

# Digital Phosphor Oscilloscopes

## MSO4000 Series, DPO4000 Series Data Sheet



### Features & Benefits

#### Key Performance Specifications

- 1 GHz, 500 MHz, 350 MHz Bandwidth Models
- 2 and 4 Channel Models
- 16 Digital Channels (MSO4000)
- Sample Rates Up to 5 GS/s on All Channels
- 10 Megasample Record Length on All Channels
- 50,000 wfms Maximum Waveform Capture Rate
- Suite of Advanced Triggers

#### Ease of Use Features

- Wave Inspector® Controls Provide Unprecedented Efficiency in Waveform Analysis
- 10.4 in. (264 mm) XGA Color Display
- USB and CompactFlash on Front Panel for Quick and Easy Storage
- USB Plug-and-Play PC Connectivity
- Small Footprint and Lightweight – Only 5.4 in. (137 mm) deep and 11 lb. (5 kg)
- TekVPI® Probe Interface Supports Active, Differential, and Current Probes for Automatic Scaling and Units

#### Serial Triggering and Analysis

- Serial Triggering, Decode, and Analysis Options for I<sup>2</sup>C, SPI, RS-232/422/485/UART, I<sup>2</sup>S/LJ/RJ/TDM, CAN, LIN, and FlexRay

#### Additional Application Support

- Power Analysis Option
- HDTV and Custom Video Analysis Option

#### Mixed Signal Design and Analysis (MSO4000)

- Parallel Bus Trigger and Analysis
- MagniVu™ 60.6 ps Technology Provides Finer Timing Resolution
- Per-channel Threshold Settings
- Multichannel Setup and Hold Triggering
- Next-generation Digital Waveform Display

### Applications

- Embedded Design and Debug
- Mixed Signal Design and Debug
- Investigation of Transient Phenomena
- Power Measurements
- Video Design and Debug
- Automotive Electronics Design and Debug

## MSO/DPO4000 Series Digital Phosphor Oscilloscopes

The DPO4000 Series Digital Phosphor Oscilloscopes (DPOs) are the first oscilloscopes to offer usable deep memory on all channels, excellent performance, serial trigger and analysis options, and all in the most compact form factor in their class. The MSO4000 Series Mixed Signal Oscilloscopes (MSOs) provide all the features and benefits of the DPO4000, but add 16 integrated digital channels, enabling you to visualize and correlate analog and digital signals on a single instrument. This integration extends triggering functionality across all 20 channels providing pattern and state triggering ideal for debugging mixed analog and digital designs.

### Designed to Make Your Work Easier

As design complexity increases, you need tools that help you find problems quickly.

### Easy to Setup and Use

The MSO/DPO4000 Series has a large 10.4 inch XGA display, a clean front panel with familiar knobs - all in a package that is only 5.4 in. deep and weighs only 11 lb. With USB plug-and-play operation and PC connectivity, acquiring data and measurements from the instrument is as simple as connecting a USB cable from the oscilloscope to the PC. Provided applications include NI LabVIEW SignalExpress™ Tektronix Edition LE, OpenChoice® Desktop and Microsoft Excel and Word toolbars enabling fast and easy direct communication with your Windows PC. USB and CompactFlash ports on the front panel enable simple transfer of screenshots, instrument settings, and waveform data in the palm of your hand.

When it comes to mixed signal design and debug, you want your instrument to be intuitive so you can start solving problems quickly. The MSO4000 Series drives like an oscilloscope, the tool you already know how to use. You do not have to relearn how to use the instrument every time you turn it on.

### Wave Inspector® Navigation

Imagine trying to efficiently use the Internet if search engines such as Google and Yahoo didn't exist, web browser features such as Favorites and Links didn't exist, or Internet Service Providers like AOL or MSN weren't around. Now you know how most modern oscilloscope users feel when



Wave Inspector® controls.

trying to actually use the long record length in their digital oscilloscope. Record length, one of the key specifications of an oscilloscope, is the number of samples it can digitize and store in a single acquisition. The longer the record length, the longer the time window you can capture with high timing resolution (high sample rate).

The first digital oscilloscopes could capture and store only 500 points, which made it very difficult to acquire all relevant information around the event being investigated. Over the years, oscilloscope manufacturers have provided longer and longer record lengths to meet market demands for long capture windows with high resolution, to the point that most mid-range oscilloscopes either come standard with, or can be optionally upgraded to, multi-megapoint record lengths. These megapoint record lengths often represent thousands of screens worth of signal activity. While standard record lengths have increased greatly over the years and can now satisfy the vast majority of applications in the marketplace, tools for effectively and efficiently viewing, navigating, and analyzing long record length acquisitions have been sorely neglected until now.

## Characteristics

### Vertical System Analog Channels

| Characteristic                                 | MSO4032                                                                                                                                      | DPO4034<br>MSO4034 | DPO4054<br>MSO4054 | DPO4104<br>MSO4104 |
|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|
| Input Channels                                 | 2                                                                                                                                            | 4                  | 4                  | 4                  |
| Analog Bandwidth (-3 dB)<br>5 mV/div - 1 V/div | 350 MHz                                                                                                                                      | 350 MHz            | 500 MHz            | 1 GHz              |
| Calculated Rise Time 5 mV/div<br>(typical)     | 1 ns                                                                                                                                         | 1 ns               | 700 ps             | 350 ps             |
| Hardware Bandwidth Limits                      | 20 MHz or 250 MHz                                                                                                                            |                    |                    |                    |
| Input Coupling                                 | AC, DC, GND                                                                                                                                  |                    |                    |                    |
| Input Impedance                                | 1 M $\Omega$ $\pm$ 1%, 50 $\Omega$ $\pm$ 1%                                                                                                  |                    |                    |                    |
| Input Sensitivity, 1 M $\Omega$                | 1 mV/div to 10 V/div                                                                                                                         |                    |                    |                    |
| Input Sensitivity, 50 $\Omega$                 | 1 mV/div to 1 V/div                                                                                                                          |                    |                    |                    |
| Vertical Resolution                            | 8 bits (11 bits with Hi Res)                                                                                                                 |                    |                    |                    |
| Max Input Voltage, 1 M $\Omega$                | 250 V <sub>RMS</sub> with peaks $\leq$ $\pm$ 400 V                                                                                           |                    |                    |                    |
| Max Input Voltage, 50 $\Omega$                 | 5 V <sub>RMS</sub> with peaks $<$ $\pm$ 20 V                                                                                                 |                    |                    |                    |
| DC Gain Accuracy                               | $\pm$ 1.5% with offset set to 0 V                                                                                                            |                    |                    |                    |
| Offset Range                                   | 1 M $\Omega$                                                                                                                                 |                    | 50 $\Omega$        |                    |
| 1 mV/div to 50 mV/div                          | $\pm$ 1 V                                                                                                                                    |                    | $\pm$ 1 V          |                    |
| 50.5 mV/div to 99.5 mV/div                     | $\pm$ 0.5 V                                                                                                                                  |                    | $\pm$ 0.5 V        |                    |
| 100 mV/div to 500 mV/div                       | $\pm$ 10 V                                                                                                                                   |                    | $\pm$ 10 V         |                    |
| 505 mV/div to 995 mV/div                       | $\pm$ 5 V                                                                                                                                    |                    | $\pm$ 5 V          |                    |
| 1 V/div to 5 V/div                             | $\pm$ 100 V                                                                                                                                  |                    | $\pm$ 5 V          |                    |
| 5.05 V/div to 10 V/div                         | $\pm$ 50 V                                                                                                                                   |                    | NA                 |                    |
| Channel-to-Channel Isolation                   | $\geq$ 100:1 at $\leq$ 100 MHz and $\geq$ 30:1 at $>$ 100 MHz up to the rated bandwidth for any two channels having equal volts/div settings |                    |                    |                    |

### Vertical System Digital Channels

| Characteristic               | MSO4032 | MSO4034                                         | MSO4054 | MSO4104 |
|------------------------------|---------|-------------------------------------------------|---------|---------|
| Input Channels               |         | 16 Digital (D15 - D0)                           |         |         |
| Thresholds                   |         | Per-channel Thresholds                          |         |         |
| Threshold Selections         |         | TTL, CMOS, ECL, PECL, User Defined              |         |         |
| User-defined Threshold Range |         | +5 to -2 V                                      |         |         |
| Maximum Input Voltage        |         | $\pm$ 15 V                                      |         |         |
| Threshold Accuracy           |         | $\pm$ (100 mV + 3% of threshold setting)        |         |         |
| Input Dynamic Range          |         | 6 V <sub>pp</sub> centered around the threshold |         |         |
| Minimum Voltage Swing        |         | 500 mV                                          |         |         |
| Input Impedance              |         | 20 k $\Omega$                                   |         |         |
| Probe Loading                |         | 3 pF                                            |         |         |
| Vertical Resolution          |         | 1 bit                                           |         |         |

**Horizontal System Analog Channels**

| Characteristic                                         | MSO4032                         | DPO4034<br>MSO4034 | DPO4054<br>MSO4054 | DPO4104<br>MSO4104 |
|--------------------------------------------------------|---------------------------------|--------------------|--------------------|--------------------|
| Maximum Sample Rate (all channels)                     | 2.5 GS/s                        | 2.5 GS/s           | 2.5 GS/s           | 5 GS/s             |
| Minimum Peak Detect Pulse Width                        | 400 ps                          |                    |                    | 200 ps             |
| Maximum Record Length (all channels)                   | 10 M points                     |                    |                    |                    |
| Maximum Duration at Highest Sample Rate (all channels) | 4 ms                            | 4 ms               | 4 ms               | 2 ms               |
| Timebase Range                                         | 1 ns to 1,000 s                 |                    |                    | 400 ps to 1,000 s  |
| Timebase Delay Time Range                              | -10 divisions to 5000 s         |                    |                    |                    |
| Channel-to-Channel Deskew Range                        | ±100 ns                         |                    |                    |                    |
| Timebase Accuracy                                      | ±5 ppm over any ≥ 1 ms interval |                    |                    |                    |

**Horizontal System Digital Channels**

| Characteristic                  | MSO4032                                 | MSO4034 | MSO4054 | MSO4104 |
|---------------------------------|-----------------------------------------|---------|---------|---------|
| Maximum Sample Rate (Main)      | 500 MS/s (2 ns resolution)              |         |         |         |
| Maximum Record Length (Main)    | 10 M points                             |         |         |         |
| Maximum Sample Rate (MagniVu)   | 16.5 GS/s (60.6 ps resolution)          |         |         |         |
| Maximum Record Length (MagniVu) | 10 k points centered around the trigger |         |         |         |
| Minimum Detectable Pulse Width  | 1.5 ns                                  |         |         |         |
| Channel-to-Channel Skew         | 60 ps typical                           |         |         |         |

**Trigger System**

| Characteristic                          | Description                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Main Trigger Modes                      | Auto, Normal, and Single                                                                                                                                                                                                                                                                                                                                          |
| Trigger Coupling                        | DC, HF reject (attenuates >50 kHz), LF reject (attenuates <50 kHz), noise reject (reduces sensitivity)                                                                                                                                                                                                                                                            |
| Trigger Holdoff Range                   | 20 ns to 8 s                                                                                                                                                                                                                                                                                                                                                      |
| Trigger Frequency Readout               | 6-digit hardware counter indicates how often triggerable events are occurring in the user's signal.                                                                                                                                                                                                                                                               |
| <b>Sensitivity</b>                      |                                                                                                                                                                                                                                                                                                                                                                   |
| Internal DC Coupled                     | 0.4 div DC to 50 MHz, increasing to 1 div at rated bandwidth                                                                                                                                                                                                                                                                                                      |
| External (Auxiliary Input)              | 200 mV from DC to 50 MHz increasing to 500 mV at 250 MHz                                                                                                                                                                                                                                                                                                          |
| <b>Trigger Level Range</b>              |                                                                                                                                                                                                                                                                                                                                                                   |
| Any Channel                             | ±8 divisions from center of screen                                                                                                                                                                                                                                                                                                                                |
| External (auxiliary input)              | ±8 V                                                                                                                                                                                                                                                                                                                                                              |
| <b>Trigger Modes</b>                    |                                                                                                                                                                                                                                                                                                                                                                   |
| Edge                                    | Positive or negative slope on any channel or front-panel auxiliary input. Coupling includes DC, HF reject, LF reject, and noise reject.                                                                                                                                                                                                                           |
| Sequence (B-trigger)                    | Trigger Delay by Time - 4 ns to 8 s. Or Trigger Delay by Events - 1 to 9,999,999 events.                                                                                                                                                                                                                                                                          |
| Pulse Width                             | Trigger on width of positive or negative pulses that are >, <, =, or ≠ a specified period of time.                                                                                                                                                                                                                                                                |
| Runt                                    | Trigger on a pulse that crosses one threshold but fails to cross a second threshold before crossing the first again.                                                                                                                                                                                                                                              |
| Logic                                   | Trigger when any logical pattern of channels goes false or stays true for specified period of time. Any input can be used as a clock to look for the pattern on a clock edge. Pattern (AND, OR, NAND, NOR) specified for all analog and digital input channels defined as High, Low, or Don't Care.                                                               |
| Setup and Hold                          | Trigger on violations of setup time and/or hold time between clock and data present on any of the input channels.                                                                                                                                                                                                                                                 |
| Rise/Fall Time                          | Trigger on pulse edge rates that are faster or slower than specified. Slope may be positive, negative, or either.                                                                                                                                                                                                                                                 |
| Video                                   | Trigger on line number, all lines, odd, even, or all fields on NTSC, PAL, and SECAM video signals.                                                                                                                                                                                                                                                                |
| Extended Video (optional)               | Trigger on 480p/60, 576p/50, 720p/30, 720p/50, 720p/60, 875i/60, 1080i/50, 1080i/60, 1080p/24, 1080p/24sF, 1080p/25, 1080p/30, 1080p/50, 1080p/60, and custom bilevel and trilevel sync video standards.                                                                                                                                                          |
| I <sup>2</sup> C (Optional)             | Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data on I <sup>2</sup> C buses up to 3.4 Mbps.                                                                                                                                                                                                                   |
| SPI (Optional)                          | Trigger on SS, Idle Time, MOSI, MISO, or MOSI and MISO on SPI buses up to 10.0 Mbps.                                                                                                                                                                                                                                                                              |
| CAN (Optional)                          | Trigger on Start of Frame, Frame Type (data, remote, error, overload), Identifier (standard or extended), Data, Identifier and Data, End of Frame, Missing ACK, or Bit Stuffing Errors on CAN signals up to 1 Mbps. Data can be further specified to trigger on ≤, <, =, >, ≥, or ≠ a specific data value. User-adjustable sample point is set to 50% by default. |
| I <sup>2</sup> S/LJ/RJ/TDM (Optional)   | Trigger on Word Select, Frame Sync, or Data. Data can be further specified to trigger on ≤, <, =, >, ≥, ≠ a specific data value, or inside or outside of a range.                                                                                                                                                                                                 |
| RS-232/422/485/UART (Optional)          | Trigger on Tx start bit, Rx start bit, Tx end of packet, Rx end of packet, Tx data, Rx data, Tx Parity Error, and Rx Parity Error.                                                                                                                                                                                                                                |
| LIN (Optional)                          | Trigger on Sync, Identifier, Data, Identifier and Data, Wakeup Frame, Sleep Frame, or Errors such as Sync, Parity, or Checksum Errors.                                                                                                                                                                                                                            |
| FlexRay (Optional)                      | Trigger on Start of Frame, Type of Frame (Normal, Payload, Null, Sync, Startup), Identifier, Cycle Count, Complete Header Field, Data, Identifier and Data, End of Frame or Errors such as Header CRC, Trailer CRC, Null Frame, Sync Frame, or Startup Frame Errors                                                                                               |
| Parallel (available on MSO models only) | Trigger on a parallel bus data value.                                                                                                                                                                                                                                                                                                                             |

**Acquisition Modes**

| Mode        | Description                                                                                     |
|-------------|-------------------------------------------------------------------------------------------------|
| Sample      | Acquires sampled values                                                                         |
| Peak Detect | Captures glitches as narrow as 200 ps at all sweep speeds                                       |
| Averaging   | From 2 to 512 waveforms included in average                                                     |
| Envelope    | Min-max envelope reflecting Peak Detect data over multiple acquisitions                         |
| Hi Res      | Real-time boxcar averaging reduces random noise and increases vertical resolution               |
| Roll        | Scrolls waveforms right to left across screen at sweep speeds slower than or equal to 40 ms/div |

**Waveform Measurements**

| Characteristic         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cursors                | Waveform and Screen                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Automatic Measurements | 29, of which up to eight can be displayed on screen at any one time. Measurements include Period, Frequency, Delay, Rise Time, Fall Time, Positive Duty Cycle, Negative Duty Cycle, Positive Pulse Width, Negative Pulse Width, Burst Width, Phase, Positive Overshoot, Negative Overshoot, Peak to Peak, Amplitude, High, Low, Max, Min, Mean, Cycle Mean, RMS, Cycle RMS, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Area, and Cycle Area. |
| Measurement Statistics | Mean, Min, Max, Standard Deviation                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Reference Levels       | User-definable reference levels for automatic measurements can be specified in either percent or units                                                                                                                                                                                                                                                                                                                                                                               |
| Gating                 | Isolate the specific occurrence within an acquisition to take measurements, using either the screen or waveform cursors                                                                                                                                                                                                                                                                                                                                                              |

**Power Measurements (optional)**

| Characteristic               | Description                                                                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Quality Measurements   | $V_{RMS}$ , $V_{Crest\ Factor}$ , Frequency, $I_{RMS}$ , $I_{Crest\ Factor}$ , True Power, Apparent Power, Reactive Power, Power Factor, Phase Angle |
| Switching Loss Measurements  | Power Loss: $T_{on}$ , $T_{off}$ , Conduction, Total<br>Energy Loss: $T_{on}$ , $T_{off}$ , Conduction, Total                                        |
| Harmonics                    | THD-F, THD-R, RMS measurements<br>Graphical and table displays of harmonics<br>Test to IEC61000-3-2 Class A and MIL-STD-1399                         |
| Ripple Measurements          | $V_{ripple}$ and $I_{ripple}$                                                                                                                        |
| Modulation Analysis          | Graphical display of +Pulse Width, -Pulse Width, Period, Frequency, +Duty Cycle, and -Duty Cycle modulation types                                    |
| Safe Operating Area          | Graphical display and mask testing of switching device safe operating area measurements                                                              |
| dV/dt and dI/dt Measurements | Cursor measurements of slew rate                                                                                                                     |

**Waveform Math**

| Characteristic | Description                                                                                                                                                                                                                                                      |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Arithmetic     | Add, subtract, multiply, and divide waveforms                                                                                                                                                                                                                    |
| Math Functions | Integrate, Differentiate, FFT                                                                                                                                                                                                                                    |
| FFT            | Spectral magnitude. Set FFT Vertical Scale to Linear RMS or dBV RMS, and FFT Window to Rectangular, Hamming, Hanning, or Blackman-Harris.                                                                                                                        |
| Advanced Math  | Define extensive algebraic expressions including analog waveforms, math functions, scalars, up to two user-adjustable variables, and results of parametric measurements (both static and trend plots) e.g., $(Intg(Ch1 - Mean(Ch1)) \times 1.414 \times VAR1)$ . |

**Software**

| Software                                               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NI LabVIEW<br>SignalExpress<br>Tektronix Edition<br>LE | A fully interactive measurement software environment optimized for the MSO/DPO4000 Series, enables you to instantly acquire, generate, analyze, compare, import, and save measurement data and signals using an intuitive drag-and-drop user interface that does not require any programming.<br>Standard MSO/DPO4000 Series support for acquiring, controlling, viewing, and exporting your live signal data is permanently available through the software. The full version (SIGEXPTE) adds additional signal processing, advanced analysis, mixed signal, sweeping, limit testing, and user-defined step capabilities and is available for a 30-day trial period standard with each instrument. |
| OpenChoice®<br>Desktop                                 | Enables fast and easy communication between a Windows PC and the MSO/DPO4000 Series, using USB or LAN. Transfer and save settings, waveforms, measurements, and screen images.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| IVI Driver                                             | Provides a standard instrument programming interface for common applications such as LabVIEW, LabWindows/CVI, Microsoft .NET and MATLAB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

**Display Characteristics**

| Characteristic        | Description                                               |
|-----------------------|-----------------------------------------------------------|
| Display Type          | 10.4 in. (264 mm) liquid-crystal TFT color display        |
| Display Resolution    | 1,024 horizontal × 768 vertical pixels (XGA)              |
| Waveform Styles       | Vectors, Dots, Variable Persistence, Infinite Persistence |
| Graticules            | Full, Grid, Cross Hair, Frame, IRE, and mV                |
| Format                | YT and simultaneous XY/YT                                 |
| Waveform Capture Rate | Up to 50,000 wfms/sec                                     |

**Input/Output Ports**

| Port                           | Description                                                                                                                              |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| CompactFlash Drive             | Front-panel access (Type 1)                                                                                                              |
| USB 2.0 Full-speed Host Port   | Supports USB mass storage devices, printers and keyboard. Two ports available on rear panel and one on front panel.                      |
| USB 2.0 High-speed Device Port | Rear-panel connector allows for control of oscilloscope through USBTMC or GPIB with a TEK-USB-488 or connection to a PictBridge printer. |
| LAN Port                       | RJ-45 connector, supports 10/100Base-T                                                                                                   |
| XGA Video Port                 | DB-15 female connector, connect to show the oscilloscope display on an external monitor or projector                                     |
| Auxiliary Input                | Front-panel BNC connector. Input Impedance 1 MΩ. Max input 250 $V_{RMS}$ with peaks $\pm 400$ V.                                         |
| Probe Compensator Output       | Front-panel pins<br>Amplitude 2.5 V<br>Frequency 1 kHz                                                                                   |
| Trigger Out                    | Rear-panel BNC connector, provides a positive polarity pulse when the oscilloscope triggers                                              |
| Kensington Lock                | Rear-panel security slot connects to standard Kensington lock                                                                            |

**Power Source**

| Characteristic         | Description                                               |
|------------------------|-----------------------------------------------------------|
| Power Source Voltage   | 100 to 240 V $\pm 10\%$                                   |
| Power Source Frequency | 47 to 66 Hz (90 to 264 V)<br>360 to 440 Hz (100 to 132 V) |
| Power Consumption      | 250 W maximum                                             |

**Physical Characteristics**

| Dimensions        | mm                                                         | in.  |
|-------------------|------------------------------------------------------------|------|
| Height            | 229                                                        | 9.0  |
| Width             | 439                                                        | 17.3 |
| Depth             | 137                                                        | 5.4  |
| Weight            | kg                                                         | lb.  |
| Net               | 5                                                          | 11   |
| Shipping          | 9.5                                                        | 22   |
| Rackmount         | 5U                                                         |      |
| Configuration     |                                                            |      |
| Cooling Clearance | 2 in. (51 mm) required on left side and rear of instrument |      |

**General Characteristics**

| Characteristic                | Description                                                                                            |
|-------------------------------|--------------------------------------------------------------------------------------------------------|
| <b>Environmental</b>          |                                                                                                        |
| Temperature                   |                                                                                                        |
| Operating                     | 0 °C to +50 °C                                                                                         |
| Nonoperating                  | -20 °C to +60 °C                                                                                       |
| Humidity                      |                                                                                                        |
| Operating                     | High: 40 °C to 50 °C, 10% to 60% Relative Humidity<br>Low: 0 °C to 40 °C, 10% to 90% Relative Humidity |
| Nonoperating                  | High: 40 °C to 60 °C, 5% to 60% Relative Humidity<br>Low: 0 °C to 40 °C, 5% to 90% Relative Humidity   |
| Altitude                      |                                                                                                        |
| Operating                     | 3,000 meters (9,843 feet)                                                                              |
| Nonoperating                  | 12,000 meters (39,370 feet)                                                                            |
| Random Vibration              |                                                                                                        |
| Operating                     | 0.31 G <sub>RMS</sub> from 5 to 500 Hz, 10 minutes each axis, 3 axes, 30 minutes total                 |
| Nonoperating                  | 2.46 G <sub>RMS</sub> from 5 to 500 Hz, 10 minutes each axis, 3 axes, 30 minutes total                 |
| <b>Regulatory</b>             |                                                                                                        |
| Electromagnetic Compatibility | 89/336/EEC                                                                                             |
| Safety                        | UL61010-1, Second Edition; CSA61010-1 Second Edition, EN61010-1:2001; IEC 61010-1:2001                 |

**Ordering Information****MSO/DPO4000 Family**

| Model                 | Description                                                                    |
|-----------------------|--------------------------------------------------------------------------------|
| <b>DPO4000 Models</b> |                                                                                |
| DPO4034               | 350 MHz, 2.5 GS/s, 10 M record length, 4-channel digital phosphor oscilloscope |
| DPO4054               | 500 MHz, 2.5 GS/s, 10 M record length, 4-channel digital phosphor oscilloscope |
| DPO4104               | 1 GHz, 5 GS/s, 10 M record length, 4-channel digital phosphor oscilloscope     |
| <b>MSO4000 Models</b> |                                                                                |
| MSO4032               | 350 MHz, 2.5 GS/s, 10 M record length, 2+16 channel mixed-signal oscilloscope  |
| MSO4034               | 350 MHz, 2.5 GS/s, 10 M record length, 4+16 channel mixed-signal oscilloscope  |
| MSO4054               | 500 MHz, 2.5 GS/s, 10 M record length, 4+16 channel mixed-signal oscilloscope  |
| MSO4104               | 1 GHz, 5 GS/s, 10 M record length, 4+16 channel mixed-signal oscilloscope      |

All models include: One P6139A 500 MHz, 10x Passive Probe per Analog Channel, Front Cover (200-4908-00), CompactFlash Memory Card; ≥32 MB (156-9413-00), User Manual (071-2121-xx), Documentation CD (063-3903-00), OpenChoice® Desktop Software, NI LabVIEW SignalExpress™ Tektronix Edition LE Software, Calibration certificates document measurement traceability to National Metrology

Institute(s) - the Quality System this product is manufactured in is ISO9001 registered, power cord, accessory bag (016-1967-00) and a three-year warranty. Please specify power plug and manual version when ordering. MSO models also include one P6516 16-channel logic probe and a logic probe accessory kit (020-2662-00).

**Application Modules**

| Module      | Description                                                                                                                                                                                                                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DPO4EMBD    | Embedded Serial Triggering and Analysis Module. Enables triggering on packet level information on I <sup>2</sup> C and SPI buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.                                       |
| DPO4COMP    | Computer Serial Triggering and Analysis Module. Enables triggering on packet level information on RS-232/422/485/UART buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.                                            |
| DPO4AUDIO   | Audio Serial Triggering and Analysis Module. Enables triggering on packet level information on I <sup>2</sup> S, L <sub>J</sub> , R <sub>J</sub> , and TDM audio buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information. |
| DPO4AUTO    | Automotive Serial Triggering and Analysis Module. Enables triggering on packet level information on CAN and LIN buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, and packet decode tables with time stamp information.                                                  |
| DPO4AUTOMAX | Extended Automotive Serial Triggering and Analysis Module. Enables triggering on packet level information on CAN, LIN and FlexRay buses as well as analytical tools such as digital views of the signal, bus views, packet decoding, search tools, packet decode tables with time stamp information, and eye-diagram analysis software. |
| DPO4PWR     | Power Analysis Application Module. Enables quick and accurate analysis of power quality, switching loss, harmonics, safe operating area (SOA), modulation, ripple, and slew rate (dI/dt, dV/dt).                                                                                                                                        |
| DPO4VID     | HDTV and Custom (nonstandard) Video Triggering Module.                                                                                                                                                                                                                                                                                  |

**Instrument Options****Power Plug Options**

| Option   | Description                 |
|----------|-----------------------------|
| Opt. A0  | North America               |
| Opt. A1  | Universal Euro              |
| Opt. A2  | United Kingdom              |
| Opt. A3  | Australia                   |
| Opt. A5  | Switzerland                 |
| Opt. A6  | Japan                       |
| Opt. A10 | China                       |
| Opt. A11 | India                       |
| Opt. A99 | No power cord or AC adapter |

### Language Options\*1

| Option   | Description               |
|----------|---------------------------|
| Opt. L0  | English manual            |
| Opt. L1  | French manual             |
| Opt. L2  | Italian manual            |
| Opt. L3  | German manual             |
| Opt. L4  | Spanish manual            |
| Opt. L5  | Japanese manual           |
| Opt. L6  | Portuguese manual         |
| Opt. L7  | Simplified Chinese manual |
| Opt. L8  | Standard Chinese manual   |
| Opt. L9  | Korean manual             |
| Opt. L10 | Russian manual            |
| Opt. L99 | No manual                 |

\*1 Language options include a translated front-panel overlay for the selected language(s).

### Service Options\*2

| Option   | Description                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------|
| Opt. C3  | Calibration Service 3 years                                                                                      |
| Opt. C5  | Calibration Service 5 years                                                                                      |
| Opt. CA1 | Provides a single calibration event, or coverage for the designated calibration interval, whichever comes first. |
| Opt. D1  | Calibration Data Report                                                                                          |
| Opt. D3  | Calibration Data Report 3 years (with Opt. C3)                                                                   |
| Opt. D5  | Calibration Data Report 5 Years (with Opt. C5)                                                                   |
| Opt. R5  | Repair Service 5 years (including warranty)                                                                      |

\*2 Probes and accessories are not covered by the oscilloscope warranty and service offerings. Refer to the datasheet of each probe and accessory model for its unique warranty and calibration terms.

### Recommended Probes

| Probe                                  | Description                                                                                                                                                                                                                                              |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TAP1500                                | 1.5 GHz TekVPI™ active probe                                                                                                                                                                                                                             |
| TAP1500X2                              | Bundle of Two 1.5 GHz Active Probes, single-ended with TekVPI Interface; Certificate of traceable calibration standard                                                                                                                                   |
| TDP0500                                | 500 MHz TekVPI 42 V differential probe                                                                                                                                                                                                                   |
| TDP1000                                | 1 GHz TekVPI 42 V differential probe                                                                                                                                                                                                                     |
| TCP0030                                | 120 MHz TekVPI 30 Ampere AC/DC current probe                                                                                                                                                                                                             |
| TCP0150                                | 20 MHz TekVPI 150 Ampere AC/DC current probe                                                                                                                                                                                                             |
| TCPA300/400*3                          | Current measurement systems                                                                                                                                                                                                                              |
| P5200                                  | 1.3 kV, 25 MHz high-voltage differential probe                                                                                                                                                                                                           |
| P5205*3                                | 1.3 kV, 100 MHz high-voltage differential probe                                                                                                                                                                                                          |
| P5210*3                                | 5.6 kV, 50 MHz high-voltage differential probe                                                                                                                                                                                                           |
| P5100                                  | 2.5 kV, 100X high-voltage passive probe                                                                                                                                                                                                                  |
| ADA400A*3                              | 100X, 10X, 1X, 0.1X high-gain differential amplifier                                                                                                                                                                                                     |
| NEX-HD2HEADER                          | Mictor connector breakout to 0.1 in. header pins                                                                                                                                                                                                         |
| DPO4PWRBND<br>Power Solution<br>Bundle | Includes P5205 and TDP0500 differential voltage probes, TCP0030 current probe, TPA-BNC adapter, deskew pulse generator (TEK-DPG), deskew fixture, and power analysis module (DPO4PWR) in a hard-sided carrying case. Bundle discount reflected in price. |

\*3 Requires TekVPI™ to TekProbe BNC adapter (TPA-BNC).

### Recommended Accessories

| Accessory                     | Description                                                         |
|-------------------------------|---------------------------------------------------------------------|
| 071-1844-XX                   | Service Manual (English only)                                       |
| SIGEXPT                       | NI LabVIEW SignalExpress™ Tektronix Edition Software (Full Version) |
| FPGAView-xx                   | MSO Support for Altera and Xilinx FPGAs                             |
| TPA-BNC                       | TekVPI to TekProbe BNC Adapter                                      |
| TEK-USB-488                   | GPIO to USB Adapter                                                 |
| TLAHR with (2)<br>196-3476-01 | High-impedance Adapter and Leadsets for P6516 MSO Probe             |
| 119-6827-00                   | CompactFlash to USB Memory Card Reader                              |
| ACD4000                       | Soft Transit Case                                                   |
| HCTEK4321                     | Hard Transit Case (Requires ACD4000)                                |
| RM4000                        | Rackmount Kit                                                       |
| AMT75*3                       | 1 GHz, 75 Ω Adapter                                                 |
| TEK-DPG                       | Deskew Pulse Generator                                              |
| 067-1686-00                   | Deskew Fixture                                                      |

\*3 Requires TekVPI™ to TekProbe BNC adapter (TPA-BNC).

### Warranty

Three-year warranty covering all parts and labor, excluding probes.



Product(s) are manufactured in ISO registered facilities.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.