



Tektronix

Ripple Measurement at Low Voltage Supply Design

한국텍트로닉스

Tektronix Korea

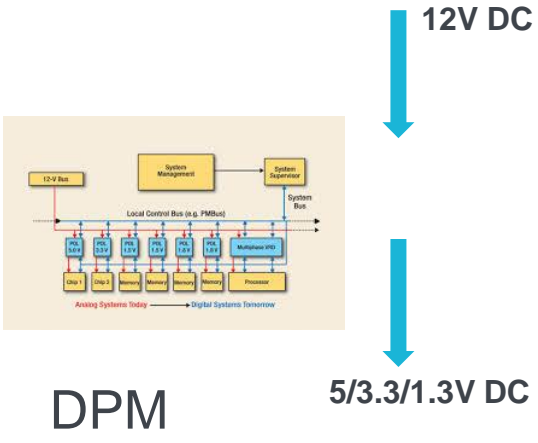
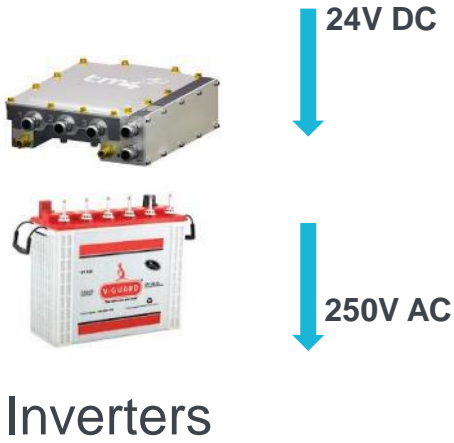
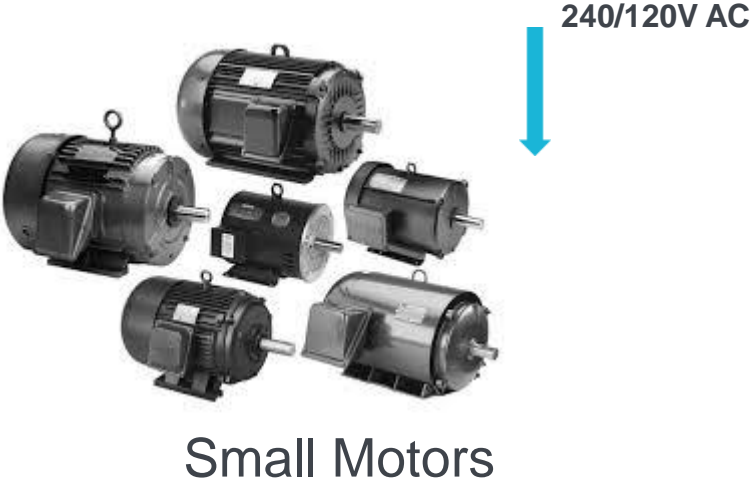
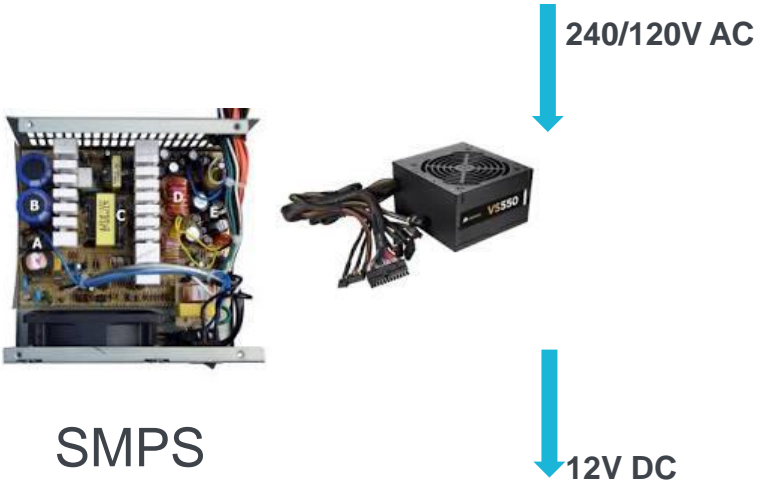


Agenda

- Market Overview
- Digital Power Management and Test challenges
- Tektronix solution
- Summary



Understanding Power



Application Segments

POWER ELECTRONICS technology segment

Automotive

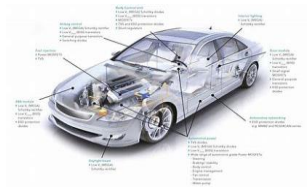
Industrial
(Lighting
Motor Control)

Consumer
(Portable
Charging
Energy
Harvesting)

Computing
(Datacom
Servers)

Telecom
RF
Military

Medical
...



GREEN
Everything

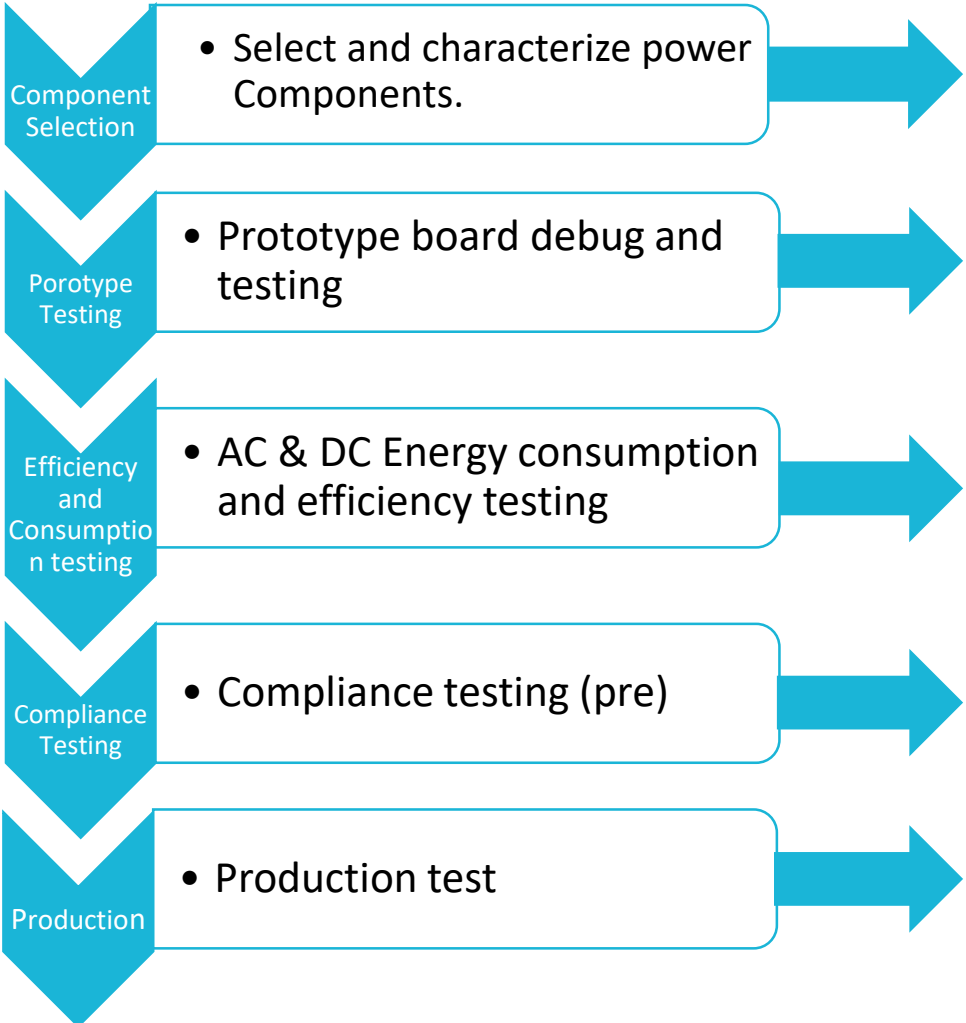
WIRELESS
Everywhere

SMART
Everything

- Power Electronics is **across markets and industries** and **within applications segments**
- Power Electronics, like any other **technology**, is **responsive to the needs** of each and every end applications in which it is embedded
- **Know customer application needs**

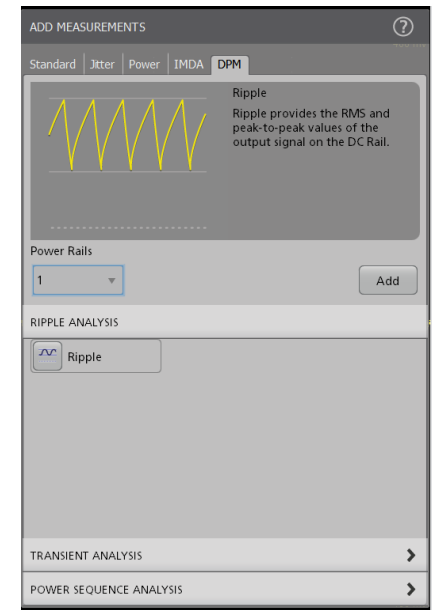
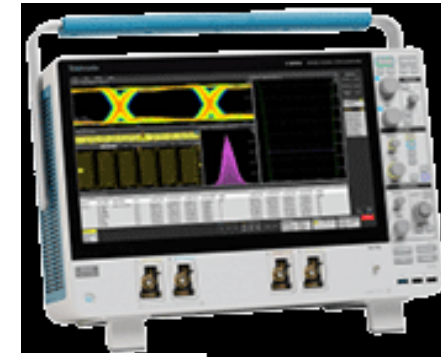
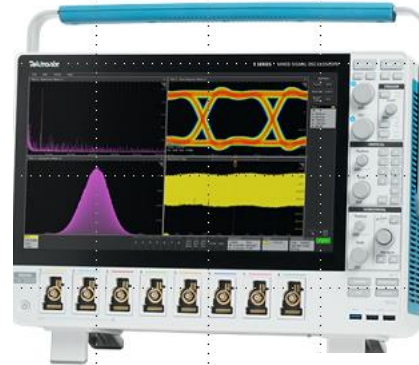


Stages of Power Hardware Design



Elements of a Complete Power Solution

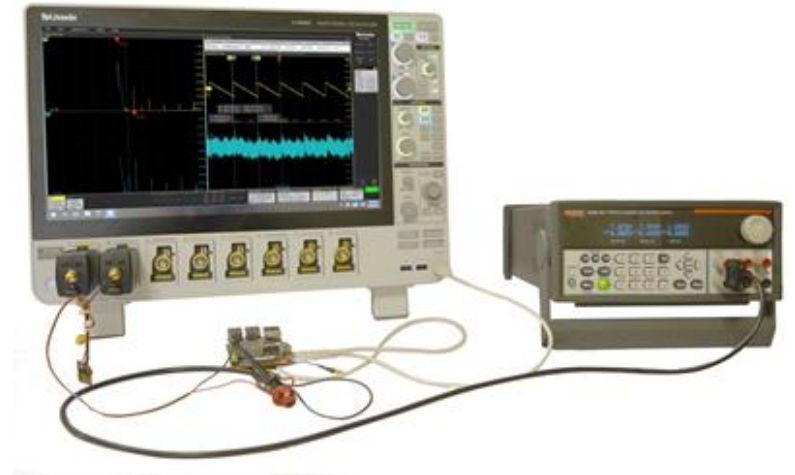
- Best in Class Acquisition System
 - Oscilloscope
- Best In Class Probing capability
 - Ability to meet new design needs
- Automated Application Software
 - Ease of Use
 - Repeatable
 - Report
- Complete Solution



Tektronix Solution- 5/6 Series MSO with 5-DPM, 6-DPM and Power Rail Probes

- Multiple FlexChannel® and path breaking GUI of 5/6 series MSO enables Power designers to test multiple test points simultaneously thereby ensuring faster validation and test times desired to meet quicker GTM needs.
- Leverage the multi-channel capability
- 12-bit ADC ensures better resolution.
- Automated multi rail Power Rail measurements reduce time to answer and guarantee repeatability: 5-DPM and 6-DPM with 5 and 6 series MSO scopes
- Complete set of Power Rail Probes (TPR1000/TPR4000) probes delivers superior performance probe tip to scope for new generation Power Rail designs
- **1 BOX Solution for Power Rail Measurements and Power Distribution Network (PDN) Frequency Response Measurements.**

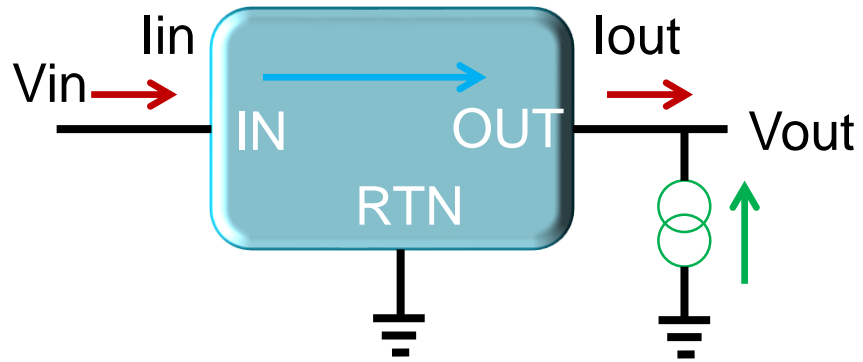
Automated multiple power rail measurements



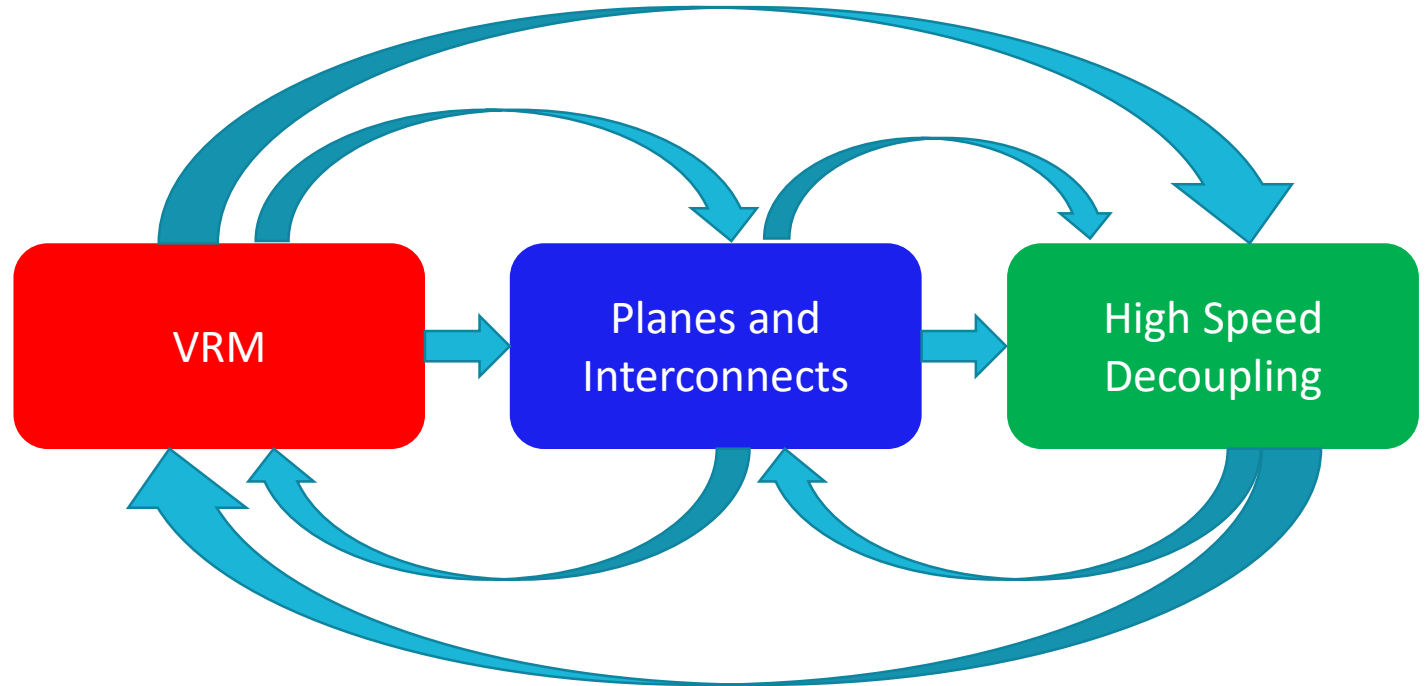
Power Rail Measurement Automation

- Automation gives the user application expertise
 - Algorithms and measurement techniques are automatically selected
 - Includes test limits for relevant industry standards
 - Simplifies probe deskew
- Automation ensures optimum setup for measurements
 - Automatically sets vertical scales, offsets, bandwidth limits, and triggering
 - Automatically sets horizontal scale, sample rate, and record length
 - Automatically selects acquisition mode (HiRes), measurement thresholds, cursor gating
- Automation ensures consistent measurement technique
 - The application executes the same steps, in single-shot and repetitive operation
- Automation enables efficient documentation of measurement results
 - Create reports easily



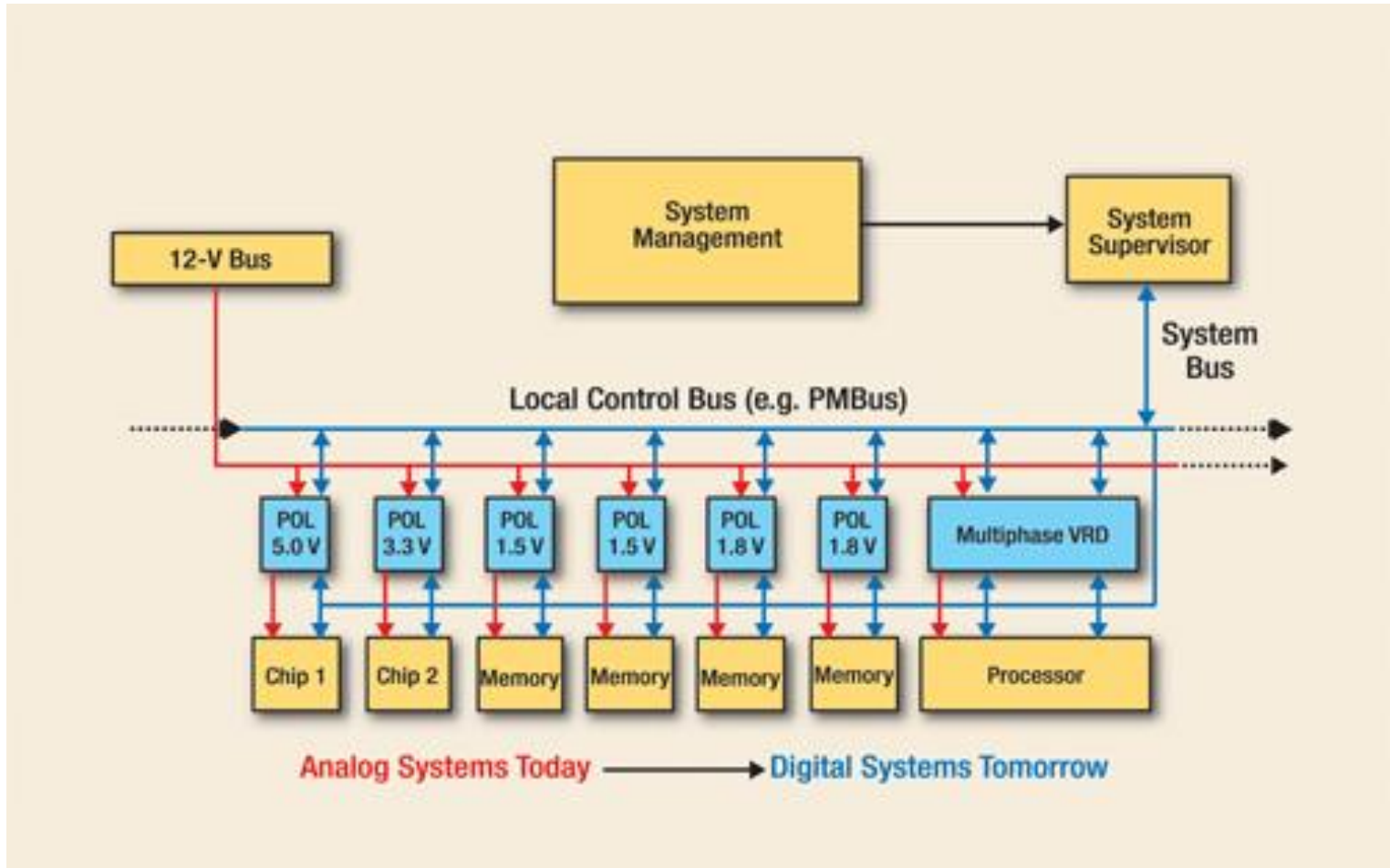


- PSRR/PSMR
- Input Impedance (can be negative!)
- Output impedance and transient
- Internally generated ripple and noise
- Reverse Transfer
- Turn on Overshoot



Copyright © 2018 Picotest.com. All Rights Reserved.

Typical DPM Circuit



Source: electronicproducts.com

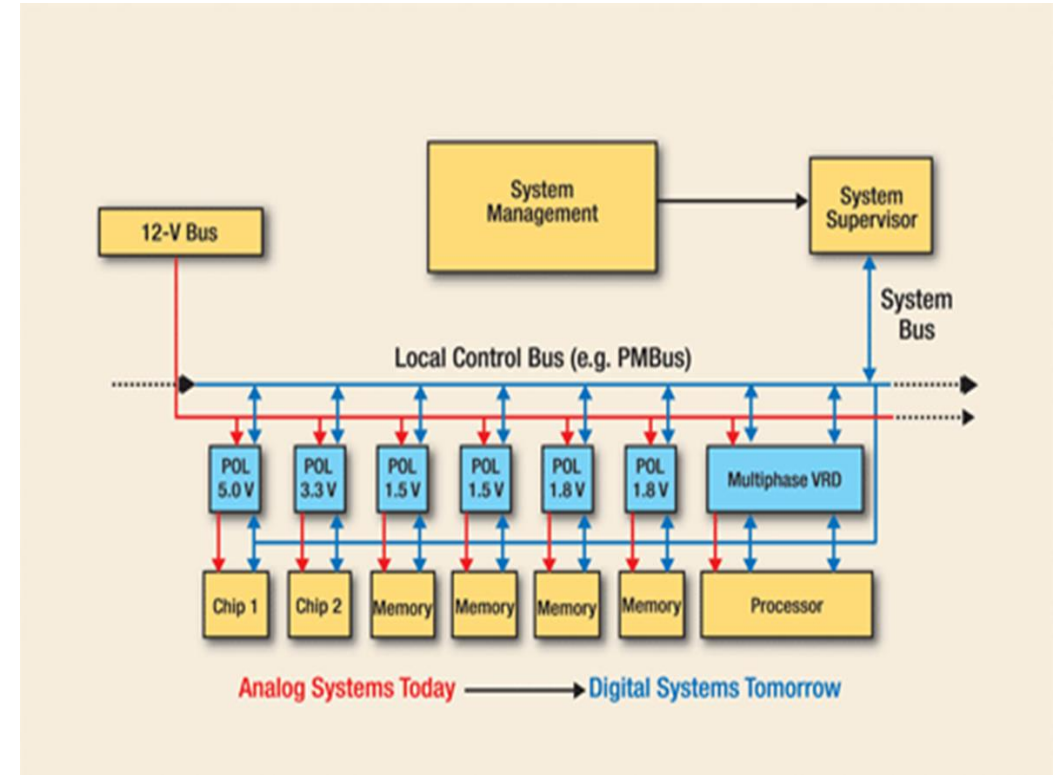
Designers need the ability to access multiple Power Rails and analyze them simultaneously to ensure quicker validation/testing cycles to meet faster GTM need.



Power Integrity/Digital Power Management

HIGH-PERFORMANCE SYSTEMS EVERYWHERE

- **Typical systems nowadays**
 - Processors, GPUs, SoCs, FPGAs
 - SerDes – High-speed data
 - Lots of power rails
 - Efficiency and heat management
 - Point of load power regulation and digital power management
- **Power integrity affected by noise**
 - Noise sources on power rails (frequencies can be quite high)
 - Cross talk from data signals, Coupling from clocks, Power supply switching noise (and harmonics)
 - What happens if power rails are noisy?
 - Jitter → bit errors, other reasons
 - Driving power rail specifications that require high accuracy ripple measurements.



Source: electronicproducts.com

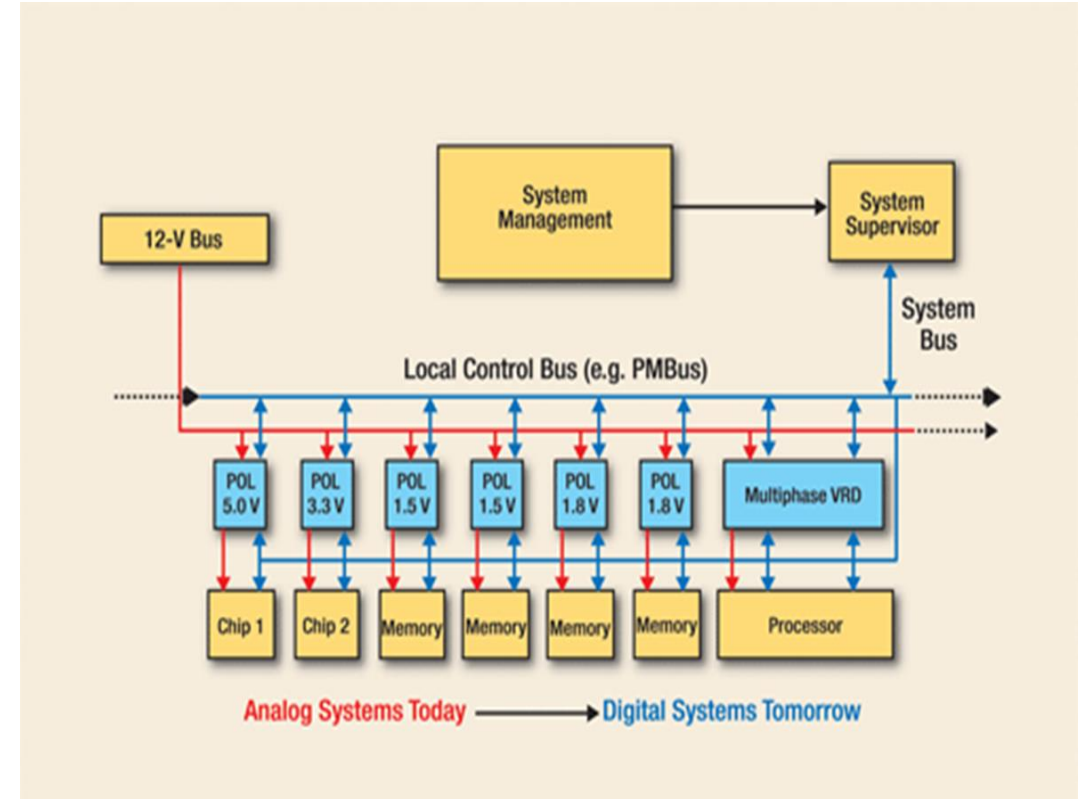
POWER INTEGRITY IS ENSURING THE POWER APPLIED TO A CIRCUIT IS AS REQUIRED FOR THE EXPECTED PERFORMANCE.

Power-Rail Specifications Getting Tighter and Tighter

Market Trends

DIGITAL POWER MANAGEMENT GROWING NEEDS

- Digital Power Management market covering many power application segments:
 - **Switched Mode Power Supplies**
 - Need greater power efficiency across multiple industries and applications
 - **Inverters, Motors and Drives – 3-Phase**
 - Need greater power efficiency across multiple industries and applications
 - **Connectivity Power** (USB, Power over Ethernet etc.)
 - Power delivery adaptation in devices, PoE and PoE Plus
 - **Wireless Power Charging**
 - Growing consumer preference towards wireless connectivity
 - **Green Power** (LED/Solar/Tidal/Wind)
 - Alternate power capacities driven worldwide
 - **Automotive Power Electronics**
 - ADAS, EPS, Safety, Infotainment are key drivers
 - **Data Center Power**
 - UPS (Uninterruptable Power Supplies) are backbone of data centers, deployed for smooth operation



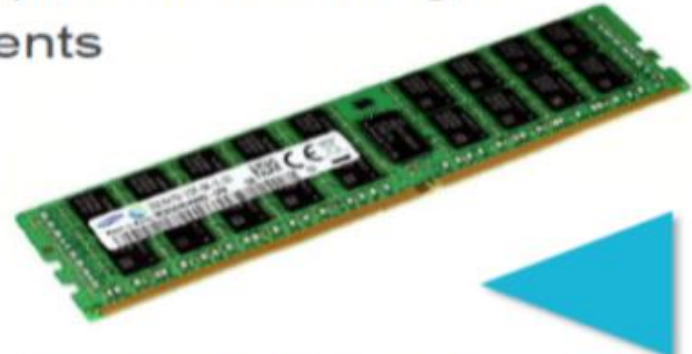
Source: electronicproducts.com

Growing DPM Market Drives New Requirements in T&M

Segmentation: Market Requirements for 3 segments

1) High speed (uP) and low power (mobile) require low voltages

- Require low ripple and fast transient measurements
- Includes DDR4 and DDR5 RAM
- **Jitter most useful here**



2) Switched Mode Power Supply (SMPS) growing, but slower

- “Next Bench” applies here – what do Tek power supply designers need?
- 10mV ripple on regulated supply voltages from 3V to 20V
- 20 MHz MOSFET switchers can generate edges at low GHz

3) Traditional ripple measurements above 30mV and below 1 GHz

Market Segmentation

GO TO MARKET PLAN

	Segment I	Segment II	Segment III
Definition	High speed (μ P) and low power (mobile)	Switched Mode Power Supply measurements	Traditional ripple measurements
Requirements	<ul style="list-style-type: none">▪ Below 10mV ripple▪ Above 2 GHz transitions	<ul style="list-style-type: none">▪ 10mV ripple on regulated supply voltages (3 – 20V)▪ Switchers can generate edges at low GHz	<ul style="list-style-type: none">• Above 30mV ripple• Below 1 GHz transitions
Opportunity	<ul style="list-style-type: none">▪ Gnome peak-to-peak ripple <600uV – less than ½ all competitors▪ Win the <3mV ripple applications that also require high bandwidth	<ul style="list-style-type: none">▪ Average, could miss uncorrelated responses▪ Trigger on the modulator▪ Reduce the measurement bandwidth	<ul style="list-style-type: none">▪ Leverage brand, technical solution leadership
Applications	Microprocessors, memory control, FPGA, storage devices and image sensors	SMPS trigger tests	Automotive applications



Need for Power Integrity

WHO SHOULD CARE ABOUT THAT?

- Power semiconductor suppliers are selling chipsets for power rail voltage supply and control in the **Automotive, Industrial** and **Consumer** markets
- These chipsets may serve the purpose of boosting or downscaling voltages to supply power to an ECU (read microprocessor board), a memory, a MIPI chipset, operating from **0.6V up to 54V**
 - There are typically **4 to more than 20 rails** in design under test
 - Typical validation requires probing **at least 1 rail at a time, up to 2 or 4 rails** in parallel with other signals
 - Lots of **constraints on connectivity** due to tight spacing, buried signals, probing components on rails etc.
 - PDN Impedance
- A practical example in the Automotive food chain:
 - *ON Semiconductor provides a chipset to supply power that powers up an SoC (system on chip) microprocessor on FPGA board from Xilinx, which performs ADAS calculations and processing as part of a car board designed by Continental*
- There is much to probe in Digital Power Management, Memory Lanes, Ethernet Connectivity Lanes

Power-Rail Connectivity & Measurements Solution



Customer Profiles/Personas



- Research Engineers
- Power Design Engineers(PDN)
- System Engineers

Why Power-Rail Probes Are Needed?

WHY CAN'T I JUST USE A REGULAR VOLTAGE PROBE?

The Requirements

- Minimize **oscilloscope and probe noise** when measuring DC power rails to see only noise from design, not measurements tools
- **Larger offset** than what available in oscilloscope to view and analyze small signals on top of DC power rails
- Minimize oscilloscope **loading effect** on DC rails (50 Ω at DC) with higher input impedance in probe
- **More bandwidth** to see more signal content (harmonics, faster ripples etc.) on DC rails that could affect data signals, clock etc.

The Challenges

- Added functionality, higher density, faster switching speeds of modern electronic products drive the **need for lower supply voltages**
- Designers need to zoom-in on power rails to look for high-frequency intruder signals, measure ripple and analyze coupling effects with **tighter tolerances**
- Oscilloscopes often don't have **enough offset** to shift the noise and ripple on DC rails to center of the screen for needed measurements
- Low noise measurement solution (oscilloscope and probe) is critical to **not confuse** the noise of the oscilloscope and probe with the noise and ripple of the DC supply being measured

Design Challenges Impose Stricter Requirements on Power Integrity



Introducing Digital Power Management Solution-1

OSCILLOSCOPES.

	Application I	Application II	Application III
Definition	High speed (μ P) and low power (mobile)	Switched Mode Power Supply measurements	Traditional ripple measurements
Customer Needs	High accuracy ripple measurements (<10mV) with very fast transitions (2 to 4 GHz)	Accurate ripple measurements (~10mV) with fast transitions (< 2 GHz)	Traditional ripple measurements (~30mV) with slower transitions (< 1 GHz)
Applications	Microprocessors, memory control, FPGA, storage devices and image sensors	SMPS trigger tests, Battery cell tests, etc.	Automotive, industrial and consumer applications
Jobs To Be Done	Power Integrity & Design Validation(Ripple Measurements, Power Sequencing, Overshoot/Undershoot and Jitter(for HSS))		
Tektronix Solution	6 Series MSO scope with power-rail probe and DPM automated measurements	5 Series MSO scope with power-rail probe and DPM automated measurements	MSO scopes with power-rail probe and DPM Automated measurements.



Our Primary Opportunity Focus is with the 5 and 6 Series Scopes with the Power-Rail Probes and DPM software

Complete Tektronix Solution for DPM Market



Introducing Digital Power Management Solution-2

POWER RAIL PROBES.

More Data, Faster Signals

- ✓ 4 GHz Bandwidth for fast transitions
- ✓ Large voltage offset of $\pm 60\text{V}$
- ✓ Wide dynamic range of $\pm 1\text{V}$

Convenient, Versatile Connectivity

- ✓ Easy to use, reliable 1 GHz browser
- ✓ Long reach, reliable soldering tips
- ✓ Various connectors available



Low Noise, High Resolution

- ✓ Lowest system noise with 6 Series scopes
- ✓ Ripple measurements in μV 's
- ✓ Clean signals at full bandwidth

Automated Measurements

- ✓ Reduce human error
- ✓ Enhanced repeatability of measurements
- ✓ Detailed reports for easy communication

Power Integrity Made Possible with Tektronix Power-Rail Probes

Introducing The Power-Rail Probes

LARGER OFFSET VOLTAGE, WIDER DYNAMIC RANGE

Specifications	TPR1000	TPR4000
Bandwidth	1 GHz	4 GHz
Offset Voltage Range	±60V	
Dynamic Range	±1V	
Input Resistance	50KΩ DC, 50Ω AC	
Input Coupling	DC, LF Reject	
Accuracy	1mV	
System Noise (With 6 Series Scopes)	$<300\mu\text{V}_{\text{Peak-To-Peak}}$ (With 20MHz Bandwidth Limit) $<1.3\text{mV}_{\text{Peak-To-Peak}}$ (At Full Bandwidth of Scope) <i>Note:</i> With grounded input, set to maximum sensitivity of 1.3mV/Div	
Attenuation	1.25x	
Connectivity & Accessories	New Browser, Solder-In & Snap-On	



Note: Specifications are estimated and may change without notice

Better Performance In Power-Rail Measurements

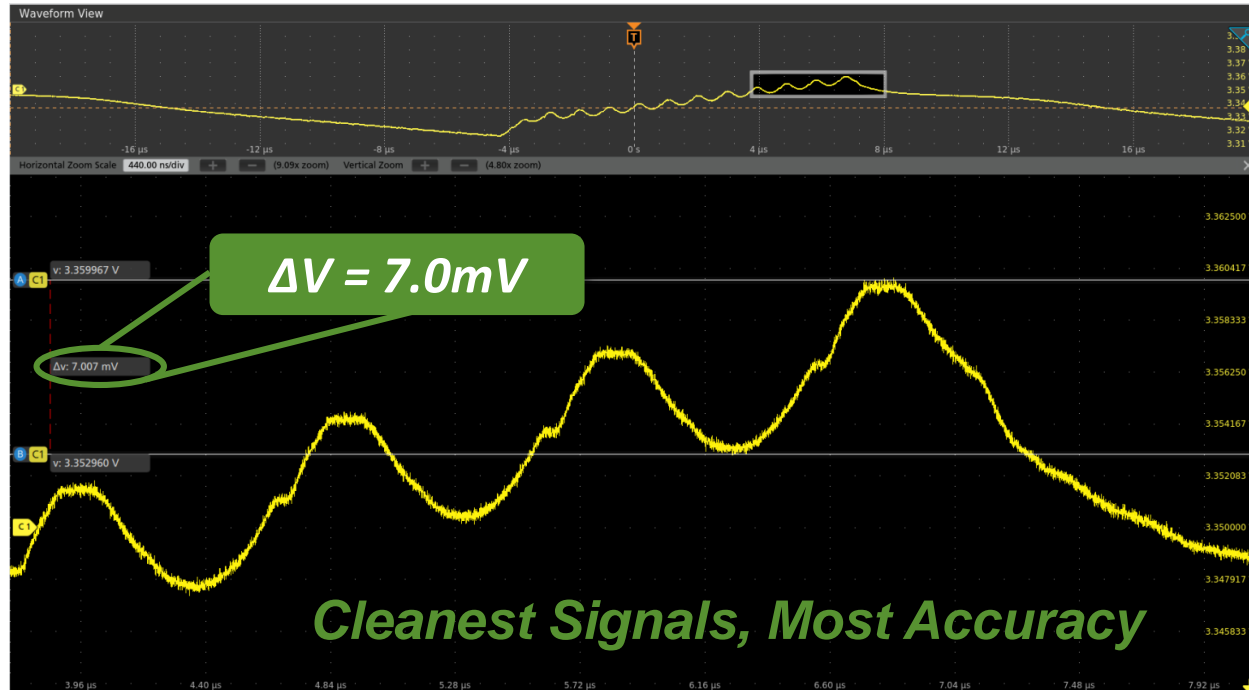


Power-Rail Probe vs. Passive Probes

WHAT POWER-RAIL PROBES SHOW THAT CAN'T BE SEEN WITH PASSIVE PROBES

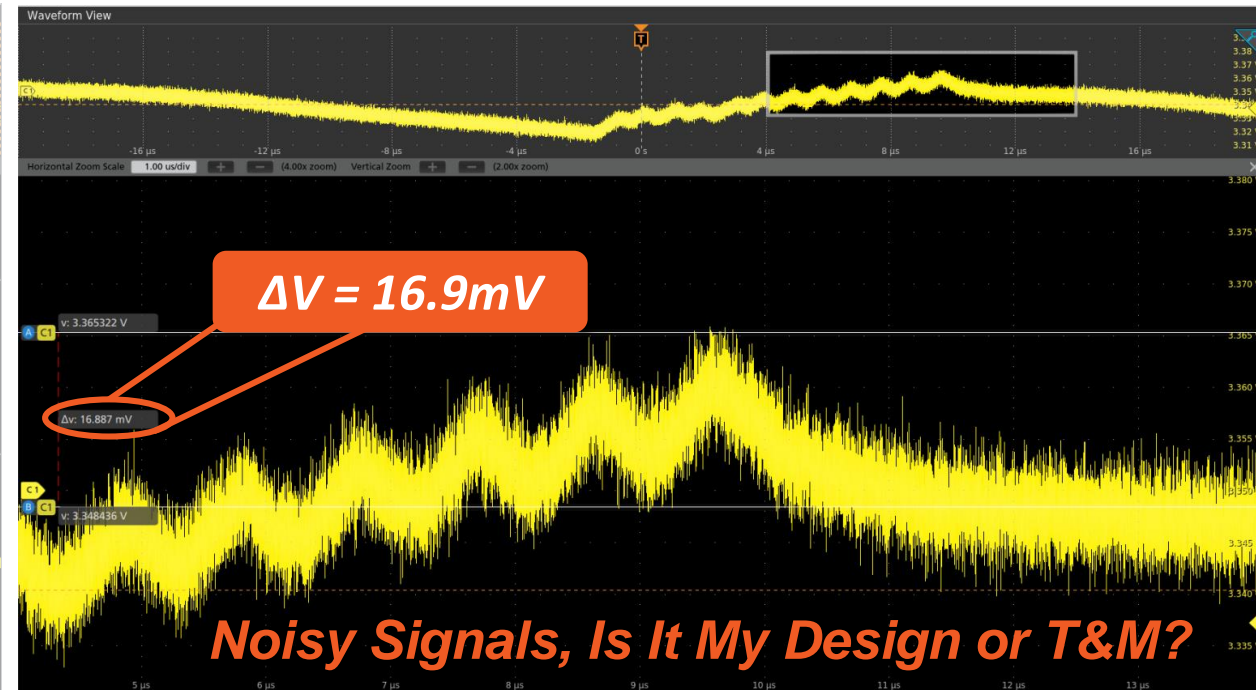
Ripple on 3.3V Rail with **Power-Rail Probe**

(Using **1GHz** Bandwidth Limit & **6 Series** Oscilloscope)



Ripple on 3.3V Rail with **TPP1000 Passive Probe**

(Using **1GHz** Bandwidth Limit & **6 Series** Oscilloscope)

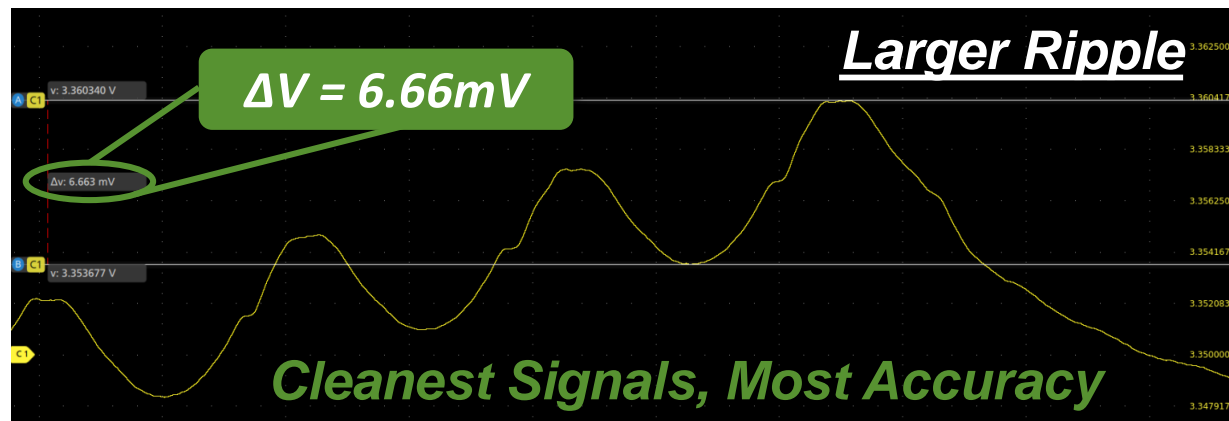


Power-Rail Probe vs. Passive Probes

WHAT POWER-RAIL PROBES SHOW THAT CAN'T BE SEEN WITH PASSIVE PROBES

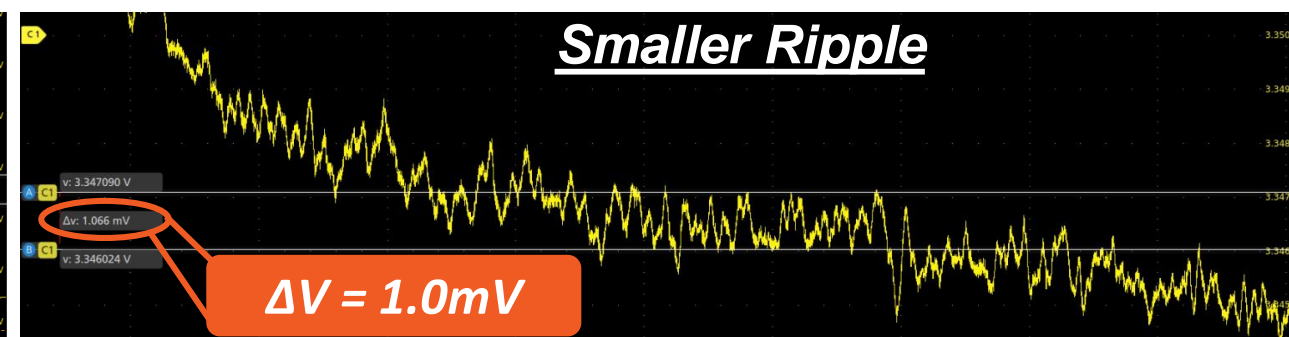
Ripple on 3.3V Rail with **Power-Rail Probe**

(Using **20MHz** Bandwidth Limit & **6 Series** Oscilloscope)



Ripple on 3.3V Rail with **TPP1000 Passive Probe**

(Using **20MHz** Bandwidth Limit & **6 Series** Oscilloscope)



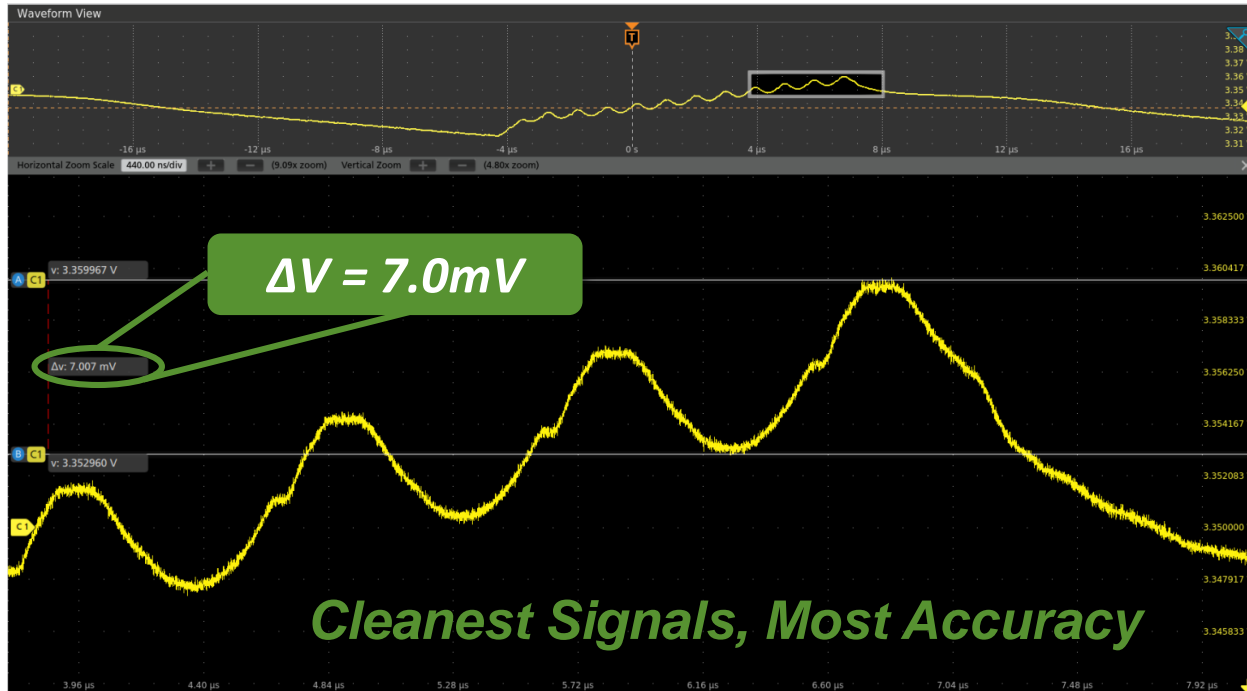
Power-Rail Probes Show What Other Probes Cannot

Power-Rail Probe With 6 Series or 5 Series

WHAT TO EXPECT WHEN USING 6 OR 5 SERIES WITH POWER-RAIL PROBES

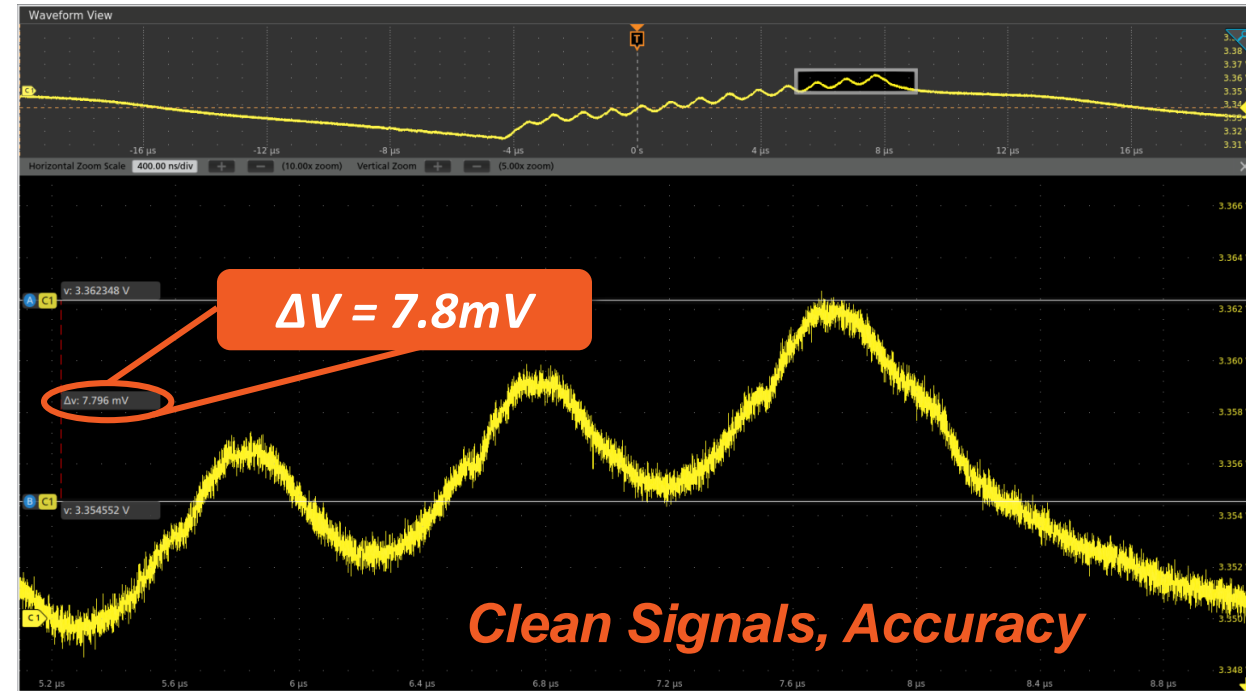
Ripple on 3.3V Rail with 6 Series Scopes

(Using 1GHz Bandwidth Limit & TPR4000 Power-Rail Probe)



Ripple on 3.3V Rail with 5 Series Scopes

(Using 1GHz Bandwidth Limit & TPR4000 Power-Rail Probe)

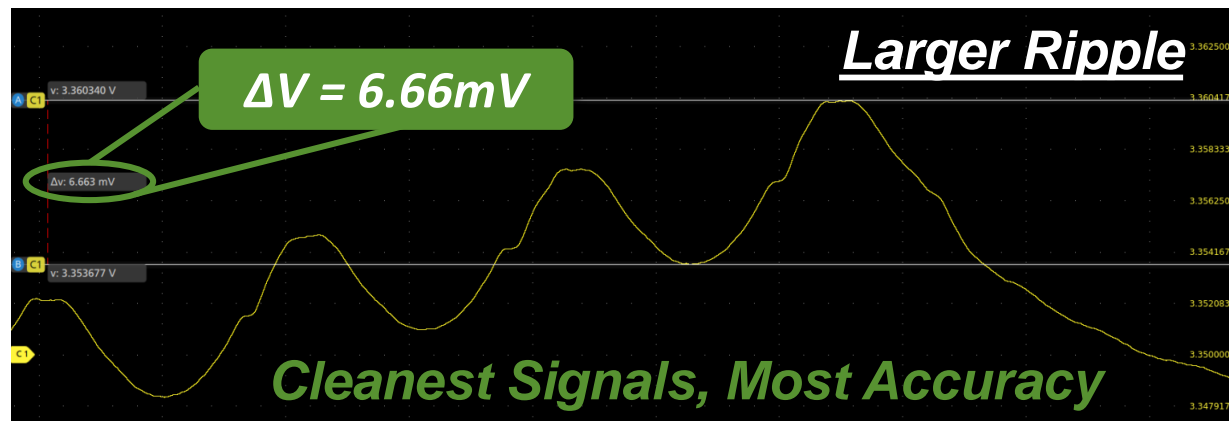


Power-Rail Probe With 6 Series or 5 Series

WHAT TO EXPECT WHEN USING 6 OR 5 SERIES WITH POWER-RAIL PROBES

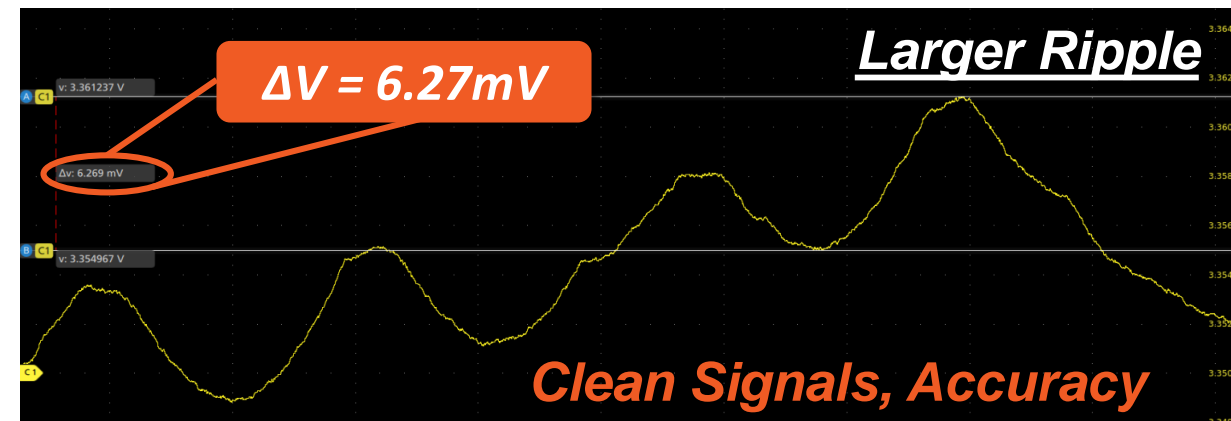
Ripple on 3.3V Rail with 6 Series Scopes

(Using 20MHz Bandwidth Limit & TPR4000 Power-Rail Probe)



Ripple on 3.3V Rail with 5 Series Scopes

(Using 20MHz Bandwidth Limit & TPR4000 Power-Rail Probe)

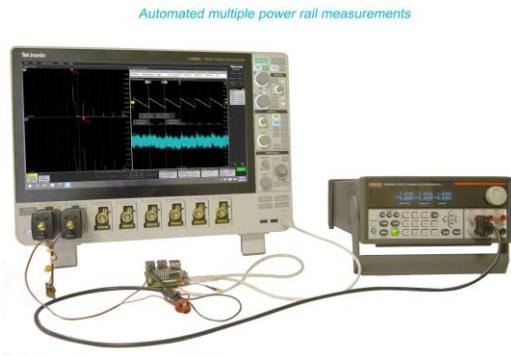


Introducing Digital Power Management Solution-3

AUTOMATED MEASUREMENTS-OPTION 5/6-DPM

Software Package to Offer measurement ensures reduced human error

- Enhanced Repeatability of measurements
- Detailed report for easy communication



Automated Measurements to Offer (2 releases)

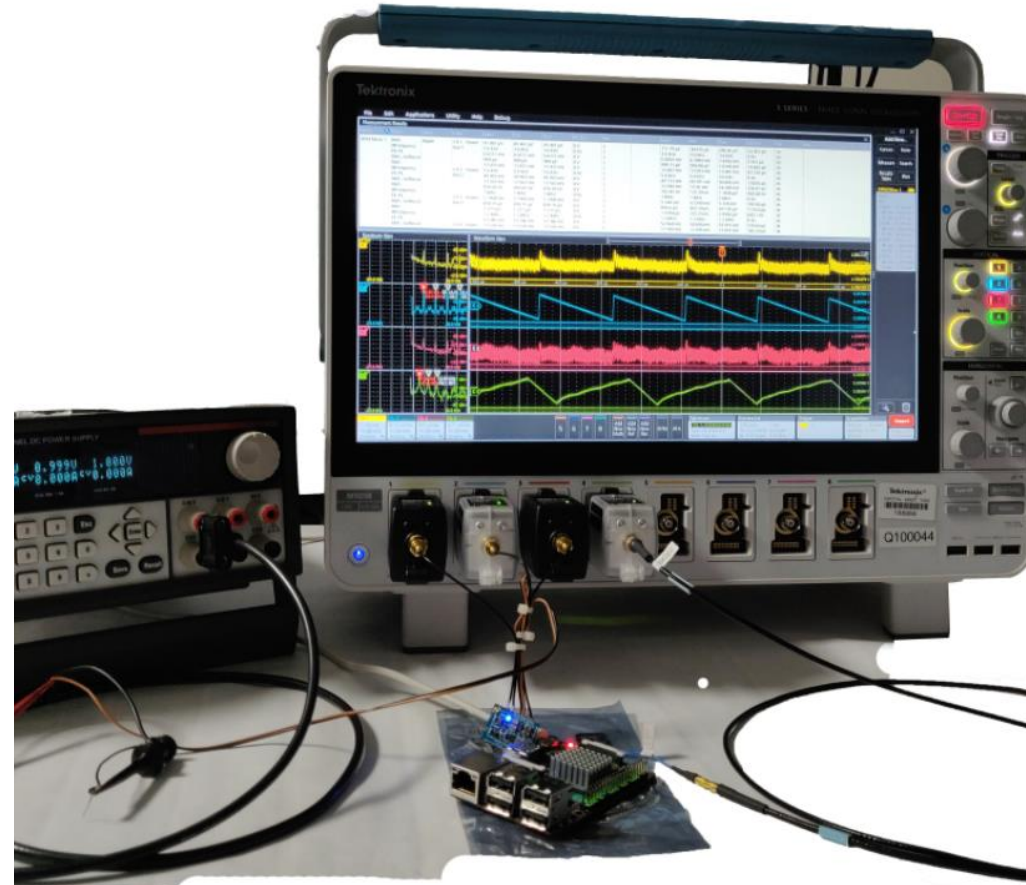
- Ripple
- Overshoot and Undershoot
- Settling time
- Turn-on and Turn-off time
- Ringing
- Voltage measurements
- Slew rate
- Jitter (HSS)
- PDN Impedance measurement (FRA suite)
- Identify signals using Spectrogram View

Reduce Human Errors With Automated Measurements

Introducing Digital Power Measurements and Analysis Software

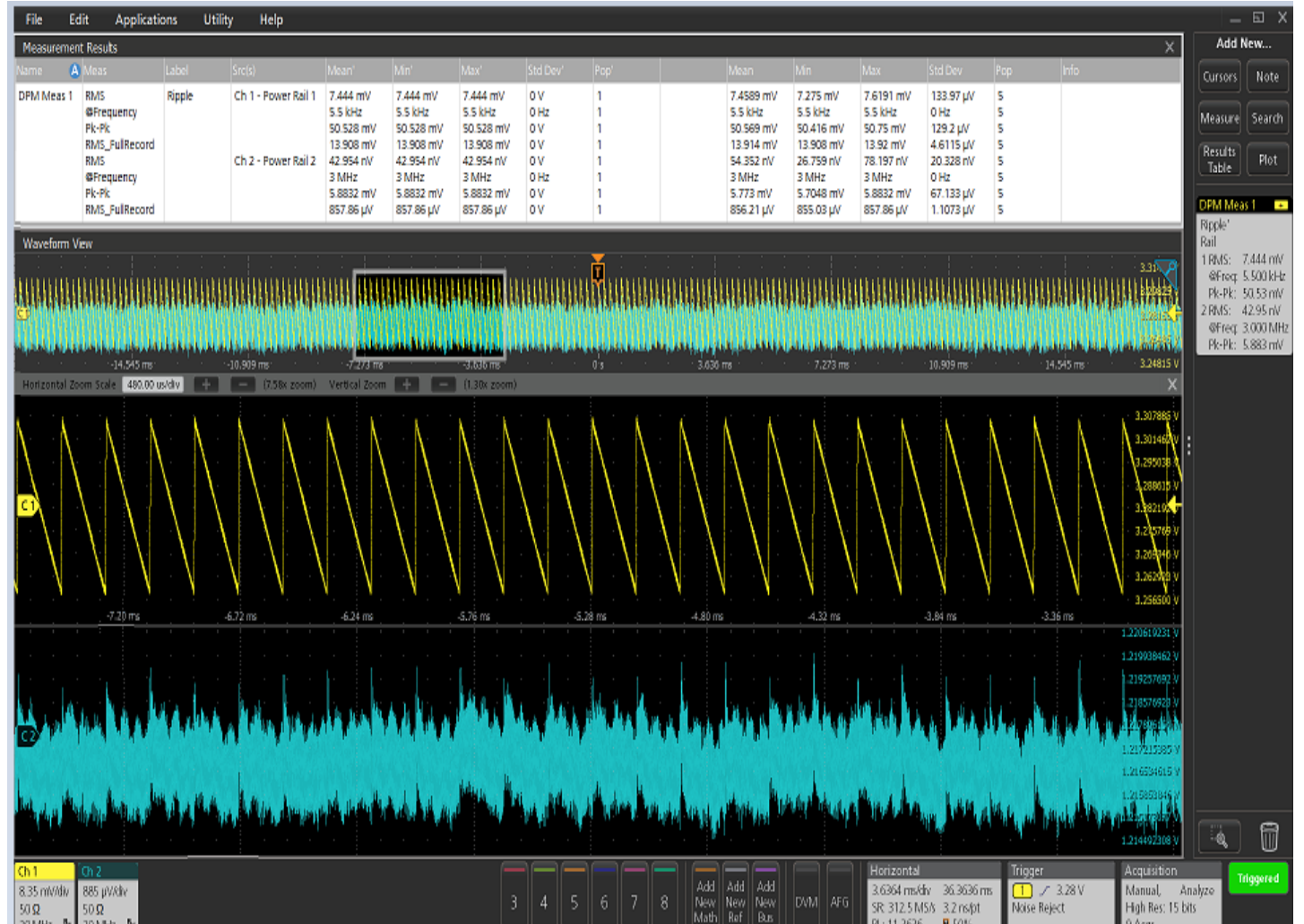
Option 5-DPM,6-DPM and upgrades SUP5-DPM, SUP5-DPM-FL ,SUP6-DPM and SUP6-DPM-FL

- Ripple Analysis
 - Ripple
- Power Sequence Analysis
 - Turn-on Time
 - Turn-Off Time
- Transient Analysis
 - Overshoot
 - Undershoot



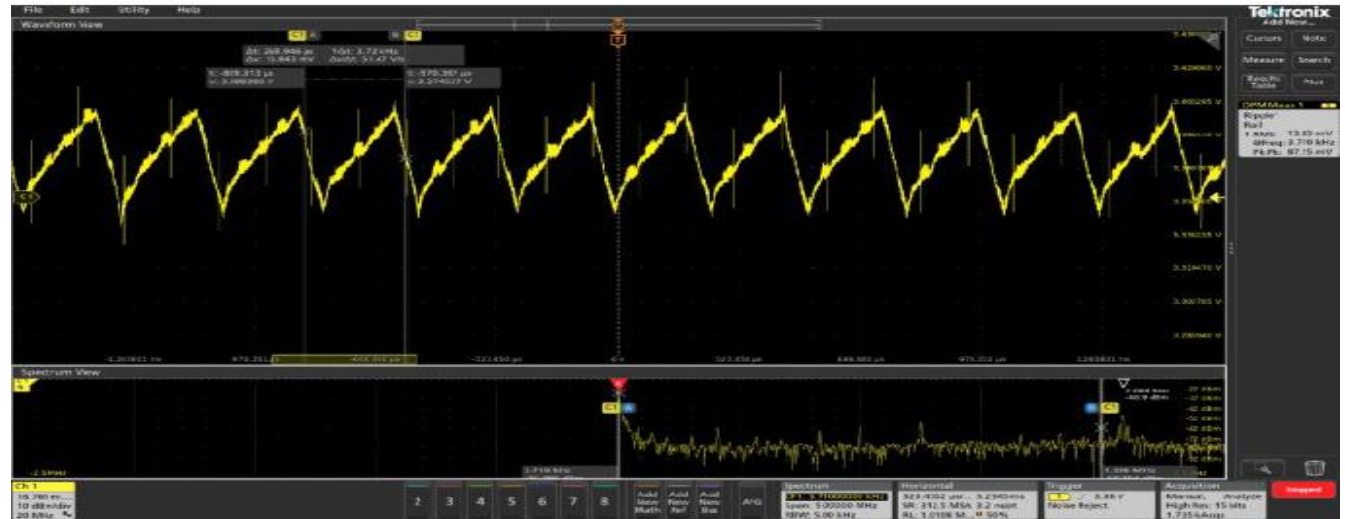
5-DPM and 6-DPM - Significance of Ripple

- Need to look at the output voltage ripple on the Power Rails.
- Multi Rail Testing is critical-saves times
- Ripple is the AC voltage that is superimposed onto the DC output of a power supply. Ripple on Power Rails can lead to incorrect performance of the circuitry.
- The output voltage ripple has two components: Low Frequency “ripple” and High Frequency “ripple-on-ripple”.
- Supports upto 7 power rail testing (MSO58) simultaneously.



5-DPM and 6-DPM - Significance of Ripple

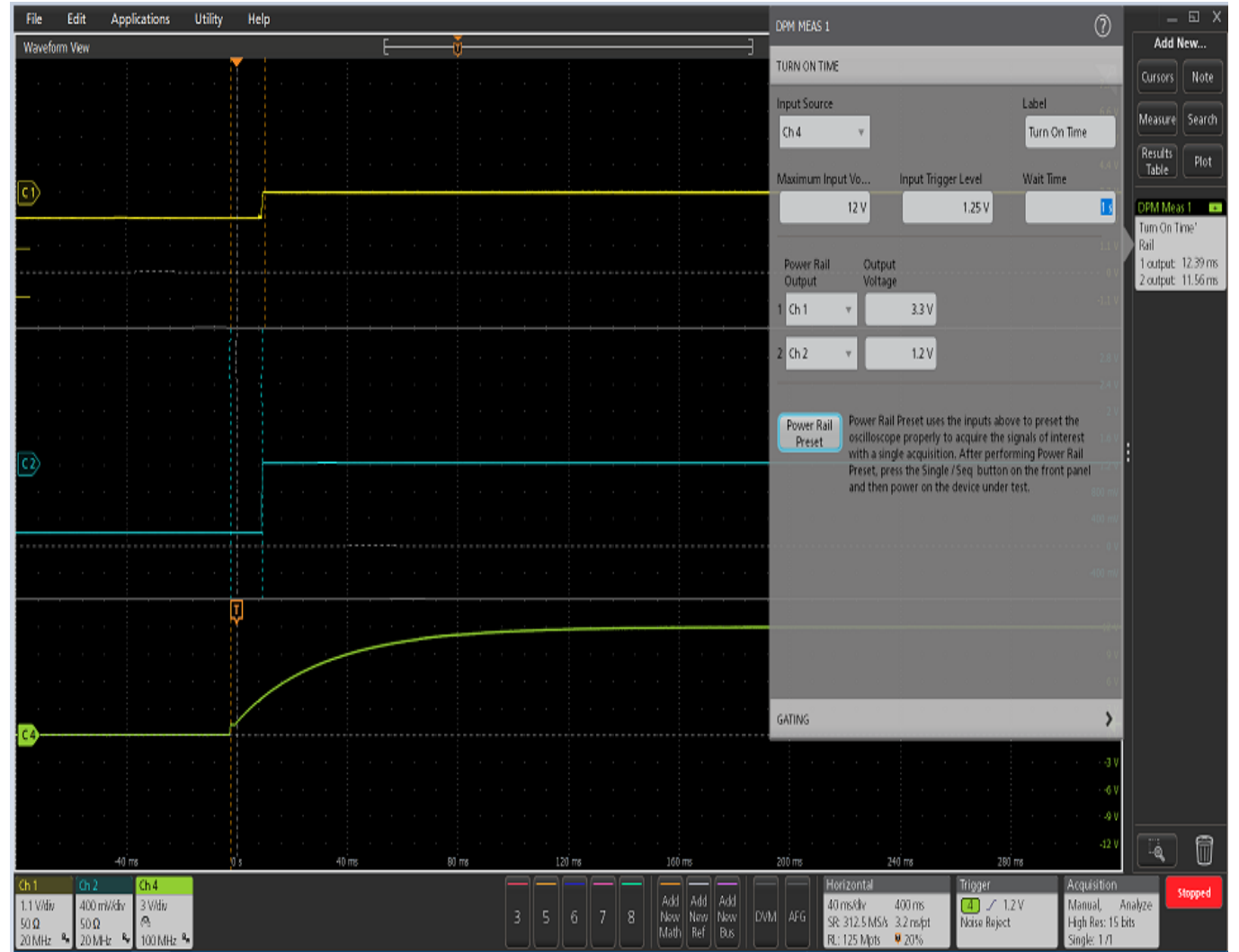
- Power Rail designers need to get insights to their ripple signals.
- They now get insights to **Ripple-on-Ripple** signals which they were missing till now.
- **Spectrum view enables designers to identify the source of ripple.**



•

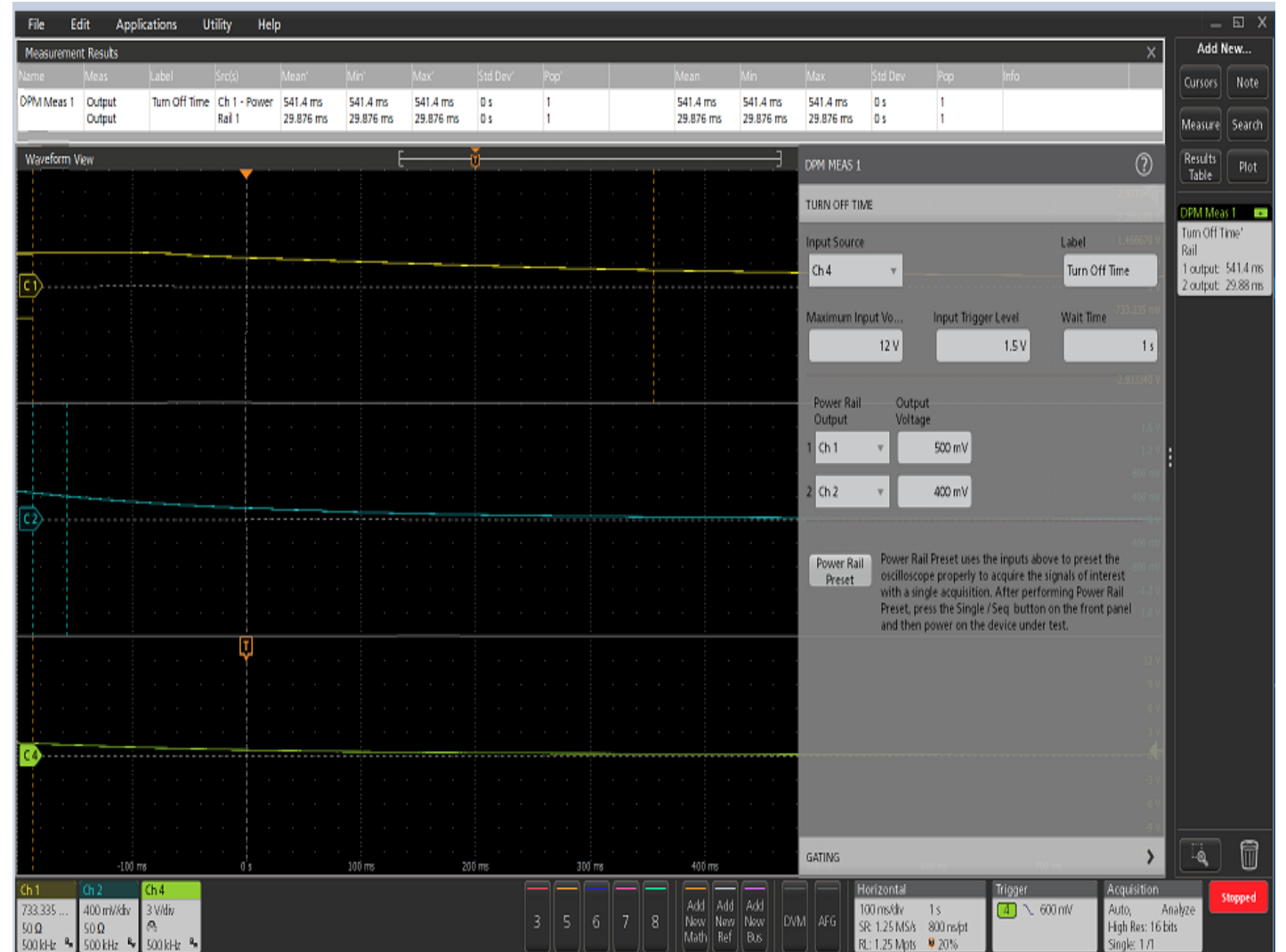
Power Sequencing - Significance of Turn on Time

- **Turn on Time** is the time taken to get the output voltage of the power supply after the input voltage is applied.
- The timing and sequencing of power supply outputs during turn-on is critical to the reliable operation of the end-products.
- Supports testing of up to **7 Power Rails simultaneously** there by enabling system testing and faster validation times.



Power Sequencing - Significance of Turn off Time

- **Turn off Time** is the time taken to get the output voltage of the power supply close to zero after the input voltage is removed.
- The timing and sequencing of power supply outputs during turn-off is critical to the reliable operation of the end-products.
- Supports testing of up to **7 Power Rails simultaneously** there by enabling system testing and faster validation times.



New Measurements in 5/6-PWR needed for Power Rail designers

- Frequency Response Analysis
 - Control Loop Response(Bode Plot)
 - Power Supply Rejection Ratio(PSRR)
 - **Impedance**

These are typically performed using stand alone Frequency Response Analyser or VNA.

- Customer Pain Points
 - Separate test setup.
 - Long test times as the Frequency Response Analyzers or VNAs are shared.

Control Loop Response (Bode Plot Capability)-only in 5/6-PWR

Power supply engineers rely on the Bode plot for the assessment of stability.

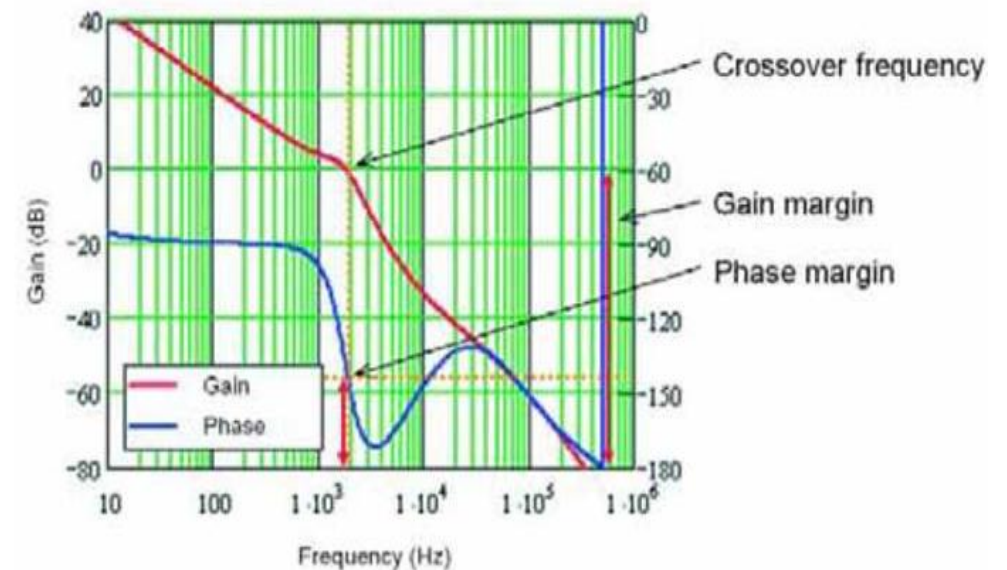
CUSTOMER NEED:

- The regulation characteristics of most power management circuits are defined by the converter loop transfer function which can be plotted in a Bode plot.
- The compensation network should be optimized in order to meet the static and dynamic performance requirements while maintaining stability.

Ideal Loop Gain shall have:

1. Fast Loop Response, achieved by a high BW (high cross zero frequency)
2. Loop Gain slope of 20dB/decade from low frequency to half the switching frequency
3. Large DC gain to achieve high DC accuracy over load and line variations.
4. Good noise immunity.
5. Flat phase curve near cross over frequency
6. Good phase margin – have good stability with minimum overshoot.

This representation of the gain of the loop as well as of the phase shift of the loop taken over frequency gives valuable information about the speed of the control loop and stability of the power supply.



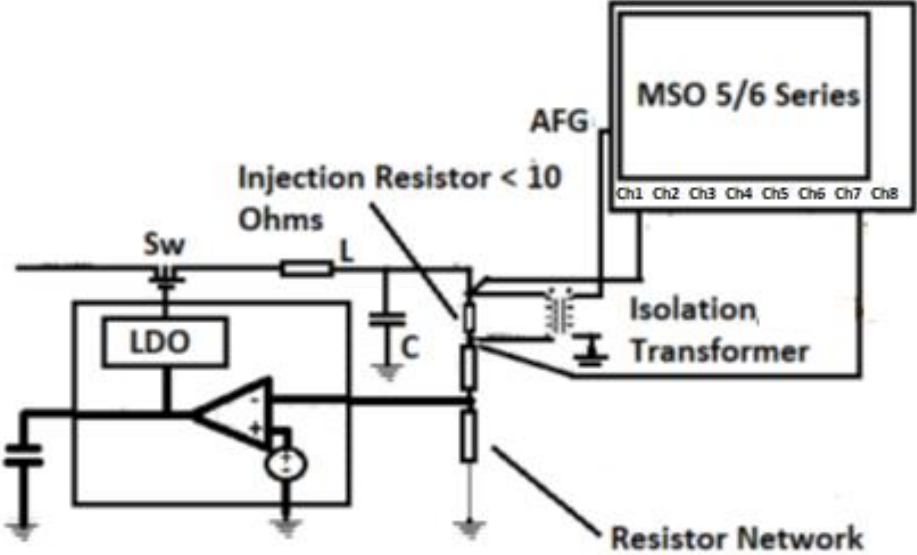
Control Loop Response (Bode Plot Capability)-only in 5/6-PWR

Power supply engineers rely on the Bode plot for the assessment of stability.

Features	Rationale	Solution Options
<p>BODE(Frequency Response Plot)</p> <p>AFG</p> <p>Picotest J2101A injection transformer.</p> <p>define the test parameters including <i>Start Frequency</i>, <i>Stop Frequency</i>, and <i>AFG signal amplitude</i>.</p>	<p>Need a low cost alternative to FRA/VNA setup. Ease of use.</p> <p>Preferably 1 BOX solution.</p>	<ol style="list-style-type: none"> Option 1: Leverage built-in SG of 5/6-series. Option 2: Control external AFG with 5/6 series.

BODE plot :

- Part of 5/6-PWR for power designers



BODE(Frequency Response)

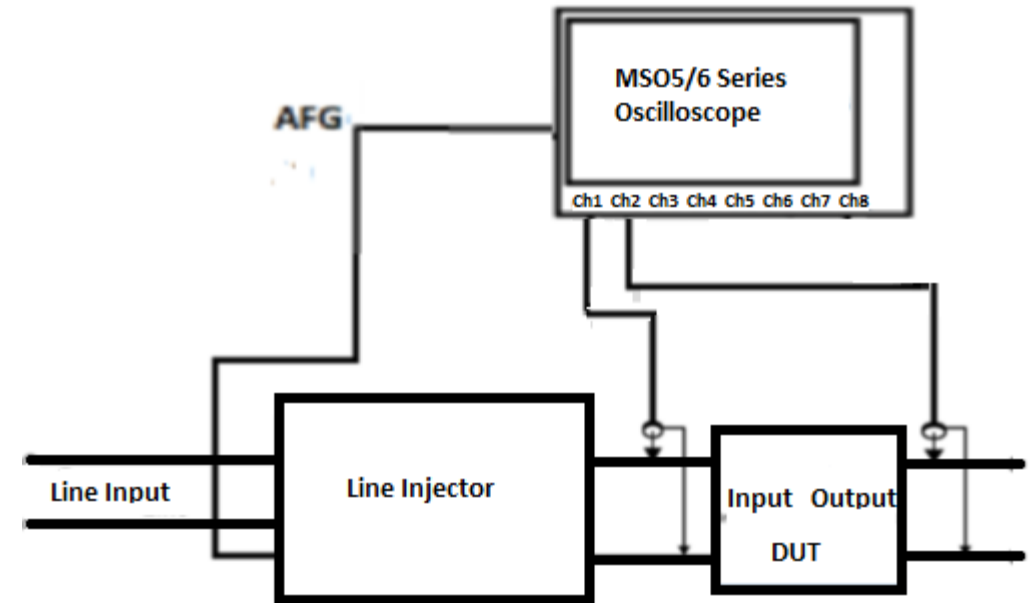
Power Supply Rejection Ratio (PSRR)-only in 5/6-PWR

CUSTOMER NEED:

- Want to see how their DUT such as a DC-to-DC converter or a low-voltage drop-out regulator (LDO), rejects various frequency components injected at the DC input of the device-under-test. In other words, how much of a disturbance signal injected at the DC input reaches the regulated DC output.
- Helps ensure their design works optimally.

To perform a PSRR test, a sine wave must be injected at the DC input and then swept from a low frequency to a high frequency. A DC + AC network summing device, such as Picotest's J2120A line injector, is required for this measurement.

The measurement system measures both the modulated input and output AC voltage levels and then computes the rejection ratio as $20\text{Log}(V_{in}/V_{out})$ at each frequency within the swept band. .



Impedance Measurement (5/6-PWR only)

CUSTOMER NEED:

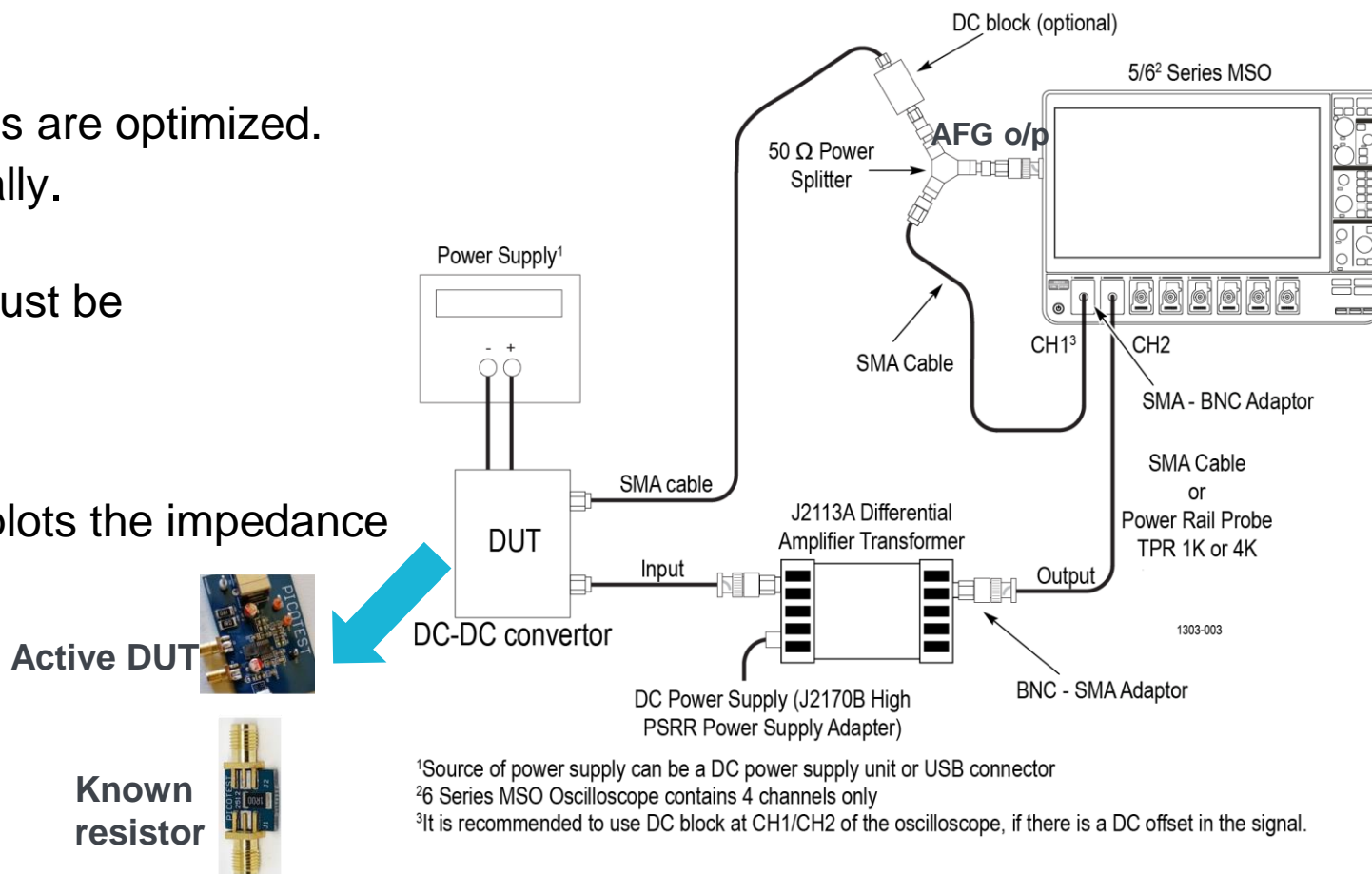
- Want to measure their PDN Impedance and make changes in their design to ensure impedance mis-match is removed..

In other words, how much L,C and R values are optimized.

- Helps ensure their design works optimally.

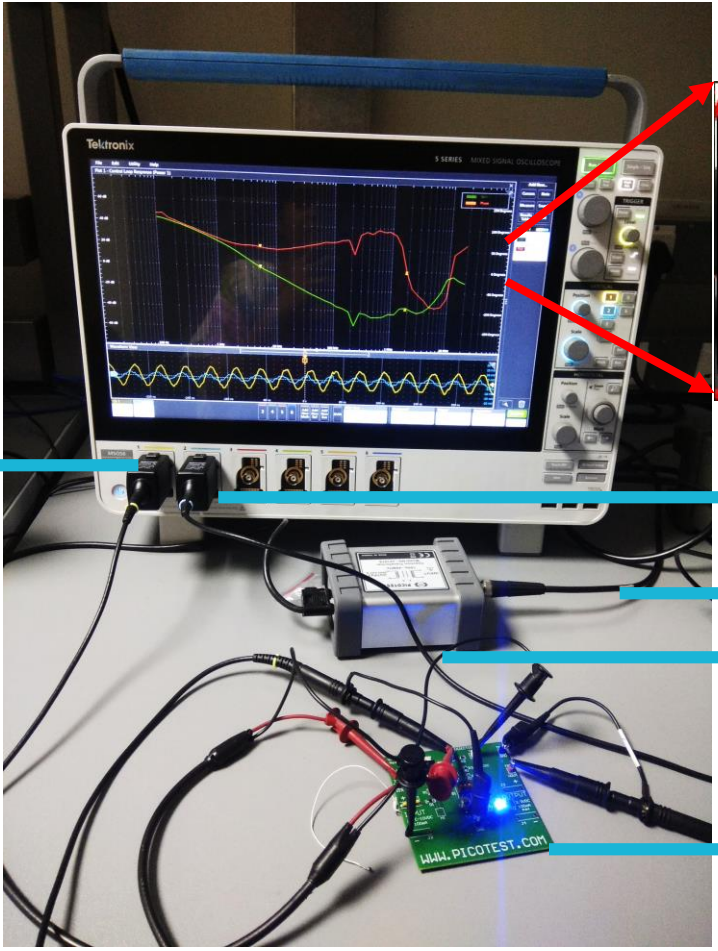
To perform Impedance test, a sine wave must be injected into the DUT through a Picotest's J2102A /J2113A line injector.

The measurement system measures and plots the impedance Over the swept frequency.



BODE plot , PSRR and Impedance Tektronix -1 BOX Solution

- MSO5/6 series with built-in AFG or External AFG31000 series.
- 2#TPP0502 probes for Bode/PSRR
- 1#TPR1000/TPR4000 Power Rail Probe
- External components
 - Pico test injector
 - Isolation transformer
 - Programmable Power Supply(for PSRR)



Power 1 1/2
Control Loop Resp.
GM: 9.98 dB
@131.5 kHz
PM: 41.31°
@62.73 kHz

DUT input

DUT output

AFG output

Picotest Injection transformer

DUT

5-PWR/6-PWR-New measurement

FREQUENCY RESPONSE ANALYSIS (FRA)

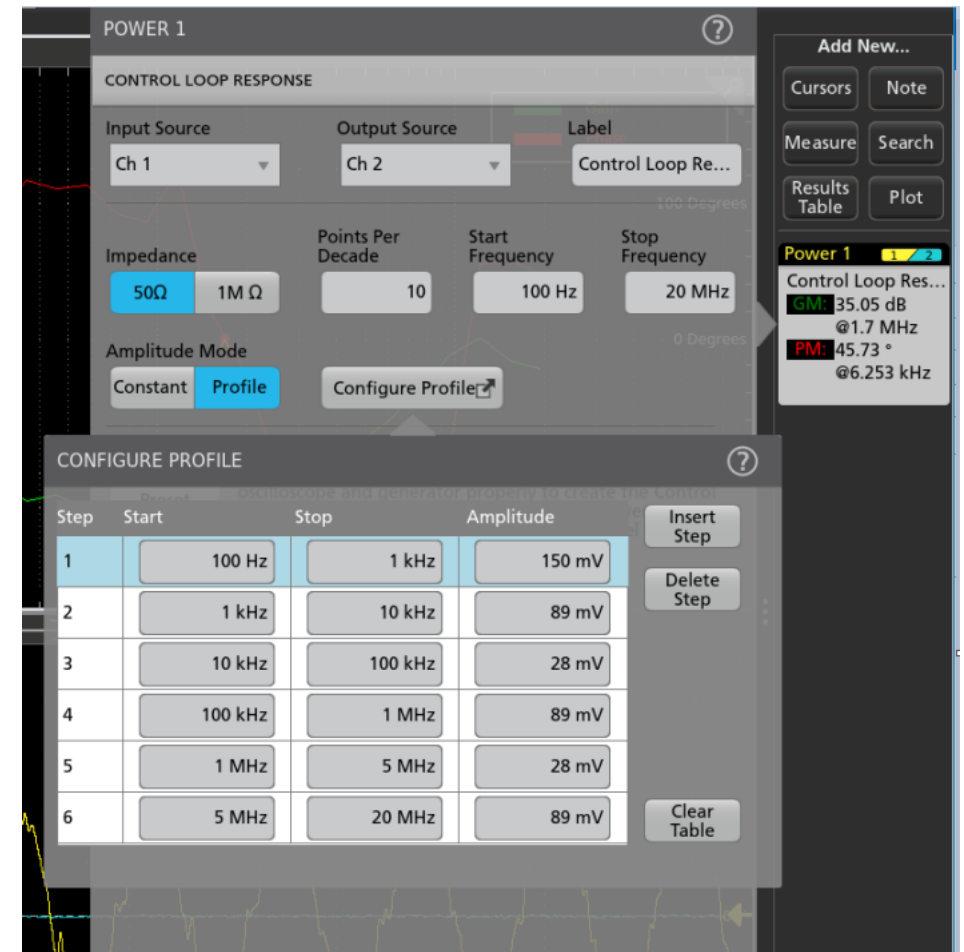
- Control Loop Response (BODE Plot)
 - Gain Margin, Phase Margin, Gain and Phase @ frequency

-Needs Option AFG on 5 series/6 series MSO or External AFG31000 series.

-2# TPP0502 probes (2x attenuation and very low input capacitance)

-Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)

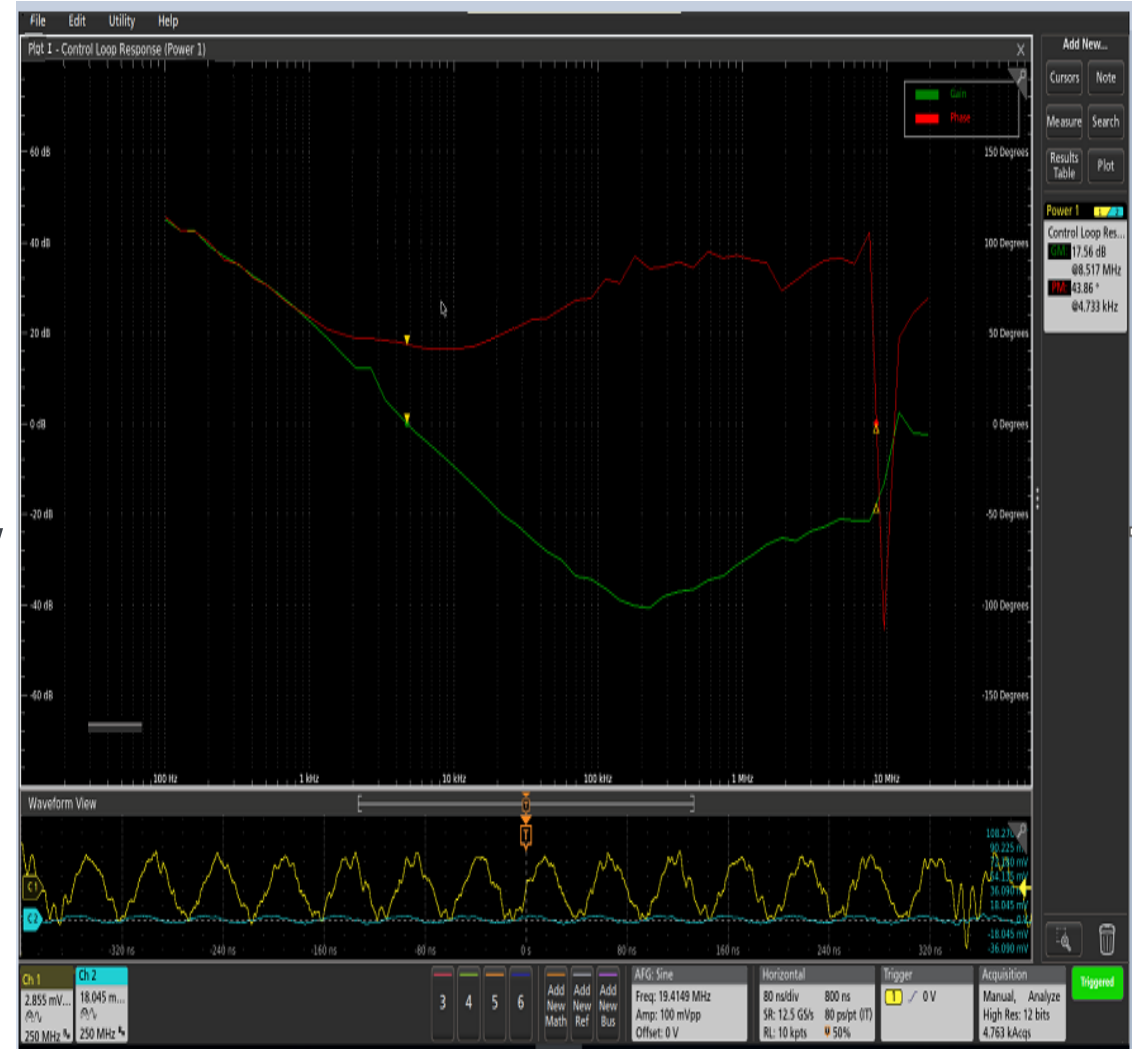
- J2100A or J2101A for BODE Plot



5-PWR/6-PWR-New measurement

FREQUENCY RESPONSE ANALYSIS (FRA)

- Control Loop Response (BODE Plot)
 - Gain Margin, Phase Margin, Gain and Phase @ frequency
- Needs Option AFG on 5 series/6 series MSO or External AFG31000 series.
- 2# TPP0502 probes (2x attenuation and very low input capacitance)
- Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)
- J2100A or J2101A for BODE Plot



5-PWR/6-PWR-New measurement

FREQUENCY RESPONSE ANALYSIS (FRA)

- Power Supply Rejection Ratio (PSRR)
 - Ripple rejection by DC-DC circuit

-Needs Option AFG on 5 series/6 series MSO or External AFG31000 series.

-2# TPP0502 probes (2x attenuation and very low input capacitance)

-Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)

- J2120A for PSRR
- Keithley Power Supply

POWER 1

POWER SUPPLY REJECTION RATIO

Input Source: Ch 1, Output Source: Ch 2, Label: Power Supply Re...

Impedance: 50Ω, 1M Ω, Points Per Decade: 10, Start Frequency: 100 Hz, Stop Frequency: 20 MHz

Amplitude Mode: Constant, Profile, Configure Profile

CONFIGURE PROFILE

Step	Start	Stop	Amplitude
1	100 Hz	1 kHz	500 mV
2	1 kHz	10 kHz	400 mV
3	10 kHz	100 kHz	350 mV
4	100 kHz	1 MHz	250 mV
5	1 MHz	10 MHz	200 mV
6	10 MHz	20 MHz	500 mV

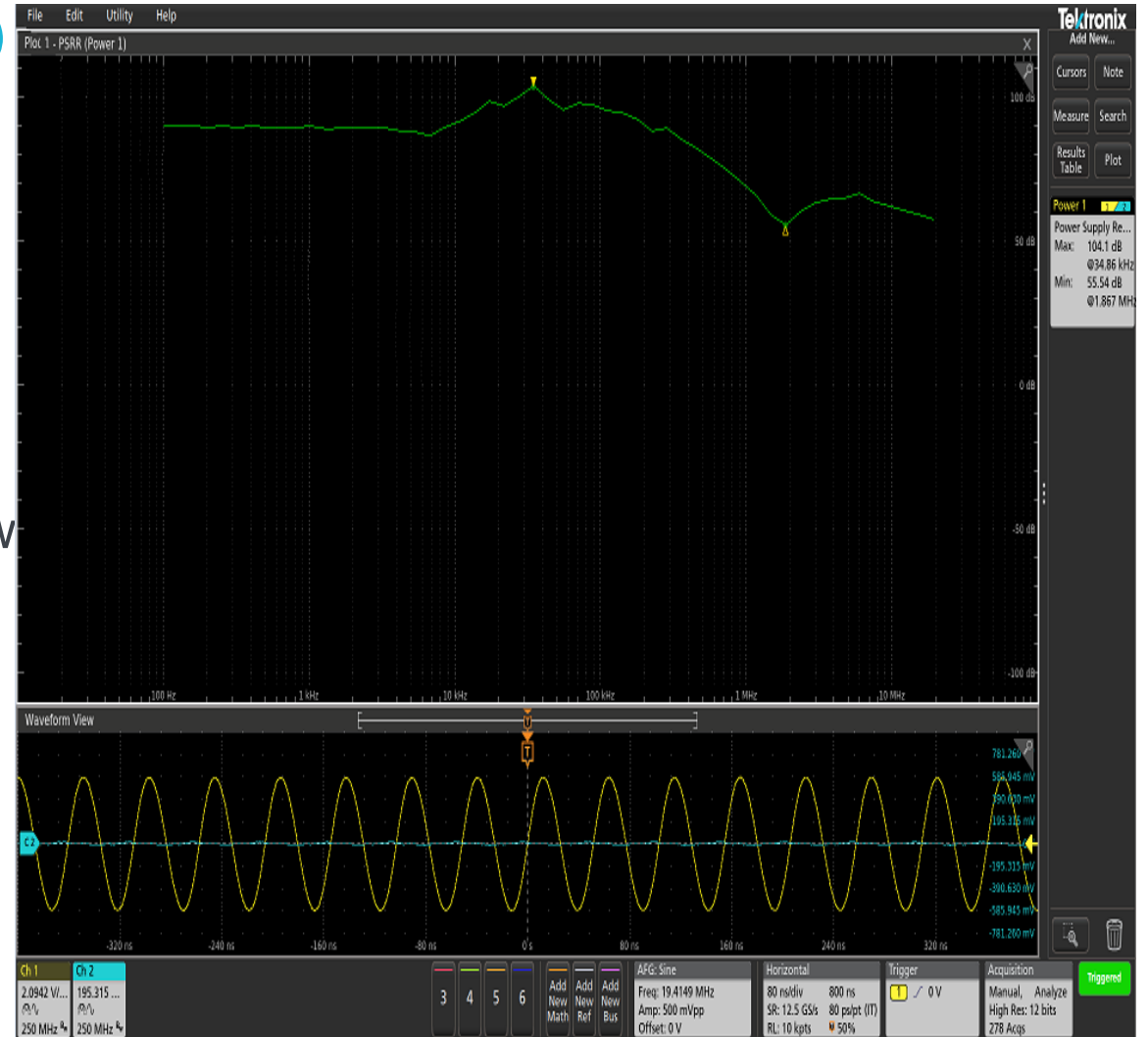
Power 1

Power Supply Re...
Max: 102 dB @27.59 kHz
Min: 54.09 dB @1.867 MHz

5-PWR/6-PWR-New measurement

FREQUENCY RESPONSE ANALYSIS (FRA)

- Power Supply Rejection Ratio (PSRR)
 - Ripple rejection by DC-DC circuit
- Needs Option AFG on 5 series/6 series MSO or External AFG31000 series.
- 2# TPP0502 probes (2x attenuation and very low input capacitance)
- Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)
- J2120A for PSRR
- Keithley Power Supply



5-PWR/6-PWR-New measurement

FREQUENCY RESPONSE ANALYSIS (FRA)

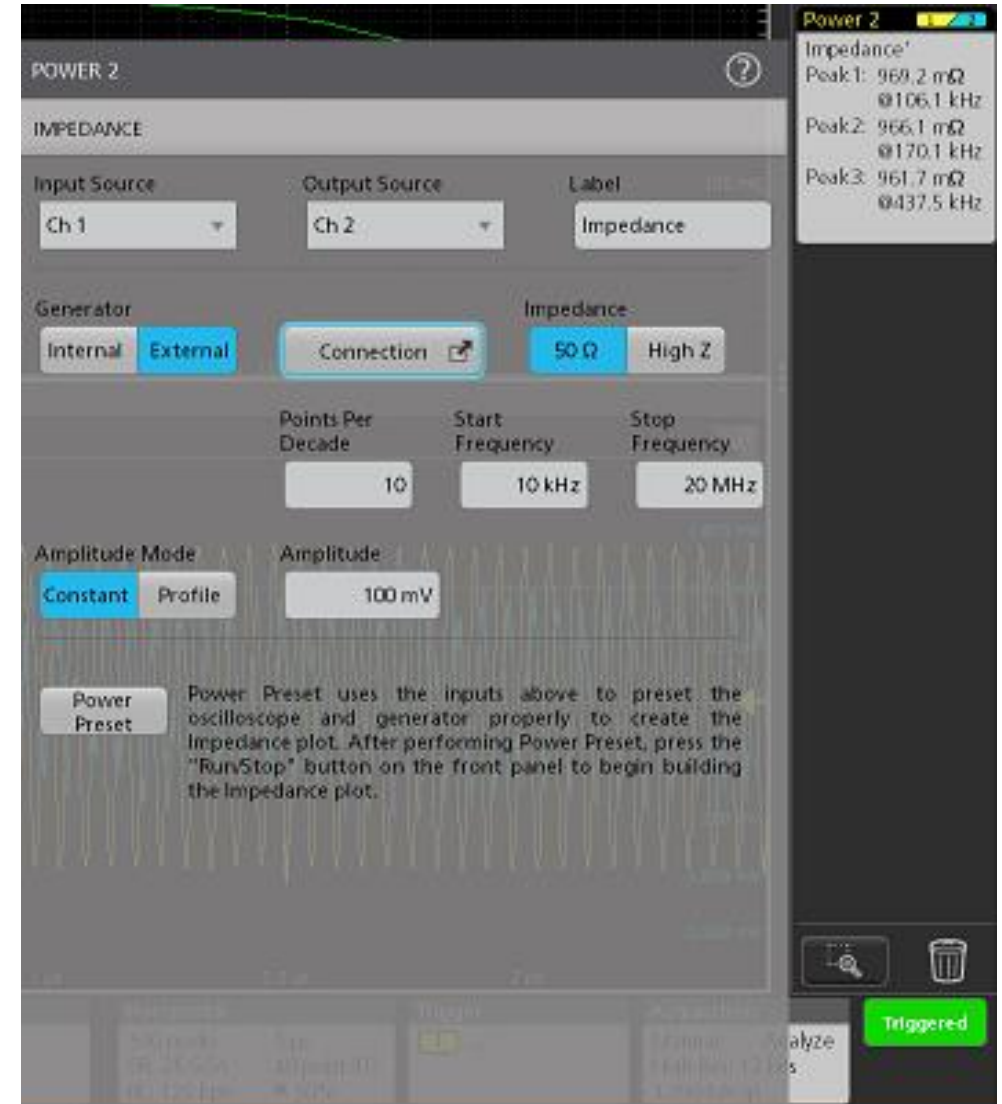
- Impedance
 - PDN Impedance

-Needs Option AFG on 5 series/6 series MSO or External AFG31000 series

-1# TPR1000/TPR4000 or P6150 probe with DC block or Direct SMA with DC block.

-Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)

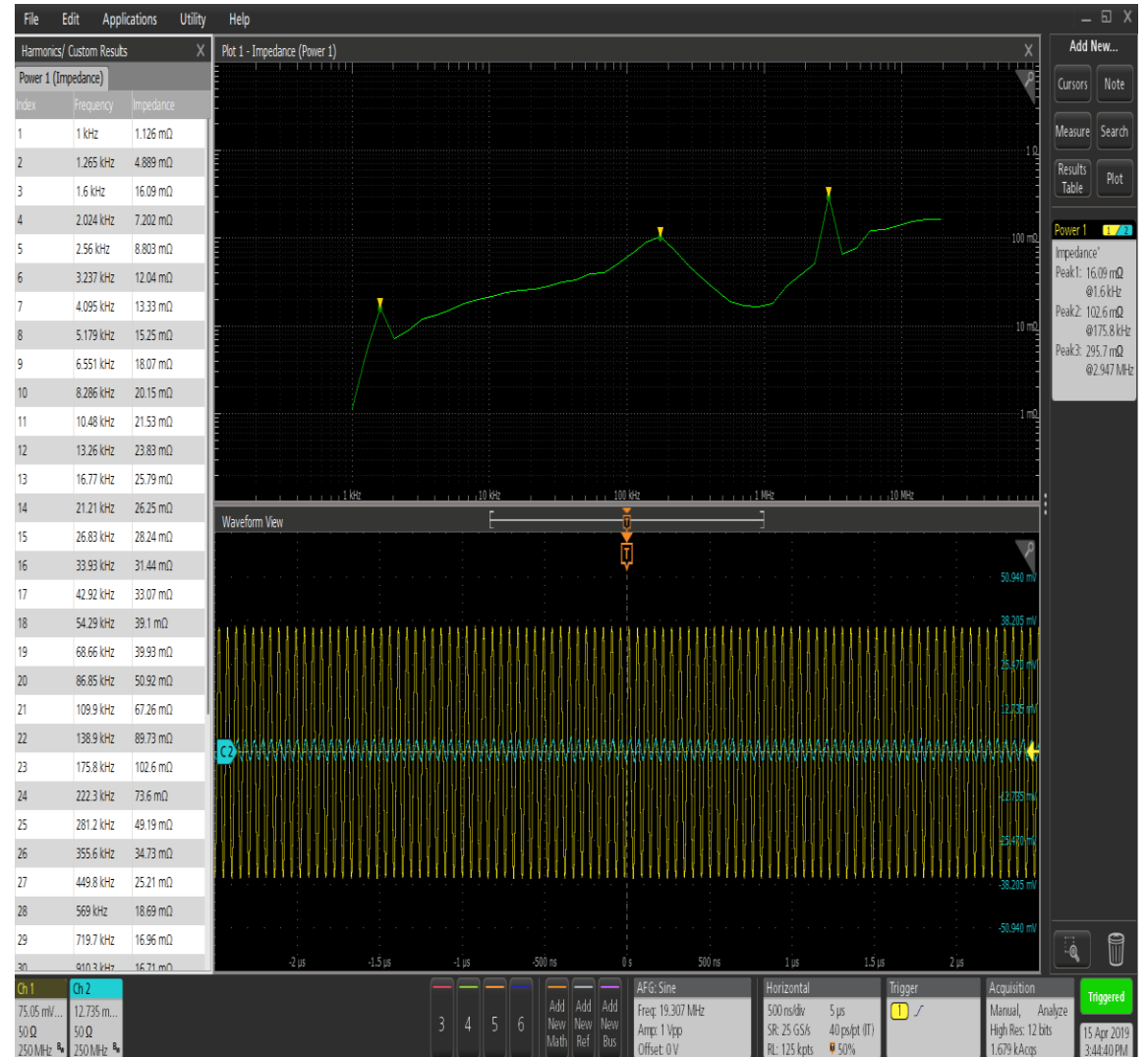
- J2102A or J2113A



5-PWR/6-PWR-New measurement







FREQUENCY RESPONSE ANALYSIS (FRA)

- Impedance
 - PDN Impedance
- Needs Option AFG on 5 series/6 series MSO or External AFG31000 series.
- 1# TPR1000/TPR4000 or P6150 probe with DC block or Direct SMA with DC block.
- Pico Test Injection transformer and Isolation transformer:(<https://www.picotest.com/>)
- J2102A or J2113A



Frequency Response Analyzer (5/6-PWR only)

- Our 1 BOX solution will be leveraging the **built-in AFG** or **external AFG31000 series (supported in 5/6-PWR only)**
- Needs external pico test injector and Isolation transformer.
- Addresses customer pain point of using multiple setups.
- Will control Power supply needed for PSRR.

Pico test model	Image
J2100A: 1Hz to 5MHz (Bode)	
J2101A: 10Hz to 45MHz (Bode)	
J2120A for PSRR	
J2102A : 1Hz to 100MHz For Impedance	
J2113A : DC to 800MHz For Impedance	
VRTS1.5 Voltage Regulator test Std	

Available @ www.picotest.com

Digital Power Management Analysis Solution-VALUE

Customer Pain point

Tektronix DPM Solution (5/6-DPM with 5/6-PWR)

Oscilloscope



Spectrum analyzer



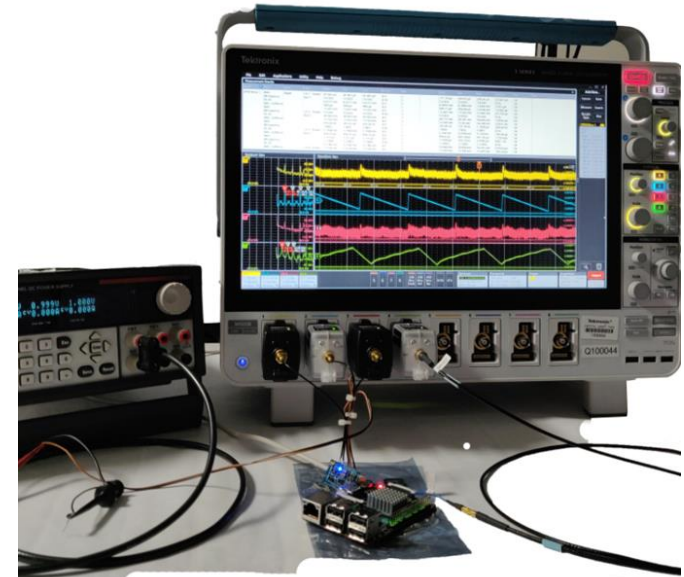
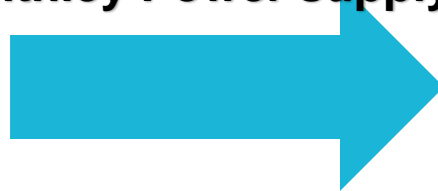
Function generator



Frequency response analyser



1 BOX Solution
+ Keithley Power supply



L C R meter



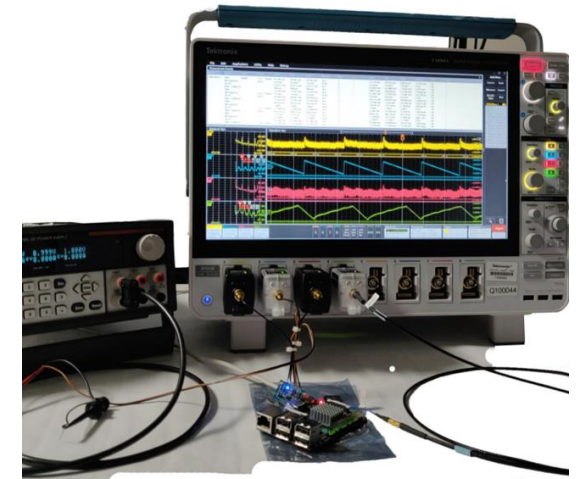
Impedance analyser



- **Up to 7 Multi Rail testing simultaneously.**(MSO58)
- **Spectrum view** to identify source of Ripple/noise.
- **Power Sequencing (7 rails at same time)**
- **PDN Impedance**
- **Bode Plot**

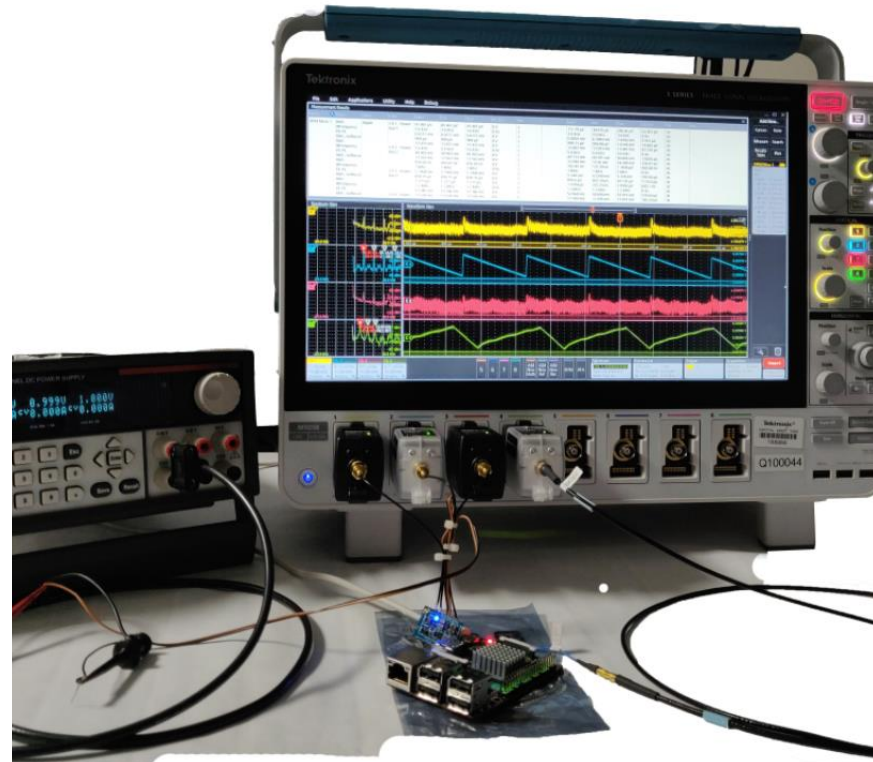
Summary

- **Best in class 5/6 Series Oscilloscope with multiple FlexChannel® and state of the art GUI**
 - Up to 8 (5 Series) and 4 (6 Series) analog channels enables multi point probing capability leading to faster validation and test times hence achieve faster time to market.
 - 6 Series with its best in class front end amplifier enables designers to look at < 10mV Ripple not seen before.
 - Digital Channels allow insights to the protocol decode of power buses.
- **Power Rail probes enables to captures signals which were not possible earlier**
 - TPR1000
 - TPR4000
- **Integrated Digital Power Management Analysis software**
 - Ease of use
 - Accuracy
 - Repeatability
 - Reports
- **1 BOX Solution for Power measurements and Frequency Response Analysis**



Complete solution including Oscilloscopes, Probes, Power Analyzers, SMUs, AFGs, DMMs, Power Supplies and Parametric Test setups meeting Power design workflow needs.





Reference Materials :

1. 5 Series MSO Data sheet: <https://kr.tek.com/datasheet/5-series-mso>
2. 6 Series MSO Data sheet: <https://kr.tek.com/datasheet/6-series-mso>
3. 5-DPM and 6-DPM Digital Power Management and Analysis Software Data sheet. <https://kr.tek.com/datasheet/advanced-power-measurement-and-analysis>
4. Power Rail Probes: <https://kr.tek.com/isolated-measurement-systems>
5. <https://kr.tek.com/power-efficiency/trends>
6. Application Notes:1.) <https://kr.tek.com/document/application-note/power-supply-measurement-and-analysis-5-pwr-application-software>

Thank You

