



RIGOL

HDO4000 Series

Digital Oscilloscope

Data Sheet

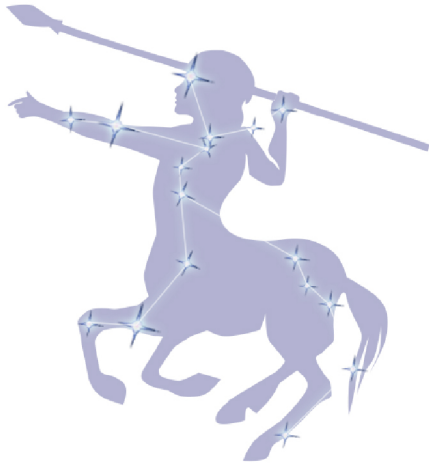
DSA33102-1110

Sep.2022



HDO4000 Series

Digital Oscilloscope

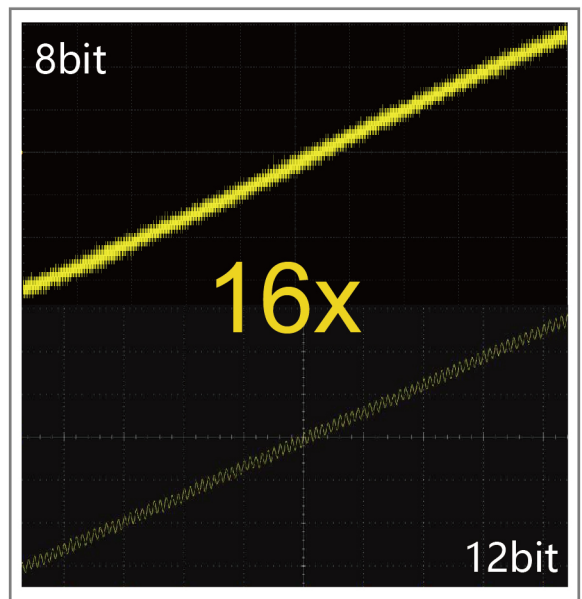


Adopting RIGOL's
Brand New
Self-developed
Chipset "Centaurus"



Highlights

- Ultra-low noise floor: 18 μVrms in minimum for cleaner signals, measuring small signals more accurately
- High resolution of 12 bits ($2^{12}=4096$) to see the most signal detail
- Up to 4 GSa/s real-time sample rate
- High sensitivity: 100 μV vertical scale, allowing capture of small signals in the microvolt (μV) range
- Wide vertical sensitivity range: 100 $\mu\text{V}/\text{div}$ to 10 V/div , capable of handling the smallest to the largest signals
- Front-panel Flex Knobs, bringing smoother interaction and easier measurements
- Optional battery pack in a highly portable package for you to enjoy unlimited freedom



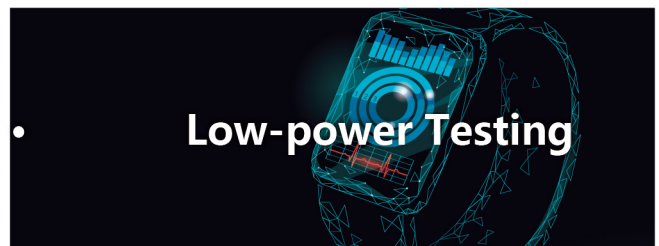
High Resolution

Digital Oscilloscopes, "See" the Most Signal Detail

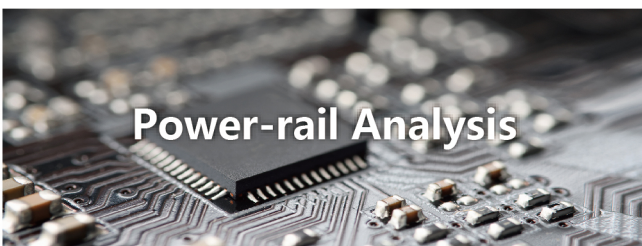
Applications



An oscilloscope is an important tool for making power supply measurements. With up to 12-bit vertical resolution, the HDO4000 series makes it easy for you to perform ripple measurement and quality test.



This series digital oscilloscope provides a minimum vertical scale of $100 \mu\text{V}/\text{div}$, $18 \mu\text{V}_{\text{rms}}$ low noise floor, together with 12-bit high resolution to capture low-power small signals effectively.



It sees intricate signal details by providing up to 4 GSa/s sample rate, 12-bit vertical resolution as well as higher DC gain accuracy.



The testing for the third generation of semiconductor materials represented by gallium nitride (GaN) usually has higher requirements for reduced quantization error of T&M equipment. The 12-bit high resolution and improved DC gain accuracy make it a perfect choice for semiconductor testing.

Product Features

Product Features

- Brand-new chipset "Centaurus" developed by RIGOL
- Ultra-low noise floor at 18 μ Vrms in minimum
- 12-bit vertical resolution^[1]
- 200/400/800 MHz analog bandwidth (selectable), 4 analog channels, and 1 EXT channel
- Up to 4 GSa/s real-time sample rate
- Max. memory depth: 500 Mpts (optional)
- Min. vertical sensitivity: 100 μ V/div
- Up to 1,500,000 wfms/s waveform capture rate with the UltraAcquire mode
- 10.1" 1280*800 HD touch display
- User-friendly Flex Knobs, bringing smoother interaction
- Standard photoelectric encoder operating knobs, effectively prolonging its service life
- Standard USB Device & Host, LAN, and HDMI interfaces
- Optional battery pack in a highly portable package for unlimited freedom
- Support online version upgrade






HDO4000 series digital oscilloscope is designed to meet the designing, debugging, and testing requirements of the mainstream oscilloscope market. Adopting the brand-new chipset "Centaurus" developed by RIGOL, this series achieves a fast waveform capture rate of 1,500,000 wfms/s with the UltraAcquire mode, 500 Mpts memory depth, 12-bit vertical resolution, all combined with excellent noise floor performance and vertical accuracy to meet your requirements for more accurate measurements, bringing extraordinary T&M experience for you.








NOTE:







[1]: 16 bits in High Resolution mode.

RIGOL Probes and Accessories Supported by the Series






RIGOL Passive Probes


| Model | Type | Description |
|--|----------------------|--|
| High-impedance Probe | | |
|  <p>PVP2150</p> | High-impedance Probe | <ul style="list-style-type: none"> Attenuation: 10:1/1:1 1X BW: DC~35 MHz 10X BW: DC~150 MHz Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>PVP2350</p> | High-impedance Probe | <ul style="list-style-type: none"> Attenuation: 10:1/1:1 1X BW: DC~35 MHz 10X BW: DC~350 MHz Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>PVP3150</p> | High-impedance Probe | <ul style="list-style-type: none"> Attenuation: 10:1/1:1 1X BW: DC~20 MHz 10X BW: DC~150 MHz Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>RP3500A</p> | High-impedance Probe | <ul style="list-style-type: none"> Attenuation: 10:1 BW: DC~500 MHz Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000/2000/1000, and DS70000 series |
| High Voltage Single-ended Probe | | |
|  <p>RP1010H</p> | High Voltage Probe | <ul style="list-style-type: none"> Attenuation: 1000:1 BW: DC~40 MHz DC: 0~10 kV DC AC: pulse ≤ 20 kV_{p-p} AC: sine ≤ 7 kV_{rms} Compatibility: All models of RIGOL's digital oscilloscopes |

| Model | Type | Description |
|--|---------------------------------|---|
|  <p>RP1018H</p> | High Voltage Probe | <ul style="list-style-type: none"> • Attenuation: 1000:1 • BW: DC~150 MHz • DC+AC_{Peak}: 18 kV CAT II • AC_{rms}: 12 kV CAT II • Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>RP1300H</p> | High Voltage Single-ended Probe | <ul style="list-style-type: none"> • Attenuation: 1000:1 • BW: DC~300 MHz • CAT I 2000 V (DC+AC) • CAT II 1500 V (DC+AC) • Compatibility: All models of RIGOL's digital oscilloscopes |
| High Voltage Differential Probe | | |
|  <p>PHA0150</p> | High Voltage Differential Probe | <ul style="list-style-type: none"> • BW: DC~70 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>PHA1150</p> | High Voltage Differential Probe | <ul style="list-style-type: none"> • BW: DC~100 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>PHA2150</p> | High Voltage Differential Probe | <ul style="list-style-type: none"> • 50X BW: DC~160 MHz • 500X BW: DC~200 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>RP1025D</p> | High Voltage Differential Probe | <ul style="list-style-type: none"> • BW: DC~25 MHz • Max. voltage ≤ 1400 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>RP1050D</p> | High Voltage Differential Probe | <ul style="list-style-type: none"> • BW: DC~50 MHz • Max. voltage ≤ 7000 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes |

| Model | Type | Description |
|--|---------------------------------|--|
|  RP1100D | High Voltage Differential Probe | <ul style="list-style-type: none"> BW: DC~100 MHz Max. voltage ≤ 7000 Vpp (DC + AC P-P) Compatibility: All models of RIGOL's digital oscilloscopes |
| Low Voltage Differential Probe | | |
|  RP7080 | Low Voltage Differential Probe | <ul style="list-style-type: none"> Input Range: ± 6.25 V BW: DC~800 MHz 30 V peak CAT I Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  RP7150 | Low Voltage Differential Probe | <ul style="list-style-type: none"> Input Range: ± 6.25 V BW: DC~1.5 GHz 30 V peak CAT I Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  PVA7250 | Low Voltage Differential Probe | <ul style="list-style-type: none"> Input Range: ± 2 V BW: DC~2.5 GHz 30 V peak CAT I Compatibility: MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
| Low Voltage Single-ended Probe | | |
|  RP7080S | Single-ended Active Probe | <ul style="list-style-type: none"> Input Range: ± 6.25 V BW: DC~800 MHz 30 V peak CAT I Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  RP7150S | Single-ended Active Probe | <ul style="list-style-type: none"> Input Range: ± 6.25 V BW: DC~1.5 GHz 30 V peak CAT I Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |

| Model | Type | Description |
|--|---------------|---|
| Current Probe | | |
|  PCA1030 | Current Probe | <ul style="list-style-type: none"> • BW: DC~50 MHz (-3 dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  PCA1150 | Current Probe | <ul style="list-style-type: none"> • BW: DC~10 MHz (-3 dB) • Max. continuous input range: 150 A • Max. peak-peak current value: 300 A (non-continuous), 500 A (pulse width ≤ 30 μs) • Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  PCA2030 | Current Probe | <ul style="list-style-type: none"> • BW: DC~100 MHz (-3 dB) • Max. continuous input range: 30 A_{rms} • Max. peak-peak current value: 50 A peak, non-continuous • Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  PCA1500 | Current Probe | <ul style="list-style-type: none"> • BW: DC~2 MHz (-3 dB) • Max. continuous input range: 500 A_{rms} • Max. peak-peak current value: 700 A peak, non-continuous • Compatibility: MSO/DS4000, DS6000, MSO/DS7000, MSO8000, HDO4000, and DS70000 series |
|  RP1001C | Current Probe | <ul style="list-style-type: none"> • BW: DC~300 kHz • Maximum Input AC: ±100 A AC P-P: 200 A AC RMS: 70 A • Compatibility: All models of RIGOL's digital oscilloscopes |

| Model | Type | Description |
|--|---------------|--|
|  <p>RP1002C</p> | Current Probe | <ul style="list-style-type: none"> BW: DC~1 MHz Maximum Input AC: ± 70 A AC P-P: 140 A AC RMS: 50 A Compatibility: All models of RIGOL's digital oscilloscopes |
|  <p>RP1003C</p> | Current Probe | <ul style="list-style-type: none"> BW: DC~50 MHz Maximum Input AC P-P: 50 A (non-continuous) AC RMS: 30 A Compatibility: All models of RIGOL's digital oscilloscopes Required to order RP1000P power supply. |
|  <p>RP1004C</p> | Current Probe | <ul style="list-style-type: none"> BW: DC~100 MHz Maximum Input AC P-P: 50 A (non-continuous) AC RMS: 30 A Compatibility: All models of RIGOL's digital oscilloscopes Required to order RP1000P power supply. |
|  <p>RP1005C</p> | Current Probe | <ul style="list-style-type: none"> BW: DC~10 MHz Maximum Input AC P-P: 300 A (non-continuous), 500 A (@pulse width ≤ 30 us) AC RMS: 150 A Compatibility: All models of RIGOL's digital oscilloscopes Required to order RP1000P power supply. |
|  <p>RP1006C</p> | Current Probe | <ul style="list-style-type: none"> BW: DC~2 MHz Maximum Input AC P-P: 700 A peaks, non-continuous AC RMS: 500 A Compatibility: All models of RIGOL's digital oscilloscopes Required to order RP1000P power supply. |

| Model | Type | Description |
|--|------------------|---|
|  <p>RP1000P</p> | 4CH Power Supply | Four-channel power adapter for RP1003C, RP1004C, RP1005C, and RP1006C Current Probes. |

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.

Overview of the HDO4000 Series Technical Specifications

| Overview of the HDO4000 Series Technical Specifications | | | |
|--|---|---------------|---------------|
| Model | HDO4204 | HDO4404 | HDO4804 |
| Analog Bandwidth (50 Ω , -3 dB) | 200 MHz | 400 MHz | 800 MHz |
| Analog Bandwidth (1 M Ω , -3 dB) | 200 MHz | 400 MHz | 500 MHz |
| Calculated Rise Time under 50 Ω (10% to 90%, typical) | ≤ 1.75 ns | ≤ 875 ps | ≤ 500 ps |
| Input Channels | 4 analog channel inputs, 1 EXT channel input | | |
| Sampling Mode | Real-time sampling | | |
| Max. Sample Rate of Analog Channels | 4 GSa/s (single channel ^[1]), 2 GSa/s (half channels ^[2]), 1 GSa/s (all channels ^[3]) Note: The sample rate reaches 1 GSa/s when all channels are enabled. For HDO4804 series, the maximum analog bandwidth is only 400 MHz. | | |
| Max. Memory Depth | Standard: 250 Mpts (single channel ^[1]), 125 Mpts (half channels ^[2]), 62.5 Mpts (all channels ^[3]) Optional: 500 Mpts (single channel ^[1]), 250 Mpts (half channels ^[2]), 125 Mpts (all channels ^[3]) | | |
| Max. Waveform Capture Rate | 50,000 wfms/s (Vector Mode) 1,500,000 wfms/s (UltraAcquire Mode) | | |
| Vertical Resolution | 12 bit | | |
| Hardware Real-time Waveform Recording and Playing | Up to 500,000 frames | | |
| Peak Detect | Capture glitches as narrow as 500 ps | | |
| Display Size and Type | 10.1-inch capacitive multi-touch display | | |

Overview of the HDO4000 Series Technical Specifications

Display Resolution 1280×800

Vertical System Analog Channels

Vertical System Analog Channels

| | | |
|---|---|--|
| Input Coupling | DC, AC, or GND | |
| Input Impedance | 1 MΩ ± 1%, 50 Ω ± 1% | |
| Input Capacitance | 19 pF ± 3 pF | |
| Probe Attenuation Ratio | 0.001X, 0.002X, 0.005X, 0.01X, 0.02X, 0.05X, 0.1X, 0.2X, 0.5X, 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, 500X, 1000X, 2000X, 5000X | |
| Probe Recognition | Auto-recognized RIGOL probe | |
| Maximum Input Voltage | 1 MΩ | CAT I 300 V _{rms} , 400 V _{pk} (DC + V _{peak}) |
| | 50 Ω | 5 V _{rms} |
| | Remarks | No transient overvoltage allowed for 50 Ω or 1 MΩ routes whether the probe is used or not. Use this instrument only for measurements within its specified measurement category (not rated for CAT II, III, IV). |
| Vertical Resolution | 12 bits | |
| Effective Number of Bits (ENOB, Typical)) | > 8 | |
| Input Sensitivity Range ^[4] | 1 MΩ | 100 μV/div to 10 V/div |
| | 50 Ω | 100 μV/div to 1 V/div |
| Offset Range | | ± 0.5 V (<500 μV/div) |
| | | ± 1 V (≥500 μV/div, ≤65 mV/div) |
| | 1 MΩ | ± 10 V (>65 mV/div, ≤270 mV/div) |
| | | ± 20 V (>270 mV/div, ≤2.75 V/div) |
| | 50 Ω | ± 100 V (>2.75 V/div, ≤10 V/div) |
| | | ± 1 V (≤135 mV/div) |
| | | ± 4 V (>135 mV/div) |

Vertical System Analog Channels

| | |
|--|--|
| Dynamic Range | ±4 div (12 bits) |
| Bandwidth Limits (Typical) | 20 MHz, 250 MHz, FULL; selectable for each channel |
| DC Vertical Gain Accuracy ^[4] | ± 2% full scale |
| DC Vertical Offset Accuracy | ≤200 mV/div (± 0.1 div ± 2 mV ± 1.5% of offset setting) >200 mV/div (± 0.1 div ± 2 mV ± 1.0% of offset setting) |
| Channel-to-channel Isolation | ≥ 100:1 (from DC to 500 MHz), ≥30:1 (> 500 MHz to full bandwidth) |
| ESD Tolerance | ±8 kV (for input BNC) |

Horizontal System Analog Channels

Horizontal System Analog Channels

| | |
|---|---|
| Time Base Range | 500 ps/div to 1 ks/div Time base fine adjustment setting available |
| Time Base Resolution | 100 ps |
| Time Base Accuracy | ±1.5 ppm ± 1 ppm/year |
| Time-base Delay Time Range | Pre-trigger -5 div Post-trigger 1 s or 100 div, whichever is greater |
| Δ Time Accuracy | ± (time base accuracy x reading) ± (0.001 x screen width) ± 20 ps |
| Channel-to-channel Deskew | Channel-to-channel deskew range: ±100 ns, accuracy: ±1 ps |
| Analog Channel-to-Channel Delay (Typical) | ≤500 ps ^[5] |

Horizontal System Analog Channels

| | | |
|-----------------|------|--|
| | YT | Default mode |
| | XY | On channel 1/2/3/4 |
| Horizontal Mode | SCAN | Time base \geq 200 ms/div |
| | ROLL | Time base \geq 50 ms/div or \geq 100 ms/div (selectable), available to enter or exit the ROLL mode by turning the horizontal timebase knob |

Acquisition System

Acquisition System

| | | |
|--------------------------------------|---|--|
| Max. Sample Rate of Analog Channels | 4 GSa/s (single channel ^[1]), 2 GSa/s (half channels ^[2]), 1 GSa/s (all channels ^[3]) | |
| Max. Memory Depth of Analog Channels | Standard: 250 Mpts (single channel ^[1]), 125 Mpts (half channels ^[2]), 62.5 Mpts (all channels ^[3]) Optional: 500 Mpts (single channel ^[1]), 250 Mpts (half channels ^[2]), 125 Mpts (all channels ^[3]) | |
| | Normal | Default mode |
| | Peak Detect | Capture glitches as narrow as 500 ps |
| Acquisition Mode | Average | Selectable from 2, 4, 8, 16...to 65,536 |
| | High Resolution | 14 bits, 16 bits |
| | UltraAcquire | Up to 1,500,000 wfms/s waveform capture rate |

Trigger System

Trigger System

| | |
|-----------------|---|
| Trigger Sources | Analog channel (1~4), EXT TRIG, AC Line |
| Trigger Mode | Auto, Normal, and Single |

Trigger System

| | | |
|-----------------------|--|---|
| Trigger Coupling | DC | DC coupled trigger |
| | AC | AC coupled trigger |
| | HF Reject | High frequency reject, cutoff frequency ~75 kHz (internal trigger only) |
| | LF Reject | Low frequency reject, cutoff frequency ~75 kHz (internal trigger only) |
| Noise Rejection | Increase delay for the trigger circuit (internal trigger only), on/off | |
| Trigger Holdoff Range | 8 ns to 10 s | |
| Trigger Bandwidth | Internal | Analog bandwidth |
| | External | 200 MHz |
| Trigger Sensitivity | Internal | 0.50 div, ≥ 50 mV/div 0.7 div (with noise rejection enabled) |
| | External | 200 mVpp, from DC to 100 MHz 500 mVpp, from 100 MHz to 200 MHz |
| EXT TRIG | Input Impedance | 1 M Ω \pm 1%, BNC connector |
| | Trigger Jitter (Typical) | < 1 ns _{rms} Normal acquisition, Edge trigger, trigger level located near 50% of EXT input signal |
| Trigger Level Range | Internal | ± 5 div from center screen |
| | External | ± 5 V |
| | AC Line | fixed 40%-60% |

Trigger Type

Trigger Type

| | |
|--------------|--|
| Trigger Type | Standard: Edge trigger, Pulse trigger, Slope trigger, Video trigger, Pattern trigger, Duration trigger, Timeout trigger, Runt trigger, Window trigger, Delay trigger, Setup/Hold trigger, Nth Edge trigger, I2C, SPI, RS232/UART, CAN Optional: CAN-FD, LIN, FlexRay, I2S, MIL-STD-1553 |
|--------------|--|

Trigger Type

| | |
|-------------|--|
| Edge | <p>Triggers on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either.</p> <p>Source channel: CH1~CH4, EXT, or AC Line</p> |
| Pulse Width | <p>Triggers on the positive or negative pulse, whose time duration is less than a value, greater than a value, or inside a time range.</p> <p>Source channel: CH1~CH4</p> |
| Slope | <p>Triggers on the positive or negative slope of the specified time, whose time is less than a value, greater than a value, or inside a time range.</p> <p>Source channel: CH1~CH4</p> |
| Video | <p>Trigger on all lines, specified line, odd/even fields that conform to the video standards. The supported video standards include NTSC, PAL/SECAM, 480p/60Hz, 576p/50Hz, 720p/60Hz, 720p/50Hz, 720p/30Hz, 720p/25Hz, 720p/24Hz, 1080p/60Hz, 1080p/50Hz, 1080p/25Hz, 1080p/24Hz, 1080i/60Hz, and 1080i/50Hz.</p> <p>Source channel: CH1~CH4</p> |
| Pattern | <p>Identifies a trigger condition by searching for a specified pattern. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X, Rising, or Falling.</p> <p>Source channel: CH1~CH4</p> |
| Duration | <p>Triggers when the specified pattern meets the specified duration condition. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, and X. The duration is less than a value, greater than a value, inside a time range, or outside a time range.</p> <p>Source channel: CH1~CH4</p> |
| Timeout | <p>Triggers when duration of a certain event exceeds the specified time. The event can be specified as Rising, Falling, or Either.</p> <p>Source channel: CH1~CH4</p> |
| Runt | <p>Triggers when the pulses pass through one threshold but fail to pass through another threshold.</p> <p>Source channel: CH1~CH4</p> |
| Window | <p>Triggers in a specified window state when the rising edge of the signal crosses the upper threshold or the falling edge crosses the lower threshold. The window state can be Enter, Exit, or Time.</p> <p>Source channel: CH1~CH4</p> |
| Delay | <p>Triggers when the time difference between the specified edges of Source A and Source B meets the preset time. The delay time is less than a value, greater than a value, inside a time range, or outside a time range.</p> <p>Source channel: CH1~CH4</p> |

Trigger Type

| | |
|--------------------|--|
| Setup/Hold | When the setup time or hold time between the input clock signal and the data signal is smaller than the specified time. Source channel: CH1~CH4 |
| Nth Edge | Triggers on the Nth edge after the specified idle time. The edge can be specified as Rising or Falling. Source channel: CH1~CH4 |
| RS232/UART | Triggers on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s). Source channel: CH1~CH4 |
| I2C | Triggers on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus. Source channel: CH1~CH4 |
| SPI | Triggers on the specified pattern of the specified data width (4 to 32) of SPI bus. CS and Timeout are supported. Source channel: CH1~CH4 |
| CAN | Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Bit Fill, Answer Error, Check Error, Format Error, and Random of the CAN signal (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4 |
| CAN-FD (Optional) | HDO4000-AUTOA option Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Bit Fill, Answer Error, Check Error, Format Error, and Random of the CAN-FD signal (up to 10 Mb/s). The supported CAN-FD bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4 |
| FlexRay (Optional) | HDO4000-FLEXA option Triggers on the specified position (TSS End, FSS_BSS End, FES End, DTS End), frame (null, Syn, Start, All), symbol (CAS/MTS and WUS), error (Head CRC Err, Tail CRC Err, Decode Err, and Random Err) of the FlexRay signal (up to 10 Mb/s). Source channel: CH1~CH4 |
| LIN (Optional) | HDO4000-AUTOA option Triggers on the Sync, ID, Data (length settable), Data&ID, Wakeup, Sleep, and Error of the LIN bus signal (up to 20 Mb/s). Source channel: CH1~CH4 |

Trigger Type

| | |
|-------------------------|---|
| I2S (Optional) | HDO4000-AUDIOA option Triggers on 2' s complement data of audio left channel, right channel, or either channel (=, ≠, >, <, <>, ><). The available alignment modes include I2S, LJ, and RJ. Source channel: CH1~CH4 |
| MIL-STD-1553 (Optional) | HDO4000-AEROA option Triggers on Sync (Data Sync, Cmd/Status Sync, and All Sync), Data, RTA, RTA +11Bit, and Error (Sync Error and Check Error) of the MIL-STD-1553 bus. Source channel: CH1~CH4 |

Search & Navigate

Search & Navigate

| | |
|----------------|---|
| Type | Edge, pulse width |
| Source | Analog channels |
| Copy | Copy to/from trigger; independent settings including threshold and trigger condition setup |
| Result Display | Event lister or be exported to external/internal memory |
| Navigate | Time: view acquired waveforms in time order |
| | Event: use the navigation controls to go to found search events |
| | Segment: use the navigation controls to play through the acquired segments in UltraAcquire mode |

Waveform Measurement

Waveform Measurement

| | | |
|--------|-------------------|---|
| | Number of Cursors | 2 pairs of XY cursors |
| | Manual Mode | Voltage deviation between cursors (ΔY) Time deviation between cursors (ΔX) Reciprocal of ΔX (Hz) ($1/\Delta X$) |
| Cursor | Track Mode | Fix Y-axis to track X-axis waveform point's voltage and time values Fix X-axis to track Y-axis waveform point's voltage and time values |
| | Auto Measurement | Allow to display cursors during auto measurement |
| | XY Mode | Measures the voltage parameters of the corresponding channel waveforms in XY time base mode X = Channel 1, Y = Channel 2 |

Waveform Measurement

| | | |
|------------------|------------------------|--|
| | Number of Measurements | 41 auto measurements; and up to 14 measurements can be displayed at a time. |
| | Measurement Source | CH1 to CH4, Math1 to Math4 |
| | Measurement Range | Main, Zoom |
| | All Measurements | Displays 33 measurement items (vertical and horizontal) for the current measurement channel; the measurement results are updated continuously. |
| Auto Measurement | Vertical | Vmax, Vmin, Vpp, Vtop, Vbase, Vamp, Vupper, Vmid, Vlower, Vavg, VRMS, Per. VRMS, Overshoot, Preshoot, Area, Period Area, and AC RMS. |
| | Horizontal | Period, Frequency, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Tvmax, Tvmin, +Slew Rate, and -Slew Rate |
| | Others | Delay (A↑-B↑), Delay (A↑-B↓), Delay (A↓-B↑), Delay (A↓-B↓), Phase (A↑-B↑), Phase (A↑-B↓), Phase (A↓-B↑), and Phase (A↓-B↓) |
| | Statistics | Items: Current, Average, Max, Min, Standard Deviation, Count Statistical times settable |

Waveform Math

Waveform Math

| | | |
|--|--------------------------|---|
| | Number of Math Functions | 4, displays 4 math functions simultaneously |
| | Arithmetic | A+B, A-B, A×B, A/B, FFT, A&&B, A B, A^B, !A, Intg, Diff, Lg, Ln, Exp, Sqrt, Abs, AX+B, LowPass, HighPass, BandPass, and BandStop |
| | Color Grade | FFT supported |

Waveform Math

| | | |
|-----|-------------|--|
| | Record Size | Up to 1 Mpts |
| FFT | Window Type | Rectangular, Blackman-Harris, Hanning (default), Hamming, Flattop, and Triangle |
| | Peak Search | A maximum of 15 peaks, confirmed by the settable threshold and offset threshold set by users |

Waveform Analysis

Waveform Analysis

| | | |
|--------------------|-------------|---|
| | | Store the signal under test in segments according to the trigger events, i.g. save all the sampled waveform data as a segment to the RAM for each trigger event. The maximum number of the sampled segments reaches 500,000. |
| Waveform Recording | Source | All enabled analog channels |
| | Analysis | Support playing frame by frame or continuous playing; capable of calculating, measuring, and decoding the played waveforms |
| Pass/Fail Test | | Compare the signal under test with the user-defined mask to provide the test results: the number of successful tests, failed tests, and the total number of tests. The pass/fail event can enable immediate stop, beeper, and the screenshot. |
| | Source | Any analog channel |
| Color Grade | | A dimensional view for color grade waveforms, color grade > 16, 256-level color scale display |
| | Source | Any analog channel |
| | Color Theme | Temperature and intensity |
| | Mode | All modes available |

Serial Decoding

Serial Decoding

| | |
|------------------|--|
| No. of Decodings | 4, decodes and enables/disables four protocol types simultaneously |
|------------------|--|

Serial Decoding

| | |
|--------------------|--|
| Decoding Type | Standard: Parallel, RS232/UART, I2C, SPI, CAN Optional: LIN, CAN-FD, FlexRay, I2S, MIL-STD-1553 |
| Parallel | Up to 4 bits of Parallel decoding, available for any analog channel User-defined clock and auto clock settings are supported. Source channel: CH1~CH4 |
| RS232/UART | Decodes the RS232/UART (up to 20 Mb/s) bus's TX/RX data (5 to 9 bits), parity (Odd, Even, or None), and stop bits (1 to 2 bits) Source channel: CH1~CH4 |
| I2C | Decodes the address (with or without the R/W bit) of the I2C bus, data, and ACK. Source channel: CH1~CH4 |
| SPI | Decodes the MISO/MOSI data (4 to 32 bits) of the SPI bus. Timeout and CS are supported. Source channel: CH1~CH4 |
| CAN | Decodes the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN bus (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4 |
| CAN-FD (Optional) | HDO4000-AUTOA option Decodes the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN-FD bus (up to 10 Mb/s). The supported CAN-FD bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4 |
| LIN (Optional) | HDO4000-AUTOA option Decodes the protocol version (1.X or 2.X) of the LIN bus (up to 20 Mb/s). The decoding displays sync, ID, data, and check sum. Source channel: CH1~CH4 |
| FlexRay (Optional) | HDO4000-FLEXA option Decodes the frame ID, PL (payload), Header CRC, Cycle Count, Data, Tail CRC, and DTS of the FlexRay bus (up to 10 Mb/s). The supported signal types include BP, BM, and RX/TX. Source channel: CH1~CH4 |

Serial Decoding

| | |
|-------------------------|--|
| | HDO4000-AUDIOA option |
| I2S (Optional) | Decodes I2S audio bus left channel data and right channel data, supporting 4 to 32 bits. The available alignment modes include I2S, LJ, and RJ. Source channel: CH1~CH4 |
| | HDO4000-AEROA option |
| MIL-STD-1553 (Optional) | Decodes the MIL-STD-1553 bus signal's data word, command word, and status word (address+last 11 bits). Source channel: CH1~CH4 |

Auto

Auto

| | |
|-----------|--|
| AutoScale | Minimum voltage greater than 10 mVpp, duty cycle greater than 1%, and frequency over 35 Hz |
|-----------|--|

Digital Voltmeter

Digital Voltmeter

| | |
|---------------|--|
| Source | Any analog channel |
| Function | DC, AC+DC _{rms} , AC _{rms} |
| Resolution | ACV/DCV: 4 bits |
| Limits Beeper | Support Upper/lower limit settings; sounds an alarm when the voltage value is inside or outside of the limit range |

Precision Counter

Precision Counter

| | | |
|-------------|---------------------------------------|--|
| Source | Any analog channel and EXT | |
| Measurement | Frequency, period, totalize | |
| Totalizer | Resolution | 3 to 6 digits, user-defined |
| | Max. Frequency | Maximum analog bandwidth or 500 MHz (the smaller of the two) |
| Totalizer | 48-bit totalizer | |
| | Counts the number of the rising edges | |

Precision Counter

| | |
|----------------|--------------------|
| Time Reference | Internal Reference |
|----------------|--------------------|

Command Set

Command Set

| | |
|---------------------------------|------------------------|
| Common Commands Support | Standard SCPI commands |
| Error Message Definition | Error Message |
| Support Status Report Mechanism | Status Reporting |
| Support Sync Mechanism | Synchronization |

Display

Display

| | |
|-------------|--|
| LCD | 10.1-inch capacitive multi-touch gesture-enabled display |
| Resolution | 1280×800 (Screen Region) 16:9 |
| Graticule | 10 vertical divisions x 8 horizontal divisions |
| Persistence | Off, Infinite, variable persistence (100 ms to 10 s) |
| Brightness | 256 intensity levels (LCD, HDMI) |

Processor System

Processor System

| | |
|------------------------------|--------------------------------|
| Processor | Cortex-A72, 1.8 GHz, hexa-core |
| System Memory | 4 GB RAM |
| Operating System | Android |
| Internal Non-volatile Memory | 8 GB |

I/O

I/O

| | |
|---------------|---|
| USB3.0 Host | 2 on the front panel |
| USB3.0 Device | 1 on the rear panel |
| LAN Port | 1 on the rear panel, 10/100/1000 Base-T, supporting LXI-C |

I/O

| | | |
|---------------------------|------------------|--|
| Web Control | | Support Web Control interface (input the IP address of the oscilloscope into the Web browser to display the operation interface of the oscilloscope) |
| | | BNC output on the rear panel |
| | | $V_o(H) \geq 2.5\text{ V}$ open circuit, $\geq 1.0\text{ V}$ $50\ \Omega$ to GND |
| | | $V_o(L) \leq 0.7\text{ V}$ to load $\leq 4\text{ mA}$; $\leq 0.25\text{ V}$ $50\ \Omega$ to GND |
| AUX Out | Trig Out | Output a pulse signal when the oscilloscope is triggered |
| | Pass/Fail | Output a pulse signal when a pass/fail event occurs. Support user-defined pulse polarity and pulse time (10 ns to 10 ms) |
| | Rise Time | $\leq 1.2\text{ ns}$ |
| | Input Interface | 1, BNC connector on the rear panel |
| 10 MHz Reference Clock | Output Interface | 1, BNC connector on the rear panel |
| In/Out | Input Mode | $50\ \Omega$, with the amplitude 130 mVpp to 4.1 Vpp (-10 dBm, 20 dBm), frequency $10\text{ MHz} \pm 10\text{ ppm}$ |
| | Output Mode | $50\ \Omega$, 1.5 Vpp sine waveform |
| HDMI Video Output | | 1 on the rear panel, HDMI 1.4, A plug; used to connect an external monitor or projector |
| Probe Compensation Output | | 1 kHz frequency, 0 to 3 V amplitude, Square |

Power

Power

| | |
|---------------|--|
| Power Voltage | AC 100 to 240 V, 50 to 60 Hz |
| Power | 400 VA maximum (connect various interfaces, USB storage device, and active probes) |
| Fuse | 3.15 A, T degree, 250 V |

Environment

| Environment | | |
|-------------------|---------------|--|
| Temperature Range | Operating | 0°C to +50°C |
| | Non-operating | -30°C to +60°C |
| Humidity Range | Operating | below +30°C: ≤90% RH (without condensation) |
| | | +30°C to +40°C, ≤75% RH (without condensation) |
| | Non-operating | +40°C to +50°C, ≤45% RH (without condensation) |
| | | below 60°C: ≤90% RH (without condensation) |
| Altitude | Operating | Below 3,000 m |
| | Non-operating | Below 15,000 m |

Warranty and Calibration Interval

| Warranty and Calibration Interval | |
|-----------------------------------|--|
| Warranty | Three years for the mainframe, excluding the probes and accessories. |
| Recommended Calibration Interval | 18 months |

Regulations

| Regulations | | |
|-----------------------------------|--|---|
| | Compliant with EMC DIRECTIVE 2014/30/EU, compliant with or higher than the standards specified in IEC 61326-1:2013/EN 61326-1:2013 Group 1 Class A | |
| | CISPR 11/EN 55011 | |
| Electromagnetic Compatibility | 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 voltage); 1 kV (phase-to-earth voltage); 1 kV (neutral-to-earth voltage) |
| | IEC 61000-4-6:2003/EN 61000-4-6 | 3 V, 0.15-80 MHz |
| | IEC 61000-4-11:2004/EN 61000-4-11 | Voltage dip: 0% UT during half cycle; 0% UT during 1 cycle ; 70% UT during 25 cycles short interruption: 0% UT during 250 cycles |
| | Safety | EN 61010-1:2019 |
| EN 61010-031:2015 | | |
| IEC 61010-1:2016 | | |
| IEC 61010-2-030:2017 | | |
| UL 61010-1:2012 R7 | | |
| UL 61010-2-31:2017 R2 | | |
| CAN/CSA-22.2 No. 61010-1-12:2017 | | |
| CAN/CSA-22.2 No. 61010-2-30:2018 | | |
| CAN/CSA-22.2 No. 61010-031-07:201 | | |
| Vibration | Meets GB/T 6587; class 2 random | |
| | Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random | |

Regulations

| | |
|-------|---|
| | Meets GB/T 6587-2012; class 2 random |
| Shock | Meets MIL-PRF-28800F and IEC 60068-2-27; class 3 random |
| | In non-operating conditions: 30 g, half-sine wave, 11 ms duration, 3 shocks along the main axis, total of 18 shocks |

Mechanical Characteristics

Mechanical Characteristics

| | |
|------------|---|
| Dimensions | 358.14 mm (W)×214.72 mm (H)×120.62 mm (D) |
|------------|---|

| | |
|----------------|----|
| Rack Mount Kit | 4U |
|----------------|----|

| | |
|-----------------------|-------------------|
| Weight ^[6] | Net: 3.8 kg |
| | Shipping: 5.37 kg |

Non-volatile Memory

Non-volatile Memory

| | | |
|--------------------|---------------|---|
| | Setup/Image | setup (*.stp), image (*.png, *.bmp, *.jpg) |
| Data/File Storage | Waveform Data | CSV waveform data (*.csv), binary waveform data (*.bin), list data (*.csv), and reference waveform data (*.ref, *.csv, *.bin) |
| Internal Capacity | | 8 GB |
| Reference Waveform | | Displays 10 internal waveforms |
| Setting | | Limited by size of USB drive |
| USB Capacity | | Industry standard flash drives |

NOTE:

[1]: If any one of the channels is enabled, it is called single channel mode.

[2]: If two of the channels are enabled, it is called half channels mode.

[3]: If any three channels or all four channels are enabled, it is called all channels mode.

[4]: 100 μ V/div, 200 μ V/div, and 500 μ V/div are a magnification of 1 mV/div setting. For vertical accuracy calculations, use full scale of 8 mV for sensitivity setting.

[5]: For any channel, under the same input impedance with DC-coupled, the Volts/div setting is the same for 100 mV/div and 200 mV/div setting.

[6]: Standard configuration.

Order Information and Warranty Period

Order Information

| Order Information | Order No. |
|--|----------------|
| Base Unit | |
| 200 MHz, 4 GSa/s, 250 Mpts, 4CH HDO | HDO4204 |
| 400 MHz, 4 GSa/s, 250 Mpts, 4CH HDO | HDO4404 |
| 800 MHz, 4 GSa/s, 250 Mpts, 4CH HDO | HDO4804 |
| Standard Accessories | |
| Power cord (based on destination country) | — — |
| USB Cable | — — |
| 4 Passive HighZ Probes (350 MHz), Standard for HDO4204 | PVP2350 |
| 4 Passive HighZ Probes (500 MHz), Standard for HDO4404/ HDO4804 | RP3500A |
| Bandwidth Upgrade Option | |
| 200 MHz to 400 MHz Upgrade Option | HDO4000-BWU2T4 |
| 200 MHz to 800 MHz Upgrade Option | HDO4000-BWU2T8 |
| 400 MHz to 800 MHz Upgrade Option | HDO4000-BWU4T8 |
| Memory Depth Upgrade Option | |
| 500 Mpts Memory Depth Upgrade Option | HDO4000-RLU-05 |
| Serial Protocol Analysis Option | |
| Automotive Serial Triggering and Analysis (CAN-FD/LIN) | HDO4000-AUTOA |
| Aerospace Serial Triggering and Analysis (MIL-STD-1553) | HDO4000-AEROA |
| Automotive Serial Triggering and Analysis (FlexRay) | HDO4000-FLEXA |
| Audio Serial Triggering and Analysis (I2S) | HDO4000-AUDIOA |
| Others | |
| Power Analysis Option | HDO4000-PWRA |
| Battery Pack Option | HDO4000-BPACK |
| Option Package (comprising HDO4000-AUTOA, AEROA, FLEXA, AUDIOA, and PWRA options) | HDO4000-BND |

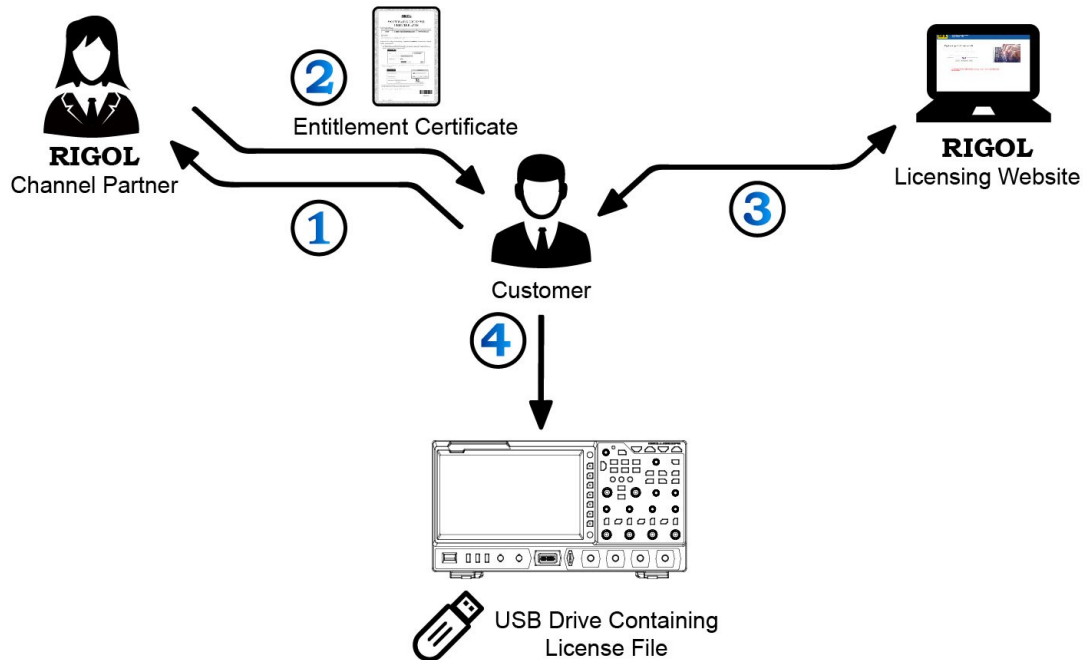
NOTE:

For all the base units, accessories, and options, please contact the local office of RIGOL.

Warranty Period

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

Option Ordering and Installation Process



1. According to the usage requirements, please purchase the specified function options from **RIGOL Sales Personnel**, and provide the serial number of the instrument that needs to install the option.
2. After receiving the option order, the **RIGOL** factory will mail the paper software product entitlement certificate to the address provided in the order.
3. Log in to **RIGOL** official website for registration. Use the software key and instruments serial number provided in the entitlement certificate to obtain the option license code and the option license file.
4. Download the option license file to the root directory of the USB storage device, and connect the USB storage device to the instrument properly. After the USB storage device is successfully recognized, the **Option install** menu is activated. Press this menu key to start installing the option.

HEADQUARTER

RIGOL TECHNOLOGIES CO., LTD.
No.8 Keling Road, New District, Suzhou,
JiangSu, P.R.China
Tel: +86-400620002
Email: info@rigol.com

EUROPE

RIGOL TECHNOLOGIES EU GmbH
Carl-Benz-Str.11
82205 Gilching
Germany
Tel: +49(0)8105-27292-0
Email: info-europe@rigol.com

NORTH AMERICA

RIGOL TECHNOLOGIES, USA INC.
10220 SW Nimbus Ave.
Suite K-7
Portland, OR 97223
Tel: +1-877-4-**RIGOL**-1
Fax: +1-877-4-**RIGOL**-1
Email: info@rigol.com

JAPAN

RIGOL JAPAN CO., LTD.
501, LATORRETTA, 2-37-1,
Numabukuro,
Nakano-Ku, Tokyo, Japan
Tel: +81-3-6262-8932
Fax: +81-3-6262-8933
Email: info-japan@rigol.com

RIGOL® is the trademark of **RIGOL TECHNOLOGIES CO., LTD.** Product information in this document subject to update without notice. For the latest information about **RIGOL**'s products, applications and services, please contact local **RIGOL** channel partners or access **RIGOL** official website: www.rigol.com