Digital Power Management Analysis and Test Solutions

Key Features

Applications
- Digital Power Management
- Power Integrity
- Power Sequencing

High Definition Oscilloscopes:
- WavePro HD:
  - 12 bits up to 8 GHz
  - 5 Gpts acquisition memory
  - Integrated mixed signal capabilities
- HDO8108A:
  - 8 channels, 12 bits, 1 GHz
  - Integrated mixed signal capabilities

Complete Probe Selection
- RP4030 DC Rail Probe (4 GHz)
- High-sensitivity Current Probes
- Differential Voltage Probes and Amplifiers with 10x Gain
- Low-cost 1 GHz Active FET probe

20+ Serial Data Standards supported, including:
- I²C (PMbus)
- SPMI
- USB2, USB2-HSIC
- UART-RS232
- SPI

Application Software Package
(DIG-PWR-MGMT)

Teledyne LeCroy High Definition oscilloscopes, probes, serial data options, and the Digital Power Management application software package provide the capabilities you need for digital power management IC (PMIC), power integrity, and power sequencing testing.

8 channels, 12 bits, 1 GHz
Monitor multiple phases of a PMIC, or multiple DC power/voltage rails and other signals. Capture and view many correlated and causal events. Very large native oscilloscope offset adjustment provides means for direct connection of voltage rails with high gain/sensitivity settings. MSO option provides added flexibility.

8 GHz with High Definition
For hunting high-frequency power rail noise sources and characterizing fast phenomena like ground bounce, WavePro HD with 12 bit HD4096 technology up to 8 GHz bandwidth is the ideal tool.

Complete Probe Selection
The RP4030 Rail Probe provides ±30V offset, high DC input impedance, and low noise at the highest sensitivities. The AP033 differential voltage probe provides 10x gain at high bandwidth for monitoring series/shunt resistor voltages, with rescale to current values. Other single-ended or differential voltage or high-sensitivity current probes provide additional critical probing capabilities.

Application Software Package
(DIG-PWR-MGMT)
Capture power/voltage rails over thousands of CPU or device switching periods and display numeric mean value measurements and variations in measurements over time, correlated to the power/voltage rail acquisitions.
Only one company – Teledyne LeCroy – can provide you with the most specifically tailored solutions for digital power management, power sequencing and power integrity test, validation and debug. Whether you are testing multi-phase digital power management IC (PMIC) DC-DC converter operation under dynamic conditions, or complete embedded systems that contain PMICs, voltage regulator modules (VRMs), point-of-load (POL) switching regulators, or low-dropout (LDO) regulators, Teledyne LeCroy has the solution for you.

**Rail Voltage Power Integrity**

1 GHz with 8 channels and 12-bit resolution (HDO8108A) is the perfect mix of capabilities for many users. Others probing nearer to the CPU may desire more bandwidth (8 GHz in the WavePro 804HD). Use the high resolution to capture wide dynamic range signals during transient disturbing events and measure noise, ripple, droop, transients, and frequency harmonics. The RP4030 rail probe provides a convenient method to probe the power/voltage rail with high fidelity and bandwidth (up to 4 GHz).

**Crosstalk and Harmonics Evaluation**

Disturbances or switching transients on the voltage rail may be closely scrutinized using vertical zoom, and further analyzed with the spectrum analysis and FFT toolsets provided standard with the oscilloscope.

**Voltage Rail Startup/Sequencing Timing Measurements**

Monitor up to 8 power/voltage rails at one time along with associated serial data signals (using the MSO digital input option) to validate startup/sequencing timing budgets. Use long memory to capture startup/sequencing events while maintaining high sample rate to correlate misbehaviors with higher frequency disturbances.

Seven voltage rails and one rail current are monitored during startup. Bus activity is captured and decoded, and power sequencing timing budgets are quickly validated.
PMIC Transient Power/Voltage Rail Response
As the CPU and embedded system is dynamically loaded/unloaded, the power management system must react to keep the power rail stable and within its tolerance band while appropriately sharing current over multiple PMIC phases. The HDO8108A is ideal for monitoring up to 8 analog voltage or current signals at one time. Use the very large native oscilloscope offset adjustment when directly connecting, or the ±30V offset provided in the RP4030 rail probe, to center the power/voltage rail and view it with high sensitivity (e.g., 5 mV/div). 12-bit resolution provides 0.5% accuracy and precision over wide dynamic ranges. Easily zoom horizontally or vertically for more details.

PMIC Current Sharing/Tracking
8 channels provide an easy way to view all PMIC phases at one time, and have additional channels to monitor other transient events. The AP033 differential voltage probe and the DA1855A differential amplifier both provide 10x gain for very low voltage differential measurements on current sense resistors, and the DA1855A has exceptional common-mode rejection ratio (CMRR).

Advanced Rail Analysis Tools
Go beyond use of cursors or simple measurements – use the Digital Power Management application package to perform a cycle-by-cycle analysis on the rail voltages and display mean parametric values in a Numerics table, and then plot the changes in these values over time as per-cycle Waveforms. This vividly displays the behaviors of the DC rails in a highly intuitive and useful manner. Zoom+Gate to view details on specific portions of large acquisitions.

8 analog channels greatly improves productivity by permitting more DC power/voltage rails to be displayed at one time to better understand causal effects.
HDO8108A
The only 8 channel, 12-bit resolution, 1 GHz bandwidth oscilloscope available, and the "workhorse" for digital power management, power sequencing, and power integrity testing, validation and debug.

- 8 channels
- 12-bit resolution (HD4096 technology)
- 1 GHz
- Up to 250 Mpts/ch memory
- Exceptional signal fidelity and DC gain accuracy
- Optional MSO capabilities
- 20+ low-speed serial data options
- Powerful, deep toolbox

WavePro HD
A higher bandwidth choice for power integrity testing of faster phenomena - power rail pollution from high-speed signals, on-die effects like ground bounce, and rail-noise-related jitter.

- 4 channels
- 12 bit resolution (HD4096 technology)
- Up to 5 Gpts memory
- Exceptional signal fidelity
- Optional MSO capabilities
- Low-speed and high-speed serial analysis options
- Powerful, deep toolbox
OTHER OPTIONS AND ACCESSORIES FOR FASTER TESTING

Mixed Signal Capability
Add 16 digital logic input channels capable of capturing 250 MHz digital clock rate signals. Utilize these inputs for correlating command digital or low-speed serial data activities with captured analog signals. Digital logic inputs can be part of a combined analog+digital pattern or used as inputs for the low-speed serial data triggers or decoders.

Long Memory
The 5 Gpts of acquisition memory available in the WavePro HD permits very long capture times of combined high-speed and low-speed events. Quickly and easily correlate rail load changes to causal commands or find system misbehaviors many milliseconds after load is applied or released from the power rail.

JITKIT Software Option
JITKIT makes it simple and easy to understand the basic system jitter performance of clock signals and clock-data activities. Four views of jitter speeds debug and analysis. Use the JITKIT toolbox to correlate clock and data jitter activities to power rail behaviors or transient events, or vice-a-versa.

Low-Speed Serial Trigger, Decode, Measure/Graph, and Eye Diagram Tools
The widest range and most complete low-speed serial data debug and validation solutions, including comprehensive triggers, color-coded decoders, automated timing measurements, serial data digital-to-analog converter (DAC) parameters and waveforms from the DAC output, and eye diagram and physical layer analysis toolsets.

SPMI Decoder
MIPI System Power Management Interface (SPMI) bus is quickly becoming the industry-standard for managing power distribution in mobile/handheld embedded systems. Teledyne LeCroy’s SPMI Decoder provides full frame and bit level decoding of SPMI low-level protocol, arbitration, and command sequences with search and filtering of decoded numeric or text data.
RP4030 DC POWER/VOLTAGE RAIL PROBE

The RP4030 is a practical and superior alternative to conventional techniques to probe a 50 Ω DC power/voltage rail. The probe has large built-in offset, low attenuation (noise), and high DC input impedance. This permits a voltage rail to be offset in the oscilloscope by its mean DC voltage with user adjustment of oscilloscope gain to achieve a noise-free view of small signal variations in the DC power/voltage rail without inadvertently loading the DC rail.

**Key Features**

- **4 GHz Bandwidth**
- **±30V Offset Capability**
- **±800mV Dynamic Range**
- **50 kΩ DC Input Impedance**
- **1.2x Attenuation** (Low Additive Noise, ~5%)

MCX terminated cable with wide variety of connections:
- Solder-in (4 GHz)
- Coaxial Cable to U.FL receptacle (3 GHz)
- MCX PCB Mount (4 GHz)
- Browser (350 MHz)

**ProBus Interface**

**High Offset Range**

Permits the DC signal to be displayed in the vertical center of the oscilloscope grid with a high-sensitivity gain setting.

**Low Attenuation and Noise**

The probe attenuation is a nominal 1.2x coupled to the oscilloscope at DC 50Ω. This keeps additive noise to a minimum, and makes it exceptionally useful with High Definition oscilloscopes for lowest noise at highest sensitivity gain settings.

**High DC Input Impedance**

50 kΩ input impedance at DC mitigates current loading of the DC power/voltage rail and provides for more accurate measurements and signal fidelity.

**4 GHz Bandwidth**

Provides maximum bandwidth for when probing is performed near the CPU, and makes it the perfect match for the 4 GHz, 10 bit HDO9404.

**Wide Assortment of Tips and Leads**

Supplied with solder-in and coaxial cables with MCX and U.FL PCB receptacle mounts. A browser tip is optionally available. Additional receptacles or leads may be purchased as accessories and left connected in circuit for easy connection of different signals during different test or validation stages.
**AP033 Differential Voltage**

500 MHz of bandwidth with a range of sensitivities from x10 gain (200 μV/div) to 100x attenuation. x10 gain is perfect for measuring low voltages across current sense resistors (4nV/√Hz noise, 5V common mode, and ±400mV offset). Up to 42V common mode and ±4V offset is available at higher attenuations. CMRR is as good as 80 dB. Tip capacitance is very low (1 pF differential).

**ZD Series Differential Voltage**

The ZD200 has 200 MHz of bandwidth with 60V common mode and ±20V differential range. 3.5 pF differential tip capacitance, and 50 dB CMRR at 10 MHz, but with a minimum sensitivity of 10 mV/div on High Definition oscilloscopes. ZD500, ZD1000 and ZD1500 provide more bandwidth (up to 1.5 GHz) but with lower common mode (10V) and higher minimum sensitivities.

**ZS Series Single-Ended Voltage**

Available from 1 to 4 GHz bandwidth, these probes have 1 MΩ input resistance and low tip capacitance (as low as 0.6pF) with up to 12V offset range and ±8V dynamic range. Many of these probes are available in packs of 4 (QuadPaks) for economical volume purchases.

**DA1855A Differential Amplifier**

With 100 dB CMRR, x10 gain, fine offset adjustment the DA1855A is the premium solution for measuring low voltages across current sense resistors. Either the DXC100A (switchable 10x/100x attenuation) provides higher common mode voltage (155V) with 500mV dynamic range, while DXC200A (1x attenuation) provides 15.5V common mode voltage with 500mV dynamic and better noise performance for lower voltage signals.

**High-sensitivity Current Probes**

The CP030A (50 MHz) and CP031A (100 MHz) current probes provide high sensitivity (1 mA/div) with excellent noise performance, high bandwidth, and 50 Apk (30 Arms) current measurement capabilities.
**Product Description**

**Recommended High Definition Oscilloscopes and Options**

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<tr>
<th>Product Description</th>
<th>Product Code</th>
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<tr>
<td>1 GHz, 8 Ch, 12-bit, 2.5 GS/s, 50 Mpts/Ch High Definition Oscilloscope with 12.1&quot; WXGA Color Touch-screen Display, Ultra HD (UHD) Extended Desktop</td>
<td>HDO8108A</td>
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<tr>
<td>16 Digital Channel Mixed Signal Option</td>
<td>HDO8k-MSO</td>
</tr>
<tr>
<td>250 Mpts/Ch Memory Option</td>
<td>HDO8k-XL</td>
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<tr>
<td>Digital Power Management Analysis Software Option</td>
<td>HDO8k-DIG-PWR-MGMT</td>
</tr>
<tr>
<td>2.5 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 254HD</td>
</tr>
<tr>
<td>4 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 404HD</td>
</tr>
<tr>
<td>6 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 604HD</td>
</tr>
<tr>
<td>8 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 804HD</td>
</tr>
<tr>
<td>2.5 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 254HD-MS</td>
</tr>
<tr>
<td>4 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 404HD-MS</td>
</tr>
<tr>
<td>6 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 604HD-MS</td>
</tr>
<tr>
<td>8 GHz, 20 GS/s, 4 Ch, 100 Mpts/Ch High Definition Mixed Signal Oscilloscope with 15.6&quot; Full HD capacitive touch screen</td>
<td>WavePro 804HD-MS</td>
</tr>
<tr>
<td>Digital Power Management Analysis Software Option</td>
<td>WPHD-DIG-PWR-MGMT</td>
</tr>
<tr>
<td>1 GHz, 4 Ch, 12-bit, 2.5 GS/s, 50 Mpts/Ch High Definition Oscilloscope with 12.1&quot; WXGA Color Touch-screen Display</td>
<td>HDO6104A</td>
</tr>
<tr>
<td>1 GHz, 4 Ch, 12-bit, 2.5 GS/s, 50 Mpts/Ch High Definition Mixed Signal Oscilloscope with 12.1&quot; WXGA Color Touch-screen Display</td>
<td>HDO6104A-MS</td>
</tr>
<tr>
<td>250 Mpts/Ch Memory Option</td>
<td>HDO6k-XL</td>
</tr>
<tr>
<td>Digital Power Management Analysis Software Option</td>
<td>HDO6k-DIG-PWR-MGMT</td>
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**Ordering Information**

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<th>Product Description</th>
<th>Product Code</th>
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<tr>
<td><strong>Recommended Power Rail Probes and Accessories</strong></td>
<td></td>
</tr>
<tr>
<td>Power/Voltage Rail Probe, 4 GHz bandwidth, 1.2x, attenuation, ±30V offset, ±800mV dynamic range</td>
<td>RP4030</td>
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<tr>
<td>RP4030 350 MHz Browser Tip Accessory</td>
<td>RP4000-BROWSER</td>
</tr>
<tr>
<td>Qty. 3 additional MCX solder-in leads</td>
<td>RP4000-MCX-LEAD-SI</td>
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<tr>
<td>Qty. 10 additional MCX PCB mount receptacles</td>
<td>RP4000-MCX-PCBMOUNT</td>
</tr>
<tr>
<td>Qty. 3 additional MCX to U.FL coaxial cables</td>
<td>RP4000-MCX-CABLE-UFL</td>
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<tr>
<td>Qty. 10 additional U.FL PCB mount receptacles</td>
<td>RP4000-UFL-PCBMOUNT</td>
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**Recommended Other Probes**

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<tr>
<td>500 MHz Differential Voltage Probe with x1 and x10 gain and /10 and /100 attenuation, 42V common-mode</td>
<td>AP033</td>
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<tr>
<td>200 MHz Differential Voltage Probe, ±20V</td>
<td>ZD200</td>
</tr>
<tr>
<td>1 GHz Differential Voltage Probe, ±8V</td>
<td>ZD1000</td>
</tr>
<tr>
<td>1 GHz, 0.9 pF, 1 MΩ Single-ended Active Voltage Probe</td>
<td>ZS1000-QUADPAK</td>
</tr>
<tr>
<td>Set of 4 ZS1000</td>
<td>ZS1000-QUADPAK</td>
</tr>
<tr>
<td>4 GHz, 0.6 pF, 1 MΩ Single-ended Active Voltage Probe</td>
<td>ZS4000</td>
</tr>
<tr>
<td>30Arms (50Apk), 50 MHz High-sensitivity AC/DC Current Probe</td>
<td>CP030A</td>
</tr>
<tr>
<td>30Arms (50Apk), 100 MHz High-sensitivity AC/DC Current Probe</td>
<td>CP031A</td>
</tr>
<tr>
<td>150Arms (500Apk), 10 MHz AC/DC Current Probe</td>
<td>CP150</td>
</tr>
<tr>
<td>Tch, 100 MHz Differential Amplifier with 100dB CMRR</td>
<td>DA1855A</td>
</tr>
<tr>
<td>100:1 High Impedance differential probe pair for DA1855A</td>
<td>DXC200A</td>
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**Serial Trigger, Decode, Measure/Graph, and Eye Diagram Options**

<table>
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<tr>
<td>PC serial trigger, decode, measure/graph, and eye diagram</td>
<td>I2Cbus TDME</td>
</tr>
<tr>
<td>SPMI serial decode</td>
<td>SPMibus D</td>
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<tr>
<td>SPI serial trigger, decode, measure/graph, and eye diagram</td>
<td>SPIbus TDME</td>
</tr>
<tr>
<td>UART-RS232 serial trigger, decode, measure/graph, and eye diagram</td>
<td>UART-RS232bus TDME</td>
</tr>
<tr>
<td>USB2 serial trigger, decode, measure/graph, and eye diagram</td>
<td>USB2bus TDME</td>
</tr>
<tr>
<td>USB2 HSIC serial decode</td>
<td>USB2-HSICbus D</td>
</tr>
</tbody>
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More than 20 standards are supported. For a complete list of supported standards and capabilities, visit our website at teledynelecroy.com/tdme

**Customer Service**

Teledyne LeCroy oscilloscopes and probes are designed, built, and tested to ensure high reliability. In the unlikely event you experience difficulties, our digital oscilloscopes are fully warranted for three years and our probes are warranted for one year. This warranty includes:
- No charge for return shipping
- Long-term 7-year support
- Upgrade to latest software at no charge

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