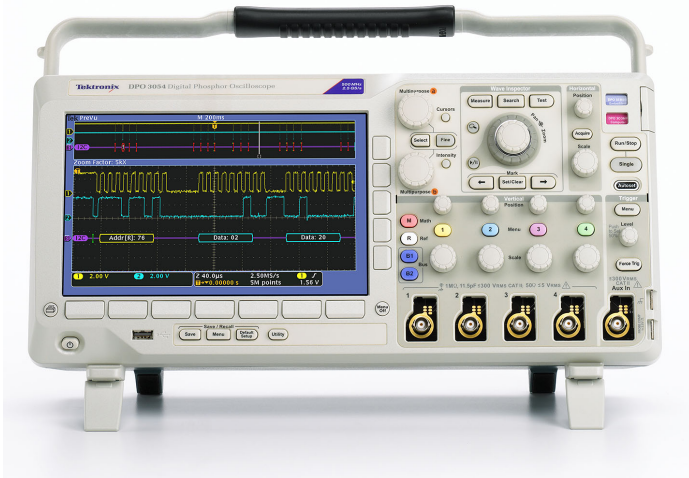# Digital Phosphor Oscilloscopes

DPO3000 Series Data Sheet

Features & Benefits

Key Performance Specifications

- 500, 300, 100 MHz Bandwidth Models
- 2 and 4 Channel Models
- 2.5 GS/s Sample Rate on All Channels
- 5 Megasample Record Length on All Channels
- 50,000 wfm/s Maximum Waveform Capture Rate
- Suite of Advanced Triggers

Ease of Use Features

- Wave Inspector® Controls Provide Unprecedented Efficiency in Waveform Analysis
- 9 in. (229 mm) WVGA Widescreen Color Display
- USB 2.0 Port on Front Panel for Quick and Easy Data Storage
- USB Plug-and-Play PC Connectivity
- TekVPI® Probe Interface Supports Active, Differential and Current Probes for Automatic Scaling and Units
- Small Footprint and Lightweight – Only 5.4 in. (137 mm) deep and 9 lb. (4 kg)

Serial Bus Trigger and Decode

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

Additional Application Support

- Power Analysis Option
- HDTV and Custom Video Analysis Option

Applications

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

DPO3000 Series Digital Phosphor Oscilloscopes

The Power to Solve Problems Quickly

The DPO3000 Series digital phosphor oscilloscopes (DPO) deliver the performance you need to visualize even your most demanding signals. Bandwidths range from 100 MHz to 500 MHz, and with all models offering a minimum of 5x oversampling on all channels and sin(x)/x interpolation standard, you can be confident that even the fastest transient events will be captured and displayed accurately. The standard 5 M record length on all channels enables you to capture long windows of signal activity while maintaining fine timing resolution. The 50,000 wfm/s waveform capture rate maximizes the probability of capturing elusive glitches and other infrequent events.

The DPO3000 Series offers a variety of analytical solutions including cursors, 29 automatic measurements, statistics, and waveform math. Despite a tiny footprint (only 5.4 in. deep) and light weight (9 lb.), the DPO3000 Series offers exceptional performance, a large 9 in. WVGA widescreen display and knob-per-channel vertical controls.

Characteristics

Vertical System

Characteristic	DPO3012	DPO3014	DPO3032	DPO3034	DPO3052	DPO3054
Input Channels	2	4	2	4	2	4
Analog Bandwidth (-3dB)	100 MHz	100 MHz	300 MHz	300 MHz	500 MHz	500 MHz
Calculated Rise Time 5 mV/div (typical)	3.5 ns	3.5 ns	1.17 ns	1.17 ns	700 ps	700 ps
Hardware Bandwidth Limits	20 MHz or 150 MHz					
Input Coupling	AC, DC, GND					
Input Impedance	1 MΩ ±1%, 75 Ω ±1%, 50 Ω ±1%					
Input Sensitivity Range, 1 MΩ	1 mV/div to 10 V/div					
Input Sensitivity Range, 75 Ω, 50 Ω	1 mV/div to 1 V/div					
Vertical Resolution	8 bits (11 bits with Hi Res)					
Max Input Voltage, 1 MΩ	300 V_{RMS} with peaks ≤±450 V					
Max Input Voltage, 75 Ω, 50 Ω	5 V_{RMS} with peaks ≤ ±20 V					
DC Gain Accuracy	±1.5% with offset set to 0 V					
Offset Range	**1 MΩ**			**50 Ω, 75 Ω**		
1 mV/div to 99.5 mV/div	±1 V			±1 V		
100 mV/div to 995 mV/div	±10 V			±5 V		
1 V/div	±100 V			±5 V		
1.01 V/div to 10 V/div	±100 V			NA		
Channel-to-Channel Isolation (Any Two Channels at Equal Vertical Scale)	≥100:1 at ≤100 MHz and ≥30:1 at >100 MHz up to the rated BW					

Horizontal System

Characteristic	All DPO3000 Models
Maximum Sample Rate (all channels)	2.5 GS/s
Maximum Record Length (all channels)	5 M points
Maximum Duration of Time Captured at Highest Sample Rate (all channels)	2 ms
Time base Range (S/div)	1 ns to 1000 s
Time base Delay Time Range	-10 divisions to 5000 s
Channel-to-Channel Deskew Range	±100 ns
Timebase Accuracy	±10 ppm over any ≥1 ms interval

7

Trigger System

Characteristic	Description
Main Trigger Modes	Auto, Normal, and Single
Trigger Coupling	DC, AC, 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.
Sensitivity	
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
Trigger Level Range	
Any Channel	±8 divisions from center of screen
External (auxiliary input)	±8 V
Acquisition Modes	
Sample	Acquire sampled values
Peak Detect	Captures narrow glitches at all real-time sampling rates
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 resolution
Roll	Scrolls waveforms right to left across the screen at sweep speeds slower than or equal to 40 ms/div
Trigger Modes	
Edge	Positive or negative slope on any channel or front-panel auxiliary input. Coupling includes DC, AC, HF reject, LF reject, and noise reject.
Pulse Width	Trigger on width of positive or negative pulse 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 four 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 two 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 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.
I2C (optional)	Trigger on Start, Repeated Start, Stop, Missing ACK, Address (7 or 10 bit), Data, or Address and Data on I2C buses up to 3.4 Mbps.
SPI (optional)	Trigger on SS, 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 Error 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.
LIN (optional)	Trigger on Sync, Identifier, Data, Id and Data, Wakeup Frame, Sleep Frame, Error up to 100 kbps.
I2S/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.[1]
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.
Trigger Delay by Time	4 ns to 8 s
Trigger Delay by Events	1 to 9,999,999 events

[1] Not available on 2-channel models.

Waveform Measurements

Characteristic	Description
Cursors	Waveform and Screen
Automatic Measurements	29, of which up to four 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, Rising Edge Count, Falling Edge Count, Positive Pulse Count, Negative Pulse 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 on, 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
	Energy Loss: T_{on}, T_{off}, Conduction, Total
Harmonics	THD-F, THD-R, RMS measurements
	Graphical and table displays of harmonics
	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 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)) × 1.414 × VAR1).

Software

Software	Description
NI LabVIEW SignalExpress™ Tektronix Edition	A fully interactive measurement software environment optimized for the DPO3000 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. Standard DPO3000 Series support for acquiring, controlling, viewing, and exporting your live signal data. A 30-day trial period of the Full Version provides additional signal processing, advanced analysis, mixed signal, sweeping, limit testing and user-defined step capabilities. Order SIGEXPTE for permanent Full Version capability.
OpenChoice® Desktop	Enables fast and easy communication between a Windows PC and the DPO3000 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	9 in. (228.6 mm) wide-format liquid-crystal TFT color display
Display Resolution	800 horizontal × 480 vertical pixels (WVGA)
Waveform Styles	Vectors, Dots, Variable Persistence, Infinite Persistence
Graticules	Full, Grid, Cross Hair, Frame, IRE, and mV
Format	YT and XY
Waveform Capture Rate	Up to 50,000 wfm/s

Input/Output Ports

Port	Description
USB 2.0 High-speed Host Port	Supports USB mass storage devices and printers. One port 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
Video Out 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 300 V_{RMS} Cat II with peaks ≤ ±450 V.
Probe Compensator Output	Front-panel pins Amplitude 2.5 V 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

9

Power Source

Characteristic	Description
Power Source Voltage	85 to 265 V ±10%
Power Source Frequency	45 to 440 Hz (85 to 265 V)
Power Consumption	120 W maximum
Optional TekVPI® Power Supply	Output Voltage – 12 V Output Current – 5 A Power Consumption – 60 W

Physical Characteristics

Dimensions	mm	in.
Height	203.2	8
Width	416.6	16.4
Depth	137.2	5.4
Weight	**kg**	**lb.**
Net	4.17	9.2
Shipping	8.62	19
Rackmount Configuration	5U	
Cooling Clearance	2 in. (51 mm) required on left side and rear of instrument	

General Characteristics

Characteristic	Description
Environmental	
Temperature	
Operating	0 ºC to +50 ºC
Nonoperating	–40 ºC to +71 ºC
Humidity	
Operating	High: 30 ºC to 50 ºC, 5% to 45% Relative Humidity Low: 0 ºC to 30 ºC, 5% to 95% Relative Humidity
Nonoperating	High: 30 ºC to 50 ºC, 5% to 45% Relative Humidity Low: 0 ºC to 30 ºC, 5% to 95% Relative Humidity
Altitude	
Operating	3,000 meters (9,843 feet)
Nonoperating	12,000 meters (39,370 feet)
Random Vibration	
Operating	0.31 G_{RMS} from 5 to 500 Hz, 10 minutes each axis, 3 axes, 30 minutes total
Nonoperating	2.46 G_{RMS} from 5 to 500 Hz, 10 minutes each axis, 3 axes, 30 minutes total
Regulatory	
Electromagnetic Compatibility	89/336/EEC
Safety	UL61010-1,Second Edition; CAN/CSA C22.2 No. 1010.1 1992, EN61010-1:2001; IEC 61010-1:2001

Ordering Information

DPO3000 Series

Product	Description
DPO3012	100 MHz, 2.5 GS/s, 5 M record length, 2-channel digital phosphor oscilloscope
DPO3014	100 MHz, 2.5 GS/s, 5 M record length, 4-channel digital phosphor oscilloscope
DPO3032	300 MHz, 2.5 GS/s, 5 M record length, 2-channel digital phosphor oscilloscope
DPO3034	300 MHz, 2.5 GS/s, 5 M record length, 4-channel digital phosphor oscilloscope
DPO3052	500 MHz, 2.5 GS/s, 5 M record length, 2-channel digital phosphor oscilloscope
DPO3054	500 MHz, 2.5 GS/s, 5 M record length, 4-channel digital phosphor oscilloscope

Included: All models include: One P6139A 500 MHz, 10x Passive Probe per Channel, Front Cover (200-5052-xx), User Manual, Documentation CD (063-4104-xx), OpenChoice® Desktop Software, NI LabVIEW SignalExpress™ Tektronix Edition LE Software, Calibration Certificate Documenting Traceability to National Metrology Institute(s) and ISO9001 Quality System Registration, Power Cord, Accessory Pouch (016-2008-xx), Three-year Warranty. Please specify power plug and manual language version when ordering.

Application Modules

Module	Description
DPO3AUDIO	Audio Serial Triggering and Analysis Module. Enables triggering on packet level information on I2S, LJ, RJ, 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.[1]
DPO3AUTO	Automotive Serial Triggering and Analysis Module. Enables triggering on packet level information on CAN bus and LIN bus 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.
DPO3EMBD	Embedded Serial Triggering and Analysis Module. Enables triggering on packet level information on I2C 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.
DPO3COMP	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.
DPO3PWR	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).
DPO3VID	HDTV and Custom (nonstandard) Video Triggering Module

[1] Not available on 2-channel models.

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

Language Options*2

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	Traditional Chinese manual
Opt. L9	Korean manual
Opt. L10	Russian manual
Opt. L99	No manual

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

Service Options*3

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)

*3 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 voltage probe
TDP0500	500 MHz TekVPI differential voltage probe with ±42 V differential input voltage
TDP1000	1 GHz TekVPI differential voltage probe with ±42 V differential input voltage
TCP0030	120 MHz TekVPI 30 Ampere AC/DC current probe
TCP0150	20 MHz TekVPI 150 Ampere AC/DC current probe
TCPA300/400*4	Current measurement systems
P5200	1.3 kV, 25 MHz high-voltage differential probe
P5205*4	1.3 kV, 100 MHz high-voltage differential probe
P5210*4	5.6 kV, 50 MHz high-voltage differential probe
P5100	2.5 kV, 100X high-voltage passive probe
ADA400A*4	100X, 10X, 1X, 0.1X high-gain differential amplifier
DPO3PWRBND Power Solution 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 (DPO3PWR) in a hard-sided carrying case. Bundle discount reflected in price.

*4 Requires TekVPI® to TekProbe BNC adapter (TPA-BNC).

Recommended Accessories

Accessory	Description
Service Manual	071-2422-xx (English only)
SIGEXPTE	NI LabVIEW SignalExpress Tektronix Edition Software
TPA-BNC	TekVPI to TekProbe BNC adapter
TekVPI® External Power Supply*5	119-7465-xx
TEK-USB-488	GPIB to USB adapter
Soft Transit Case	ACD4000
Hard Transit Case	HCTEK4321 (requires ACD4000)
Rackmount Kit	RMD3000
TEK-DPG	Deskew Pulse Generator
067-1686-00	Deskew Fixture

*5 Required when total oscilloscope probe power usage exceeds 20 W.

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

CE

ISO 9001 — Product(s) are manufactured in ISO registered facilities.

GPIB IEEE-488 — Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.