



Chapter 9

Specifications

Introduction

Performance Characteristics

FLUKE guarantees the properties expressed in numerical values with the stated tolerance. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical ScopeMeter test tools.

Environmental Data

The environmental data mentioned in this manual are based on the results of the manufacturer's verification procedures.

Safety Characteristics

The test tool has been designed and tested in accordance with Standards ANSI/ISA S82.01-1994, EN 61010.1 (1993) (IEC 1010-1), CAN/CSA-C22.2 No.1010.1-92 (including approval), UL3111-1 (including approval) Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use.

This manual contains information and warnings that must be followed by the user to ensure safe operation and to keep the instrument in a safe condition. Use of this equipment in a manner not specified by the manufacturer may impair protection provided by the equipment.

Dual Input Oscilloscope

Isolated Inputs A and B (Vertical)

Bandwidth, DC Coupled

FLUKE 199	200 MHz (-3 dB)
FLUKE 196	100 MHz (-3 dB)
FLUKE 192	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 199	1.7 ns
FLUKE 196	3.5 ns
FLUKE 192	5.8 ns

Analog Bandwidth Limiters 20 MHz and 10 kHz

Input Coupling AC, DC

Polarity Normal, Inverted

Sensitivity Ranges

with 10:1 probe	50 mV to 1000 V/div
direct (1:1)	5 mV to 100 V/div

Trace Positioning Range ± 4 divisions

Input Impedance on BNC

DC Coupled 1 M Ω (± 1 %)/15 pF (± 2 pF)

Max. Input Voltage

with 10:1 probe	600 V CAT III
	1000 V CAT II
direct (1:1)	300 V CAT III

(For detailed specifications, see "Safety")

Vertical Accuracy $\pm(1.5\% + 0.04 \text{ range/div})$

Digitizer Resolution 8 bits, separate digitizer
for each input

Horizontal

Maximum Time Base Speed:

FLUKE 199	5 ns/div
FLUKE 196	5 ns/div
FLUKE 192	10 ns/div

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

Real Time Sampling Rate (for both inputs simultaneously)

FLUKE199:

5 ns to 2 μ s /div	up to 2.5 GS/s
5 μ s to 120 s/div	20 MS/s

FLUKE 196:

5 ns to 2 μ s /div	up to 1 GS/s
5 μ s to 120 s/div	20 MS/s

FLUKE 192

10 ns to 2 μ s /div	up to 500 MS/s
5 μ s to 120 s/div	20 MS/s

Record Length
 Scope Record Mode..... 27500 points on each input
 Scope Normal Mode..... 1000 points on each input
 Scope Glitch Capture Mode... 500 points on each input

Glitch Detection
 5 μ s to 120 s/div displays glitches as fast as 50 ns

Waveform Display A, B, A+B, A-B, A*B, A vs B
 Normal, Average (2,4,8,64 x), Persistence

Time Base Accuracy \pm 100 ppm

Trigger and Delay

Trigger Modes..... Automatic, Edge,
 External, Video, Pulse Width

Trigger Delay up to +1000 divisions

Pre Trigger Viewone full screen length

Max. Delay..... 10 seconds

Automatic Connect-and-View Trigger

Source A, B, EXT

Slope Positive, Negative

Edge Trigger

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

Source A, B, EXT

Slope Positive, Negative

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

Trigger Sensitivity A and B

DC to 5 MHz at $>$ 5 mV/div0.5 divisions

DC to 5 MHz at 5 mV/div 1 division

200 MHz (FLUKE 199) 1 division

250 MHz (FLUKE 199) 2 divisions

100 MHz (FLUKE 196) 1 division

150 MHz (FLUKE 196) 2 divisions

60 MHz (FLUKE 192) 1 division

100 MHz (FLUKE 192) 2 divisions

Isolated External Trigger

Bandwidth 10 kHz

Modes..... Automatic, Edge

Trigger Levels (DC to 10 kHz) 120 mV, 1.2 V

Video Trigger

Standards PAL, PAL+, NTSC, SECAM

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 (±10 %), ≠T(±10 %)
Source.....A
PolarityPositive or negative pulse
Pulse Time Adjustment Range 1/100 div. to 250 div.
with a maximum resolution of 50 ns.

Continuous Auto Set

Autorangeing 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 and B

DC to 1 MHz 10 mV
1 MHz to max. bandwidth.....20 mV

Automatic Capturing Scope Screens

Capacity 100 dual input scope Screens

For viewing screens, see Replay function.

Automatic Scope Measurements

The accuracy of all readings is within ± (% 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 unless the probe has been calibrated on the test tool. At least 1.5 waveform period must be visible on the screen.

General

InputsA and B
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 µV

Full Scale Reading 1100 counts
Accuracy at 5 s to 5 µs/div±(1.5 % +5 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 1100 counts

Accuracy

DC coupled:

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

AC coupled, low frequencies:

50 Hz direct (1:1)..... $\pm(2.1 \% + 10 \text{ counts})$

60 Hz direct (1:1)..... $\pm(1.9 \% + 10 \text{ counts})$

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.

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

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.

Amperes (AMP)

With Optional Current Probe or Current Shunt

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

Probe Sensitivity100 μ 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)

Peak

ModesMax peak, Min peak, or pk-to-pk

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..... ± 0.2 division
Peak-to-peak ± 0.4 division

Frequency (Hz)

Range.....1.000 Hz to full bandwidth

Full Scale Reading 9 999 counts
with at least 10 waveform periods on screen.

Accuracy
1 Hz to full bandwidth $\pm(0.5 \% + 2 \text{ counts})$

Duty Cycle (DUTY)

Range.....4.0 % to 98.0 %

Pulse Width (PULSE)

Resolution (with GLITCH off)..... 1/100 division

Full Scale Reading 999 counts

Accuracy
1 Hz to full bandwidth $\pm(0.5 \% + 2 \text{ counts})$

Power

Power Factor ratio between Watts and VA
 Range 0.00 to 1.00

Watt..... RMS reading of multiplication
 corresponding samples of input A (volts)
 and Input B (amperes)
 Full Scale Reading 999 counts

VA $V_{rms} \times I_{rms}$
 Full Scale Reading 999 counts

VA Reactive $\sqrt{((VA)^2 - W^2)}$
 Full Scale Reading 999 counts

Phase

Range..... -180 to +180 degrees
 Resolution..... 1 degree
 Accuracy

0.1 Hz to 1 MHz ± 1 degrees
 1 MHz to 10 MHz ± 3 degrees

Temperature (TEMP)

With Optional Temperature Probe

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


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

Meter Input

Input Coupling DC
Frequency Response DC to 10 kHz (-3 dB)
Input Impedance 1 M Ω (± 1 %)//10 pF (± 1.5 pF)

 Max. Input Voltage 1000 V CAT II
600 V CAT III
(For detailed specifications, see "Safety")

Meter Functions

Ranging Auto, Manual
Modes Normal, Relative

DMM Measurements on Meter Inputs

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.

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 $\pm(0.6$ % +5 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

Amperes (AMP)

With Optional Current Probe or Current Shunt

Ranges..... same as VDC, VAC, VAC+DC
Probe Sensitivity100 μ 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..... > 2.5 measurements/s
Time/Div 10 s/div to 20 min/div
Record Size 13500 points per input
Recorded Time Span 90 min to 8 days
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, Input B
Max. Sample Speed (10 ms/div to 1 min/div)..... 20 MS/s
Glitch capture (10 ms/div to 1 min/div) 50 ns
Time/Div in normal mode 10 ms/div to 2 min/div
Record Size 27500 points per input
Recorded Time Span 11 s to 30 hours
Acquisition Modes Single Sweep
Continuous Roll
External Triggering
Time Reference time from start, time of day

Zoom, Replay and Cursors

Zoom

Horizontal Magnification
 Scope Record up to 100x
 TrendPlot up to 50x
 Scope up to 8x

Replay

Displays a maximum of 100 captured dual 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
 Time of Day (Recorder modes)
 Time from Start (Recorder modes)
 Rise Time

Miscellaneous

Display

View Area 132 mm (5.2 inches)
 Backlight Cold Cathode Fluorescent (CCFL)
 Temperature compensated
 Brightness Power Adapter: 60 cd / m²
 Batteries: 35 cd / m²

Power

Rechargeable NiMH Batteries:
 Operating Time 4 hours
 Charging Time 4 hours
 Allowable ambient
 temperature during charging: .0 to 40 °C (32 to 104 °F)
 Auto power down
 time (battery saving): 5 min, 30 min or disabled

Battery Charger / Power Adapter BC190:
 • BC190/801 European line plug 230 V ±10 %
 • BC190/803 North American line plug 120 V ±10 %
 • BC190/804 United Kingdom line plug 230 V ±10 %
 • BC190/806 Japanese line plug 100 V ±10 %
 • BC190/807 Australian line plug 230 V ±10 %
 • BC190/808 Universal switchable adapter 115 V ±10 %
 or 230 V ±10 %, with plug EN60320-2.2G
 Line Frequency 50 and 60 Hz

Probe Calibration

Manual pulse adjustment and automatic DC adjustment with probe check.

Generator Output..... 3 Vpp / 500 Hz square wave

Memory

Number of Scope Memories..... 10

Each memory can contain two waveforms plus corresponding setups

Number of Recorder Memories 2

Each memory can contain:

- a dual input TrendPlot (2 x 13500 points per input)
- a dual input Scope Record (2 x 27500 points per input)
- 100 dual input Scope screens

Mechanical

Size 64 x 169 x 254 mm (2.5 x 6.6 x 10 in)

Weight 1.95 kg (4.3 lbs) including battery

Optical InterfacePort

Type RS-232, optically isolated

To Printer..... supports Epson FX, LQ, and HP Deskjet®, Laserjet®, and Postscript

- Serial via PM9080 (optically isolated RS-232 Adapter/Cable, optional).
- Parallel via PAC91 (optically isolated Print Adapter Cable, optional).

To PC/Notebook

- Serial via PM9080 (optically isolated RS-232 Adapter/Cable, optional), using SW90W (FlukeView® software for Windows 95®, 98®, Me®, 2000® and NT4®).

Environmental

Environmental..... MIL-PRF-28800F, Class 2

Temperature

Operating:

battery only.....0 to 50 °C (32 to 122 °F)

power adapter0 to 40 °C (32 to 104 °F)

Storage -20 to +60 °C (-4 to +140 °F)

Humidity

Operating:

0 to 10 °C (32 to 50 °F)..... noncondensing

10 to 30 °C (50 to 86 °F)..... 95 %

30 to 40 °C (86 to 104 °F).....75 %

40 to 50 °C (104 to 122 °F).....45 %

Storage:

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

Altitude

Operating 3 km (10 000 feet)

Storage 12 km (40 000 feet)

Vibration (Sinusoidal) max. 3 g

Shock max. 30 g

Electromagnetic Compatibility (EMC)

Emission and immunity EN-IEC61326-1 (1997)

Enclosure Protection IP51, ref: IEC529

⚠ Safety

Designed for measurements on 1000 V Category II Installations, 600 V Category III Installations, Pollution Degree 2, per:

- ANSI/ISA S82.01-1994
- EN61010-1 (1993) (IEC1010-1)
- CAN/CSA-C22.2 No.1010.1-92
- UL3111-1

⚠ Max. Input Voltages

Input A and B directly	300 V CAT III
Input A and B via 10:1 probe	1000 V CAT II
	600 V CAT III
METER/EXT TRIG inputs	1000 V CAT II
	600 V CAT III

⚠ Max. Floating Voltage

From any terminal to ground	1000 V CAT II
	600 V CAT III
Between any terminal.....	1000 V CAT II
	600 V CAT III

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.

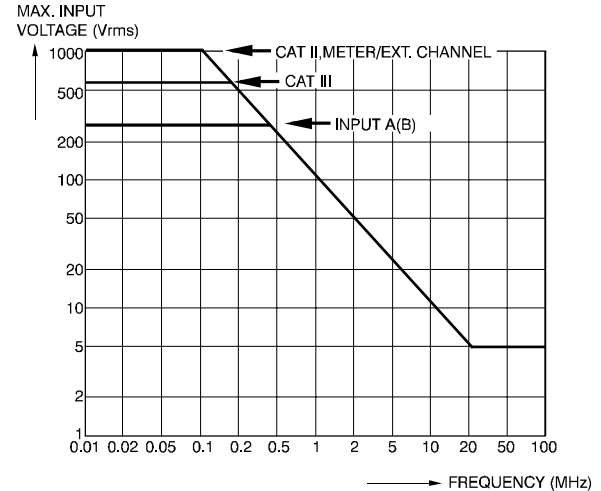


Figure 51. Max. Input Voltage v.s. Frequency

Note

Overvoltage Category III refers to distribution level and fixed installation circuits inside a building. Overvoltage Category II refers to local level, which is applicable for appliances and portable equipment.

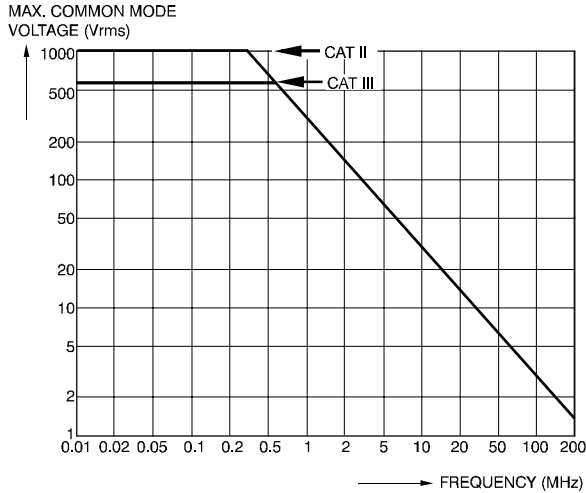


Figure 52. Safe Handling: Max. Input Voltage Between Scope References, and Between Scope References and Meter Reference

10:1 Probe

Safety

⚠ Max. Input Voltage 1000 V CAT II
600 V CAT III

⚠ Max. Floating Voltage
from any terminal to ground..... 1000 V CAT II
600 V CAT III
up to 400 Hz

Electrical specifications

Input Impedance at probe tip 10 MΩ (±2 %)/14 pF (±2 pF)
Capacity Adjustment Range 10 to 22 pF
Attenuation at DC (1 MΩ input) 10 x (±2 %)
Bandwidth (with FLUKE 199)..... DC to 200 MHz (-3 dB)

Environmental

Temperature
Operating 0 to 50 °C (32 to 122 °F)
Storage..... -20 to +60 °C (-4 to +140 °F)
Altitude
Operating 3 km (10 000 feet)
Storage..... 12 km (40 000 feet)
Humidity
Operating at 10 to 30 °C (50 to 86 °F)..... 95 %

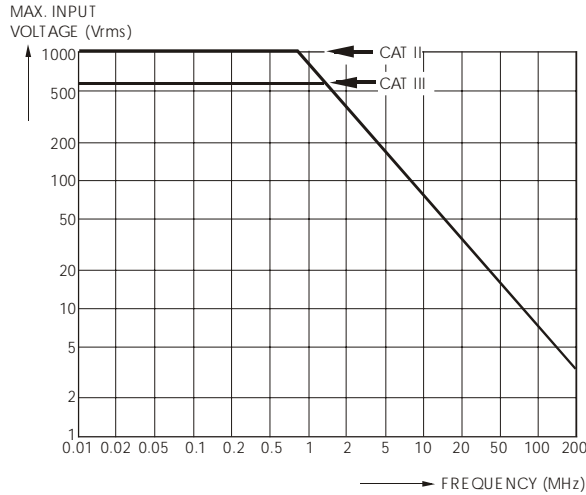


Figure 53. Max. Voltage From Probe Tip to Ground and From Probe Tip to Probe Reference

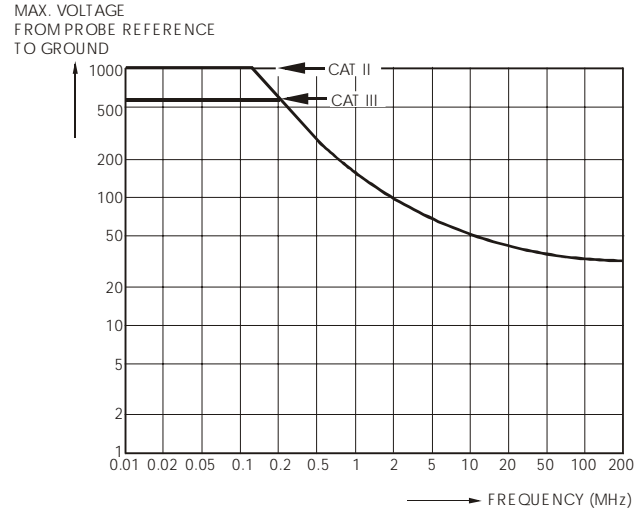


Figure 54. Safe Handling: Max. Voltage From Probe Reference to Ground

Electromagnetic Immunity

The Fluke 190 series, including standard accessories, conforms with the EEC directive 89/336 for EMC immunity, as defined by EN-61326-1, with the addition of the following tables.

Scope Mode (10 ms/div): Trace disturbance with VPS200 voltage probe shorted

Table 1

No visible disturbance	E = 3V/m
Frequency range 10 kHz to 20 MHz	5 mV/div to 100 V/div
Frequency range 20 MHz to 100 MHz	100 mV/div to 100 V/div
Frequency range 100 MHz to 1 GHz	500 mV/div to 100 V/div ^{*)}

- (*) With the 20 MHz Bandwidth Filter switched on: no visible disturbance.
 With the 20 MHz Bandwidth Filter switched off: disturbance is max 2 div.

Table 2

Disturbance less than 10% of full scale	E = 3V/m
Frequency range 20 MHz to 100 MHz	10 mV/div to 50 mV/div

Test Tool ranges not specified in tables 1 and 2 may have a disturbance of more than 10% of full scale.

Meter Mode (Vdc, Vac, Vac+dc, Ohm and Continuity): Reading disturbance with test leads shorted

Table 3

Disturbance less than 1% of full scale	E = 3V/m
Frequency range 10 kHz to 1 GHz	500mV to 1000V , 500Ohm to 30 MOhm ranges