Tektronix®

Digital Power Management and Analysis Software - Enabling Power Integrity Analysis

5/6 Series MSO Option 5-DPMBAS, 5-DPM, and 6-DPM Application Datasheet

Most of today's electronic designs require different supply voltages to function properly. Some components within a given circuit require multiple voltage levels. Testing a product for its specification is a time consuming process; debugging is even more cumbersome process. Hence, power integrity has started playing a significant role and the companies are able to improve their time to market.

The Digital Power Management and Analysis (DPM) software option provides automated power rail measurements for the Power Integrity Analysis on the 5/6 Series MSO oscilloscopes. The solution enables simultaneous analysis of multiple power rails using power rail probes and sequencing of measurements using passive probes. The solution is designed with the user work flow in mind to help design engineers meet their time-to-market needs. It also generates an automated report that includes measurements, test results, and plot images.

The solution in combination with the Tektronix 5/6 Series MSO and Power Rail Probes helps engineers to measure and analyze Ripple, Transient characteristics, Power Supply Sequencing, Amplitude, Jitter, Eye and timing diagrams and perform measurements repeatability, analyse results to increase accuracy. The multiple FlexChannel® inputs and the next generation user interface of the 5/6 Series MSO enables engineers to view the waveform, a spectral view, or both simultaneously to efficiently debug and analyze the circuit design.

Salient Features of the software solutions

- Test up to 7 rails simultaneously with automated measurements and configure each channel
- Allows you to identify the source of the ripple
- Analyze high frequency ripple overlaid on ripple for better design – Ripple on Ripple
- Single click detection and set up of probes
- Auto-zero: User can deskew probes from menu for each channel

Customer applications

Power integrity Analysis plays a very critical role especially with highly-integrated system on chip and microprocessor designs in which multiple technologies interface together. It is important to look at each DC line to see if the power supplied is within the tolerance band of a target system or device. The typical applications can be found across almost all industries that need power conversion and have multiple DC voltage levels in the circuit design. Some examples include:

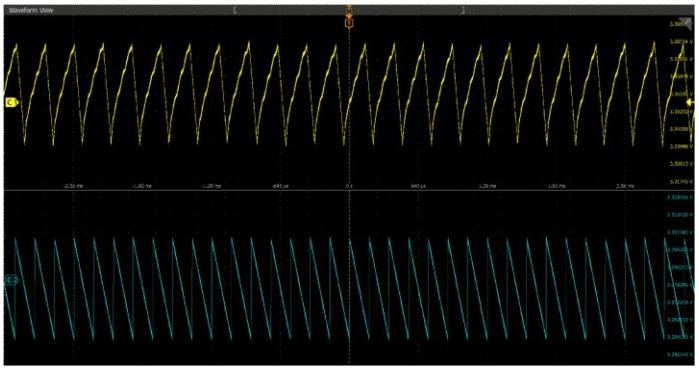
- Mobiles, Computers, and Tablets
- Automotive
- Industrial

Measurement overview

Two of the most important measurements while analyzing a Power Supply design are Ripple and Transient. However, when looking at the complex IC designs these days, there are a few other measurements like Power Sequencing and Jitter that have also become important.

Ripple analysis

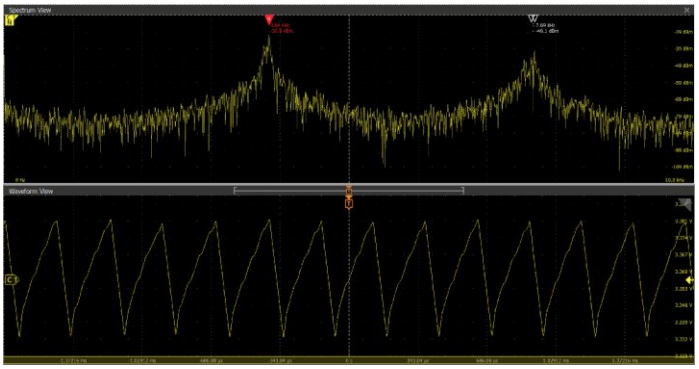
In simple terms, Ripple can be defined as the residual AC voltage on a constant DC component (offset). Typically, the ripple component is often small in magnitude relative to the DC component.



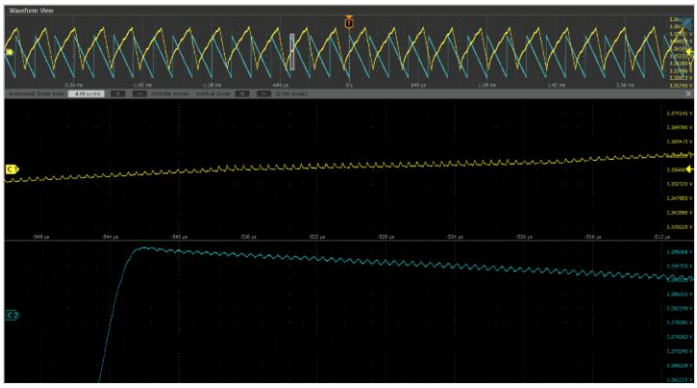
Designers should not confuse Ripple with System noise. It is possible to see only the ripple by minimizing oscilloscope and probe noise when measuring DC power rails.

The Digital Power Management solution enables analysis of multiple power rails simultaneously to reduce test times during design and validation. The 8-Channel 5-Series MSO can measure up to 7 power rails at once.

The solution also leverages the Spectrum View capability to perform Spectrum Analysis on the ripple. This helps the designers to identify the source of ripple which can help save a lot of time and efforts on debugging.



You can analyze cycle-by-cycle by selecting a PWM clock (if available) and view peak-peak and RMS values for each ripple cycle. This gives statistics for all of the cycles within an acquisition. Bandwidth limit capability enables designers to analyze the ripple numbers at different bandwidths.

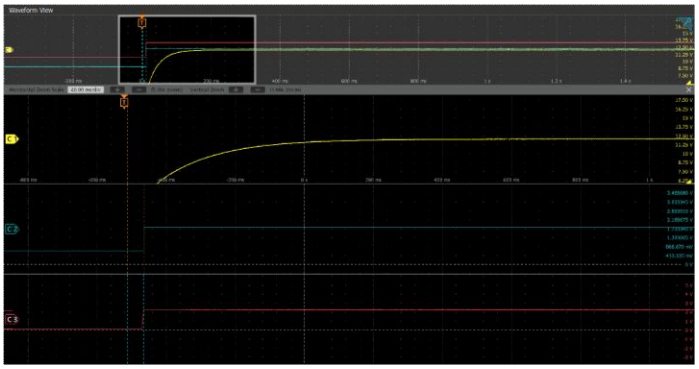


One of the unique features of the DPM solution is the ability to analyze additional high frequency noise overlaid on the ripple. This is typically known as Ripple-on-Ripple.

Power sequence analysis

Power sequence analysis enables power designers to ensure that the power rails reach the on or off states in the expected times.

Power sequence analysis can be run simultaneously on 7 power rails. You can configure the 8th source as reference input to measure the turn-on and turn-off time. It enables the designers to measure the power sequencing of their power rails and ensure that they reach their turn-on and turn-off states within the required times. Automating these tests helps achieve consistent and accurate results under different load conditions.

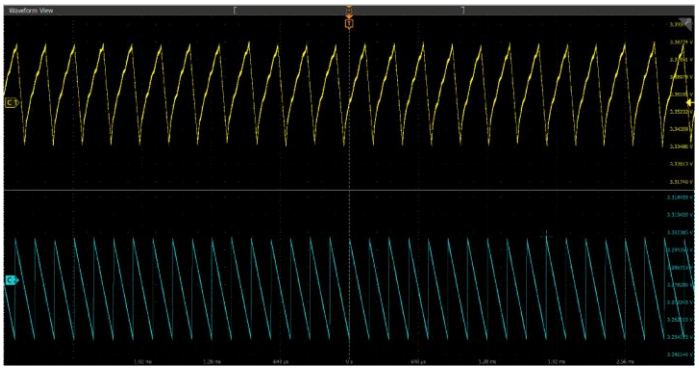


To set up the test, user needs to configure the nominal input and output voltages, trigger level, and wait time (duration). Pressing the Power Rail Preset button initiates an optimization process in which the software optimizes scale settings, record length, and sample rate for the best results. Turn-on and turn-off times are displayed in the results badge and indicated on the waveform with colors. Results are also available in a tablular format. You can compare and validate the design for wait times by observing the results table and look for any anomalies.

Transient analysis

A transient phenomenon in any type of system can be caused by a change of the operating conditions or the system configuration. The importance of their study is mainly to identify the effects the disturbances can have on the system performance or the failures they can cause to power equipment.

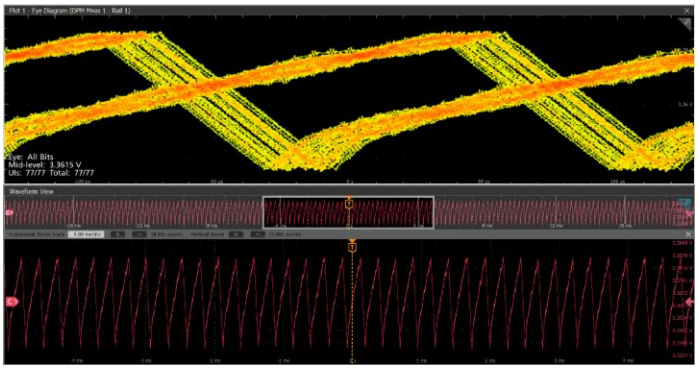
Transient analysis typically includes overshoot and undershoot measurements. Just like Ripple, the application allows for simultaneous automated measurements with a few simple steps. A reference voltage is entered for each power rail before initiating the test. The overshoot measurement gives the difference between the maximum voltage and the reference voltage. The undershoot measurement gives the difference between the minimum voltage and the reference voltage.



You can perform this measurement for a single cycle within an acquisition or over every cycle within an acquisition (Cycle Mode). You can synchronize cycles based on a power rail signal or another signal in the system. Cycle-by-cycle measurements can be analyzed using statistics, histograms, or plots. Bandwidth limit capability enables designers to analyze the ripple numbers at different bandwidths.

Jitter analysis

Jitter measurements helps to validate the jitter tolerances on the high speed side, which uses the DPM outputs to power-on their loads. The common noise sources are cross talk from data signals, coupling from clocks and power supply switching noise (and harmonics) and SSN (Simultaneous Switching Noise). The DPM multi-rail outputs power on different loads such as FPGA, system/CPU clocks, DDR memories, transceivers, etc. Both, Power Integrity and Signal Integrity (SI) functions are interrelated and it is important to know that the PI modifications will improve the SI. Power artifacts impacts high speed loads. It is important to understand that the power supply noise results in high speed jitter, which eventually results in bit errors and one can observe the eye closure.



For instance, a signal integrity engineer can measure POL powering the clock and observe eye diagram where its clean and opens up. If eye diagram is not clean and if there are spurs from POL, then the PI engineer can work to modify their power supply design to get better sensitivity. This makes SI engineer to see the improvement on the HSS load.

Jitter analysis can be run simultaneously on 7 power rails to automate the jitter and eye measurements. To set up the test, the user needs to specify the jitter frequency, reference levels, and clock recovery.

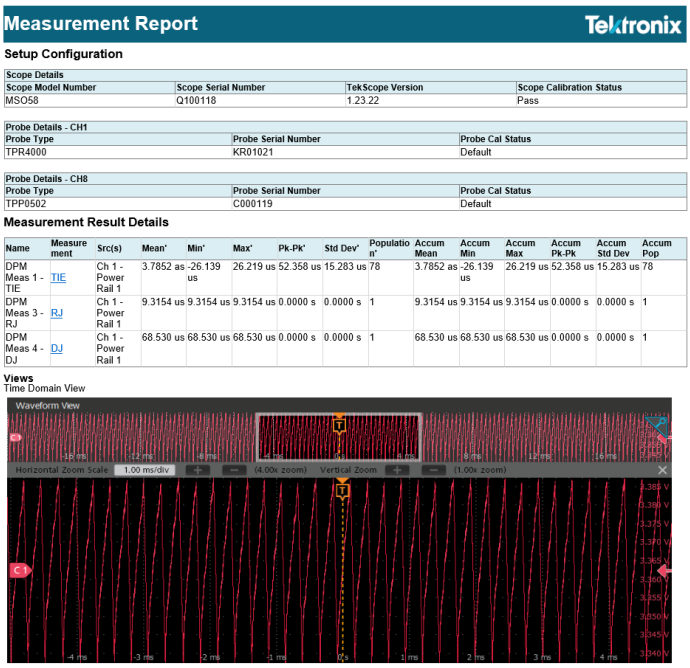
Summary of measurements and features supported

Ripple Analysis	• Based on the oscilloscope and the power rail probes used, the ripple varies:
	  ○ <10 mV (MSO6x)
	  ○ >10 mV (MSO5x)
	• Spectrum View enables to identify the source of ripple
	• Set bandwidth limit from the measurements
	• Configure ripple frequency for each power rail

Transient Analysis	• Measurements include Overshoot, Turn-on Undershoot, and DC Rail Voltage • Allows designers to enter voltage levels and reference voltage levels for calculating overshoot and undershoot • Set bandwidth limit from the measurements
Power Sequence Analysis	• Turn-on and Turn-off times testing enables designers to find out the Turn-on or Turn-off times of all rails in one go • Allows designers to configure the capture time.
Jitter Analysis	Measurements include TIE, RJ, DJ, PJ, Eye High, Eye Low, Eye Height, and Eye Width • Capture jitter across multiple rails at one go
Plots	Eye Diagram, Spectrum, and Histogram
Reporting	• MHT and PDF format • Raw data can be exported to CSV format
Degauss / Deskew (Static)	• Automatic detection of probes, • Auto Zero: allows to deskew probes from the menu of each channel
Source Support	Live analog signals, reference waveforms, and math waveforms

Report generation

The application allows for data collection, archiving and documentation necessary for the design and development process. It can let the user generate the reports in MHT, PDF or CSV formats and document the measurement results. The DPM software also provides the ability to compile all the results of a test run into different report formats with pass/fail results for easy analysis.



Measurement Report Tektronix

Setup Configuration

Scope Details			
Scope Model Number	Scope Serial Number	TekScope Version	Scope Calibration Status
MSO58	Q100118	1.23.22	Pass

Probe Details - CH1		
Probe Type	Probe Serial Number	Probe Cal Status
TPR4000	KR01021	Default

Probe Details - CH8		
Probe Type	Probe Serial Number	Probe Cal Status
TPP0502	C000119	Default

Measurement Result Details

Name	Measurement	Src(s)	Mean'	Min'	Max'	Pk-Pk'	Std Dev'	Population'	Accum Mean	Accum Min	Accum Max	Accum Pk-Pk	Accum Std Dev	Accum Pop
DPM Meas 1 - TIE	TIE	Ch 1 - Power Rail 1	3.7852 as	-26.139 us	26.219 us	52.358 us	15.283 us	78	3.7852 as	-26.139 us	26.219 us	52.358 us	15.283 us	78
DPM Meas 3 - RJ	RJ	Ch 1 - Power Rail 1	9.3154 us	9.3154 us	9.3154 us	0.0000 s	0.0000 s	1	9.3154 us	9.3154 us	9.3154 us	0.0000 s	0.0000 s	1
DPM Meas 4 - DJ	DJ	Ch 1 - Power Rail 1	68.530 us	68.530 us	68.530 us	0.0000 s	0.0000 s	1	68.530 us	68.530 us	68.530 us	0.0000 s	0.0000 s	1

Views

Time Domain View

Ordering information

Models

Order type	Nomenclature	Applicable on Scopes
New Instrument	5-DPMBAS	MSO54, MSO56, MSO58
	5-DPM	MSO54, MSO56, MSO58, MSO58-LP
	6-DPM	MSO64
Upgrade software on an existing Scope	SUP5-DPMBAS	MSO54, MSO56, MSO58
	SUP5-DPM	MSO54, MSO56, MSO58, MSO58-LP
	SUP6-DPM	MSO64

Recommended oscilloscopes series

Oscilloscope series	Nomenclature	Description
MSO 5-Series Oscilloscope	• MSO54 • MSO56 • MSO58 • MSO58-LP	Available bandwidth option: • 350 MHz, 500 MHz, 1GHz, 2 GHz Each model is supplied with one analog probe per FlexChannel: • 350 MHz / 500 MHz bandwidth models: TPP0500B 500 MHz probes • 1 GHz or 2 GHz bandwidth models: TPP1000 1 GHz probes
MSO 6-Series Oscilloscope	MSO64	Available Bandwidth Option: • 1GHz, 2.5 GHz, 4 GHz, 6 GHz, 8 GHz Each model is supplied with one analog probe per FlexChannel: • Four TPP1000 1 GHz probes.

Recommended probes

Probe type	Nomenclature	Probe bandwidth
Power Rail Probes	TPR1000	1 GHz Probe
	TPR4000	4 GHz Probe

Note:

- TPR1000 and TPR4000 are the recommended probes for the DPM measurement. The TPR1000 and TPR4000 probes and oscilloscope provides a low-noise measurement solution. The higher input impedance in the probes minimizes the oscilloscope loading effect on the DC rails (50 kΩ at DC).
- Do not confuse the noise of the oscilloscope and probe with the noise and ripple of the measured DC supply.
- P6150 and Direct SMA cable with DC Block can also be used for power rail measurement.

Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.

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

Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

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