

**FLUKE®**

# 190 Series II

ScopeMeter

## Product Specifications

December 2013, Rev. C

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## Specifications

### General

(Meter/Ext terminals or with VPS410) Maximum voltage between any Terminal and Earth Ground: 1000V

(BNC input terminals A, B, C, D)

Maximum voltage between any Terminal and Earth Ground: 300V

IEC 61010-1: Pollution Degree 2

Measurement

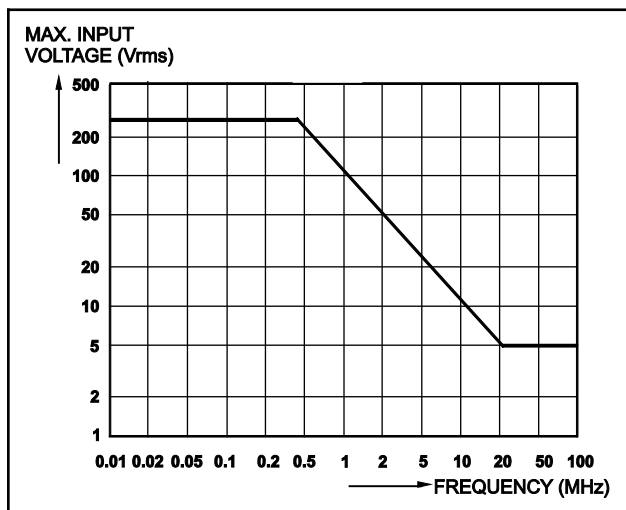
IEC 61010-2-030: CAT IV 600 V / CAT III 1000 V (VPS410, METER/EXT input terminals)

IEC 61010-2-030: CAT IV 300 V

(BNC input terminals A, B, C, D)

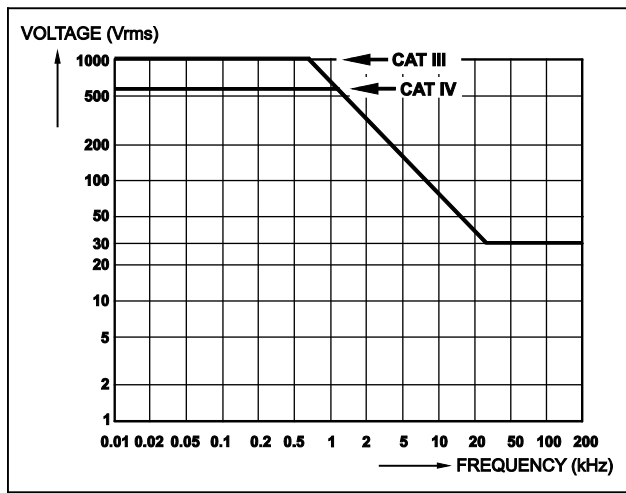
### Voltage vs. Frequency Operating Range

Voltage ratings are given as "working voltage". They should be read as Vac-rms (50-60 Hz) for AC sinewave applications and as Vdc for DC applications.



hpp049.eps

Max. Input Voltage vs. Frequency



hpp50

Safe Handling: Max. Voltage between Scope References,  
and between Scope References and Earth Ground

## Environmental

### Temperature

|                              |                                     |
|------------------------------|-------------------------------------|
| Operating.....               | 0 °C to 50 °C (32 °F to 122 °F)     |
| Operating and charging ..... | 0 °C to 40 °C (32 °F to 104 °F)     |
| Storage.....                 | -20 °C to +60 °C (-4 °F to +140 °F) |

### Humidity (Maximum Relative)

#### Operating

|                                        |               |
|----------------------------------------|---------------|
| 0 °C to 10 °C (32 °F to 50 °F).....    | noncondensing |
| 10 °C to 30 °C (50 °F to 86 °F).....   | 95 % (± 5 %)  |
| 30 °C to 40 °C (86 °F to 104 °F).....  | 75 % (± 5 %)  |
| 40 °C to 50 °C (104 °F to 122 °F)..... | 45 % (± 5 %)  |

#### Storage

|                                           |               |
|-------------------------------------------|---------------|
| -20 °C to +60 °C (-4 °F to +140 °F) ..... | noncondensing |
|-------------------------------------------|---------------|

### Altitude

#### Operating

|                                  |                      |
|----------------------------------|----------------------|
| CATIV 600 V, CATIII 1000 V.....  | 2000 m (6,600 feet)  |
| CATIII 600 V, CATII 1000 V ..... | 3000 m (10,000 feet) |

|              |                        |
|--------------|------------------------|
| Storage..... | 12,000 m (40,000 feet) |
|--------------|------------------------|

|                           |                 |
|---------------------------|-----------------|
| Enclosure Protection..... | IEC 60529: IP51 |
|---------------------------|-----------------|

## Electromagnetic Compatibility (EMC)

|                    |                                                |
|--------------------|------------------------------------------------|
| International..... | IEC 61326-1: Basic Electromagnetic Environment |
|--------------------|------------------------------------------------|

#### CISPR 11: Group 1, Class A

*Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.*

*Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.*

*Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.*

*Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.*

*The equipment may not meet the immunity requirements of this standard when test leads and/or test probes are connected. (IEC 61326-2-1)*

|                  |                                                                       |
|------------------|-----------------------------------------------------------------------|
| Korea (KCC)..... | Class A Equipment (Industrial Broadcasting & Communication Equipment) |
|------------------|-----------------------------------------------------------------------|

*Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.*

|                |                                                                                     |
|----------------|-------------------------------------------------------------------------------------|
| USA (FCC)..... | 47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103. |
|----------------|-------------------------------------------------------------------------------------|

Scope Mode (10 ms/div: Waveform disturbance with VPS410 voltage probe shorted (see table below).

(E = 3V/m)

| Frequency               | No Disturbance | Disturbance <10 % of full scale | Disturbance >10 % of full scale |
|-------------------------|----------------|---------------------------------|---------------------------------|
| 80 MHz – 450 MHz        | ≥500 mV/d      | 100, 200 mV/div                 | 2, 5, 10, 20, 50 mV/div         |
| 450 MHz – 1 GHz         | All ranges     |                                 |                                 |
| 1.4 GHz – 2 GHz         | All ranges     |                                 |                                 |
| 2 GHz – 2.7 GHz (1 V/m) | All Ranges     |                                 |                                 |

## **Power**

FLUKE 190-xx4, -50x: Rechargeable Li-ion Battery (model BP291):

|                        |                               |
|------------------------|-------------------------------|
| Operating Time .....   | up to 7 hours (Low Intensity) |
| Charging Time .....    | 5 hours                       |
| Capacity/Voltage ..... | 52 Wh / 10.8 V                |

FLUKE 190-062, -102, -202: Rechargeable Li-ion Battery (model BP290):

|                        |                               |
|------------------------|-------------------------------|
| Operating Time .....   | up to 4 hours (Low Intensity) |
| Charging Time .....    | 2.5 hours                     |
| Capacity/Voltage ..... | 26 Wh / 10.8 V                |

Rechargeable Li-ion Battery (model BP 290 and BP291):

|                                                        |                                 |
|--------------------------------------------------------|---------------------------------|
| Life Time (>80 % capacity) .....                       | 300 x charge/discharge          |
| Allowable ambient temperature<br>during charging ..... | 0 °C to 40 °C (32 °F to 104 °F) |
| Auto power down time<br>(battery saving) .....         | 5 min, 30 min or disabled       |

Power Adapter BC190:

- BC190/830, Power Adapter, SMPS Level-VI Universal 190 Series
- Line Frequency 50 Hz and 60 Hz

## **Oscilloscope**

### **Isolated Inputs A, B, C and D (Vertical)**

Number of Channels

|                     |                |
|---------------------|----------------|
| Fluke 190-xx2 ..... | 2 (A, B)       |
| Fluke 190-xx4 ..... | 4 (A, B, C, D) |

Bandwidth, DC Coupled

|                     |                 |
|---------------------|-----------------|
| FLUKE 190-50x ..... | 500 MHz (-3 dB) |
| FLUKE 190-2xx ..... | 200 MHz (-3 dB) |
| FLUKE 190-1xx ..... | 100 MHz (-3 dB) |
| FLUKE 190-062 ..... | 60 MHz (-3 dB)  |

Lower Frequency Limit, AC Coupled

|                       |               |
|-----------------------|---------------|
| with 10:1 probe ..... | <2 Hz (-3 dB) |
| direct (1:1) .....    | <5 Hz (-3 dB) |

Rise Time

|                     |        |
|---------------------|--------|
| FLUKE 190-50x ..... | 0.7 ns |
| FLUKE 190-2xx ..... | 1.7 ns |
| FLUKE 190-1xx ..... | 3.5 ns |
| FLUKE 190-062 ..... | 5.8 ns |

Analog Bandwidth Limiters.....20 MHz and 10 kHz

Input Coupling .....AC, DC

Polarity .....Normal, Inverted

Sensitivity Ranges

|                       |                     |
|-----------------------|---------------------|
| with 10:1 probe ..... | 20 mV to 1000 V/div |
| direct (1:1) .....    | 2 mV to 100 V/div   |

Dynamic Range .....>  $\pm 8$  div (<10 MHz)

>  $\pm 4$  div (>10 MHz)

Waveform Positioning Range..... $\pm 4$  divisions

Input Impedance on BNC, DC Coupled

|                        |                                                  |
|------------------------|--------------------------------------------------|
| 4-channel models ..... | 1 M $\Omega$ ( $\pm 1$ %)/14 pF ( $\pm 2.25$ pF) |
| 2-channel models ..... | 1 M $\Omega$ ( $\pm 1$ %)/15 pF ( $\pm 2.25$ pF) |

Vertical Accuracy ..... $\pm (2.1 \% + 0.04 \text{ range/div})$

2 mV/div ..... $\pm (2.9 \% + 0.08 \text{ range/div})$

Digitizer Resolution.....8 bits, separate digitizer for each input

**Horizontal**

Minimum Time Base Speed  
(Scope Record) ..... 2 min/div

Real Time Sampling Rate

FLUKE 190-50x:

5 ns to 4  $\mu$ s/div (3 or 4 channels) ..... up to 1.25 GS/s

2 ns to 4  $\mu$ s/div (2 channels) ..... up to 2.5 GS/s

1 ns to 4  $\mu$ s/div (1 channel) ..... up to 5 GS/s

10  $\mu$ s to 120 s/div ..... 125 MS/s

FLUKE 190-202, -204:

2 ns to 4  $\mu$ s/div (1 or 2 channels) ..... up to 2.5 GS/s

5 ns to 4  $\mu$ s/div (3 or 4 channels) ..... up to 1.25 GS/s

10  $\mu$ s to 120 s/div ..... 125 MS/s

FLUKE 190-102, -104:

5 ns to 4  $\mu$ s/div (all channels) ..... up to 1.25 GS/s

10  $\mu$ s to 120 s/div ..... 125 MS/s

FLUKE 190-062:

10 ns to 4  $\mu$ s/div (all channels) ..... up to 625 MS/s

10  $\mu$ s to 120 s/div ..... 125 MS/s

Glitch Detection

4  $\mu$ s to 120 s/div ..... displays glitches as fast as 8 ns

Waveform Display ..... A, B, C, D, Math (+, -, x, X-Y mode, spectrum) Normal, Average, Persistence, Reference

Time Base Accuracy .....  $\pm(100 \text{ ppm} + 0.04 \text{ div})$

Record Length (all models): see table that follows.

**Record Length (all models, Samples/points per input)**

| Mode              | Glitch Detect On  | Glitch Detect Off                                                                           | Max. Sample Rate                                                                                                                                                                                                                                       |
|-------------------|-------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scope - Normal    | 300 min/max pairs | 3 k true samples compressed into 1 screen (300 samples per screen)                          | 190-062: 625 MS/s<br>190-102/104: 1.25 GS/s<br>190-202/204: 2.5 GS/s (1 or 2 channels on)<br>190-204: 1.25 GS/s (3 or 4 channels on)<br>190-50x: 5 GS/s (1 channel on)<br>190-50x: 2.5 GS/s (2 channels on)<br>190-504: 1.25 GS/s (3 or 4 channels on) |
| Scope - Fast      | 300 min/max pairs | -                                                                                           |                                                                                                                                                                                                                                                        |
| Scope - Full      | 300 min/max pairs | 10 k true samples, compressed into 1 screen.<br>Use Zoom and Scroll to see waveform details |                                                                                                                                                                                                                                                        |
| Scope Record Roll |                   | 30 k samples                                                                                | 4x 125 MS/s                                                                                                                                                                                                                                            |
| Trend Plot        |                   | >18 k min/max/average values/measurement                                                    | Up to 5 measurements/second                                                                                                                                                                                                                            |

**Trigger and Delay**

Trigger Modes ..... Automatic, Edge, Video, Pulse Width, N-Cycle, External (190-xx2)

Trigger Delay ..... up to +1200 divisions

Pre-Trigger View ..... one full screen length

Delay ..... -12 div to +1200 div

Max. Delay ..... 48 s at 4 s/div

**Automatic Connect-and-View Trigger**

Source ..... A, B, C, D  
EXT (190-xx2)

Slope ..... Positive, Negative, Dual

**Edge Trigger**

Screen Update ..... Free Run, On Trigger, Single Shot

Source ..... A, B, C, D, EXT (190-xx2)

Slope ..... Positive, Negative, Dual

Trigger Level Control Range .....  $\pm 4$  divisions

Trigger Sensitivity

|                                              |              |
|----------------------------------------------|--------------|
| DC to 5 MHz at >5 mV/div .....               | 0.5 division |
| DC to 5 MHz at 2 mV/div<br>and 5 mV/div..... | 1 division   |
| 500 MHz (FLUKE 190-50x).....                 | 1 division   |
| 600 MHz (FLUKE 190-50x).....                 | 2 divisions  |
| 200 MHz (FLUKE 190-2xx).....                 | 1 division   |
| 250 MHz (FLUKE 190-2xx).....                 | 2 divisions  |
| 100 MHz (FLUKE 190-1xx).....                 | 1 division   |
| 150 MHz (FLUKE 190-1xx).....                 | 2 divisions  |
| 60 MHz (FLUKE 190-062).....                  | 1 division   |
| 100 MHz (FLUKE 190-062).....                 | 2 divisions  |

### **Isolated External Trigger (190-xx2)**

|                                    |                 |
|------------------------------------|-----------------|
| Bandwidth.....                     | 10 kHz          |
| Modes.....                         | Automatic, Edge |
| Trigger Levels (DC to 10 kHz)..... | 120 mV, 1.2 V   |

### **Video Trigger**

|                  |                                        |
|------------------|----------------------------------------|
| Standards.....   | PAL, PAL+, NTSC, SECAM, Non-interlaced |
| Modes.....       | Lines, Line Select, Field 1 or Field 2 |
| Source.....      | A                                      |
| Polarity.....    | Positive, Negative                     |
| Sensitivity..... | 0.7 division sync level                |

### **Pulse Width Trigger**

|                                  |                                                                                                                                                                |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Screen Update.....               | On Trigger, Single Shot                                                                                                                                        |
| Trigger Conditions .....         | <T, >T, =T ( $\pm 10\%$ ), $\neq T(\pm 10\%)$                                                                                                                  |
| Source.....                      | A                                                                                                                                                              |
| Polarity.....                    | Positive or negative pulse                                                                                                                                     |
| Pulse Time Adjustment Range..... | 0.01 div. to 655 div.<br>with a minimum of 300 ns (<T, >T) or 500 ns (=T, $\neq T$ ), a maximum of 10 s, and a resolution of 0.01 div. with a minimum of 50 ns |

### **Continuous Auto Set**

Autoranging attenuators and time base, automatic Connect-and-View™ triggering with automatic source selection.

|                              |                         |
|------------------------------|-------------------------|
| Modes                        |                         |
| Normal.....                  | 15 Hz to max. bandwidth |
| Low Frequency .....          | 1 Hz to max. bandwidth  |
| Minimum Amplitude A, B, C, D |                         |
| DC to 1 MHz .....            | 10 mV                   |
| 1 MHz to max. bandwidth..... | 20 mV                   |

### **Automatic Capturing Scope Screens**

|                |                   |
|----------------|-------------------|
| Capacity ..... | 100 Scope Screens |
|----------------|-------------------|

For viewing screens, see *Replay function*.

## **Automatic Scope Measurements**

The accuracy of all readings is within  $\pm$  (% of reading + number of counts) from 18 °C to 28 °C. Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C. For voltage measurements with 10:1 probe, add probe accuracy. At least 1.5 waveform period must be visible on the screen.

### **General**

|                                                        |               |
|--------------------------------------------------------|---------------|
| Inputs .....                                           | A, B, C and D |
| DC Common Mode Rejection (CMRR).....                   | >100 dB       |
| AC Common Mode Rejection at<br>50, 60, or 400 Hz ..... | >60 dB        |

**DC Voltage (VDC)**

|                                                  |                                   |
|--------------------------------------------------|-----------------------------------|
| Maximum Voltage                                  |                                   |
| with 10:1 probe .....                            | 1000 V                            |
| direct (1:1) .....                               | 300 V                             |
| Maximum Resolution                               |                                   |
| with 10:1 probe .....                            | 1 mV                              |
| direct (1:1) .....                               | 100 $\mu$ V                       |
| Full Scale Reading.....                          | 999 counts                        |
| Accuracy at 4 s to 10 $\mu$ s/div, FLUKE 190-xx2 |                                   |
| 2 mV/div .....                                   | $\pm(1.5 \% + 10 \text{ counts})$ |
| 5 mV/div to 100 V/div.....                       | $\pm(1.5 \% + 6 \text{ counts})$  |
| Accuracy at 4 s to 10 $\mu$ s/div, FLUKE 190-xx4 |                                   |
| 2 mV/div .....                                   | $\pm(3 \% + 10 \text{ counts})$   |
| 5 mV/div to 100 V/div.....                       | $\pm(3 \% + 6 \text{ counts})$    |
| Normal Mode AC Rejection                         |                                   |
| at 50 or 60 Hz .....                             | >60 dB                            |

**AC Voltage (VAC)**

|                                                                                                                                                                                                                                         |                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Maximum Voltage                                                                                                                                                                                                                         |                                   |
| with 10:1 probe .....                                                                                                                                                                                                                   | 1000 V                            |
| direct (1:1) .....                                                                                                                                                                                                                      | 300 V                             |
| Maximum Resolution                                                                                                                                                                                                                      |                                   |
| with 10:1 probe .....                                                                                                                                                                                                                   | 1 mV                              |
| direct (1:1) .....                                                                                                                                                                                                                      | 100 $\mu$ V                       |
| Full Scale Reading.....                                                                                                                                                                                                                 | 999 counts                        |
| Accuracy, FLUKE 190-xx2                                                                                                                                                                                                                 |                                   |
| DC coupled:                                                                                                                                                                                                                             |                                   |
| DC to 60 Hz .....                                                                                                                                                                                                                       | $\pm(1.5 \% + 10 \text{ counts})$ |
| AC coupled, low frequencies:                                                                                                                                                                                                            |                                   |
| Below 100 Hz there is signal loss that must be included. These are the expected loss at 2 common frequencies.                                                                                                                           |                                   |
| 50 Hz direct (1:1) .....                                                                                                                                                                                                                | - 0.6%                            |
| 60 Hz direct (1:1) .....                                                                                                                                                                                                                | - 0.4%                            |
| Apply this loss and then the DC coupled accuracy. With the 10:1 probe the low frequency roll-off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy. |                                   |
| AC or DC coupled, high frequencies:                                                                                                                                                                                                     |                                   |
| 60 Hz to 20 kHz .....                                                                                                                                                                                                                   | $\pm(2.5 \% + 15 \text{ counts})$ |
| 20 kHz to 1 MHz .....                                                                                                                                                                                                                   | $\pm(5 \% + 20 \text{ counts})$   |
| 1 MHz to 25 MHz .....                                                                                                                                                                                                                   | $\pm(10 \% + 20 \text{ counts})$  |
| For higher frequencies the instrument's frequency roll-off starts affecting accuracy.                                                                                                                                                   |                                   |
| Accuracy, FLUKE 190-xx4                                                                                                                                                                                                                 |                                   |
| DC coupled:                                                                                                                                                                                                                             |                                   |
| DC to 60 Hz .....                                                                                                                                                                                                                       | $\pm(3 \% + 10 \text{ counts})$   |
| AC coupled, low frequencies:                                                                                                                                                                                                            |                                   |
| Below 100 Hz there is signal loss that must be included. These are the expected loss at 2 common frequencies.                                                                                                                           |                                   |
| 50 Hz direct (1:1) .....                                                                                                                                                                                                                | - 0.6%                            |
| 60 Hz direct (1:1) .....                                                                                                                                                                                                                | - 0.4%                            |
| Apply this loss and then the DC coupled accuracy.                                                                                                                                                                                       |                                   |
| With the 10:1 probe the low frequency roll-off point will be lowered to 2 Hz, which improves the AC accuracy for low frequencies. When possible use DC coupling for maximum accuracy.                                                   |                                   |
| AC or DC coupled, high frequencies:                                                                                                                                                                                                     |                                   |
| 60 Hz to 20 kHz .....                                                                                                                                                                                                                   | $\pm(4 \% + 15 \text{ counts})$   |
| 20 kHz to 1 MHz .....                                                                                                                                                                                                                   | $\pm(6 \% + 20 \text{ counts})$   |
| 1 MHz to 25 MHz .....                                                                                                                                                                                                                   | $\pm(10 \% + 20 \text{ counts})$  |
| For higher frequencies the instrument's frequency roll-off starts affecting accuracy.                                                                                                                                                   |                                   |

Normal Mode DC Rejection ..... >50 dB

All accuracies are valid if:

- The waveform amplitude is larger than one division
- At least 1.5 waveform period is on the screen

### **AC+DC Voltage (True RMS)**

Maximum Voltage

with 10:1 probe ..... 1000 V

direct (1:1) ..... 300 V

Maximum Resolution

with 10:1 probe ..... 1 mV

direct (1:1) ..... 100  $\mu$ V

Full Scale Reading..... 1100 counts

Accuracy, FLUKE 190-xx2

DC to 60 Hz .....  $\pm(1.5 \% + 10 \text{ counts})$

60 Hz to 20 kHz .....  $\pm(2.5 \% + 15 \text{ counts})$

20 kHz to 1 MHz .....  $\pm(5 \% + 20 \text{ counts})$

1 MHz to 25 MHz .....  $\pm(10 \% + 20 \text{ counts})$

For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

Accuracy, FLUKE 190-xx4

DC to 60 Hz .....  $\pm(3 \% + 10 \text{ counts})$

60 Hz to 20 kHz .....  $\pm(4 \% + 15 \text{ counts})$

20 kHz to 1 MHz .....  $\pm(6 \% + 20 \text{ counts})$

1 MHz to 25 MHz .....  $\pm(10 \% + 20 \text{ counts})$

For higher frequencies the instrument's frequency roll-off starts affecting accuracy.

### **Amperes (AMP)**

*With Optional Current Probe or Current Shunt*

Ranges ..... same as VDC, VAC, VAC+DC

Probe Sensitivity ..... 100  $\mu$ V/A, 1 mV/A, 10 mV/A, 100 mV/A, 400 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracy ..... same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

### **Peak**

Modes ..... Max peak, Min peak, or peak-to-peak

Maximum Voltage

with 10:1 probe ..... 1000 V

direct (1:1) ..... 300 V

Maximum Resolution

with 10:1 probe ..... 10 mV

direct (1:1) ..... 1 mV

Full Scale Reading..... 800 counts

Accuracy

Max peak or Min peak .....  $\pm 0.2 \text{ division}$

Peak-to-peak .....  $\pm 0.4 \text{ division}$

### **Frequency (Hz)**

Range ..... 1.000 Hz to full bandwidth

Full Scale Reading..... 999 counts

Accuracy

1 Hz to full bandwidth .....  $\pm(0.5 \% + 2 \text{ counts})$  (4 s/div to 10 ns/div and 10 periods on the screen)

### **Duty Cycle (DUTY)**

Range ..... 4.0 % to 98.0 %

Resolution ..... 0.1 % (when period >2 div)

Full Scale Reading..... 999 counts (3-digit display)

Accuracy (logic or pulse) .....  $\pm(0.5 \% + 2 \text{ counts})$

**Pulse Width (PULSE)**

|                                   |                                  |
|-----------------------------------|----------------------------------|
| Resolution (with GLITCH off)..... | 1/100 division                   |
| Full Scale Reading.....           | 999 counts                       |
| Accuracy                          |                                  |
| 1 Hz to full bandwidth.....       | $\pm(0.5 \% + 2 \text{ counts})$ |

**V<sub>pwm</sub>**

|            |                                                                                                                                       |
|------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Purpose:   | to measure on pulse width modulated signals, like motor drive inverter outputs                                                        |
| Principle: | readings show the effective voltage based on the average value of samples over a whole number of periods of the fundamental frequency |
| Accuracy:  | as $V_{rms}$ for sinewave signals                                                                                                     |

**V/Hz**

|           |                                                                                                                                             |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Purpose:  | to show the measured V <sub>pwm</sub> value (see V <sub>pwm</sub> ) divided by the fundamental frequency on Variable AC Motor Speed drives. |
| Accuracy: | % $V_{rms}$ + % Hz                                                                                                                          |

**Note**

*AC motors are designed for use with a rotating magnetic field of constant strength. This strength depends on the applied voltage (V<sub>pwm</sub>) divided by the fundamental frequency of the applied voltage (Hz). The nominal Volt and Hz values are shown on the motor type plate.*

**Power (A and B, C and D)**

|                         |                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------|
| Power Factor .....      | ratio between Watts and VA                                                                             |
| Range.....              | 0.00 to 1.00                                                                                           |
| Watt.....               | RMS reading of multiplication corresponding samples of input A or C (volts) and Input B or D (amperes) |
| Full Scale Reading..... | 999 counts                                                                                             |
| VA .....                | $V_{rms} \times A_{rms}$                                                                               |
| Full Scale Reading..... | 999 counts                                                                                             |
| VA Reactive (VAR) ..... | $\sqrt{((VA)^2 - W^2)}$                                                                                |
| Full Scale Reading..... | 999 counts                                                                                             |

**Phase (A and B, C and D)**

|                      |                      |
|----------------------|----------------------|
| Range.....           | -180 to +180 degrees |
| Resolution .....     | 1 degree             |
| Accuracy             |                      |
| 0.1 Hz to 1 MHz..... | $\pm 2$ degrees      |
| 1 MHz to 10 MHz..... | $\pm 3$ degrees      |

**Temperature (TEMP)**

*With Optional Temperature Probe (°F not for Japan)*

|                         |                                                                                        |
|-------------------------|----------------------------------------------------------------------------------------|
| Ranges (°C or °F).....  | -40.0 to +100.0 °                                                                      |
|                         | -100 to +250 °                                                                         |
|                         | -100 to +500 °                                                                         |
|                         | -100 to +1000 °                                                                        |
|                         | -100 to + 2500 °                                                                       |
| Probe Sensitivity ..... | 1 mV/°C and 1 mV/°F                                                                    |
| Accuracy.....           | $\pm(1.5 \% + 5 \text{ counts})$ (add temperature probe accuracy for overall accuracy) |

**Decibel (dB)**

|               |                                                      |
|---------------|------------------------------------------------------|
| dBV .....     | dB relative to one volt                              |
| dBm.....      | dB relative to one mW in 50 $\Omega$ or 600 $\Omega$ |
| dB on.....    | VDC, VAC, or VAC+DC                                  |
| Accuracy..... | same as VDC, VAC, VAC+DC                             |

## Meter Measurements for Fluke 190-xx4

Four of the Automatic Scope Measurements as defined above may be displayed at the same time, using larger screen area for convenient reading, suppressing the scope waveform information. For specifications see Automatic scope Measurements above.

## Meter Measurements for Fluke 190-xx2

The accuracy of all measurements is within  $\pm$  (% of reading + number of counts) from 18 °C to 28 °C. Add 0.1x (specific accuracy) for each °C below 18 °C or above 28 °C.

### Meter Input (Banana Jacks)

|                                                                                                            |                                                                               |
|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Input Coupling .....                                                                                       | DC                                                                            |
| Frequency Response.....                                                                                    | DC to 10 kHz (-3 dB)                                                          |
| Input Impedance .....                                                                                      | 1 M $\Omega$ ( $\pm 1$ %)/14 pF ( $\pm 1.5$ pF)                               |
|  Max. Input Voltage ..... | 1000 V CAT III<br>600 V CAT IV<br>(For detailed specifications, see "Safety") |

### Meter Functions

|               |                  |
|---------------|------------------|
| Ranging ..... | Auto, Manual     |
| Modes.....    | Normal, Relative |

### General

|                                                        |         |
|--------------------------------------------------------|---------|
| DC Common Mode Rejection (CMRR).....                   | >100 dB |
| AC Common Mode Rejection at 50, 60,<br>or 400 Hz ..... | >60 dB  |

### Ohms ( $\Omega$ )

|                                    |                                                                                                               |
|------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Ranges .....                       | 500.0 $\Omega$ , 5.000 k $\Omega$ , 50.00 k $\Omega$ , 500.0 k $\Omega$ , 5.000 M $\Omega$ , 30.00 M $\Omega$ |
| Full Scale Reading                 |                                                                                                               |
| 500 $\Omega$ to 5 M $\Omega$ ..... | 5000 counts                                                                                                   |
| 30 M $\Omega$ .....                | 3000 counts                                                                                                   |
| Accuracy.....                      | $\pm(0.6$ % +6 counts)                                                                                        |
| Measurement Current .....          | 0.5 mA to 50 nA, $\pm 20$ % decreases with increasing ranges                                                  |
| Open Circuit Voltage.....          | <4 V                                                                                                          |

### Continuity (CONT)

|                             |                                    |
|-----------------------------|------------------------------------|
| Beep .....                  | <50 $\Omega$ ( $\pm 30$ $\Omega$ ) |
| Measurement Current .....   | 0.5 mA, $\pm 20$ %                 |
| Detection of shorts of..... | $\geq 1$ ms                        |

### Diode

|                               |                      |
|-------------------------------|----------------------|
| Maximum Voltage Reading ..... | 2.8 V                |
| Open Circuit Voltage.....     | <4 V                 |
| Accuracy.....                 | $\pm(2$ % +5 counts) |
| Measurement Current .....     | 0.5 mA, $\pm 20$ %   |

### Temperature (TEMP)

With Optional Temperature Probe

|                         |                                                                                                      |
|-------------------------|------------------------------------------------------------------------------------------------------|
| Ranges (°C or °F) ..... | -40.0 to +100.0 °<br>-100.0 to +250.0 °<br>-100.0 to +500.0 °<br>-100 to +1000 °<br>-100 to + 2500 ° |
| Probe Sensitivity ..... | 1 mV/°C and 1 mV/°F                                                                                  |

### DC Voltage (VDC)

|                         |                                             |
|-------------------------|---------------------------------------------|
| Ranges .....            | 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V |
| Full Scale Reading..... | 5000 counts                                 |
| Accuracy.....           | $\pm(0.5$ % +6 counts)                      |

Normal Mode AC Rejection at  
50 or 60 Hz  $\pm 1$  % ..... >60 dB

### **AC Voltage (VAC)**

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading ..... 5000 counts

Accuracy

15 Hz to 60 Hz .....  $\pm(1\% + 10 \text{ counts})$

60 Hz to 1 kHz .....  $\pm(2.5\% + 15 \text{ counts})$

*For higher frequencies the frequency roll-off of the Meter input starts affecting accuracy.*

Normal Mode DC Rejection ..... >50 dB

### **AC+DC Voltage (True RMS)**

Ranges ..... 500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading ..... 5000 counts

Accuracy

DC to 60 Hz .....  $\pm(1\% + 10 \text{ counts})$

60 Hz to 1 kHz .....  $\pm(2.5\% + 15 \text{ counts})$

*For higher frequencies the frequency roll-off of the Meter input starts affecting accuracy.*

*All accuracies are valid if the waveform amplitude is larger than 5 % of full scale.*

### **Amperes (AMP)**

*With Optional Current Probe or Current Shunt*

Ranges ..... same as VDC, VAC, VAC+DC

Probe Sensitivity ..... 100  $\mu\text{V/A}$ , 1 mV/A, 10 mV/A, 100 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracy ..... same as VDC, VAC, VAC+DC (add current probe or current shunt accuracy)

## **Recorder**

### **TrendPlot (Meter or Scope)**

Chart recorder that plots a graph of min and max values of Meter or Scope measurements over time.

Measurement Speed ..... >5 measurements/s

Time/Div ..... 5 s/div to 30 min/div

Record Size (min, max, average) ..... 19200 points

Recorded Time Span ..... 64 min to 546 hours

Time Reference ..... time from start, time of day

### **Scope Record**

Records scope waveforms in deep memory while displaying the waveform in Roll mode.

Source ..... Input A, B, C, D

Max. Sample Speed

(4 ms/div to 1 min/div) ..... 125 MS/s

Glitch capture (4 ms/div to 2 min/div) ..... 8 ns

Time/Div in normal mode ..... 4 ms/div to 2 min/div

Record Size ..... 30k points per waveform

Recorded Time Span ..... 4.8 s to 40 hours

Acquisition Modes ..... Single Sweep, Continuous Roll, Start/Stop on Trigger

Time Reference ..... time from start, time of day

## **Zoom, Replay and Cursors**

### **Zoom**

Zoom ranges from full record overview to detailed view of individual samples

### **Replay**

Displays a maximum of 100 captured quad input Scope screens.

Replay modes ..... Step by Step, Replay as Animation

### **Cursor Measurements**

Cursor Modes ..... single vertical cursor, dual vertical cursors, dual horizontal cursors  
(Scope mode)

Markers ..... automatic markers at cross points

Measurements:

- value at cursor 1
- value at cursor 2
- difference between values at cursor 1 and 2
- time between cursors
- RMS between cursors
- Time of Day (Recorder modes)
- Time from Start (Recorder modes)
- Rise Time, fall time
- A x s (current over time between cursors)
- V x s (voltage over time between cursors)
- W x s (power over time between cursors using powerwaveform AxB or CxD)

### **Miscellaneous**

#### **Display**

View Area ..... 126.8 mm x 88.4 mm (4.99 in x 3.48 in)

Resolution ..... 320 pixels x 240 pixels

Backlight ..... LED (Temperature compensated)

Brightness ..... Power Adapter: 200 cd/m<sup>2</sup>  
Battery Power: 90 cd/ m<sup>2</sup>

Display Auto-OFF time (battery saving) ..... 30 seconds, 5 minutes or disabled

#### **Probe Calibration**

Manual pulse adjustment and automatic DC adjustment with probe check

Generator Output ..... 1.225 Vpp / 500 Hz square wave

#### **Internal Memory**

Number of Scope Memories ..... 30

*Each memory can contain 2/4 waveforms plus corresponding setups*

Number of Recorder Memories ..... 10

Each memory can contain:

- 2/4 channel input TrendPlot
- 2/4 channel input Scope Record
- 100 2/4 channel input Scope screens (Replay)

Number of Screen Image memories ..... 9

*Each memory can contain one screen image*

#### **External Memory**

USB stick, 2GB max

#### **Mechanical**

Size ..... 265 mm x 190 mm x 70 mm (10.5 in x 7.5 in x 2.8 in)

Weight

FLUKE 190-xx4 ..... 2.2 kg (4.8 lb) including battery

FLUKE 190-5xx ..... 2.2 kg (4.8 lb) including battery

FLUKE 190-xx2 ..... 2.1 kg (4.6 lb) including battery

**Interface Ports**

Two USB ports provided. Ports are fully insulated from instrument's floating measurement circuitry:

- A USB-host port directly connects to external flash memory drive ('USB-stick', ≤2 GB) for storage of waveform data, measurement results, instrument settings and screen copies.
- A mini-USB-B is provided which allows for interconnection to PC for remote control and data transfer using SW90W (FlukeView® software for Windows®).
- One port can be active at the same time, so remote control and data transfer via mini-USB is not possible when saving or recalling data to or from the USB-stick.

**10:1 Probe VPS410****Accuracy**

Probe accuracy when adjusted on the test tool:

|                       |      |
|-----------------------|------|
| DC to 20 kHz .....    | ±1 % |
| 20 kHz to 1 MHz ..... | ±2 % |
| 1 MHz to 25 MHz ..... | ±3 % |

For higher frequencies the probe's roll-off starts affecting the accuracy.

For further probe specifications see the instruction sheet supplied with the VPS410 probe set.