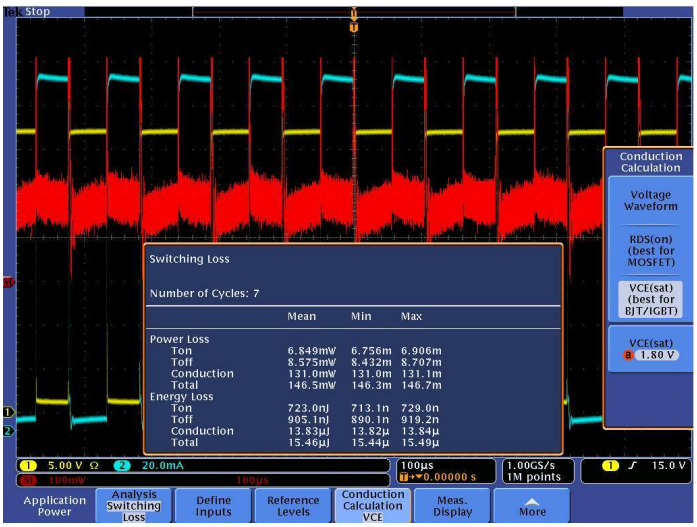
Power Analysis Application Module

DPO4PWR • DPO3PWR Data Sheet



Features & Benefits

- Power Loss Measurements at the Switching Device for Improving Switching Power Supply Efficiency
- Customizable Safe Operating Area Mask Testing with Linear and Log Scale for Reliability Testing
- Automatic Ripple Measurement Setup eliminates Manual Processes
- Precompliance Testing to the EN61000-3-2 Class A and MIL Standard 1399 Section 300A Standards reduces Compliance Test Time and Risk
- Automated THD, True Power, Apparent Power, Power Factor, and Crest Factor Features eliminate Tedious Manual Calculations
- Modulation Analysis quickly provides Accurate Active Power Factor Characterization
- Deskew Wizard ensures Accurate, Time-correlated Results
- Correct Scale Factor and Unit Display while using Third-party Current Probes eliminates Manual Calculations and Human Error

Applications

- Power Loss Measurement at Switching Device
- Characterization of Power Semiconductor Devices
- Optimal Drive Characterization of Synchronous Rectifiers
- Measurement and Analysis of Ripple and Noise
- Precompliance Testing to IEC Standard EN61000 3-2 Class A, MIL Standard 1399 Section 300A, and up to 400 Harmonics
- Debugging Active Power Factor Correction Circuits

Note: Additional power analysis solutions are available. Please go to www.tektronix.com/power for more.

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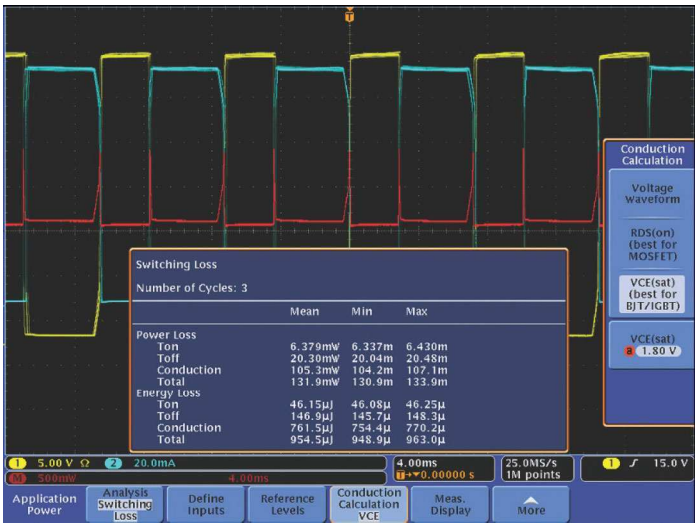

Figure 1 – DPOxPWR switching loss measurements.

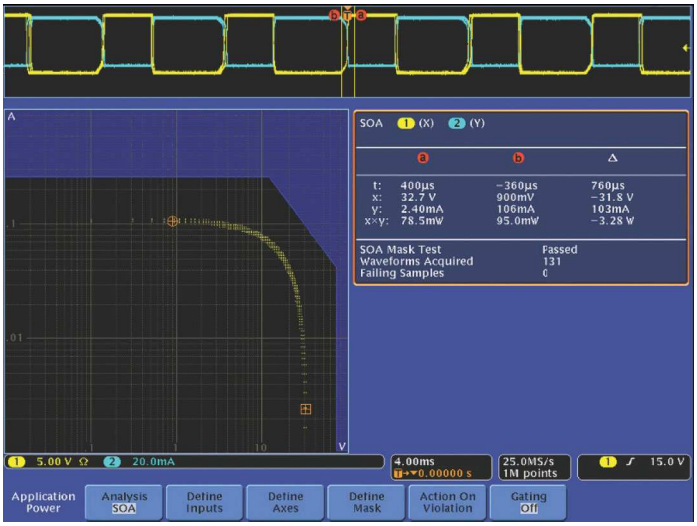

Figure 2 – DPOxPWR Safe Operating Area (SOA) display.

DPO4PWR/DPO3PWR

With the DPOxPWR (DPO4PWR, DPO3PWR) Power Analysis Module installed on a MDO4000, MSO/DPO4000, or MSO/DPO3000 Series oscilloscope, an embedded designer who rarely deals with power measurements can quickly get the same accurate, repeatable results as a power supply expert. DPOxPWR with a MDO4000, MSO/DPO4000, or MSO/DPO3000 Series oscilloscope and differential voltage and current probes forms a complete measurement system for power supply design and test.

DPOxPWR provides a number of specific measurements to characterize power supplies: Switching Component Analysis, Input Analysis, and Output Analysis.

Switching Component Analysis

The accurate calculation and evaluation of energy loss in power supplies has become even more critical with the drive to higher power conversion efficiency and greater reliability.

Switching Loss Measurements

Although almost all components of a power supply contribute to energy losses, the majority of energy losses in a switch-mode power supply (SMPS) occur when the switching transistor transitions from an OFF to an ON state (turn-on loss) and vice versa (turn-off loss). By measuring the voltage drop across the switching device and the current flowing through the switching device, DPOxPWR measures the switching losses as shown in Figure 1.

Safe Operating Area

The Safe Operating Area (SOA) plot is a graphical technique for evaluating a switching device to ensure that it is not being stressed beyond its maximum specifications. SOA testing can be used to validate performance over a range of operating conditions, including load variations, temperature changes, and variations in input voltages. Limit testing can also be used with SOA plots to automate the validation. An example of an SOA plot is shown in Figure 2.

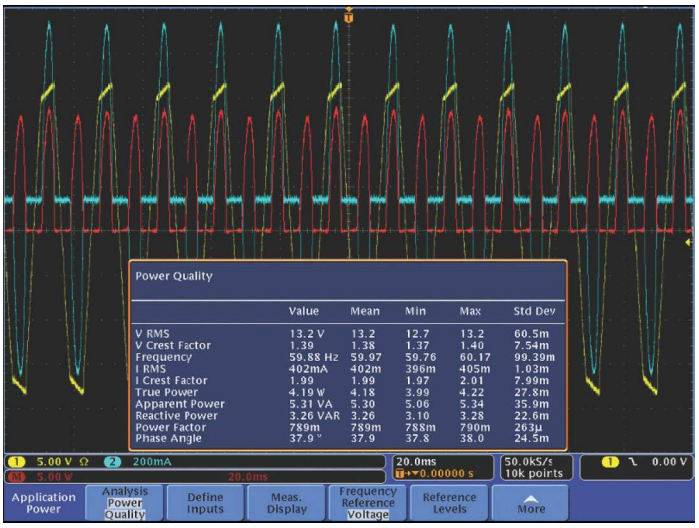

Figure 3 – DPOxPWR power quality measurements.

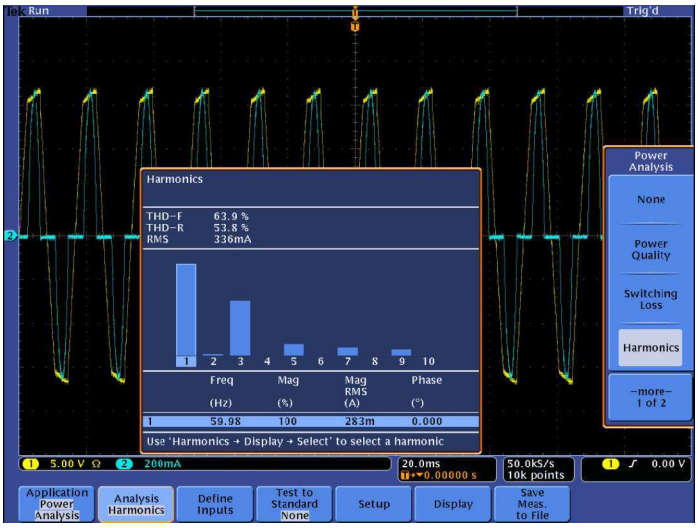

Figure 4 – DPOxPWR current harmonics measurements.

Input Analysis

Power quality measurements and current harmonics are two common sets of measurements made on the input section of a power supply to analyze the effects of the power supply on the power line.

Power Quality

Power quality refers to a power supply's ability to function properly with the electric power that is supplied to it. These measurements help to understand the effects of distortions caused by nonlinear loads, including the power supply itself. The measurements include RMS voltage and current, true and apparent power, crest factor, line frequency, and power factor, as shown in Figure 3.

Current Harmonics

Because a switching power supply presents a nonlinear load to the power line, the input voltage and current waveforms are not identical. Current is drawn for some portion of the input cycle, causing the generation of harmonics on the input current waveform. Excessive harmonic energy can affect the operation of other equipment connected to the power line, as well as increase the cost of delivering the electric power. Therefore, power supply designers can use the DPOxPWR current harmonics measurements to assure precompliance of their designs to industry standards (such as IEC61000-3-2 Class A and MIL Standard 1399 Section 300A) before investing in the official compliance testing. An example of the current harmonics graph display is shown in Figure 4.

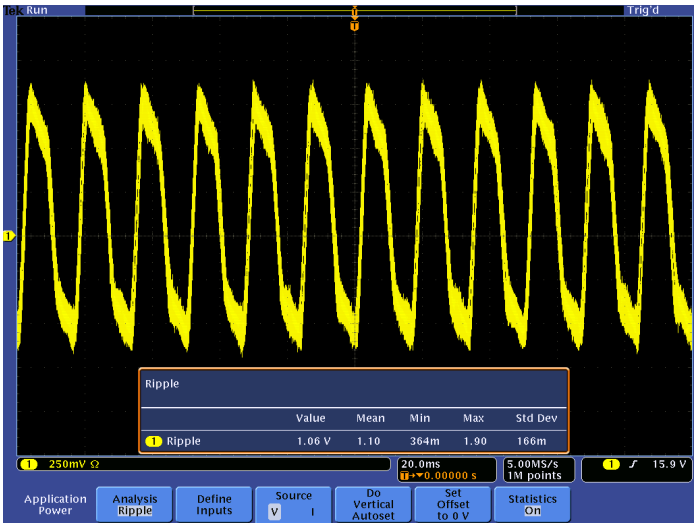

Figure 5 – DPOxPWR ripple measurements.

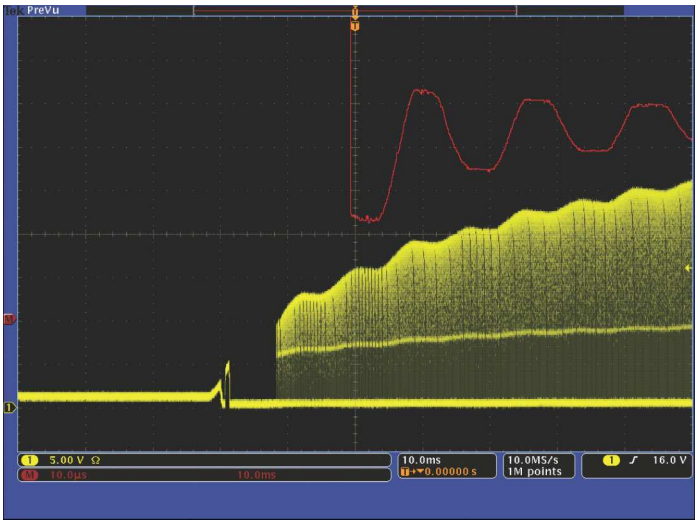

Figure 6 – DPOxPWR modulation analysis on an IGBT's gate drive during power up.

Output Analysis

The ultimate goal of a DC-output power supply is to transform input power into one or more DC-output voltages. Especially for switching power supplies, the output measurements are essential. These measurements include line ripple, switching ripple, and modulation analysis.

Line and Switching Ripple

The quality of a power supply's DC output should be clean with minimal noise and ripple. Line ripple measures the amount of AC-output signal related to the input line frequency. Switching ripple measures the amount of AC signal related to the switching frequency. The output line ripple is usually twice the line frequency; whereas the switching ripple is typically coupled with noise and in the kHz frequency range. DPOxPWR greatly simplifies the separation of line ripple from switching ripple.

Modulation Analysis

Modulation is important in a feedback system to control the loop. However, too much modulation can cause the loop to become unstable. DPOxPWR calculates and shows the trend in the on-time and off-time information of a modulated signal controlling the output control loop on a power supply, as shown in Figure 6. The modulation analysis could also be used to measure the response of the power supply's control loop to change in input voltage ("line regulation") or change in load ("load regulation").

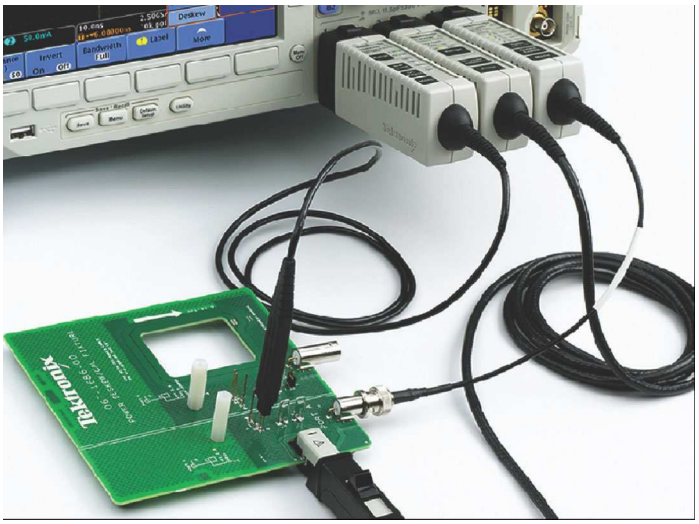

Figure 7 – Tektronix Deskew Pulse Generator and Deskew Fixture.

Characteristics

Measurements

Characteristic	Description
Power Quality Measurements	V_{RMS}, $V_{Crest\ Factor}$, Frequency, I_{RMS}, $I_{Crest\ Factor}$, True Power, Apparent Power, Reactive Power, Power Factor, Phase Angle
Switching Loss Measurements	Power Loss: T_{On}, T_{Off}, Conduction, Total
	Energy Loss: T_{On}, T_{Off}, Conduction, Total
Harmonics	THD-F, THD-R, RMS measurements up to 400 harmonics
	Graphical and table displays of harmonics
	Test to IEC61000-3-2 Class A and MIL-STD-1399 Section 300A
Ripple Measurements	V_{Ripple} and I_{Ripple}
Modulation Analysis	Graphical display of +Pulse Width, –Pulse Width, Period, Frequency, +Duty Cycle, and –Duty Cycle modulation types
Safe Operating Area	Graphical display and mask testing of switching device safe operating area measurements
dV/dt and dI/dt Measurements	Cursor measurements of slew rate

Deskew

Recommended deskew values automatically calculated based on propagation delay. Deskews can be set to recommended values or adjusted manually.

Characteristic	Description
TekVPI and TekProbe II	Nominal propagation delay value automatically loaded
Built-in Probe Model List	Nomination propagation delay value provided when probe is selected
Other	Propagation delay can be manually entered

Ordering Information

DPO4PWR/DPO3PWR

Power Analysis Application Modules.

Model	Series
DPO4PWR	MDO4000, MSO/DPO4000B, MSO/DPO4000 Series
DPO3PWR	MSO/DPO3000 Series

Recommended Accessories

Accessory	Description
067-1686-xx	Deskew fixture
TEK-DPG	Deskew pulse generator

Tektronix Oscilloscopes and Probes Supported

For a complete listing of compatible probes for each oscilloscope, please refer to www.tektronix.com/probes for specific information on the recommended models of probes and any necessary probe adapters.

Additional Information

Additional information about power analysis is available at www.tektronix.com/power.

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