheld Digital Multimeter

## Fluke Model 117

- Resistance Measurements
- Voltage Measurements
- Current Measurements

# Measurements

DC Current – measured in series (you must insert the meter into the circuit)



# Handheld Digital Multimeter

## Fluke Model 117

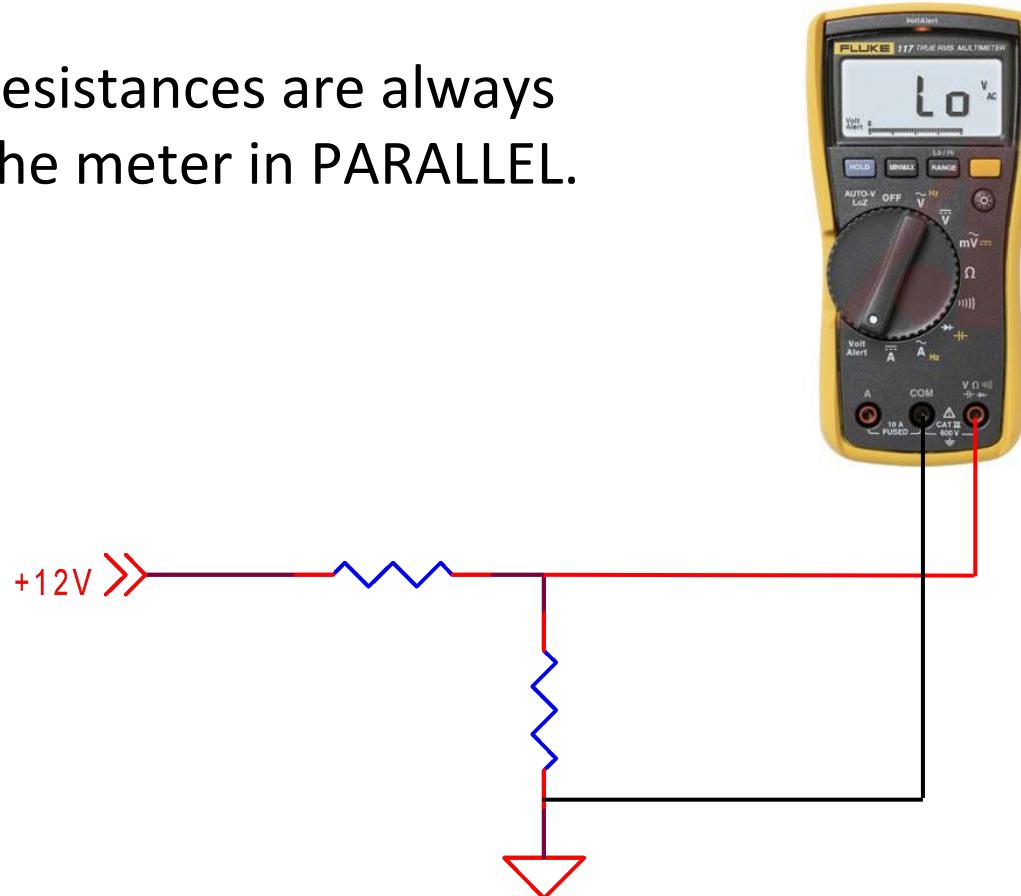
- Resistance Measurements
- Voltage Measurements
- Current Measurements
- Other Features

# Fluke 117 Handheld Digital Multimeter



# DMM Measurements

- Voltages and Resistances are always measured with the meter in PARALLEL.



# DMM Measurements

- Currents are always measured with the meter in SERIES.

