

See a World Others Don't

The Story Behind DPO, DPX[®] and Waveform Capture Rates
Digital Phosphor Oscilloscopes

Primer

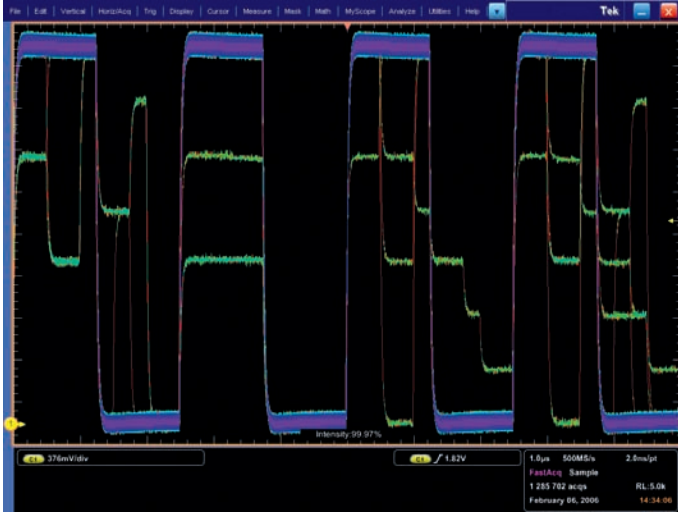


Figure 1. Digital Phosphor Oscilloscope (DPO).

DPO Provides Unprecedented Signal Insight

Perfect Vision

Imagine a world where your oscilloscope lets you see a signal anomaly, pinpoint the nature of the fault and trigger on the event to isolate it; all in a matter of minutes. Imagine getting done with your debugging in hours, not days. Imagine having total confidence and trust that you're accurately seeing details of an entire signal, and a true representation of what it really looks like. That world exists. Tektronix created it. It's called the Digital Phosphor Oscilloscope (DPO).

The Tektronix Digital Phosphor Oscilloscope (DPO) is in a class by itself. DPOs utilize parallel processing that provides unmatched waveform update performance to capture, display, store and analyze complex signals in near real-time, using three dimensions to display signal information — amplitude, time and distribution of amplitude over time — resulting in an intensity or color graded display. DPOs let you see the details behind the details. Your waveform may contain events that occur once per second and others that occur every nanosecond. Only a DPO can show you the difference in real time. With a DPO you can see anomalies at a glance; get a quick estimate of jitter behavior; determine where amplitude variations are affecting your signal; spot those one-time transients.

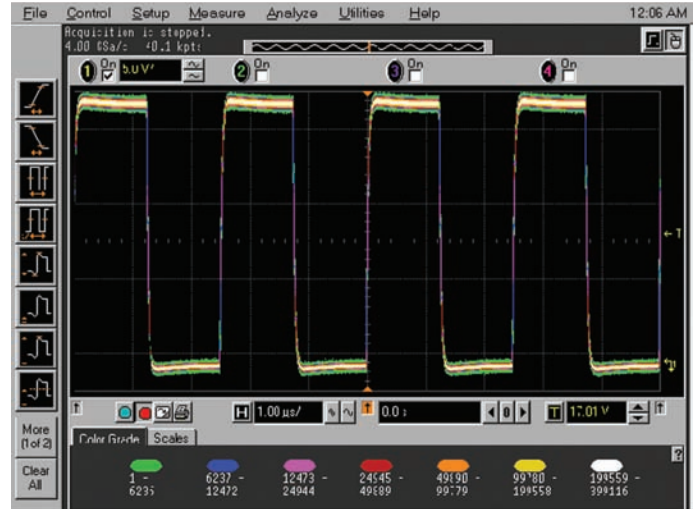


Figure 2. Digital Storage Oscilloscope (DSO).

A DPO helps you make the right troubleshooting and analysis decisions the first time. Imagine getting done with your debugging in hours instead of days!

DPX® Acquisition Technology Captures More Signal Data In Less Time

Where does the DPO's unprecedented level of signal insight come from? It all starts with DPX® acquisition technology, an innovative parallel processing architecture that delivers continuous waveform capture rates of over 300,000 waveforms per second (wfms/s). Compare that with the typical DSO, whose waveform capture rate may approach 8000 wfms/s. In practice the DPO is far more likely to be doing its job — acquiring waveforms — when an anomaly occurs. It gives you the highest probability of witnessing problems common to digital systems: runt pulses, glitches, timing issues, and more.

Signal aberrations simply can't hide from a DPO.

Digital phosphor oscilloscopes speed your work and enable you to design, build, deploy, and manage advanced technologies ranging from global communication networks to computing and beyond. DPOs are part of a world-class family of Tektronix products, services and support designed to help customers meet their business objectives.

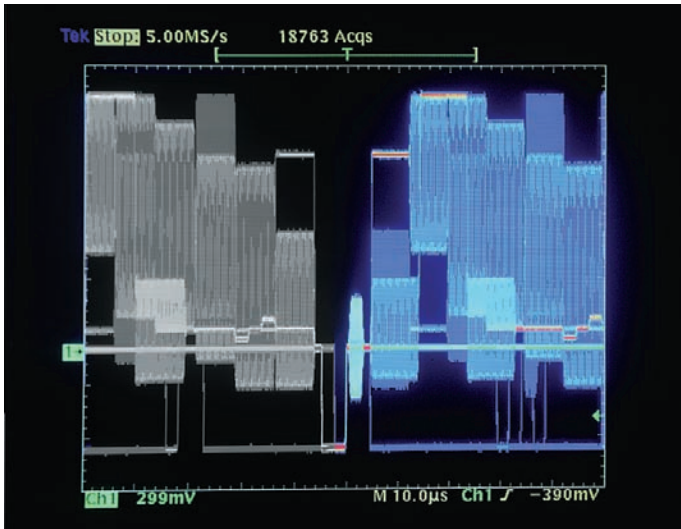


Figure 3. Digital Phosphor Oscilloscope (Color graded or grayscale).

Three Dimensions of Signal Information

DPOs are known for their exceptional waveform capture rate, which surpasses that of equivalent digital storage oscilloscopes (DSO) by a wide margin. A DPO can accumulate a huge amount of information about the signal as it captures and stores thousands of waveforms per second thousands of times per second.

That's the basis of the striking DPO waveform display. Every waveform acquisition is superimposed with the previous acquisition and waveform-points that occur more frequently than others are intensity graded. This quickly highlights the contrast between events that over time occur more and less often. Color-graded displays, provide even more definition. Instead of relying on post-process information, as with other Oscilloscopes, DPOs enables to capture, display, store and analyze complex signals through the acquisition system in real time using three dimensions of signal information:

- Amplitude
- Time
- Distribution of occurrence over time

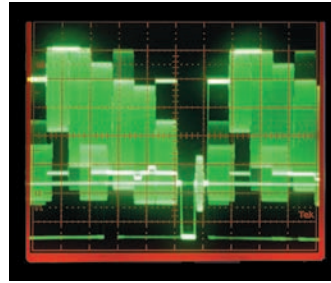


Figure 4. Analog Real Time (ART) Oscilloscope.

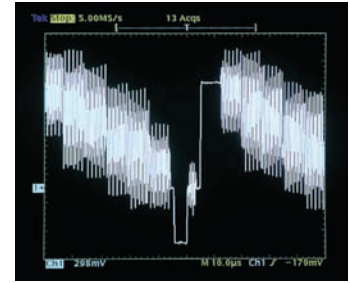


Figure 5. Digital Storage Oscilloscope.

The result is a near real-time display that most accurately represents the feature-rich nature of the signal, providing greater insight into critical signal behavior and more data for in-depth analysis. Plus, it provides you with unmatched insight into the dynamic characteristics of the signal and subtle and infrequent behavior patterns.

Information-Rich Display

For years, digital oscilloscopes have been held to the analog standard. Analog real-time (ART) oscilloscopes provided an information-rich display (Figure 4). They did this by having a short retrace period between each successive sweep. A higher percentage of time was spent displaying the signal than prepping for the next sweep. Infrequent signal artifacts would appear as dim traces, more frequent, common attributes would appear as bright traces. Digital storage oscilloscopes provide a display in a flat, two-dimensional manner (Figure 5). DPOs (Figure 3) rapidly store waveform data points in a three-dimensional database, then display the data base just as rapidly provide a live analog-like display. The DPO has broken down the barrier: it combines a rich analog-like display with uncompromised digital oscilloscope performance.

Serial Processing

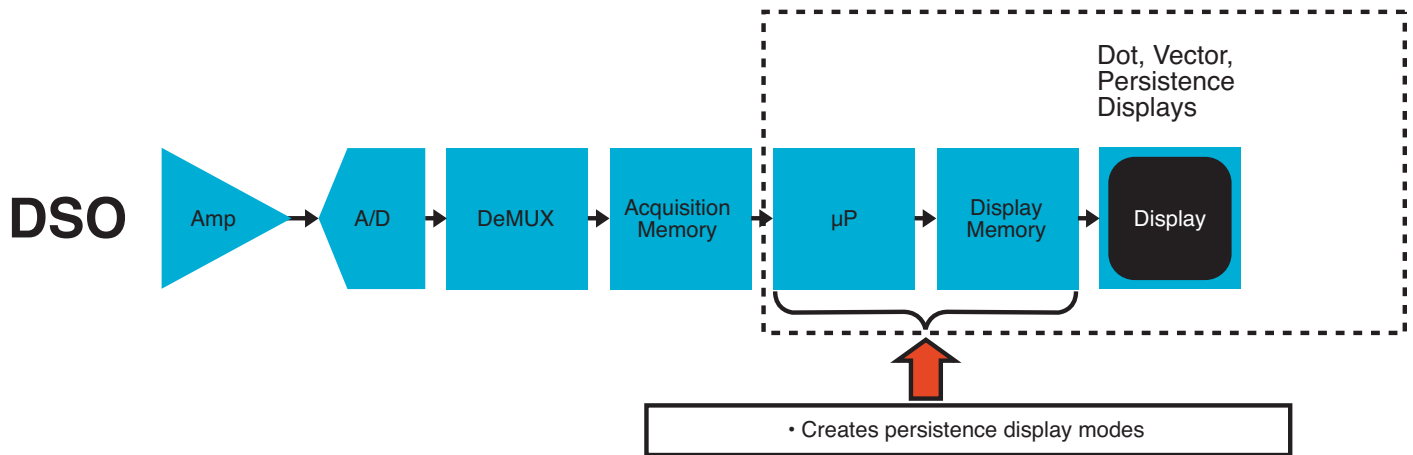


Figure 6. In a DSO, the acquisition path is purely serial. This requires microprocessor intervention in the signal acquisition process. The microprocessor slows down the waveform capture rate.

The DPO Advantage

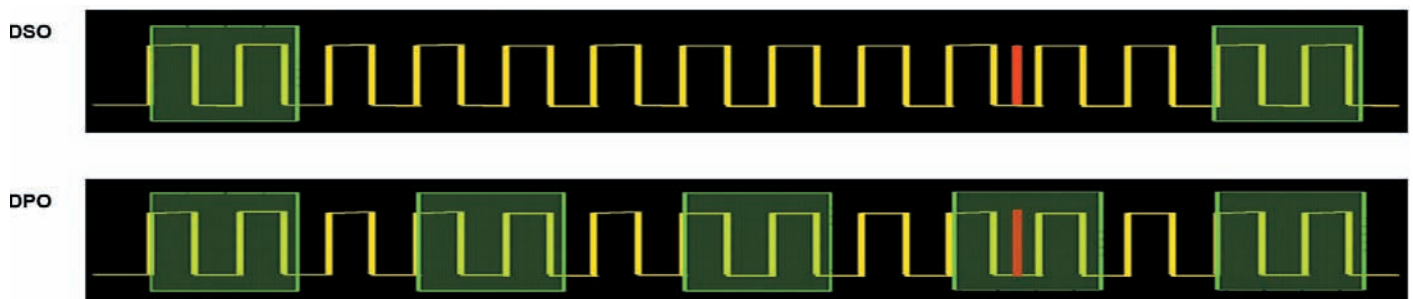


Figure 7. The DPO rasterizes acquired waveforms into a usable image by building a real-time database of waveforms. The database accumulates waveform images or “screens” continuously, increasing the probability to capture signal anomalies.

Parallel Processing is Key to DPO

Unique Internal Architecture Powers DPO

The power of a DPO lies in its parallel architecture. The DPO acquires and rasterizes the digitized waveform data into a waveform image by creating a waveform database. About every 1/30th of a second, nearly as fast as the eye can perceive it, a snapshot of the signal image stored in the digital phosphor is sent directly to the display system. This direct rasterization of waveform data, and direct copy-to-display memory, removes any slowdown in data processing.

This approach eliminates time-consuming interruptions for image processing to support operations such as vector and persistence display modes.

Periodically (about as fast as the eye can perceive it), a snapshot of the signal image stored in the database is sent directly to the display system. This direct rasterization of waveform data works with the direct copy-to-display memory to avoid any slowdown in data processing.

Parallel Architecture Frees Microprocessor

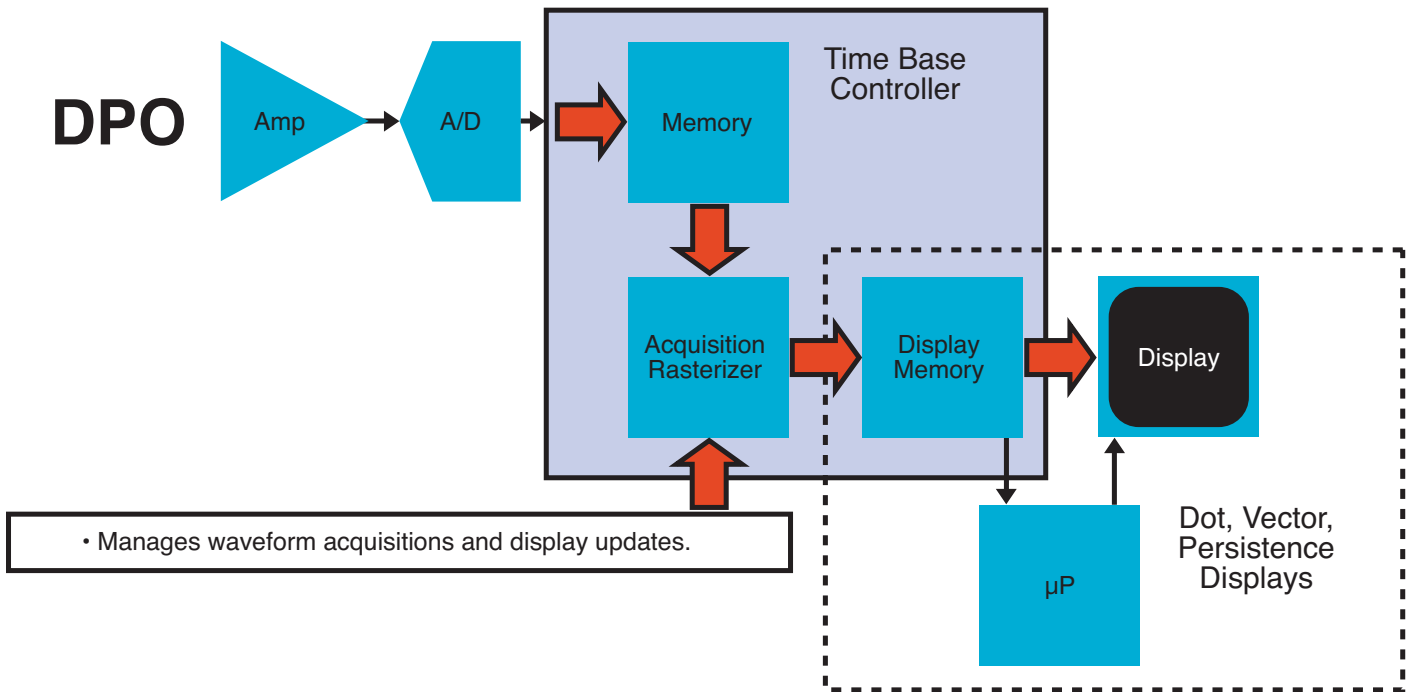


Figure 8. DPO parallel processing architecture.

In most DPO models, exclusive DPX® acquisition technology takes the DPO advantage to its logical conclusion, with the highest continuous capture rates and additional powerful tools including the FastAcq acquisition mode and more.

DPX Acquisition Technology Provides Maximum Performance

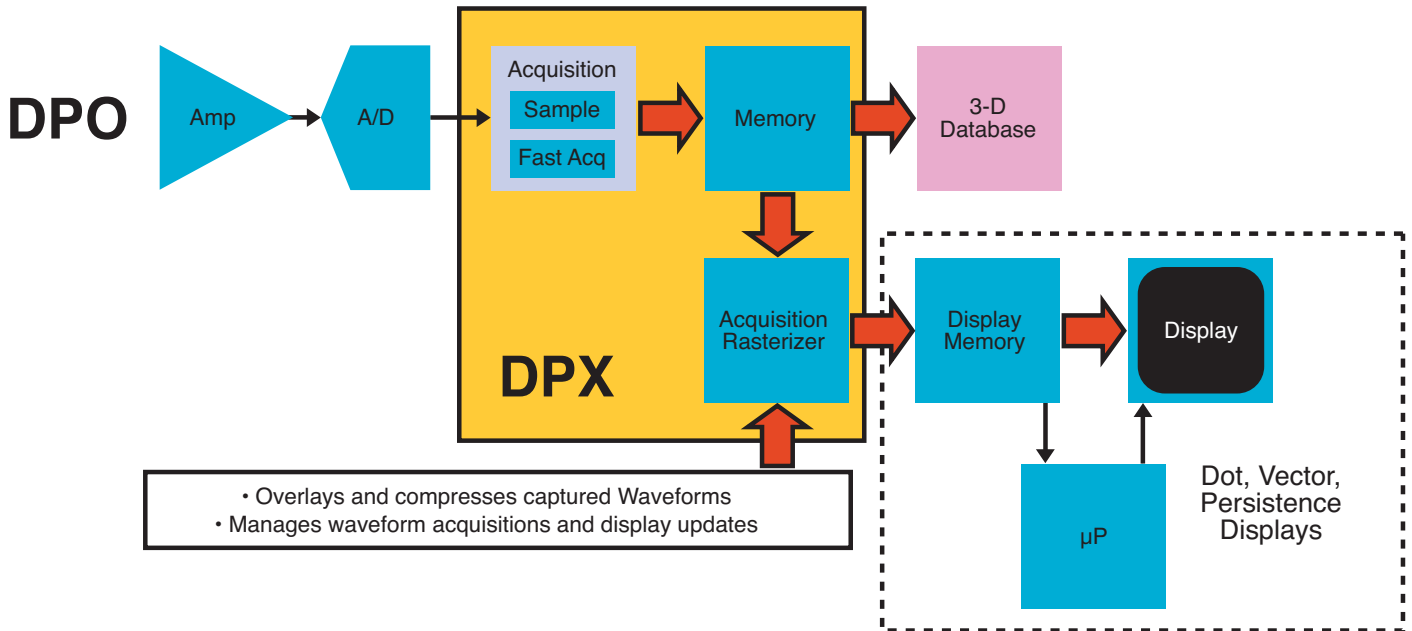


Figure 9. Simplified block diagram of a DPX-based system.

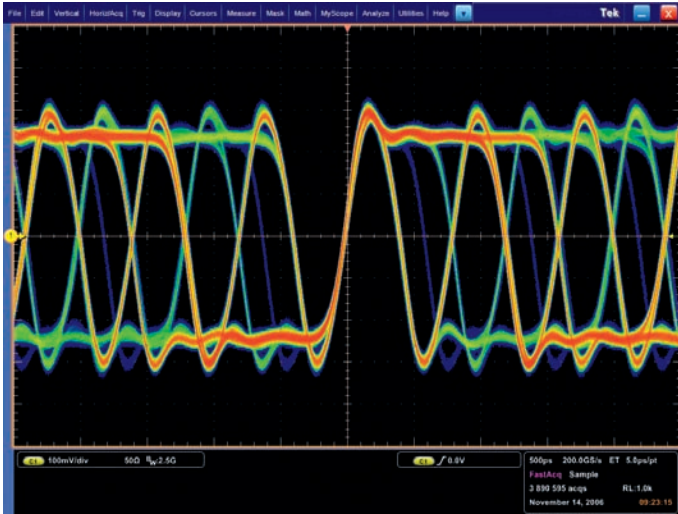


Figure 10. A DPO shows millions of waveforms in seconds, allowing you to quickly pinpoint a fault location and trigger on the event. Tektronix' DPX waveform image processing finds elusive faults in seconds.

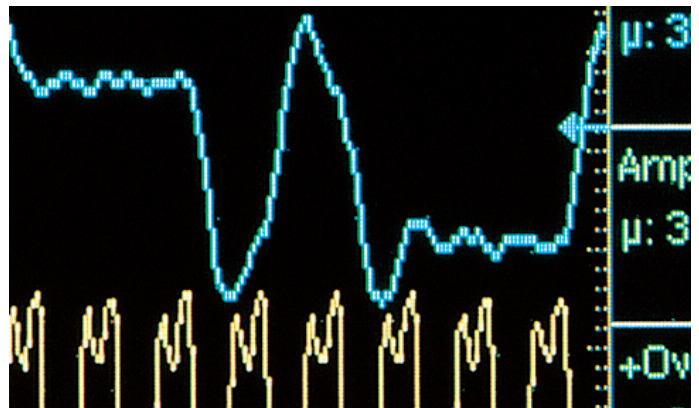
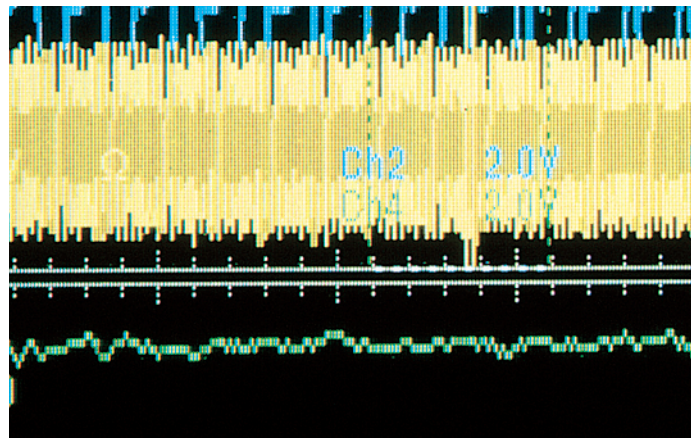
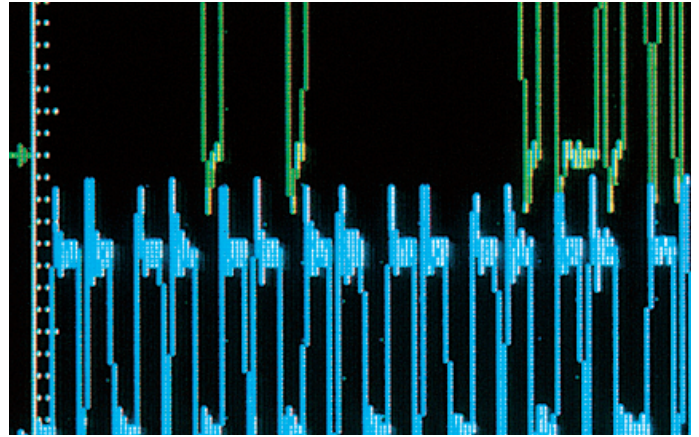
Third Generation DPX® Acquisition Technology Increases Waveform Capture Rate

Find Elusive Faults in Seconds with DPO

The DPO is your strongest ally in digital troubleshooting. With many thousands of waveform captures occurring every second, even the rarest events can be captured in short order.

To truly understand the importance of continuous waveform capture, imagine using a DSO to track down a problem that stems from some infrequent or random fault condition. Typically, you move the probe from one test point to the next, hoping the error will appear. You contact each circuit location for just a few seconds, then move on. If the fault occurs but the oscilloscope misses it (perhaps because its acquisition system is busy processing display information instead of acquiring) then you might spend minutes, hours... even days trying to solve the problem.

The DPO changes all this. With a continuous capture rate of over 300,000 wfms/s, the DPO is always on the lookout for transient events. You'll see the details others don't!



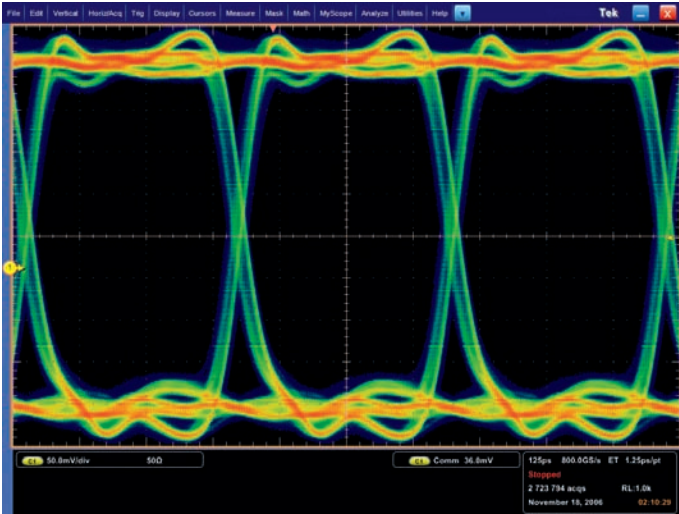


Figure 11. With a waveform capture rate that exceeds 300,000, the DPO70000B brings out rich signal details not available with traditional DSOs.

Looking at the DPO Display: The Difference is in the Details

The DPO's continuous waveform capture approach means it gathers more waveforms in less time, creating detail-rich displays and deep analytical databases in seconds rather than minutes. Intensity-graded trace data begins building up immediately. Brief transients are revealed with unmistakable clarity. Subtle modulation patterns show up in dynamic shaded images. Eye diagrams clarify transitions and expose mask hits at a glance.

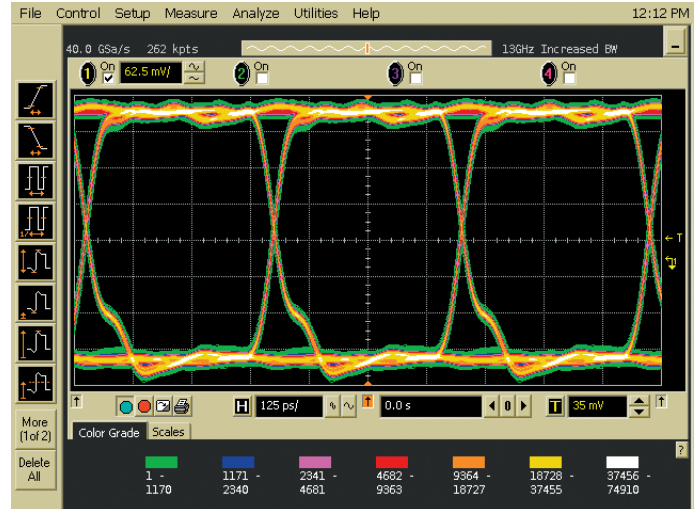


Figure 12. The DSO eye diagram is the result of post-processing, and its frequency of occurrence dimension is more difficult to interpret.

The trigger rate of an oscilloscope is driven by two factors: acquisition time and hold-off time (sometimes referred to as re-arm or dead time). A DPO provides more signal details, minimizes hold-off time, and significantly reduces how long it takes discover and identify elusive faults. In comparison the slower trigger rate of a DSO provides less signal detail, as illustrated in the eye diagram shown here. Another way of saying this is a DPO “blinks” less, so therefore sees more than a DSO.

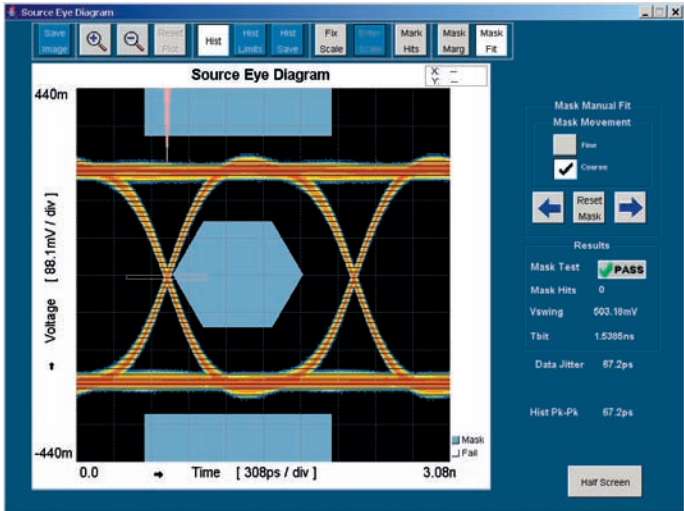


Figure 13. A DPO provides sophisticated processing, analysis and display functions for serial data analysis.

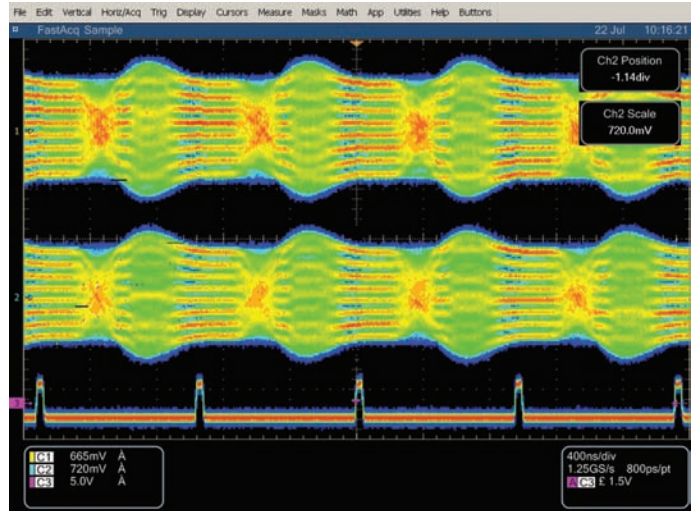


Figure 14. A DPO provides insight into 64QAM signal information.

DPO Meets Your Signal Challenges

An Ideal Solution

In fields ranging from computing to communications to networking and video, acquiring and analyzing today's complex dynamic signals demands exceptional live-time, deep signal insight and sophisticated trigger capabilities. A digital phosphor oscilloscope is the test and measurement solution that fulfills all of these requirements, and more.

Computer

The challenge: ever-increasing data rates, ascending clock rates and tighter timing margins. Complex serial data formats. Signals made almost unrecognizable by their own transmission. Jitter and transient problems that are more difficult to see, yet more critical to find than ever before.

The DPO solution:

- Build eye diagrams and statistical data including histograms quickly, thanks to the DPO's ability to capture millions of waveforms in seconds
- Get fast, accurate signal characterization results with DPO models offering the highest bandwidth and sample rate in the marketplace
- Interpret eye diagrams easily; detect transients and timing violations more reliably with intensity-graded DPO display

Communications

The challenge: characterizing complex dynamic signals and asynchronous packetized data signals, proliferating modulation formats. Increasing telecom transmission rates and channel counts. Next-generation protocols, with all their compliance challenges.

The DPO solution:

- See subtle modulation patterns quickly with the DPO's intensity-graded display
- Enjoy full bandwidth and continuous acquisition capability for accurate XY and XYZ display
- Benefit from precise representation of dynamic signal details thanks to DPO's continuous real-time capture rate

Serial Data Analysis

The challenge: fast next-generation serial buses, multi-lane serial signals, complex encoding, widespread use of low- and high-speed protocols.

The DPO solution:

- See eye diagram details and mask violations easily with intensity-graded DPO
- Add serial decoding and triggering, eye diagram analysis, jitter measurement tools to most DPO models to save time when working with high-speed protocols
- Use certain DPO models to automatically decode low-speed protocols (CAN, I2L, etc.) and find errors quickly with powerful built-in search tools

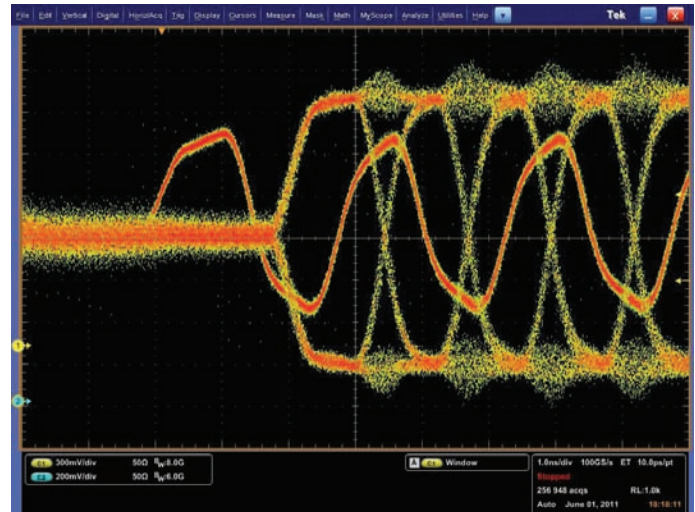
Complete Family of DPOs to Meet Your Test and Measurement Needs

Tektronix extensive family of DPOs provides enhanced productivity and performance for characterizing, testing, and debugging digital designs. DPOs give you the power to acquire the fastest waveforms with crystal clarity and easily detect the most rarified events.

DPOs are equally suitable for viewing signals at high frequencies or low repetition rates; for capturing brief transients or complex serial data in real time. Models are available in a range of performance levels, from the technician's service tool to researcher's cutting-edge measurement solution.



A DPO brings out the live analog-like display for video measurements.



DDR burst traffic captured with DPX display.

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Contact List Updated 10 February 2011

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