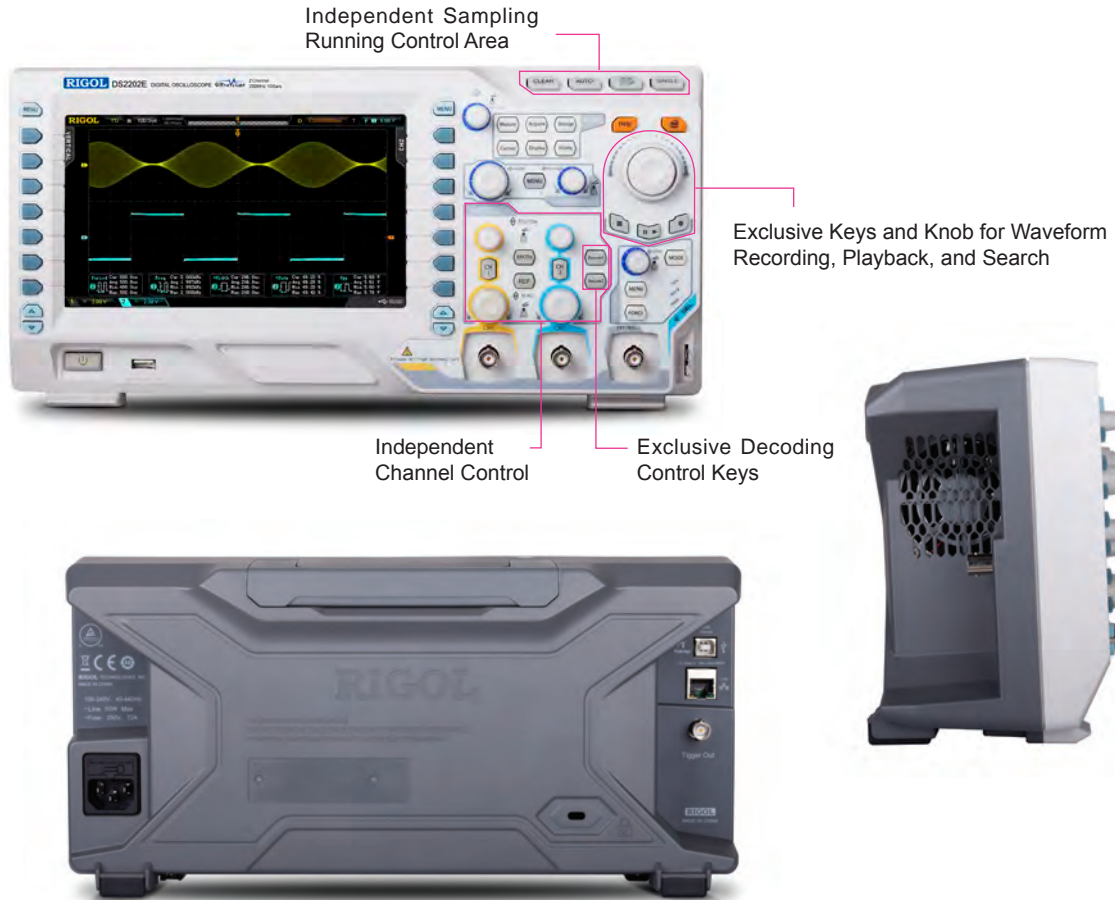# RIGOL
Innovation or nothing

# DS2000E Series
# Digital Oscilloscope

UltraVision

- 2 analog channels, 100 MHz/200 MHz bandwidth, 50 Ω input impedance (standard)
- Wide range, low noise floor, vertical sensitivity range: 500 µV/div ~ 10 V/div
- Real-time sample rate: up to 1 GSa/s per channel
- Memory depth: up to 28 Mpts per channel
- Waveform capture rate: 50,000 wfms/s (dots display)
- Real-time hardware waveform recording, playback, constant-on, analysis functions; up to 65,000 frames of waveforms can be recorded
- Unique UltraVision technology
- A variety of trigger and decoding functions (Parallel, RS232/UART, I2C, SPI, CAN, and LIN)
- A variety of interfaces: USB DEVICE, USB Host, LAN, and optional GPIB
- Novel and delicate industrial design and easy operation
- 8-inch WVGA (800×480), 256-level intensity grading display

Based on the UltraVision technology, DS2000E series is a type of digital oscilloscope with high performance. Its cost-effective features and high performance make it prominent among the digital oscilloscopes with the same level and price. It is equipped with extremely high memory depth, wide dynamic range, superb waveform capture rate, and comprehensive trigger functions. It also features hardware waveform recording function and good display effects. As a rare debugging instrument, it has been widely applied to various industries and fields, such as communications, aerospace, defense, embedded systems, computers, research, and education.

RIGOL TECHNOLOGIES, INC.

# DS2000E Series Digital Oscilloscope

Independent Sampling
Running Control Area

Exclusive Keys and Knob for Waveform
Recording, Playback, and Search

Independent
Channel Control

Exclusive Decoding
Control Keys

*Dimensions: W×H×D = 361.6 mm×179.6 mm×130.8 mm*
*Weight: 3.9 kg±0.2 kg (Package Excluded)*

## ▶ Unique UltraVision technology

- High memory depth (up to 28 Mpts for each channel)
- High waveform capture rate (up to 50,000 waveforms per second)
- Rea-time waveform recording, playback, and analysis functions (up to 65,000 frames)
- Multi-level intensity grading display (up to 256-level)

## ▶ Models and Specifications

| Model | DS2102E | DS2202E |
|---|---|---|
| Analog Bandwidth | 100 MHz | 200 MHz |
| No. of Analog Channels | 2 | |
| Max. Real-time Sample Rate | 1 GSa/s per channel | |
| Max. Memory Depth | 28 Mpts per channel | |
| Max. Waveform Capture Rate | 50,000 wfms/s | |
| Hardware Real-time and Ceaseless Waveform Recording, Playback, and Analysis Functions | Up to 65,000 frames can be recorded. | |
| Standard Probe | All the models have a standard configuration of 2 sets of PVP2350 350 MHz passive high-impedance probes. | |

# ▶ Features and Benefits

### Wide range (500 µV/div~10 V/div), low noise floor, clearly capture the low-level signals
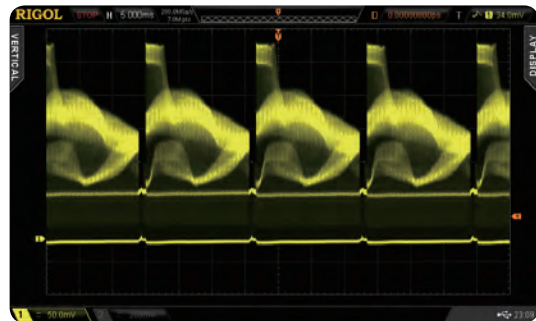


### UltraVision: waveform capture rate up to 50,000 wfms/s



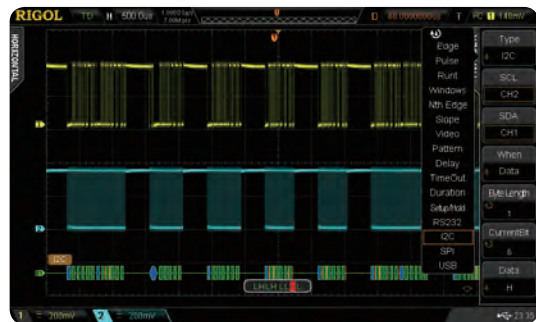### UltraVision: high memory depth up to 28 Mpts per channel
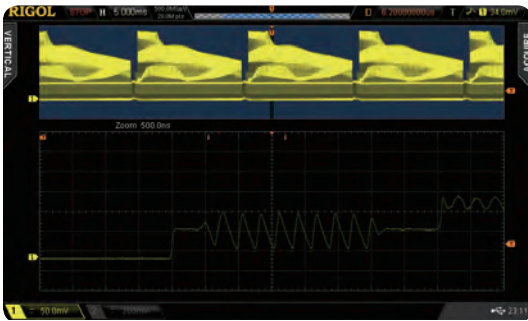


### UltraVision: multi-level intensity grading display (256-level)
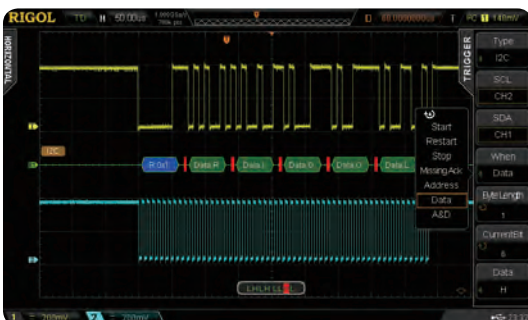


### UltraVision: real-time and ceaseless waveform recording, playback, and analysis functions



### Abundant advanced triggering functions (e.g. Runt Trigger, Setup/Hold Trigger, and Nth Edge Trigger)



### Serial bus trigger and decoding functions (supporting RS232/UART, I2C, SPI, CAN and LIN)

# RIGOL Probes and Accessories Supported by the DS2000E Series

## ▶ RIGOL Passive Probes

| Model | Type | Description |
|---|---|---|
| PVP2150 | High–impedance Probe | 1X: DC to 35 MHz<br>10X: DC to 150 MHz<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| PVP2350 | High–impedance Probe | 1X: DC to 35 MHz<br>10X: DC to 350 MHz<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP3500A | High–impedance Probe | DC to 500 MHz<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1300H | High–voltage Probe | DC to 300 MHz<br>CAT I 2000 V (DC+AC),<br>CAT II 1500 V (DC+AC)<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1010H | High–voltage Probe | DC to 40 MHz<br>DC: 0 to 10 kV DC,<br>AC: pulse ⩽ 20 kVpp,<br>AC: sine wave ⩽ 7 kVrms<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1018H | High–voltage Probe | DC to 150 MHz<br>DC+AC Peak: 18 kV CAT II<br>AC RMS: 12 kV CAT II<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |

## ▶ RIGOL Active & Current Probes

| Model | Type | Description |
|---|---|---|
| RP1001C | Current Probe | BW: DC to 300 kHz<br>Maximum Input<br>DC: ± 100 A,<br>AC P–P: 200 A,<br>AC RMS: 70 A<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1002C | Current Probe | BW: DC to 1 MHz<br>Maximum Input<br>DC: ± 70 A,<br>AC P–P: 140 A,<br>AC RMS: 50 A<br>Compatibility: All models of **RIGOL**L's digital oscilloscopes |
| RP1003C | Current Probe | BW: DC to 50 MHz<br>Maximum Input<br>AC P–P: 50 A (non–continuous),<br>AC RMS: 30 A<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes<br>Required to order RP1000P power supply. |
| RP1004C | Current Probe | BW: DC to 100 MHz<br>Maximum Input<br>AC P–P: 50 A (non–continuous),<br>AC RMS: 30 A<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes<br>Required to order RP1000P power supply. |
| RP1005C | Current Probe | BW: DC to 10 MHz<br>Maximum Input<br>AC P–P: 300 A (non–continuous), 500 A (@pulse width ⩽ 30 us),<br>AC RMS: 150 A<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes<br>Required to order RP1000P power supply. |
| RP1000P | Power Supply | Power supply for RP1003C, RP1004C and RP1005C, supporting 4 channels. |
| RP1025D | High–voltage Differential Probe | BW: 25 MHz<br>Max. voltage ⩽ 1400 Vpp<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1050D | High–voltage Differential Probe | BW: 50 MHz<br>Max. voltage ⩽ 7000 Vpp<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |
| RP1100D | High–voltage Differential Probe | BW: 100 MHz<br>Max. voltage ⩽ 7000 Vpp<br>Compatibility: All models of **RIGOL**'s digital oscilloscopes |

## ► Specifications

All the specifications are guaranteed except the parameters marked with "Typical" and the oscilloscope needs to operate for more than 30 minutes under the specified operation temperature.

### Sample

| | |
|---|---|
| Sample Mode | Real-time Sampling |
| Real-time Sample Rate | 1 GSa/s per channel |
| Peak Detection | 500 ps |
| Averaging | After all the channels have reached N times of sampling at the same time, N can be 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, or 8192. |
| High Resolution | 12-bit resolution when ≥5 µs/div @ 1 GSa/s |
| Memory Depth | Auto, 7 kpts, 70 kpts, 700 kpts, 7 Mpts, and 28 Mpts |

### Input

| | |
|---|---|
| Number of Channels | 2 analog channels |
| Input Coupling | DC, AC or GND |
| Input Impedance | (1 MΩ±1%)‖(16 pF±3 pF) or 50 Ω±1.5% |
| Probe Attenuation Coefficient | 0.01X-1000X, at 1-2-5 step |
| Maximum Input Voltage (1 MΩ) | CAT I 300 Vrms, CAT II 100 Vrms, Transient Overvoltage 1000 Vpk |

### Horizontal

| | |
|---|---|
| Timebase Scale | DS2102E: 5.000 ns/div to 1.000 ks/div<br>DS2202E: 2.000 ns/div to 1.000 ks/div |
| Channel to Channel Skew | 1 ns (typical), 2 ns (maximum) |
| Max. Record Length | 28 Mpts per channel |
| Timebase Accuracy[1] | ≤±25 ppm |
| Clock Drift | ≤±5 ppm/year |
| Max. Delay Range | Negative Delay: ≥1 screen width<br>Positive Delay: 1 s to 100 ks |
| Timebase Mode | Y-T, X-Y, Roll |
| Number of X-Ys | 1 path |
| Waveform Capture Rate[2] | 50,000 wfms/s (dots display) |

## Vertical

| | |
|---|---|
| Bandwidth (-3 dB) (50 Ω) | DS2102E: DC to 100 MHz<br>DS2202E: DC to 200 MHz |
| Single-shot Bandwidth (50 Ω) | DS2102E: DC to 100 MHz<br>DS2202E: DC to 200 MHz |
| Vertical Resolution | 8 bit |
| Vertical Scale[3] | When the input impedance is 50 Ω: 500 µV/div to 1 V/div<br>When the input impedance is 1 MΩ: 500 µV/div to 10 V/div |
| Offset Range | When the input impedance is 50 Ω:<br>500 µV/div to 50 mV/div: ±2 V<br>51 mV/div to 200 mV/div: ±10 V<br>205 mV/div to 1 V/div: ±12 V<br>When the input impedance is 1 MΩ:<br>500 µV /div to 50 mV/div: ±2 V<br>51 mV/div to 200 mV/div: ±10 V<br>205 mV/div to 2 V/div: ±50 V<br>2.05 V/div to 10 V/div: ±100 V |
| Bandwidth Limit[1] | DS2102E: 20 MHz<br>DS2202E: 20 MHz/100 MHz |
| Low Frequency Response (AC Coupling, -3 dB) | ≤5 Hz (on BNC) |
| Calculated Rise Time[1] | DS2102E: 3.5 ns<br>DS2202E: 1.8 ns |
| DC Gain Accuracy[3] | ±2% of full scale |
| DC Offset Accuracy | ±0.1 div±2 mV±1% of offset value |
| Channel to Channel Isolation | DC to maximum bandwidth: >40 dB |

## Trigger

| | | |
|---|---|---|
| Trigger Level Range | Internal: | ± 5 div from the center of the screen |
| | EXT | ±4 V |
| Trigger Mode | Auto, Normal, Single | |
| Holdoff Range | 100 ns to 10 s | |
| High Frequency Rejection[1] | 75 kHz | |
| Low Frequency Rejection[1] | 75 kHz | |
| Trigger Sensitivity | 1 div (below 10 mV or noise rejection enabled)<br>0.3 div (above 10 mV and noise rejection disabled) | |
| **Edge Trigger** | | |
| Edge Type | Rising, Falling, Rising/Falling | |
| **Pulse Trigger** | | |
| Pulse Condition | Positive Pulse Width (greater than, smaller than, within a specific range)<br>Negative Pulse Width (greater than, smaller than, within a specific range) | |
| Pulse Width | 2 ns to 4 s | |
| **Runt Trigger** | | |
| Pulse Condition | None, >, <, <> | |
| Pulse Polarity | Positive, Negative | |
| Pulse Width Range | 2 ns to 4 s | |
| **Windows Trigger (Optional)** | | |
| Windows Type | Rising, Falling, Rising/Falling | |
| Trigger Position | Enter, Exit, Time | |
| Windows Time | 16 ns to 4 s | |
| **Nth Edge Trigger (Optional)** | | |

| Edge Type | Rising, Falling |
|---|---|
| Idle Time | 16 ns to 4 s |
| Number of Edges | 1 to 65535 |
| **Slope Trigger** | |
| Slope Condition | Positive Slope (greater than, smaller than, within a specific range)<br>Negative Slope (greater than, smaller than, within a specific range) |
| Time Setting | 10 ns to 1 s |
| **Video Trigger** | |
| Polarity | Positive, Negative |
| Synchrony | All Lines, Line Num, Odd Field, Even Field |
| Standard | standard: NTSC, PAL/SECAM, 480P, 576P<br>optional: 720P, 1080P, 1080I |
| **Pattern Trigger** | |
| Pattern Setting | H, L, X, Rising Edge, Falling Edge |
| **Delay Trigger (Optional)** | |
| Edge Type | Rising, Falling |
| Delay Type | >, <, <>, >< |
| Delay Time | 2 ns to 4 s |
| **TimeOut Trigger (Optional)** | |
| Edge Type | Rising, Falling, Rising/Falling |
| Timeout Time | 16 ns to 4 s |
| **Duration Trigger (Optional)** | |
| Pattern Setting | H, L, X |
| Trigger Criteria | >, <, <> |
| Duration Time | 2 ns to 4 s |
| **Setup/Hold Trigger** | |
| Edge Type | Rising, Falling |
| Data Type | H, L |
| Setup Time | 2 ns to 1 s |
| Hold Time | 2 ns to 1 s |
| **RS232 Trigger** | |
| Polarity | Normal, Invert |
| Trigger Condition | Start, Error, Check Error, Data |
| Baud | 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps, 1 Mbps, and User |
| Data Bits | 5 bit, 6 bit, 7 bit, 8 bit |
| **I2C Trigger** | |
| Trigger Condition | Start, Restart, Stop, Missing ACK, Address, Data, A&D |
| Address Bits | 7 bits, 8 bits, 10 bits |
| Address Range | 0 to 127, 0 to 255, 0 to 1023 |
| Byte Length | 1 to 5 |
| **SPI Trigger** | |
| Trigger Condition | Timeout |
| Timeout Value | 100 ns to 1 s |
| Data Bits | 4 bits to 32 bits |
| Data Setting | H, L, X |
| **CAN Trigger (Optional)** | |
| Signal Type | Rx, Tx, CAN_H, CAN_L, Differential |
| Trigger Condition | SOF, EOF, Frame Type, Frame Error |
| Baud | 10 kbps, 20 kbps, 33.3 kbps, 50 kbps, 62.5 kbps, 83.3 kbps, 100 kbps, 125 kbps, 250 kbps, 500 kbps, 800 kbps, 1 Mbps, User |

| | |
|---|---|
| Sample Point | 5% to 95% |
| Frame Type | Data, Remote, Error, Over Load |
| Error Type | Bit Fill, Answer Error, Check Error, Format Error, Random Error |
| **USB Trigger (Optional)** | |
| Baud | Low Speed, Full Speed |
| Trigger Condition | SOP, EOP, RC, Suspend, Exit Suspend |
| **LIN Trigger (Optional)** | |
| Version | 1.X, 2.X, Both |
| Trigger Condition | Sync, Identifier, Data, ID&Data, Wakeup, Sleep, Error |
| ID Range | 0 to 63 |
| Data Comparison | =, ≠, <, >, ≤, ≥ |
| Data Length | 1 to 8 |
| Data Level | H, L |
| Baud Rate | 19200 bps, 10417 bps, 9600 bps, 4800 bps, 2400 bps, 1200 bps, User |
| Error Type | Sync, Even-Odd, Checksum |

## Measure

| | | |
|---|---|---|
| Marker | Manual Mode | Voltage Deviation between Cursors ( △V)<br>Time Deviation between Cursors ( △T)<br>Reciprocal of △T (Hz) (1/ △T) |
| | Track Mode | Voltage and Time Values of the Waveform Point |
| | Auto Mode | Allows to display cursors during auto measurement |
| Auto Measurement | Maximum, Minimum, Peak-Peak Value, Top Value, Bottom Value, Amplitude, Average, Vrms-N, Vrms-1, Overshoot, Pre-shoot, Area, Period Area, Frequency, Period, Rise Time, Fall Time, Positive Pulse Width, Negative Pulse Width, Positive Duty Cycle, Negative Duty Cycle, Delay A↟→B↟, Delay A↟→B↟, Delay A↟→B↟, Delay A↟→B↟, Phase A↟→B↟, Phase A↟→B↟, Phase A↟→B↟, Phase A↟→B↟ | |
| Number of Measurements | Displays 5 measurements at the same time | |
| Measurement Range | Screen region or cursor region | |
| Measurement Statistics | Current, Average, Max, Min, Standard Deviation, Number of Measurements | |
| Frequency Counter | Hardware 6-bit frequency counter (channels are selectable) | |

## Math Operation

| | |
|---|---|
| Waveform Operation | A+B, A-B, A×B, A÷B, FFT, Digital Filter, Editable Advanced Operation, Logic Operation |
| FFT Window Function | Rectangle, Hanning, Blackman, Hamming |
| FFT Display | Split, Full screen |
| FFT Vertical Scale | Vrms, dB |
| Logic Operation | AND, OR, NOT, XOR |
| Math Function | Intg, Diff, Lg, Exp, Sqrt, Sine, Cosine, Tangent |
| Number of Buses for Decoding | 2 |
| Decoding Type | Parallel (standard), RS232/UART (optional), I2C (optional), SPI (optional), CAN (optional), LIN (optional) |

## Display

| | |
|---|---|
| Display Type | 8.0-inch (203 mm) TFT LCD |
| Display Resolution | 800 Horizontal ×RGB×480 Vertical Pixel |
| Display Color | 160,000 Color (TFT) |

| Persistence Time | Min, 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s, Infinite |
|---|---|
| Display Type | Dots, Vectors |
| Real-time Clock | Time and Date (adjustable for users) |

## I/O

| Standard Ports | USB Host (USB-GPIB supported), USB Device, LAN, Aux Output (TrigOut/PassFail) |
|---|---|
| Printer Compatibility | PictBridge |

## General Specifications

| Probe Compensation Output | |
|---|---|
| Output Voltage[1] | About 3 V, peak-peak |
| Frequency[1] | 1 kHz |
| **Power** | |
| Power Voltage | 100 V to 240 V, 45 Hz to 440 Hz |
| Power | Maximum 50 W |
| Fuse | 2 A, T degree, 250 V |
| **Environment** | |
| Temperature Range | Operating: 0℃ to +50℃ |
| | Non-operating: -40℃ to +70℃ |
| Cooling Method | Fan cooled |
| Humidity Range | 0℃ to +30℃ : ≤95%RH |
| | +30℃ to +40℃ : ≤75%RH |
| | +40℃ to +50℃ : ≤45%RH |
| Altitude | Operating: below 3,000 m |
| | Non-operating: below 15,000 m |
| **Physical Characteristics** | |
| Dimensions[4] | Width×Height×Depth = 361.6 mm×179.6 mm×130.8 mm |

| Weight[5] | Package Excluded | 3.9 kg±0.2 kg |
|---|---|---|
| | Package Included | 4.5 kg±0.5 kg |

| **Calibration Interval** | |
|---|---|
| The recommended calibration interval is one year. | |

**Regulatory Information**

| | Meets EMC Directive (2014/30/EU), meets or exceeds IEC 61326-1:2013/EN 61326-1:2013 Group 1 Class A requirement | |
|---|---|---|
| Electromagnetic compatibility | CISPR 11/EN 55011 | |
| | IEC 61000-4-2:2008/EN 61000-4-2 | ±4.0 kV (contact discharge), ±8.0 kV (air discharge) |
| | IEC 61000-4-3:2002/EN 61000-4-3 | 3 V/m (80 MHz to 1 GHz); 3 V/m (1.4 GHz to 2 GHz); 1 V/m (2.0 GHz to 2.7 GHz) |
| | IEC 61000-4-4:2004/EN 61000-4-4 | 1 kV power line |
| | IEC 61000-4-5:2001/EN 61000-4-5 | 0.5 kV (phase to neutral point voltage); 1 kV (phase to ground voltage); 1 kV (neutral to ground voltage) |
| | IEC 61000-4-6:2003/EN 61000-4-6 | 3 V, 0.15 to 80 MHz |
| | IEC 61000-4-11:2004/EN 61000-4-11 | Voltage drop: 0% UT during half cycle; 0% UT during 1 cycle; 70% UT during 25 cycles<br>Short supply interruption: 0% UT during 250 cycles |
| Safety | IEC 61010-1:2010 (Third Edition)/EN 61010-1:2010, UL 61010-1:2012 R4.16 and CAN/CSA-C22.2 NO. 61010-1-12+ GI1+ GI2 | |

Note[1]: Typical.
Note[2]: Maximum value. 10 ns, dots display, auto memory depth.
Note[3]: 500 μV/div is a magnification of 1 mV/div. When calculating the DC Gain Accuracy, the full scale should be considered as 8 mV (calculated based on 1 mV/div).
Note[4]: Supporting legs and handle folded, knob height included.
Note[5]: Standard configuration.

## ▶ Order Information

| | Description | Order No. |
|---|---|---|
| **Model** | DS2102E (100 MHz, 2 analog channels) | DS2102E |
| | DS2202E (200 MHz, 2 analog channels) | DS2202E |
| **Standard Accessories** | Power Cord conforming to the standard of the destination country | - |
| | USB Cable | CB-USBA-USBB-FF-150 |
| | 2 Passive Probes (BW: 350 MHz) | PVP2350 |
| | Quick Guide (hard copy) | - |
| **Optional Accessories** | Rack Mount Kit | RM-DS2000A |
| | Passive Probe (500 MHz) | RP3500A |
| | USB-GPIB Interface Converter | USB-GPIB |
| | A Portable Bag | BAG-G1 |
| **High Memory Depth Option** | 28 Mpts/CH memory (offering the official option for free) | MEM-DS2000A |
| **Advanced Trigger Option** | Windows Trigger, Nth Edge Trigger, Delay Trigger, TimeOut Trigger, Duration Trigger, USB Trigger | AT-DS2000A |
| **Decoding Options** | RS232/UART, I2C, SPI Decoding Kit | SD-DS2000A |
| | CAN/LIN Protocol Analysis Kit (Trigger + Decoding) | CAN-DS2000A |

Note: For all the accessories and options, please contact the local office of **RIGOL**.

## Warranty Period

Three years for the mainframe, excluding the probes and accessories.

**RIGOL**

Jun. 2017