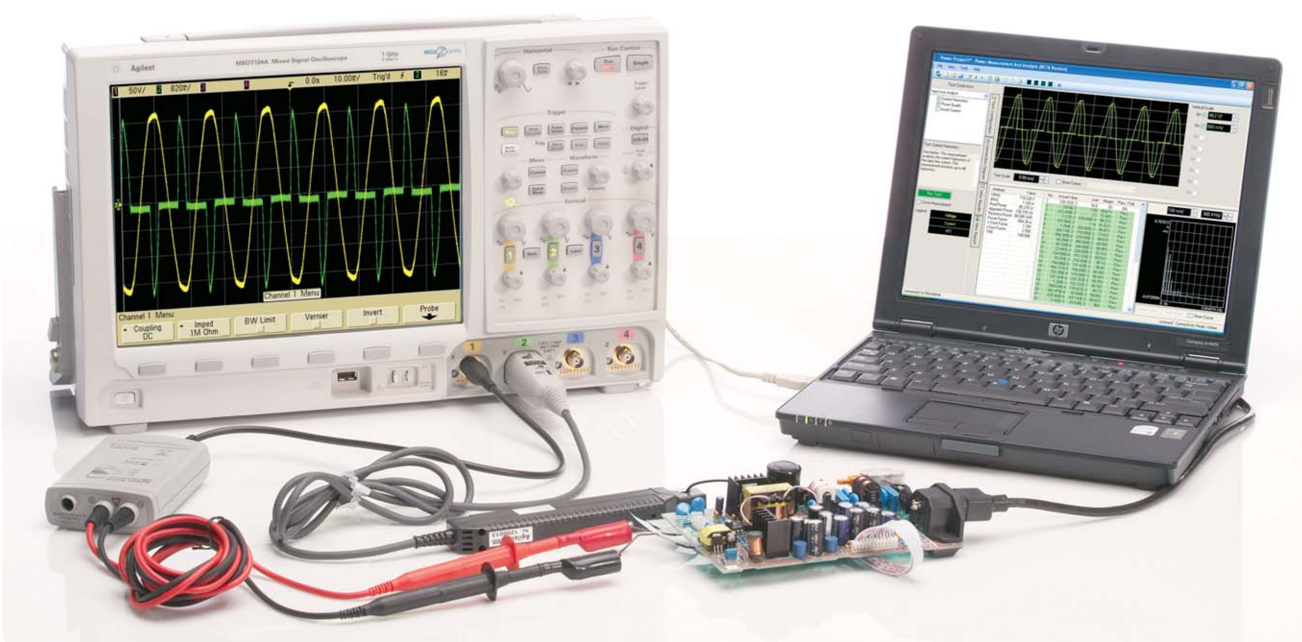
Agilent U1881A and U1882A Power Measurement Application for Agilent InfiniiVision and Infiniium Oscilloscopes

Data Sheet

Fast, automatic and reliable characterization of switching mode power devices



Agilent Technologies

Today's power supply designers are facing an increasing number of constraints in the development of high-efficiency, low-cost power supplies. Cost-effective solutions used to be the designer's key target. Today, rising energy costs bring power supply efficiency to the forefront. Additionally, other constraints such as design compactness, migration to digital control, tighter voltage tolerances and regulations for power quality and EMI force the need for quick and reliable power supply testing. Increasing design constraints translate into more time dedicated to power device measurement and analysis for today's power supply designers.

In spite of the increasing analysis capability offered by many oscilloscopes over recent years, it is not uncommon to see designers perform measurements and characterization manually. These measurements typically take a considerable amount of time to capture, analyze, and report.

Figure 1. Power measurement application running on an Agilent 8000 Series oscilloscope provides a single-box solution for testing switching mode power supply characteristics.

Full-featured measurements and automatic reporting of switching mode power supply (SMPS) characteristics

Now you can skip the time-consuming manual measurements when you are characterizing your power devices. The U1881A and U1882A power measurement application for Agilent oscilloscopes provides a full suite of power measurements that run directly on an Infiniium 8000 and 9000 Series oscilloscope or on a separate PC for use with InfiniiVision 5000, 6000 and 7000 Series oscilloscopes.

Agilent's power measurement application offers seven modules to help you characterize your devices (power device analysis, input line analysis, output analysis, turn on/off analysis, transient analysis, modulation analysis) in addition to deskew and report generation. Each module contains relevant measurement and setup selections for easy repeatability.

Modules	Measurements
Deskew	Automatic deskew for voltage and current probes
Power device analysis	Switching loss Safe operating area (SOA) with SOA mask editing Dynamic ON resistance dI/dt dV/dt
Input line analysis	Power factor (real power/apparent power) Real power Apparent power Reactive power Crest factor Precompliance test to IEC61000-3-2 std A,B,C,D and RTCA DO-160E
Inrush current analysis	Inrush current
Output analysis	Output voltage ripple
Turn on/off analysis	Turn on time Turn off time
Transient analysis	Transient load response
Modulation analysis	Pulse width versus time plot Duty cycle versus time plot Period versus time plot Frequency versus time plot
Report generation	Report generation

Auto deskewing and U1880A deskew fixture

A power measurement is simply a point-by-point multiplication of the voltage and current waveforms measured by the voltage and current probes. To make accurate power measurement and calculation, it is extremely important to equalize the time delay between the voltage and current probes using a procedure known as “deskewing.” This step is critically important since a small offset in the timing of the voltage and current traces can cause a large error in the instantaneous power reading. To deskew a pair of probes, drive both voltage and current probes with the same pulse signal using the U1880A deskew fixture. With only a single click on the menu, deskewing is automatically performed and its values are saved in the power measurement software, so the next time you launch the power measurement application, you can use the saved deskew values or perform the deskewing again.

The deskew accuracy is a function of the electrical characteristics of the voltage and current probes as well as the risetime of the signal under test. In general, higher bandwidth probes will allow for better risetime fidelity and better deskew resolution. Agilent's N2790A - N2793A differential probes are recommended for most applications.

The U1880A deskew fixture is recommended for use with the following voltage and current probe combinations given various test signal risetime characteristics.

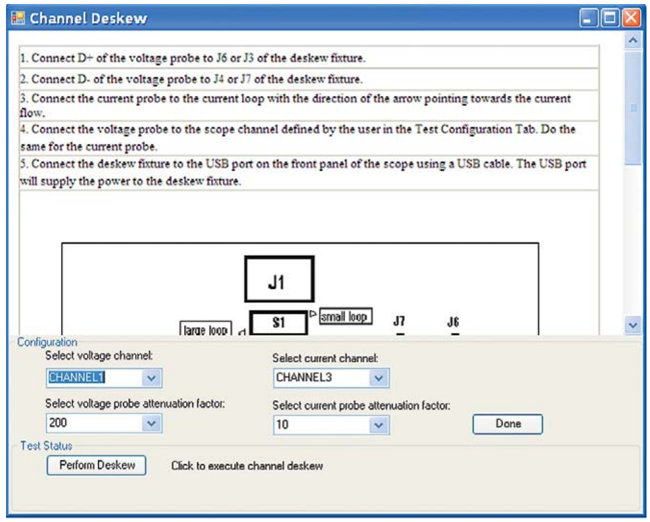


Figure 2. Deskew dialog

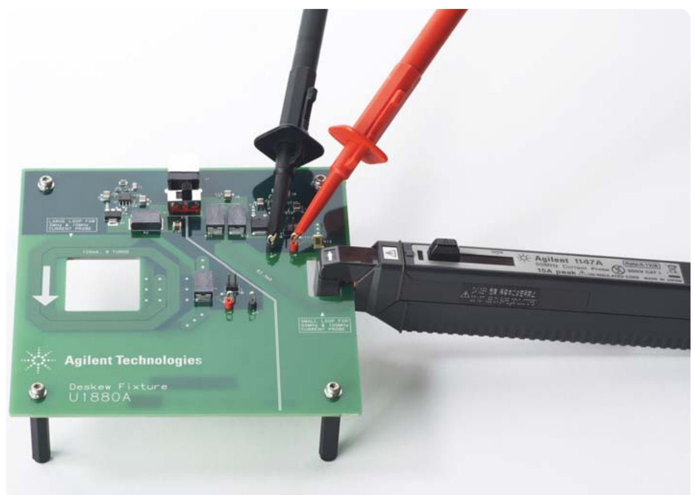


Figure 3. Deskew fixture

Power device analysis

The switching loss in a power supply determines its efficiency. You can easily characterize instantaneous power loss and conduction power loss at the switching device over a designated switching cycle. The dynamic ON resistance measurement shows you power loss while the power transistor is conducting.

To determine the reliability of the power supply it is very important to measure the power loss during dynamic load changes and to observe the SOA (safe operating area) plot. Using deep acquisition memory on the scope with the SOA plot, you can easily identify improper power transistor behavior.

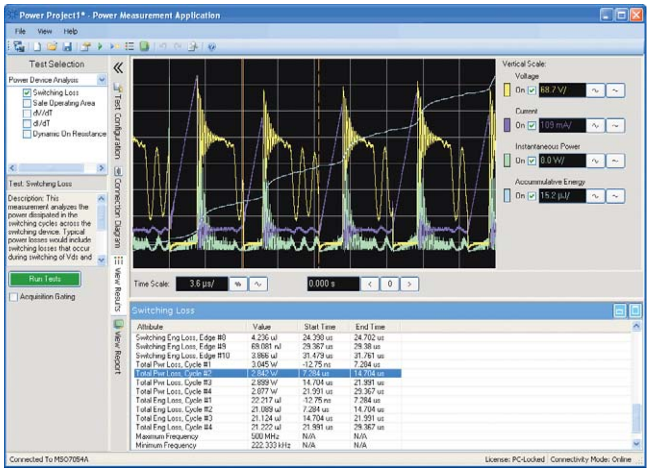


Figure 4. Power device analysis results are displayed both graphically and in a tabular, "lister" format.

Input line analysis

Power supply designers need to characterize the line power for power quality, harmonics and conducted emissions under different operating conditions of the power supply. Some of the implicit measurements are real power, apparent power, reactive power, power and crest factor and graphical display of harmonics with respect to standards such as IEC 61000-3-2 (Class A,B,C,D) and RTCA DO 160E. By using a current probe and the power measurement software (equipped with an FFT math function), you can measure conducted power line harmonics.

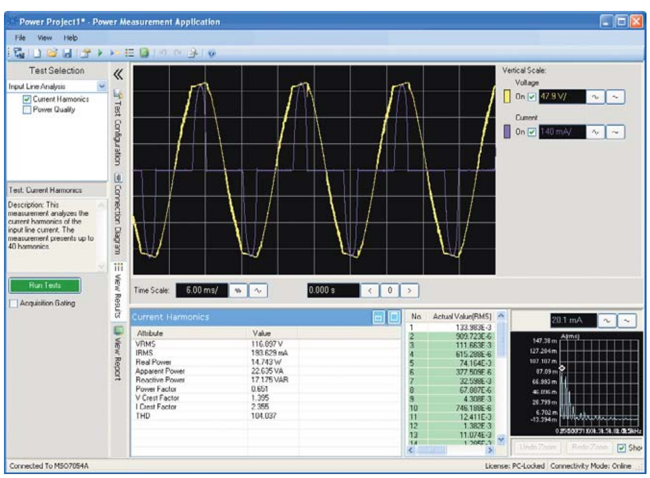


Figure 5. Input line analysis results

Modulation analysis

Modulation analysis allows you to quickly see the on-time and off-time information of the PWM signal, which is difficult to visualize because the information bandwidth is much lower than the pulse switching frequency. Plotting the embedded variation of on time or off time in the PWM signal over a long period of time can reveal the control loop response of the feedback loop system. This measurement performs data trending on the switching variation of the acquired waveform in the following formats:

- Frequency versus time
- Period versus time
- Duty cycle versus time
- Positive pulse width versus time

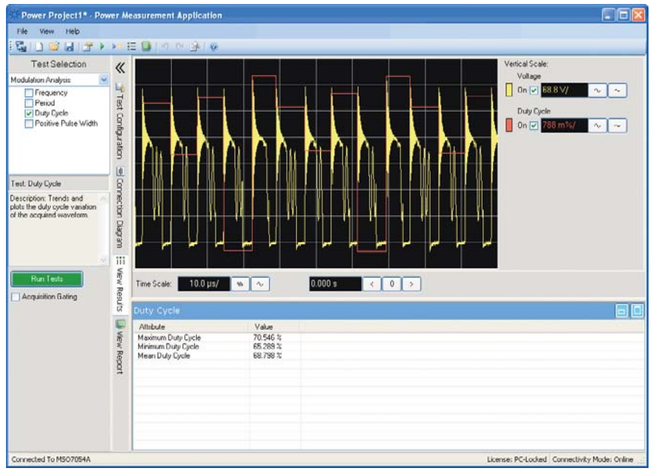


Figure 6. Modulation analysis results

Output analysis

This module includes characterizing the ripple (either AC or switching) component in the output DC voltage. Ripple is the residual AC component that is superimposed on the DC output of a power supply. Line frequency and switching frequency can contribute to the ripple. This measurement presents the peak-to-peak ripple value as well as the frequency response of the captured signal.

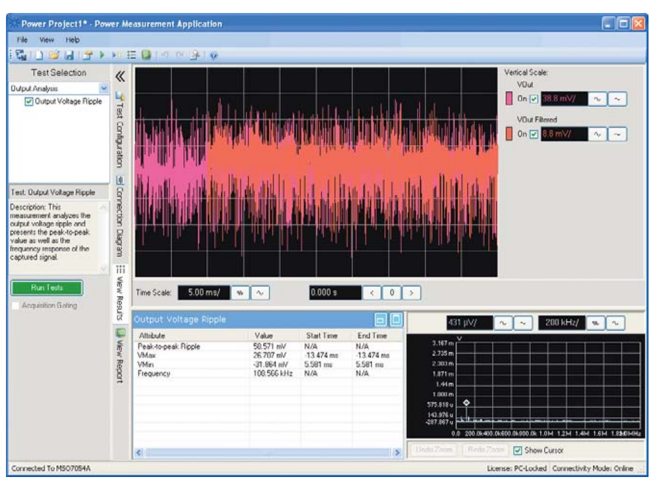


Figure 7. Output analysis results

Turn on/off time analysis

This module measures the time taken to get to the steady output voltage of the power supply after the input voltage is applied (turn on time) and for the output voltage of the power supply to turn off after the input voltage is removed (turn off time).

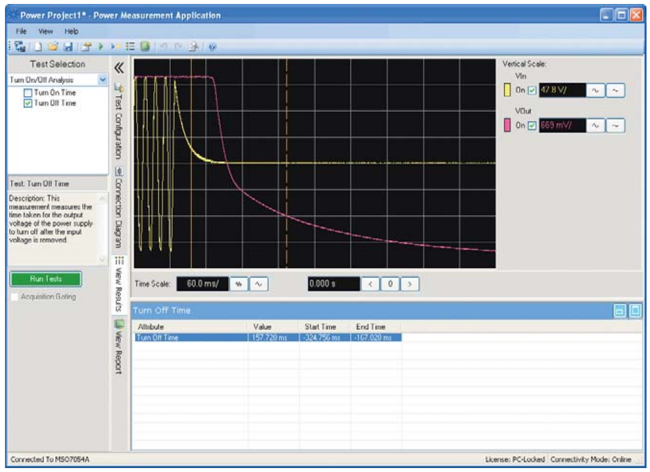


Figure 8. Turn on/off analysis results

Transient response analysis

Power supplies are subject to transient conditions, such as turn-on and turn-off transients, as well as sudden changes in output load and line input voltage. These conditions lead to one of the key specifications of the power supplies: load transient response. This module measures the load transient response of the DC output; namely, the time taken for the DC output to stabilize during a load change.

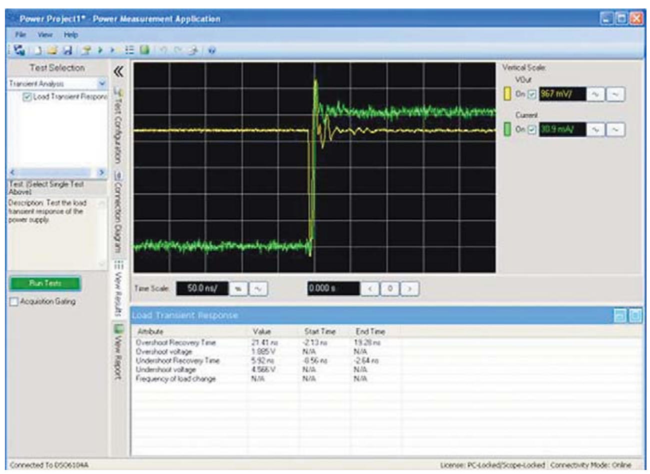


Figure 9. Transient response results

Report generation

After a single test or a test module has been run, the View Report tab populates with measurement data and graphs for your archival and date sharing purposes. Reports are saved in a .htm format. Each report contains an up-front summary of pertinent test information.

Reports are automatically saved to a test folder on the directory of your choice.

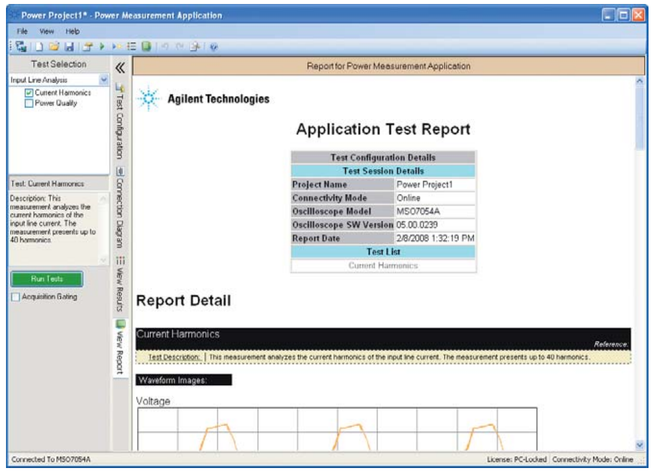


Figure 10. Automatic report generation makes test result archival easy.

Ordering information

Product number	Description
U1881A	Power measurement application for InfiniiVision 5000, 6000 and 7000 Series oscilloscopes
Option 001	Oscilloscope-locked license (most common license type) (connect with 1 of any number of PCs)
Option 002	PC-locked license (connect this PC to one of many scopes)
U1882A	Power measurement application for Infiniium 8000 and 9000 Series oscilloscopes
Option 001	Oscilloscope-locked license (most common license type)
Option 002	PC-locked license (not common for Windows-based Infiniium scopes)
U1880A	Deskew fixture

Recommended probes and accessories	
U1880A	Deskew fixture for voltage and current probe deskewing
AC/DC current probes (one or more of these Agilent current probes)	• 1147A 50-MHz, 15-A current probe with AutoProbe interface • N2780A 2-MHz, 500-A current probe (requires N2779A power supply) • N2781A 10-MHz, 150-A current probe (requires N2779A power supply) • N2782A 50-MHz, 30-A current probe (requires N2779A power supply) • N2783A 100-MHz, 30-A current probe (requires N2779A power supply)
Differential probes (one or more of these Agilent differential probes)	• N2790A 100-MHz differential probe with AutoProbe interface (±1.4 kV differential) • N2791A 25-MHz differential probe (± 700 V differential) • N2792A 200-MHz differential probe (± 20V differential) • N2793A 800-MHz differential probe (± 15V differential)
Passive probe (for measuring output noise)	• 1162A 1:1, 25-MHz passive probe • N2870A 1:1, 35-MHz passive probe

Related literature

Publication title	Publication type	Publication number
Agilent 5000 Series Oscilloscopes	Data Sheet	5989-6110EN
Agilent 6000 Series Oscilloscopes	Data Sheet	5989-2000EN
Agilent 7000 Series Oscilloscopes	Data Sheet	5989-7736EN
Agilent 8000 Series Oscilloscopes	Data Sheet	5989-4271EN
Agilent Infiniium 9000 Series Oscilloscopes	Data Sheet	5990-3746EN
Agilent oscilloscope probes and accessories	Selection Guide	5989-6162EN

Product Web site

For the most up-to-date and complete application and product information, please visit our product Web site at: **www.agilent.com/find/scopes**

Agilent Email Updates

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

Agilent Direct

www.agilent.com/find/agilentdirect
Quickly choose and use your test equipment solutions with confidence.

Agilent Channel Partners

www.agilent.com/find/channelpartners
Get the best of both worlds: Agilent's measurement expertise and product breadth, combined with channel partner convenience..

LXI

www.lxistandard.org
LXI is the LAN-based successor to GPIB, providing faster, more efficient connectivity. Agilent is a founding member of the LXI consortium.

Windows® is a U.S. registered trademark of Microsoft Corporation.

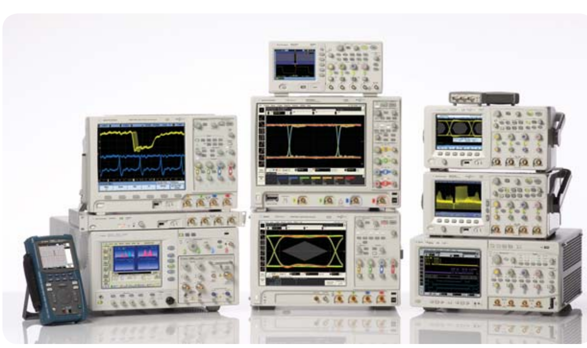
Remove all doubt

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Agilent equipment through-out its lifetime. Your equipment will be serviced by Agilent-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements. For information regarding self maintenance of this product, please contact your Agilent office.

Agilent offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance, onsite education and training, as well as design, system integration, and project management.

For more information on repair and calibration services, go to

www.agilent.com/find/removealldoubt



Agilent Technologies Oscilloscopes
Multiple form factors from 20 MHz to >90 GHz | Industry leading specs | Powerful applications

www.agilent.com
www.agilent.com/find/xxxx

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

Americas	
Canada	(877) 894-4414
Latin America	305 269 7500
United States	(800) 829-4444

Asia Pacific	
Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Thailand	1 800 226 008

Europe & Middle East	
Austria	43 (0) 1 360 277 1571
Belgium	32 (0) 2 404 93 40
Denmark	45 70 13 15 15
Finland	358 (0) 10 855 2100
France	0825 010 700*
	*0.125 €/minute
Germany	49 (0) 7031 464 6333
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
Switzerland	0800 80 53 53
United Kingdom	44 (0) 118 9276201
Other European Countries:	

Product specifications and descriptions in this document subject to change without notice.

October 1, 2009

Printed in USA, October 20, 2009
5989-7835EN

Agilent Technologies