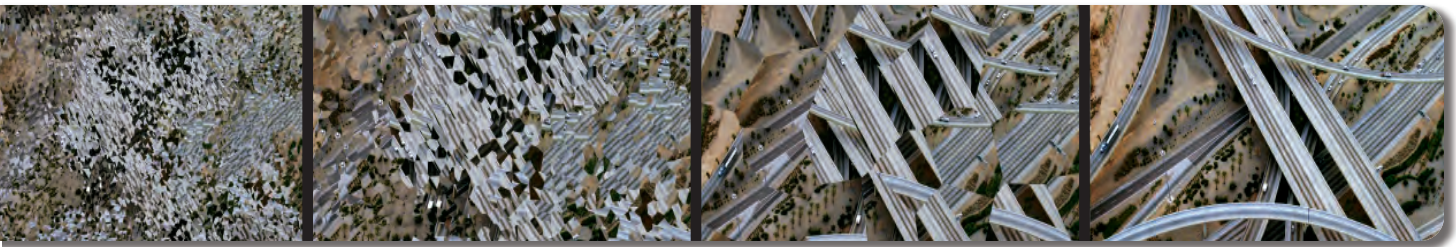


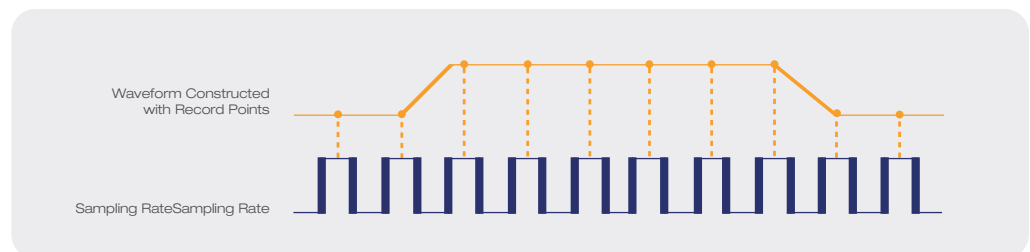
Be sure to capture the complete picture



Tektronix Digital Real-time (DRT) Sampling Technology

As an engineer or technician, you need the confidence and trust that you're accurately capturing the details of your signal. If an oscilloscope's sample rate isn't fast enough, transient signal details are lost, resulting in errors. Digital real-time oscilloscopes acquire signals in real time, capturing enough samples of the signal needed to faithfully reconstruct a waveform in a single acquisition cycle.

The Solution ... Digital Real-time (DRT) Sampling Technology



Why is Sample Rate So Important?

Real-world events are dynamic and occur in real time. Shouldn't your oscilloscope be equipped with adequate technology to capture dynamic signals in real time as well?

Transient events occur only once, and therefore, must be sampled in the same time frame in which they occur. If your oscilloscope's sample rate isn't fast enough, high-frequency components can "fold down" into a lower frequency, causing aliasing in the display.

The faster a digital storage oscilloscope samples an input signal, the greater the resolution and detail realized on the displayed waveform. The Nyquist sampling theory states that a waveform must be sampled at a rate that is at least twice the highest expected frequency in the signal under test. However, this theory only applies to sinusoidal signals. Today's complex waveforms undoubtedly require higher than 2X sample rate multipliers to accurately capture changing or single-shot events.

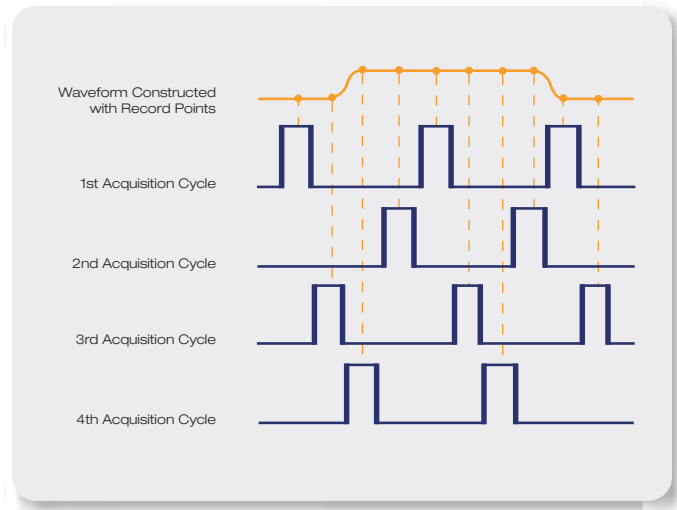
Digital Real-time vs. Equivalent-time Sampling Techniques

	Equivalent-time (ET) Sampling	Digital Real-time (DRT) Sampling
Definition	A sampling technique in which a representative waveform is created with a series of samples taken from identical repetitive waveforms	A sampling technique in which all samples are taken in a single cycle of the digitizing system, capturing and displaying the event in the same time frame in which it occurs
Elements	<p>Allows the oscilloscope to accurately capture signals whose frequency components are higher than the oscilloscope's sample rate; however, the input signal must be repetitive</p> <p>Requires multiple triggering events, which often results in missing signal information in the case of non-repetitive or single-shot events</p> <p>Most ET-sampling DSOs have actual real-time bandwidths of less than a third of their published analog or repetitive-signal bandwidths</p> <p>If pushed to published bandwidth, displays of single-shot waveforms can be marred by digital aliasing or other distortions caused by exceeding the oscilloscope's effective real-time bandwidth</p>	<p>Affords true 4X to 10X over-sampling of the signal on all channels simultaneously</p> <p>Input signal need not be repetitive</p> <p>Samples are equally spaced in time and acquired in a single trigger event</p> <p>Every single waveform cycle is sampled completely, providing all the detail needed to accurately reconstruct the signal</p> <p>Real-time acquisition up to the instrument's full analog bandwidth for both repetitive and single-shot events</p>

The Limitation of Equivalent-time (ET) Sampling Technology

Would you use a digital camera if it required you to take a series of pictures before producing a clear image? Most people would probably find this unacceptable. The same holds true for a digital storage oscilloscope's ability to take snapshots that accurately reproduce non-repetitive or single-shot waveforms in a single acquisition cycle.

One persistent limitation of many conventional digital storage oscilloscopes (DSO) has been their inability to perform to published bandwidths when acquiring non-repetitive waveforms and single-shot events. This limitation is an artifact of the equivalent-time (ET) sampling architecture that requires multiple acquisition cycles in order to display a meaningful waveform. ET sampling techniques work well for repetitive waveforms, but often fall short when reconstructing non-repetitive or single-shot events.



Equivalent-time sampling oscilloscopes construct a picture of a repetitive signal by capturing a little bit of information from a series of acquisition cycles

How Do I Avoid Products with Equivalent-time (ET) Sampling Technology?

When evaluating the purchase of your next digital storage oscilloscope, make sure the maximum specified single-shot sample rate is at least 4X, and preferably 10X, greater than the instrument's published bandwidth.

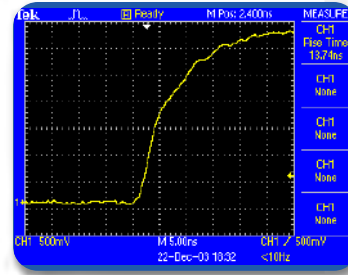
Specification	Sampling Techniques	
	Equivalent-time (ET)	Digital Real-time (DRT)
Bandwidth	100 MHz	100 MHz
Sample Rate (Single-shot or Real-time)	100 MS/s	1 GS/s
Sample Rate (Equivalent-time)	25 GS/s	N/A
Sample Rate*/Bandwidth =	1X	10X

*Single-shot or real-time sample rate for non-repetitive events

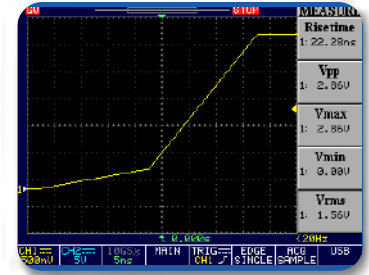
Benefits of Digital Real-time Sampling Technology

Single-shot Events

Equivalent-time sampling does little for single-shot events since they must be sampled entirely within one trigger event.



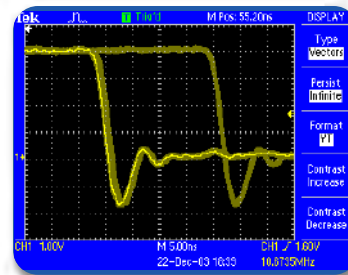
► DRT Sampling Technology*1



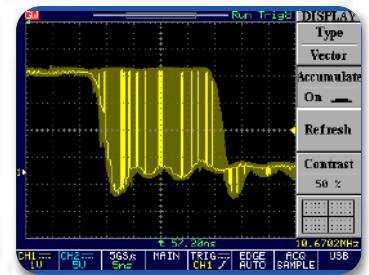
► ET Sampling Technology*2

Meta-stable (Non-repetitive) Events

Since an equivalent-time waveform is constructed from successive acquisition cycles of a signal, its update rate is relatively low. If the input signal modulates or changes during acquisition, ET sampling averages the momentary changes over time, displaying a distorted representation of the actual events.



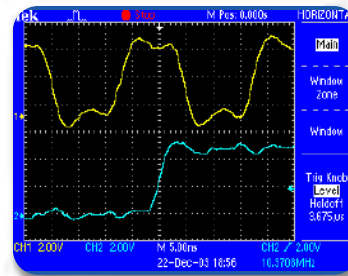
► DRT Sampling Technology*1



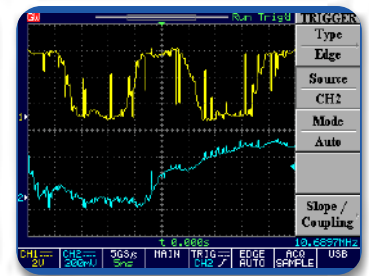
► ET Sampling Technology*2

Multiple Channel Acquisitions (Digital Output: Clock and Data)

DRT sampling technology maintains the same level of real-time sample rate performance, even on multiple-channel acquisitions. It would be very difficult to reveal timing relationships on equivalent-time-generated signals.



► DRT Sampling Technology*1



► ET Sampling Technology*2

*1 Tektronix TDS2012 digital storage oscilloscope

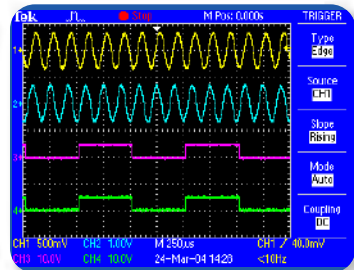
*2 Goodwill Instek GDS820S digital storage oscilloscope

TPS2000 Series Digital Storage Oscilloscopes

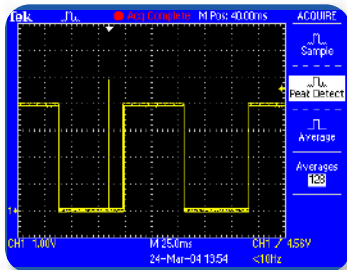
The DRT Advantage

Powerful Productivity from Bench to Field

Specification	TPS2012	TPS2014	TPS2024
Channels (Isolated)	2	4	4
Bandwidth (MHz)	100	100	200
Sample Rate (GS/s) (Real-time)	1.0	1.0	2.0
Record Length	2.5 K points on all models		
Display (1/4 VGA LCD)	Color on all models		
CompactFlash Mass Storage	Integrated in all models		



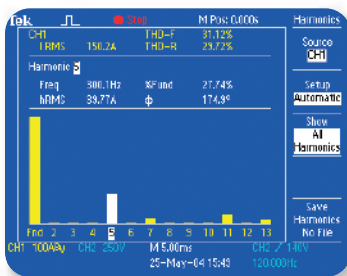
- ▶ Make floating and differential measurements, accurately and quickly with four IsolatedChannel inputs and isolated external trigger^{*3}



- ▶ Capture elusive glitches—the first time—with DRT sampling technology



- ▶ Easily correlate measurements between bench, lab and field with eight hours of battery power and beyond



- ▶ Conduct harmonic distortion measurements with TPS2PWR1 power measurement software

- ▶ 2 or 4 IsolatedChannel™ inputs and isolated external trigger input
- ▶ 8 hours of continuous battery operation with two batteries installed, hot-swappable for virtually unlimited freedom from an AC power source
- ▶ Optional power application software offers the broadest range of power measurements at its price point
- ▶ OpenChoice® software and integrated CompactFlash mass storage to quickly store, document and analyze measurement results
- ▶ Traditional oscilloscope user interface with backlit menu buttons/display and brightness/contrast controls for ease of operation in a variety of challenging environments^{*4}

^{*3} Make floating, or differential measurements up to 30 V_{RMS} floating on four channels simultaneously when the TPS2000 Series is paired with its standard P2220 passive probe. For floating or differential measurements up to 600 V_{RMS} CAT II (or 300 V_{RMS} CAT III) floating, use the optional P5120 passive, high-voltage probe.

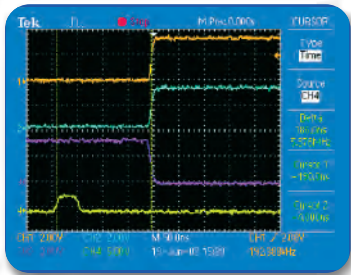
^{*4} Do not operate TPS2000 Series oscilloscopes where conductive pollutants may be present, or in wet or damp conditions.

TDS1000 and TDS2000 Series Digital Storage Oscilloscopes

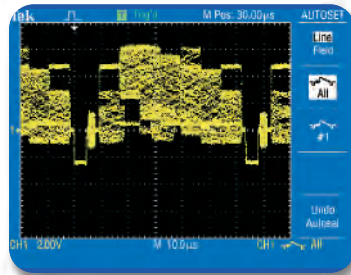
The DRT Advantage

Colorful Performance at a Black and White Price

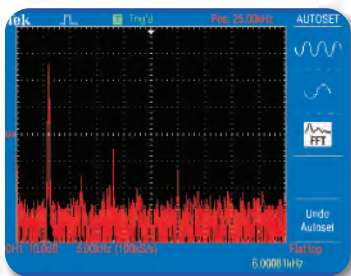
Specifications	TDS1002	TDS1012	TDS2002	TDS2012	TDS2014	TDS2022	TDS2024
Channels	2	2	2	2	4	2	4
Bandwidth (MHz)	60	100	60	100	100	200	200
Sample Rate (GS/s) (Real-time)	1.0	1.0	1.0	1.0	1.0	2.0	2.0
Record Length	2.5 K points on all models						
Display (1/4 VGA LCD)	Mono	Mono	Color	Color	Color	Color	Color
CompactFlash Mass Storage	Optional on all models						



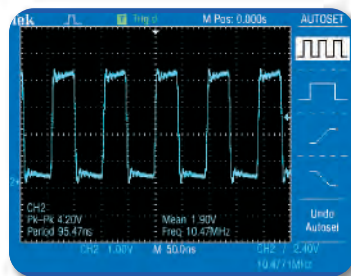
► Capture signals with far greater precision than a conventional DSO with DRT sampling technology



► Advanced triggers make even complex characterization and debugging fast and easy



► Fast Fourier Transform (FFT) makes it easy to precisely analyze, characterize and troubleshoot circuits in the frequency domain



► Autoset menu simplifies setup and operation

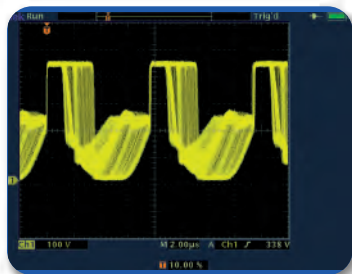
- Up to 11 automatic measurements to speed measurement tasks
- FFT standard on all models
- Optional TDS2MEM storage and communication module offers CompactFlash mass storage, RS-232 and Centronics printer ports
- Optional TDS2CMAX communication module offers GPIB programmability, RS-232 and Centronics printer ports
- OpenChoice software for easy documentation and analysis of measurement results (included with communication modules)
- Quick, easy setup and operation with traditional, analog-style knobs, multiple-language user interface, autoset menu, built-in context-sensitive help, and probe check wizard

TDS3000B Series Digital Phosphor Oscilloscopes

The DRT Advantage

More Powerful. More Portable. Still Affordable.

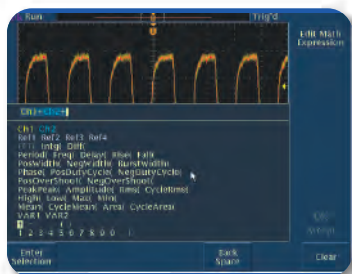
Specification	TDS3012B	TDS3014B	TDS3024B	TDS3032B	TDS3034B	TDS3044B	TDS3052B	TDS3054B	TDS3064B
Channels	2	4	4	2	4	4	2	4	4
Bandwidth (MHz)	100	100	200	300	300	400	500	500	600
Sample Rate (GS/s) (Real-time)	1.25	1.25	2.5	2.5	2.5	5	5	5	5
Record Length	10 K points on all models								
Display (1/4 VGA LCD)	Color on all models								
Floppy Disk Storage	Standard on all models								



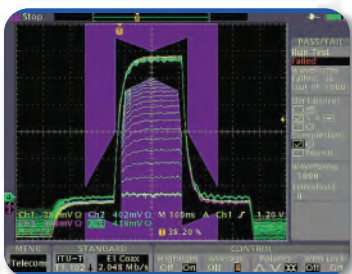
- ▶ High waveform capture rate combined with intensity grading reveals modulation effects on a power supply control loop



- ▶ WaveAlert® waveform anomaly detection alerts you to any waveform that deviates from the “normal” input



- ▶ TDS3AAM advanced analysis module delivers advanced waveform math



- ▶ TDS3TMT telecommunications mask testing module provides breakthrough test speeds for telecommunications line card testing



- ▶ Continuous waveform capture rate up to 3,600 wfms/s to reveal dynamic signals and elusive events in real time
- ▶ Three-dimensional waveform intensity grading
- ▶ Anti-aliasing
- ▶ Ultra portable with 3 hours of continuous operation at 7.0 lbs
- ▶ Wide array of application-specific modules

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For Further Information

For more information about digital real-time sampling technology, please contact your local authorized Tektronix representative or visit www.tektronix.com/oscilloscopes.

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