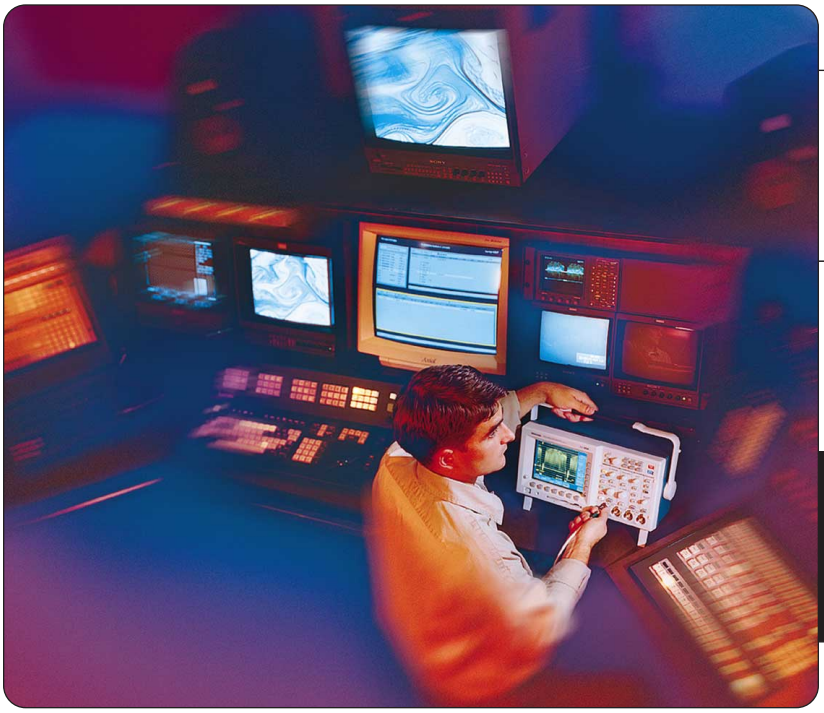
Video Installation and Troubleshooting with the TDS3000B Digital Phosphor Oscilloscope



Better than analog...

Automatic measurements, optional video modules, and battery-capable portability make the better-than-analog Tektronix TDS3000B the best choice for video measurement.

A good eye for a waveform is a video technician's first line of defense. That's why Tektronix, the leader in video measurement, developed the TDS3000B digital phosphor oscilloscope. Its real-time, intensity-graded, full-color display gives technicians the intuitive edge of a legendary Tektronix analog oscilloscope and the full feature set of a digitizing oscilloscope.

Analog Heritage – Digital Perfection

Beauty begins deep within the TDS3000B. Tektronix dedicates unique ASIC hardware to the task of capturing, analyzing, and portraying complex dynamic waveforms almost instantaneously. The result? An oscilloscope with the same information-rich display as an analog oscilloscope, but with much more detail. The TDS3000B is better at capturing those elusive anomalies that are invisible on an analog oscilloscope or poorly displayed on a DSO. Tektronix DPO technology gives you a live display that captures anomalies while providing the intensity-graded vision you need to interpret the waveform. Both patterns and one-time events are easy to see and understand.

The TDS3054B, a favorite for video applications, brings four inputs, 500 MHz of bandwidth, and a 5 GS/s sample rate to the measurement of fast video signals. With the TDS3054B's high bandwidth and fast update rate, you can interpret waveforms with confidence.

To learn more about the DPO difference, visit our Web site at www.escope.tektronix.com

Creating the Virtual Test Bench

Some video challenges take a bench full of specialized gear to see and solve. Having to haul extra equipment, such as picture monitors and vectorscopes, wherever you go doesn't make your job any easier. The TDS3000B can lighten your load. Its two optional video modules, the TDS3VID and the TDS3SDI, give the TDS3000B a bench full of extra capabilities at an awesome power-to-weight ratio.

Tektronix

TDS3VID – The Tiny Video Expert

Assembling a capable video test bench is as easy as plugging in the TDS3VID video module. It transforms the TDS3000B into a troubleshooting vectorscope for standard and HDTV signals complete with graticules for 100% and 75% color bars. You can measure chroma levels and correct white balance problems on the spot. The TDS3VID module also gives the TDS3000B picture monitor capabilities with on-screen line selection.

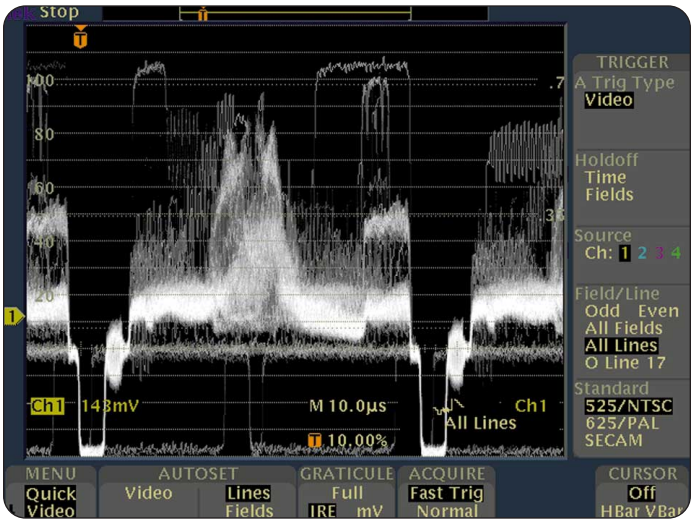
Other TDS3VID capabilities include an Individual line trigger, IRE and mV graticules, custom line/scan rates, and analog HDTV triggering for emerging standards such as 1080i, 1080p, 720p, and 480p. The module includes a simple-to-use Video QuickMenu that keeps all the sophisticated features within reach. Together, the TDS3000B and the TDS3VID form a portable, battery-capable, all-in-one measurement tool that weighs less than 5 kilograms with the battery installed.

TDS3SDI – A Serial Hero

ITU-R BT.601 Serial Digital Video has become the digital transfer standard for in-studio use. The problem with serial digital video is that you can't see it, as a familiar waveform at least. The soap opera, the commercial, the satellite sports feed, and the editing suite's output all look the same – a stream of ones and zeroes.

Enter the TDS3SDI module. When plugged into a TDS3000B, this optional video module does everything a TDS3VID can do – and adds a lot more. Feed serial video into the TDS3SDI and it converts the 601 signal into familiar analog output. Four separate cables carry composite and component signals (RGB, Y, Pb, and Pr) to the inputs of your four-channel TDS3000B. Make many standard video measurements, such as eye-diagram checks of the SMPTE 259M digital transport stream, without hauling around extra equipment. You can even work confidently up to 250 feet down from the source because of the TDS3SDI's cable auto-equalization.

These capabilities make it the perfect module for troubleshooting standard or serial digital video installations, regular maintenance, and sophisticated troubleshooting. Combining the measurement capabilities of the TDS3SDI video module with the better-than-analog TDS3054B creates the smartest (and lightest) video measurement tool you've ever carried.



▶ ***Figure 1.*** *DPO technology brings out vivid waveform detail on the IRE graticule (available with both video modules).*

The TDS3000B In Action

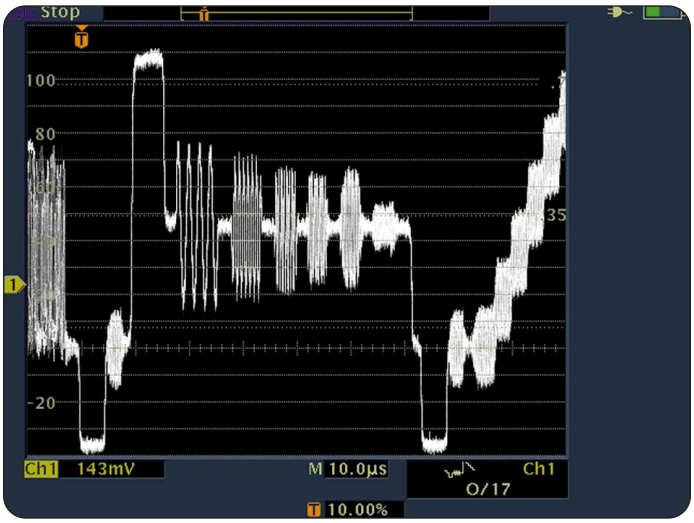
How does the TDS3000B perform when needed? Following are some typical test situations that put it to the test.

Analog Signal-Present and Video Picture Checks

The Signal-Present check is a quick test to confirm that an analog video signal is present at a given test point. It displays a classic analog video waveform showing the basic horizontal-rate of the signal amplitude vs. time. It is especially easy to do with a TDS3000B with a TDS3VID or TDS3SDI module.

Select the IRE graticule and the video triggering controls from the QuickVideo menu. Use the Video Autoset to automatically adjust vertical, horizontal, and trigger settings to bring up the waveform. Figure 1 shows an NTSC video waveform.

▶ ***Figure 2****. The optional video module lets you see the signal as monochrome display with on-screen line select.*



▶ ***Figure 3****. Line count triggering displays line 17 on an NTSC broadcast video signal.*

You know you have a signal present, but is it the right signal? Either video module lets you perform a Video Picture Check without running back for a monitor. Just select Video Picture Mode from the QuickMenu. Figure 2 shows you have the news broadcast, not the cooking show you were searching for.

That bright line in the picture is the On-Screen Line Select. You can move it to check the waveform display of any line in the picture.

Line Count Triggering

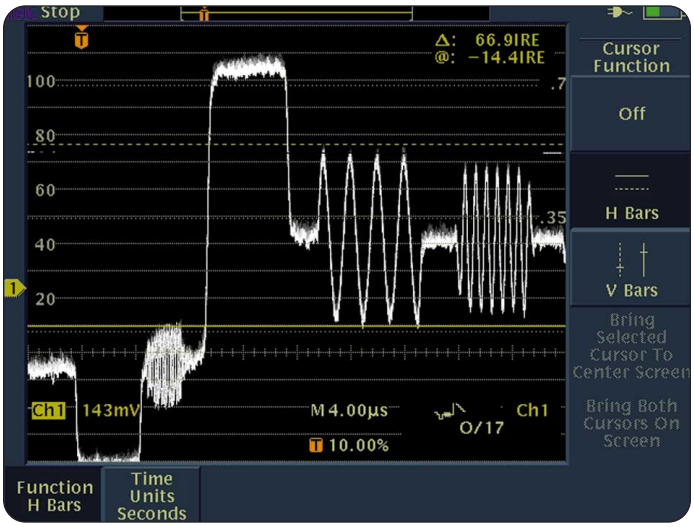
Sometimes, you need to see lines that aren't even on the screen. The V-chip programming information, for example, is found on Line 20 in the NTSC signal. You can use your TDS3000B and either video module to isolate single lines of video.

Both video modules expand the TDS3000B's video triggering capability. While the standard instrument can trigger on All Fields or on All Lines, the video modules add menu selections to trigger on any specific line number in an NTSC, PAL, SECAM, or Analog HDTV system.

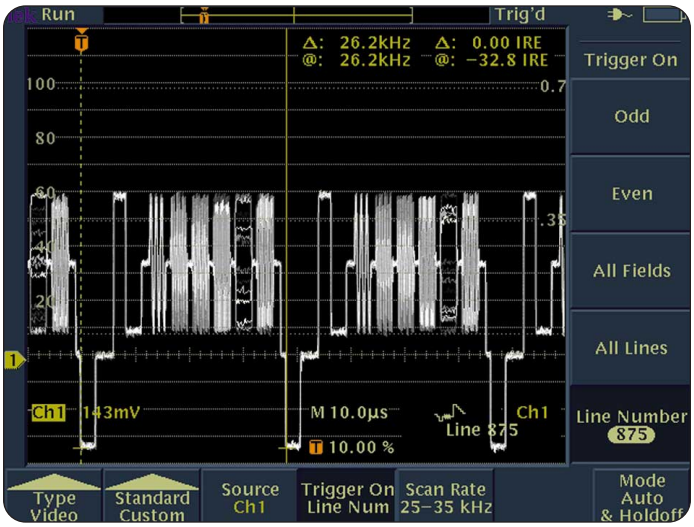
Line-number triggering is a first level QuickVideo menu selection. Choosing "Line Number" sets up the general-purpose knob to scroll through the line numbers. In Figure 3, we chose line 17 on an NTSC signal.

Automating Everyday Measurements

The TDS3000B makes routine video amplitude and timing measurements faster and more accurate. Both video modules provide IRE graticules that allow you to display and measure amplitude levels visually without converting voltage readings.



▶ ***Figure 4****. Cursor measurements allow accurate digital readout on both vertical and horizontal signal details.*



▶ ***Figure 5****. Custom video trigger allows the TDS3000 to trigger on standards such as RS343 (26.2 kHz scan rate).*

For higher accuracy, use video cursors. The CURSOR button brings up a menu to select horizontal bars for amplitude measurements. The general-purpose knob positions the cursors individually to bracket the desired waveform points. Whenever the active cursor moves, the change in the amplitude reading appears automatically on the screen. When the IRE or mV graticule is selected, the amplitude readout is expressed in the appropriate units. Figure 4 shows the cursors and the readout. For timing measurements, both video modules offer a pair of vertical bars.

You can also use the TDS3000B to automate repetitive measurements. To measure sync width, for example, trigger on the video waveform, and then expand the vertical and horizontal scales until the sync pulse almost fills the screen. Press the MEASURE button to activate the measurement menu. Select the automatic Negative Pulse Width measurement to complete the test.

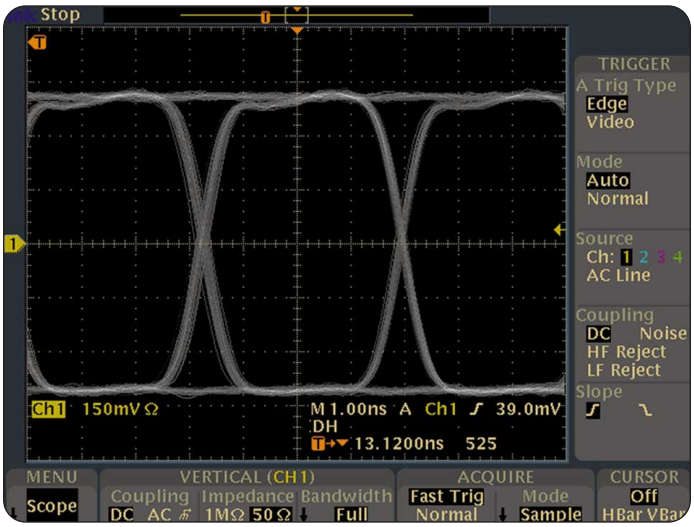
Triggering for Other Standards

Often, computer video monitors, medical displays, security cameras, and other self-contained systems don't play by NTSC, PAL, or SECAM rules. You can count on the TDS3000B to keep you in the game.

Start by capturing a stable video waveform on the screen using the oscilloscope's Edge trigger (not Video trigger, because that function is set up for standard line rates). Then use the Vertical Bars cursors (accessed by pressing the CURSOR button) to measure the time between sync pulses. The Time Units menu button lets you select the reciprocal (1/time) of the reading. Next, press the trigger MENU button. Select Type>Video and then select Standard>Custom as shown in Figure 5. Scan Rate appears as a menu option. For this signal, select Rate 3 (25 to 35 kHz) as the scan rate.

Typical Serial Digital Measurements

The TDS3054B DPO and the TDS3SDI video module make a terrific combination for troubleshooting serial digital video installations. For example, verifying that a serial digital signal is present is as simple as plugging the source into the TDS3SDI module and checking to see if the "SDI" signal button lights.



▶ ***Figure 6.*** *Eye diagram of a 601 serial digital bit stream.*

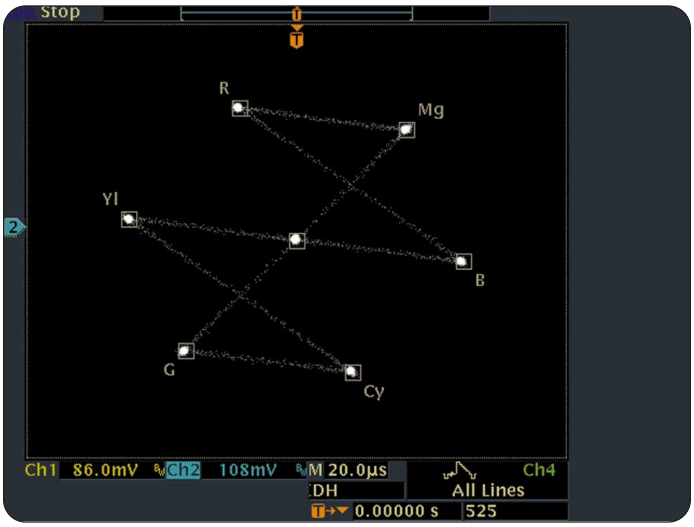
▶ ***Figure 7****. TDS3SDI decoding of the 601 bit stream showing* YP_bP_r.

Once you have confirmed that that you have a serial digital signal, it's easy to perform "eye diagram" measurements. Cable the source to Channel 1 on the oscilloscope, using one of the 75-Ohm terminators included with the SDI module. Capturing the 270 Mbit waveform requires a high bandwidth oscilloscope such as the TDS3054B. Use the automatic measurements to verify 800 mV peak-to-peak. The "X" crossings should show minimum jitter (see Figure 6).

Decoding the "eye" into its components requires the TDS3SDI video module. Plug the serial digital signal into the module. Then connect the four outputs (composite video and the three component signals) to the four channels of the TDS3054B. Press the QuickMenu and use the soft keys to display the three components. It is important to check the levels of the signals and their relative timing (see Figure 7).

The phase information among the three components creates the color information of a broadcast picture. The easiest way to adjust that relationship is on a vectorscope. The easiest way to carry a serial digital vectorscope with you is to combine the TDS3054B and the TDS3SDI video module.

Once you connect the TDS3SDI's component output to the TDS3054, press the "Vectorscope" button on the QuickMenu soft key. That displays the three components in vectorscope format for easy adjustment (see Figure 8).



▶ ***Figure 8****. TDS3SDI vectorscope display.*

Go Ahead, You Can Take It with You

Together, your TDS3000B and its optional video application modules create a lightweight, battery capable, virtual test bench that can chase down trouble spots wherever they hide. Whether you need to measure eye diagrams, check color on a vector oscilloscope display, decode serial digital signals, or unravel video artifacts 250 feet down the cable, the TDS3000B with its TDS3VID and TDS3SDI modules is your best choice.

Video Recorder "Tape Run" Adjustments

The fast update rate of the TDS3000B speeds up many time-consuming video maintenance tasks. Helical-scan video tape recorders (VTRs), for example, can be a nightmare to adjust with an ordinary oscilloscope. Even humble VHS front panels hide surprisingly complex electromechanical systems.

A video recorder typically uses a rotary scanner with two playback heads to read the signal from the videotape. The two heads read alternating interleaved tracks of information stored in a helical pattern on the tape.

To align the VTR you need to physically adjust the tape path until it passes across the scanning heads in perfect orientation. Improper adjustment can cause line dropouts – vertical striations in the video image. Even if the VTR has a dropout compensation circuit, poor alignment can degrade overall quality. Moreover, if the VTR has been damaged or if the upper drum of the scanner assembly has been newly replaced, you will need to perform an exhaustive alignment.

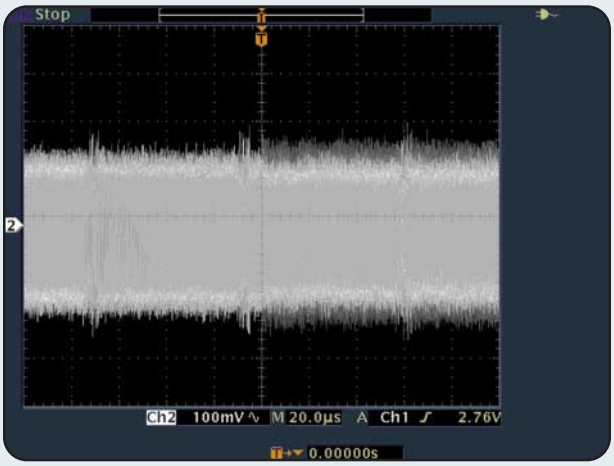
Adjusting the tape path requires positioning a series of tape guides while viewing the effect on an RF signal from the video heads. You will need an oscilloscope and an alignment tape. Some VTR manufacturers offer an optional adjustment tool for setting the tape guide screws.

TIP: It's wise to run a "known-good" tape through the machine before starting the actual adjustments. When a new scanner assembly is installed, the tape path can be grossly out of alignment – even wrinkling or scoring the first tape you try. Protect your costly alignment tapes by starting a tape you can afford to lose. You can use the "known good" tape for initial adjustments.

To set up the TDS3000B for head alignment, start the calibration tape and connect Channel 2 to the head switching pulse. This becomes the trigger source. Connect Channel 1 to the output of the high-level RF amplifier receiving the signal from the video heads. It's best to set the time base so that two, and only two, cycles of the signal are visible on-screen. The "thicker" portions of the waveform are the areas of head switching. The screen image should be centered on one of these events. Figure A shows the result.

In Figure A, the heads are out of adjustment. There are "pinched" areas in the waveform. The ideal is to set the alignment screws so the waveform peaks are relatively consistent across the top and bottom. Avoid gross variations in amplitude. The alignment screws are interactive, so it's usually necessary to do the adjustment cycle

A. RF Envelope before adjustment.



B. RF Envelope after adjustment.

Digital phosphor technology makes video head alignment as fast and easy as using an analog oscilloscope for the job.

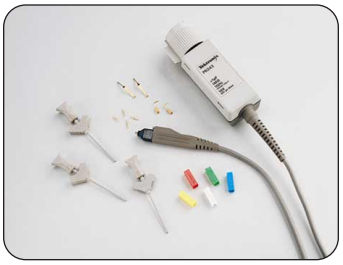
several times, making small changes each time. Figure B shows the waveform after the procedure is finished.

Interestingly, it's usually better not to strive for perfectly flat waveform peaks with uniform amplitude throughout. A small amount of variation actually improves the portability (interchangeability) of tapes recorded on the machine.

The TDS3000B DPO is a great tool for VTR head alignments. Unlike a DSO, the TDS3000B's analog-like real-time intensity grading displays the familiar RF signal envelope seen in every VTR service manual. Without intensity grading, the waveform in Figures A and B would appear as a pair of indistinct lines, almost useless for the alignment procedure.

The TDS3000B also provides tactile feedback during the procedure. The instrument's extraordinary waveform capture and display update rates ensure that the display immediately tracks any changes as adjustments are made. A continuous adjustment, therefore, appears as a continuous change in the waveform – not a series of abrupt jumps from one increment to the next.

▶ **The AMT75 75Ω Adapter** provides an effective means for 50Ω terminated instruments to connect to and analyze differential and high-speed electrical communications signals as well as video signals.



▶ **The P6243 Active FET Probe** is a high-performance probing solution for 500 MHz oscilloscopes. The P6243 has a probe-only bandwidth of 1 GHz.

For Further Information

Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology.

Please visit "Resources For You" at **www.tektronix.com**

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