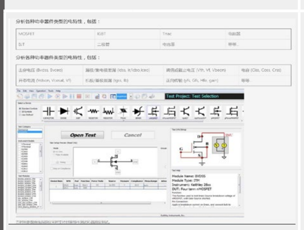
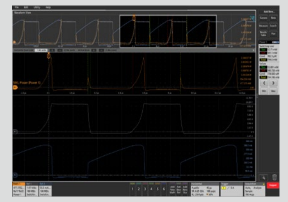
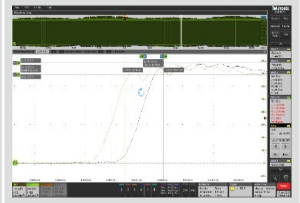
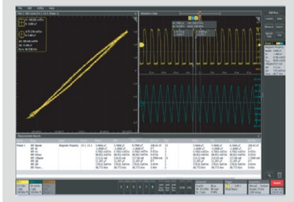
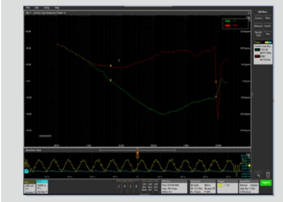
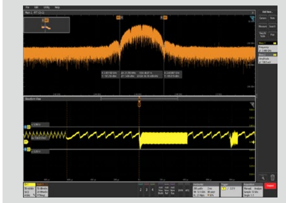
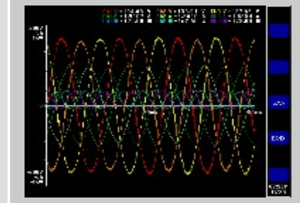
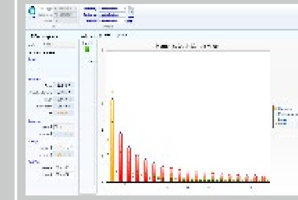
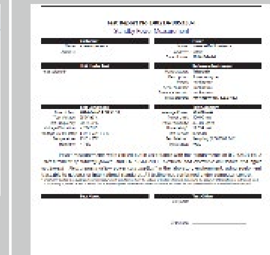
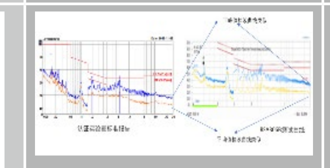
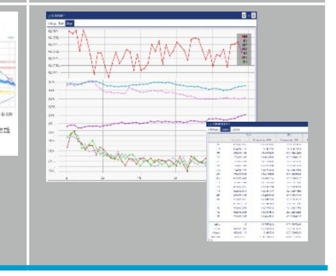
Power Supply Converter Design Procedures

Components → **Modules** → **Final Products/System**

Power Supply Design Procedure	Components Selection and Characteristics Verification			Power Supply Prototype Design and Test						Power Supply Quality Analysis				
Test Stages	IC	Capacitance	Transistor MOSFET, IGBT, GaN, SiC	Circuit design optimization	Swiching loss	Wide bandgap semiconductor GaN, SiC	Magnetic device loss	Loop response optimization	Output ripple test	Efficiency test	Harmonic test	Power supply standard test	EMC certification	Burn-in test
Test Painpoints	It is difficult to accurately grasp the characteristics of the newly launched low-power IC and power devices on the market, and there isn't a simple and economical evaluation method to determine whether they really play the biggest role in their own power supply design.		Selection of high power switch transistor is critical but difficult for power supply product design. It has become a major headache for engineers on how to test IGBT module characteristics before system debugging, especially for testing IGBT and corresponding diode characteristics under different load conditions based on bridge topology.	Test the input and output signals in the power supply function design, signal waveform and main parameters. It is a major concern for engineers whether the test equipment can reliably and accurately reflect the real signal characteristics for the evaluation of the system.	As the main components of switching power supply, MOSFET and IGBT are the most important factors affecting the overall efficiency. In the past, the influence of calculation on power supply efficiency was always understood through the parameters provided by device manufacturers. But in different applications, power consumption varies greatly due to different driving conditions. How to quantify the loss has become a very important problem for engineers.	The emergence of GaN and SiC, the third generation of wide bandgap semiconductor devices, promotes the revolutionary transformation of power electronics industry. The ability of new switching devices to achieve low switching losses, handle ultra-fast dv/dt converters, and support ultra-fast switching frequencies makes these new technologies desirable for engineers, but also brings huge testing challenges.	Many power supply design engineers are paying more and more attention to inductors, transformers and other magnetic devices, as they have become the second major factor affecting the efficiency of power supply products. How is the effect of magnetic devices on power supply stability and overall efficiency evaluated? How is inductance, magnetic loss, BH curve, magnetic properties, etc., measured? These are major concerns for engineers.	Engineers need to spend more time and energy on power supply integrity (PDN). For power supply integrity, in addition to switching loss, input power supply quality, output ripple test that are often mentioned, loop response test is also involved. Loop response testing helps to determine how stable our feedback loop really is.	Power output quality is an important part of power supply evaluation. Especially for DC output, not only the voltage and current, but also the output ripple should be accurately tested. For some special power supply devices, ripple needs to be controlled in a very small range. How to test tiny ripple signals accurately is tricky.	When a product design is completed, efficiency is its most important evaluation index. How is the quality of the power supply accurately evaluated, as well as the active power, power factor, efficiency, etc.?	In order to meet the standard of power supply industry, harmonic is a key index. But how are the power harmonics evaluated accurately? How to pass the IEC61000-3-2 standard consistency test at one time?	Energy saving certification is very important for power supplies. Consider the standby power pre-consistency standard IEC62301 v2.0 of the power supply.	The power supply needs to pass the CE certification before entering the market, and the EMC consistency certification is very important. Many engineers take the challenges of EMC into consideration while implementing functional design. How can engineers understand the EMC status of power supply products and pass the certification at one time?	The last procedure of power supply products requires a long time burn-in test. How can efficiency be improved, especially for mass production? An accurate and efficient test method is very important.
Solutions	Many power supply design engineers choose to use the device manufacturer's index because of the price of the test instrument. However, for characteristic verification, the market normally uses a semiconductor parameter analyzer to analyze the characteristics of MOSFETS, IGBTs, diodes and other high-power devices used in the design.		Dynamic testing is designed to test the gate drive and dynamic characteristics of power electronic devices under various conditions with very small power drive. The following parameters can be tested: 1. Characteristics of different temperatures 2. Short circuit characteristics and short circuit off 3. Gate drive characteristics 4. Off-power overvoltage characteristics 5. Diode recovery characteristics 6. Switching loss tests	The power supply design process basically uses an oscilloscope and a voltage & current probe to drive waveform analysis. In order to ensure the reliability of test data, the common way is to choose the reliable and stable oscilloscope and probe instruments brands recognized by the power supply industry.	A high bandwidth oscilloscope and voltage & current probe are used to quantitatively evaluate the switching device loss and confirm that the device is within the safe range. Accurate measurement of opening and closing points, conduction, overall loss and conduction impedance is widely used in the industry.	The industry uses a high bandwidth oscilloscope and high bandwidth differential probe. However, the current capacity of high voltage probes in the market is up to about 200 M, which cannot meet its test requirements. Especially in the bridge topology, the upper tube works under the common mode voltage environment of up to several hundred volts, making it impossible to detect the true driving state. Many engineers choose to test the lower tube and estimate the driving state of the upper tube, but the hidden dangers are well known.	The industry normally uses professional magnetic material testing equipment, but its high price discourages many potential users. Using an oscilloscope and professional algorithm to test the magnetic loss and inductance and BH curve analysis is also a new test method in the industry.	The traditional method is to use a network analyzer, or proprietary equipment to test, but this test is relatively expensive. Nowadays, emerging oscilloscopes have integrated the loop response test function, providing another method for engineers to conduct the test. Simple and efficient!	Using an oscilloscope and voltage or current probe to test ripple is the mainstream test method in the industry. Considering the development of power supply technology, more and more customers begin to pay attention to the micro ripple signal testing ability.	A high-precision multi-channel power analyzer can evaluate power supply quality, active power, power factor, efficiency and other items. These are the necessary factors for overall evaluation of power supply quality.	A power analyzer is the first choice of harmonic analysis in the industry. Due to its high accuracy and ability to provide professional harmonic analysis, the power supply industry generally requires more than 50 harmonic testing capabilities.	A power analyzer is the first choice of harmonic analysis in the industry. Because of its high test accuracy, and the ability to accurately test mA level low standby current, it also requires a high waveform factor test ability.	Establishing an EMC conformance laboratory is the ideal approach. However, due to its high cost, more power supply engineers choose to use a spectrum analyzer to conduct EMC pre-consistency tests to reduce the risk of product non-compliance. This is a common approach in the industry.	It is recommended to test thermocouple and thermal resistance multi-point temperature and voltage by using a high precision data acquisition multimeter to realize long time data acquisition and monitoring.
Tektronix Solutions	The 370B Semiconductor Parameter Tester is well-known in the industry, but the production has been stopped. To meet customers' testing needs, Keithley/ Tektronix has introduced an alternative to the 370B, PCT Parametric Curve Tracer Configurations, that provides comprehensive device-level testing, such as breakdown voltage, on-state current and capacitance measurements up to 3 kV/100 A.		Tektronix launched IGBT power devices single pulse, double pulse and multi-pulse test programs, integrating powerful generator, data testing device and software. Users can customize test conditions. The test items include: Toff, td(off), tf(Ic), Eoff, Ton, td(on), tr(Ic), Eon, di/dt, dv/dt, Err, qrr, Irr based on IEC60747	Tektronix has a history of more than 70 years since its establishment in 1946. The reliability and stability of Tektronix oscilloscopes and voltage & current probes have been recognized by the industry. Engineers can have confidence in the results of every test.	Tektronix' latest MSO5 series oscilloscopes provide a complete set of solutions using its 12-bit ADC high-precision testing and newly optimized switching loss algorithm.	Tektronix launched the targeted comprehensive optical isolation probe with bandwidth of up to 1 GHz, difference mode of up to 2500 V, and common mode rejection ratio of up to 120 dB. Combined with the MSO5 12-bit high precision oscilloscope, the system provides excellent anti-interference capability, helping engineers to optimize the design of the third generation semiconductor devices at the system level.	Tektronix MSO5 series oscilloscope features a new TEK049 platform that provides a complete set of solutions based on its 12-bit ADC high-precision measurement and newly optimized magnetic loss algorithm. It has up to 8 channels that support multiple transformer types.	Tektronix integrated the loop response test function into the oscilloscope to inject a sinusoidal signal of frequency change into the switch power supply circuit, measuring the characteristics of the switch power supply in the frequency domain, and to determine loop stability by analyzing the gain margin and phase margin.	Tektronix MSO5 oscilloscope hardware with 12-bit ADC high-precision testing capability combined with the dedicated ripple probe, TPR series probe, with minimum noise level of 200 μV and bandwidth of up to 4 GHz, can test mV level micro ripple.	Tektronix PA3000 power analyzer with up to 0.04% test accuracy, up to 4 channels, may improve high precision test results.	Tektronix PA1000 power analyzer with 0.05% test accuracy with built-in IEC61000-3-2 harmonic consistency test standard may provide real-time test.	Tektronix PA1000 power analyzer with 0.05% test accuracy is equipped with IEC62301 V2 standby power consistency test standard can test a minimum standby power as low as 10 mW.	Tektronix RSA series of real-time spectrum analyzers with professional EMCVU software and LISN accessories provide high-priced pre-consistency test solutions for conduction and radiation.	Tektronix DAQ6510 data acquisition multimeter with up to 6 bit half test accuracy has powerful functions and supports up to 80 channels signal tests, providing special software that can easily solve testing problems.
														

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