Performance Characteristics

The performance characteristics describe the typical performance of the new 54615B, 54616B, and 54616C oscilloscopes. You will notice that some of the characteristics are marked as tested, these are values that you can verify with the performance tests under "Verifying Oscilloscope Performance," on page 4-5.

Vertical System

Bandwidth[1]

dc to 500 MHz ±3 dB
ac coupled, 10 Hz to 500 MHz ±3 dB

Rise time 700 ps (calculated)

Dynamic range ±12 divisions from center screen

Math functions Channel 1 + or – Channel 2

Input resistance 1 MΩ or 50Ω selectable

Input capacitance ≈9 pf

⚠ **Maximum input voltage** 250 V [dc + peak ac(<10 kHz)] or 5 Vrms in 50Ω mode

[1] Tested, see "To verify bandwidth" on page 4-10.
Upper bandwidth reduced 2 MHz per degree C above 35°C

Sensitivity 2 mV/div to 5 V/div

Accuracy[1] ±2.0% of full scale

Verniers[1] Fully calibrated, accuracy ±2.0 % of full scale

Cursor accuracy[1, 2, 3]

Single cursor accuracy: vertical accuracy ±1.2% of full scale ±0.5% of position value

Dual cursor accuracy: vertical accuracy ±0.4% of full scale

Bandwidth limit ≈30 MHz

Coupling Ground, ac, and dc

Inversion Channel 1 and channel 2

CMRR (common mode rejection ratio) ≥ 20 dB at 50 MHz

Probe Sense Automatic readout of 1X, 10X, 20X and 100X probes

50Ω protection Protects 50Ω load from excessive voltage.

Time skew Adjustable over a range of ±25 ns to remove effects of cabling and probe delays.

[1] When the temperature is within ±10 °C from the calibration temperature.

[2] Magnification is used below 7 mV/div range. Below 7 mV/div full scale is defined as 56 mV.

[3] Tested, see "To verify voltage measurement accuracy" on page 4-8.

Horizontal System

Sweep speeds 5 s/div to 1 ns/div main and delayed

Accuracy ±0.005% of reading

Horizontal resolution 20 ps

Cursor accuracy[1] **(Δt and 1/Δt)** ±0.005% ±0.2% of full scale ±100 ps

Delay jitter ≤1 ppm

Pretrigger delay (negative time)
54615B–The greater of 30 µs or 60 divisions, not to exceed 100 s

54616B/16C–The greater of 15 µs or 60 divisions, not to exceed 100 s.

Posttrigger delay (from trigger point to start of sweep)
The greater of 10 ms or 20,000 divisions, not to exceed 100 s.

Delayed sweep operation

Up to 200 times main sweep when main sweep is from 5 s/div to 10 ms/div.

Up to 1 ns/div with main sweep set to 5 ms/div and faster.

Horizontal modes Main, Delayed (Alt), X-Y, and Roll

[1] Tested, see "To verify horizontal Δt and 1/Δt accuracy," on page 4-13.

Trigger System

Sources Channels 1, 2, line, and external

Internal trigger

Sensitivity[1]

dc to 100 MHz:	0.50 div or 5.0 mV
100 MHz to 500 MHz:	1 div or 10 mV

Coupling
ac, dc, LF reject, HF reject, and noise reject
LF reject attenuates –3 dB for signals below 50 kHz, and
HF reject attenuates –3 dB for signals above 50 kHz

Modes Auto, Autolevel, Normal, Single, and TV

TV triggering Available on channels 1 and 2

TV line and field 0.5 division of composite sync for stable display

Holdoff Adjustable from 300 ns to ≈13 s

External trigger

Range ±2 V

Sensitivity[1]

dc to 100 MHz:	<75 mV
100 MHz to 500 MHz:	<150 mV

Coupling ac, dc

Input resistance 1 MΩ or 50Ω

Input capacitance ≈12 pf

⚠ **Maximum input voltage** 250 V [dc + peak ac(<10 kHz)]

50Ω protection Protects 50Ω load from excessive voltage.

Probe Sense Automatic readout of 1X, 10X, 20X, and 100X probes

[1] Tested, see "To verify trigger sensitivity," on page 4-15.

TV Functions

Line counting Delay time calibrated in NTSC and PAL line numbers.

All field trigger Oscilloscope triggers on the vertical sync pulse in both fields allowing use with non-interlaced video.

XY Operation

Operating mode X=Channel 1, Y=Channel 2

Bandwidths X-axis and Y-axis same as vertical system

Phase difference ±3 degrees at 10 MHz

Display System

Display

54615B/16B — 7-inch raster CRT

54616C — 5.8-inch Active Matrix Color LCD Display. The present state-of-the-art for the color displays allows for some pixel defects to be present. The number of these allowed is no more than six active (those which cannot be turned off), and six inactive (those which cannot be turned on).

Resolution 256 vertical by 500 horizontal points

Controls Front-panel intensity control (54615B/16B only)

Graticule 8 × 10 grid or frame

Storage Scope Autostore saves previous sweeps in half bright display and the most recent sweep in full bright display. This allows easy differentiation of current and historic information.

Acquisition System

Maximum sample rate

54615B – 1 GSa/s simultaneous on 2 channels

54616B/16C – 2 GSa/s simultaneous on 2 channels

Resolution 8 bits

Simultaneous channels Channels 1 and 2

Record length

Vectors off:
- 5000 points
- 4000 points (200 ns/div, 54615B)
- 4000 points (100 ns/div, 54616B/16C)
- 1000 points (peak detect on)

Vectors on:
- 2000 points
- 1000 points (peak detect on)

Roll Mode (vectors off or on):
- 1000 points
- 500 points (200 ms/div, channel 1 and 2 on, 54615B/16B)

Single-shot bandwidth

54615B – 250 MHz on channels 1 and 2 simultaneously (1 GSa/s, display vectors on)

54616B/16C – 500 MHz on channels 1 and 2 simultaneously (2 GSa/s, display vectors on)

Acquisition modes Normal, Peak Detect, and Average

Peak detect 1 ns glitch capture

Average Number of averages selectable at 8, 64, and 256

Roll Mode At sweep speeds of 200 ms/div and slower (54615B/16B)
At sweep speeds of 500 ms/div and slower (54616C):

waveform data moves across the display from right to left with no dead time. Display can be either free-running (non-triggered) or triggered to stop on a trigger event.

Advanced Functions

Automatic measurements (measurements are continuously updated)

Voltage Vavg, Vrms, Vp-p, Vtop, Vbase, Vmin, Vmax

Time Frequency, period, + width, – width, duty cycle, rise time, and fall time

Cursor Measurements Four cursors can be positioned on the display to make time voltage measurements. The cursors will track changes in position and delay controls. Readout in V, T.

Setup functions

Autoscale Sets vertical and horizontal deflections and trigger level. Requires a signal with a frequency >49 Hz, duty cycle >0.5% and voltage level : channels 1 and 2 > 20 mVp-p,

Save/Recall 16 front-panel setups can be stored and recalled from nonvolatile memory.

Trace memory Two volatile pixel memories allow storage of multi-valued waveforms.

Power Requirements

Line voltage range 100 Vac to 240 Vac

Line voltage selection Automatic

Line frequency 45 Hz to 440 Hz

Maximum power consumption 300 VA

General (54615B and 54616B only)

Environmental characteristics

The instrument meets or exceeds the environmental requirements of MIL-T-28800E for Type III, Class 3, Style D equipment as described below.

Ambient temperature (Tested to MIL-T-28800E paragraph 4.5.5.1.1)

Operating –10 °C to +55 °C
Nonoperating –51 °C to +71 °C

Humidity tested to Agilent Technologies environmental specification section 758 paragraphs 4.0, 4.1, and 4.2 for class B-1 products

Operating 95% relative humidity at +40 °C for 24 hours
Nonoperating 90% relative humidity at +65 °C for 24 hours

Altitude (Tested to MIL-T-28800E paragraph 4.5.5.2)

Operating to 4,500 m
Nonoperating to 15,000 m

EMI

EMI (commercial) CISPR 11 Group1 Class A
EMI Meets the requirements in accordance with MIL-T-28800E (prior to Interim Amendment 1) and MIL-STD-461C as described below.

CE01 Part 2 narrow band requirements up to 15 kHz

CE03 Part 2

CS01 Part 2

CS02 Part 2 limited to 100 MHz

CS06 Part 5 limited to 400 V

RE01 Part 5 measured at 15.24 cm and exceptioned from 19kHz to 50 kHz.

RE02 Part 2 (limited to 1 GHz) Full limits of class A1C and A1F, with option 002 installed; without option 002 installed 10 dB relaxation, 14 kHz to 100 kHz

RS03 Part 2, limited to 1 V/meter from 14 kHz to 1 GHz. Slight trace susceptibility from 450 MHz to 600 MHz and at 950 MHz.

Vibration

Operating 15 minutes along each of the 3 major axes; 0.635 mm displacement, 10 Hz to 55 Hz in one-minute cycles. Held for 10 minutes at 55 Hz (4 g at 55 Hz).

Nonoperating survival random vibration, 5Hz to 500 Hz at 2.41 grms.

Shock

Operating 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along major axis. Total of 18 shocks.

General (54616C only)

Environmental characteristics

These general characteristics apply to the 54616C only. This instrument meets Agilent Technologies environmental specifications (section 750) for class B-1 products.

Ambient temperature

Operating 0 °C to +55 °C
Nonoperating –40 °C to +70 °C

Humidity

Operating 95% relative humidity at +40 °C for 24 hours
Nonoperating 90% relative humidity at +65 °C for 24 hours

Altitude

Operating to 3,048 m
Nonoperating to 12,192 m

Vibration

Operating Random vibration 5-500 Hz, 10 minutes per axis, 0.3 grms.

Nonoperating Random vibration 5-500 Hz, 10 minutes per axis, 2.41 grms; Resondant search, 5-500 Hz swept sine, 1 octave/minute sweep rate, 0.75 g, 5-minute resonant dwell at 4 resonances per axis.

Shock

Operating Half-sine pulse, 2.8 meters/second, along all 6 axes.

Nonoperating Trapezoidal pulse, 7.4 meters/second, along all 6 axes.

General (54615B, 54616B, and 54616C)

Physical characteristics

Size (excluding handle)
Height 172 mm
Width 322 mm
Depth 317 mm
Weight: 6.6 kg

Product Regulations

Safety IEC 1010-1:1990+A1 / EN 61010-1:1993
UL 3111
CSA-C22.2 No.1010.1:1993

EMC This Product meets the requirement of the European Communities (EC) EMC Directive 89/336/EEC.

Emissions EN55011/CISPR 11 (ISM, Group 1, Class A equipment)

Immunity

EN50082-1	Code[1]	Notes[2]
IEC 555-2	1	
IEC 555-3	1	
IEC 801-2 (ESD) 8kV AD	1,2	*
IEC 801-3 (Rad.) 3 V/m	2	
IEC 801-4 (EFT) 1kV	1,2	*

[1] Performance Codes:
1 PASS - Normal operation, no effect.
2 PASS - Temporary degradation, self recoverable.
3 PASS - Temporary degradation, operator intervention required.
4 FAIL - Not recoverable, component damage.

[2] Notes:
* Code 1 for 54616C
Code 2 for 54615B and 54616B

Sound Pressure Level Less than 60 dBA

Option 005 General Performance Characteristics

Video Standards

NTSC
PAL
PAL-M
SECAM
Generic

Video Trigger Modes

Line (number) of Field 1
Field 2
Alternate Fields

All Lines

Field 1 Defined as that field with the 3 lines of vertical sync starting at line 4. Is actually color field 1 or color field 3.

Field 2 Defined as that field with the 3 lines of vertical sync starting at the midpoint of line 3. Is actually color field 2 or color field 4.

All Fields

Option 005 Trigger System

Internal trigger

Sensitivity Performance remains unchanged

Coupling Performance remains unchanged

Modes Performance remains unchanged

Holdoff Performance remains unchanged

TV triggering Available on channels 1 and 2 only

TV line and field 0.5 division of composite sync for stable display

External trigger

Performance remains unchanged

Vertical output

Connector Rear panel BNC (f)

Source Impedance 50Ω (nominal)

Signal source selected by internal trigger source

Amplitude approximately 90mVp-p into 50Ω for a full scale display at full bandwidth of the oscilloscope

TV Trigger output

Connector Rear panel BNC (f)

Amplitude TTL

Pulse width a function of TV trigger mode, Minimum approximately 5us in line modes to the width of a field in field modes

Delay from Vertical Output approximately 400ns.