

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

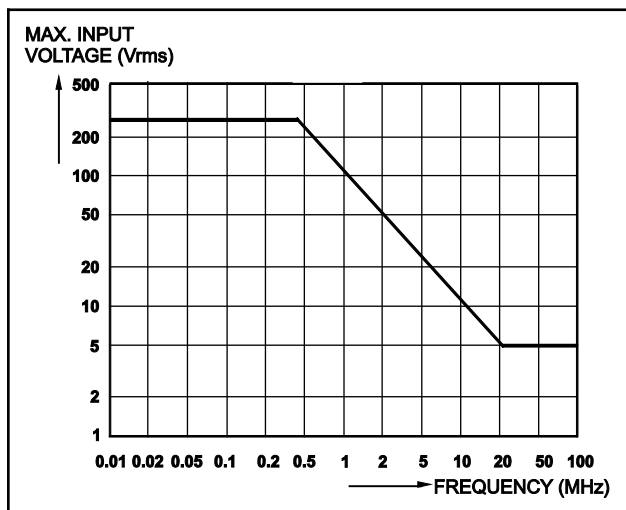
IEC 61010-2-030: CAT IV 600 V / CAT III 1000 V (VPS410, METER/EXT input terminals)

IEC 61010-2-030: CAT IV 300 V

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

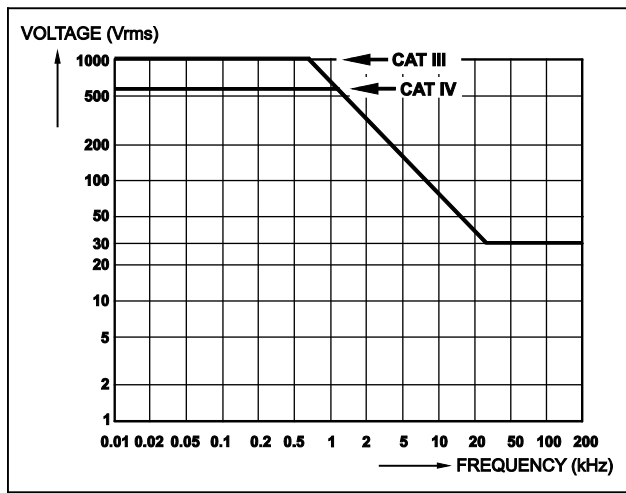
Voltage vs. Frequency Operating Range

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
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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)
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Enclosure Protection.....	IEC 60529: IP51
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Electromagnetic Compatibility (EMC)

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

Horizontal

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

Real Time Sampling Rate

FLUKE 190-50x:

5 ns to 4 μ s/div (3 or 4 channels) up to 1.25 GS/s

2 ns to 4 μ s/div (2 channels) up to 2.5 GS/s

1 ns to 4 μ s/div (1 channel) up to 5 GS/s

10 μ s to 120 s/div 125 MS/s

FLUKE 190-202, -204:

2 ns to 4 μ s/div (1 or 2 channels) up to 2.5 GS/s

5 ns to 4 μ s/div (3 or 4 channels) up to 1.25 GS/s

10 μ s to 120 s/div 125 MS/s

FLUKE 190-102, -104:

5 ns to 4 μ s/div (all channels) up to 1.25 GS/s

10 μ s to 120 s/div 125 MS/s

FLUKE 190-062:

10 ns to 4 μ s/div (all channels) up to 625 MS/s

10 μ s to 120 s/div 125 MS/s

Glitch Detection

4 μ 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 190-102/104: 1.25 GS/s 190-202/204: 2.5 GS/s (1 or 2 channels on) 190-204: 1.25 GS/s (3 or 4 channels on) 190-50x: 5 GS/s (1 channel on) 190-50x: 2.5 GS/s (2 channels on) 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. 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 ± 4 divisions

Trigger Sensitivity

DC to 5 MHz at >5 mV/div	0.5 division
DC to 5 MHz at 2 mV/div 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. 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
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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 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 μ V
Full Scale Reading.....	999 counts
Accuracy at 4 s to 10 μ 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 μ 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 μ 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 μ 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 μ 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_{pwm}

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 _{pwm} value (see V _{pwm}) 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_{pwm}) 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.....	± 2 degrees
1 MHz to 10 MHz.....	± 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 Ω or 600 Ω
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 Ω (± 1 %)/14 pF (± 1.5 pF)
 Max. Input Voltage	1000 V CAT III 600 V CAT IV (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, or 400 Hz	>60 dB

Ohms (Ω)

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

Continuity (CONT)

Beep	<50 Ω (± 30 Ω)
Measurement Current	0.5 mA, ± 20 %
Detection of shorts of.....	≥ 1 ms

Diode

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

Temperature (TEMP)

With Optional Temperature Probe

Ranges (°C or °F)	-40.0 to +100.0 ° -100.0 to +250.0 ° -100.0 to +500.0 ° -100 to +1000 ° -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 ± 1 %>60 dB

AC Voltage (VAC)

Ranges500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading5000 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)

Ranges500.0 mV, 5.000 V, 50.00 V, 500.0 V, 1100 V

Full Scale Reading5000 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

Rangessame as VDC, VAC, VAC+DC

Probe Sensitivity100 $\mu\text{V/A}$, 1 mV/A, 10 mV/A, 100 mV/A, 1 V/A, 10 V/A, and 100 V/A

Accuracysame 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/Div5 s/div to 30 min/div

Record Size (min, max, average)19200 points

Recorded Time Span64 min to 546 hours

Time Referencetime from start, time of day

Scope Record

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

SourceInput 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 mode4 ms/div to 2 min/div

Record Size30k points per waveform

Recorded Time Span4.8 s to 40 hours

Acquisition ModesSingle Sweep, Continuous Roll, Start/Stop on Trigger

Time Referencetime 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 modesStep 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/m²
Battery Power: 90 cd/ m²

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.