ISR Qualification Process

Introduction All new Power Trends ISRs (Integrated Switching Regulators) go through a rigorous qualification process before they are introduced into production. The qualification process includes electrical design characterization and verification testing, mechanical package integrity testing, and environmental endurance testing. The tests are designed to meet customer requirements and industry standards for sub-assemblies. All of the environmental testing is performed according to industry standard test procedures (see tables 9, 10, and 11). Electrical testing is performed to verify compliance with Power Trends' published specifications.

Electrical design characterization and verification includes tests for efficiency, ripple, current limit, loop stability, and thermal derating. The ISRs are evaluated at room temperature, and at the lowest and highest operating temperatures listed on the data sheet . Typical evaluation temperatures are -40°C, 25°C and 70°C.

Mechanical qualification consists of mechanical shock and vibration testing and characterization. The mechanical shock test is performed with the test units clamped in a fixture. This test is designed to simulate an ISR during shipping or mishandling. The mechanical vibration test is performed with the test units soldered into a PC board. All mounting configurations and package styles are tested: Vertical Through Hole, Horizontal Through Hole, and Surface Mount.

Environmental endurance testing consists of thermal shock, humidity and accelerated life testing. The thermal shock testing cycles the ISRs in a shuttle temperature chamber from maximum temperatures of 125°C to minimum temperatures of -40°C at 15 minute intervals for 100 cycles. Thermal shock tests the assembly integrity of the components and ensures that there are no stress defects which would cause the product to fail over time.

Humidity testing determines a product's resistance to moisture and resulting corrosion. The humidity test is carried out in a 70°C environment with the test units operating from their maximum input voltage while supplying a minimum load current. Units are subjected to 85% relative humidity for 240 hours. Accelerated life tests determine a product's long term reliability. The accelerated life test operates the ISRs at maximum input voltage, full load current, and the highest ambient temperature possible without thermal shutdown for a period of 1,000 hours.

Qualification Similarities Although all ISRs are individually electrically tested, in other tests, a representative product may be tested for the group. For mechanical testing, every unique package is tested. For environmental and ESD testing, the PT6100 ISR is tested for all PT6000 and PT5000 ISRs and the PT78ST105 is tested for all the PT78 and PT79 ISRs because their electrical specifications, component types and construction are virtually the same. Table 7 summarizes the various qualification tests.

Table 8

Test	Criteria
Electrical Design Verification and Characterization	All ISR Products
Mechanical Qualification	Every unique package style
Environmental Endurance	Representative circuit designs
ESD	Representative circuit designs

Electrical Qualification and Testing Electrical qualification and testing is performed to verify the product design and to create detailed characteristic information on the product. Every new Power Trends product is tested and qualified to a qualification test procedure based on the product's electrical specification.

The process has tests and procedures for measuring efficiency, ripple voltage, current limit, short circuit current, transient load response, response to step input, minimum input voltage, and thermal derating. Each test is detailed in Table 9.

Table 9

ELECTRICAL TESTS

Test	Description
Efficiency	Characterize the efficiency across the range of minimum input voltage to maximum input voltage, from minimum rated output current to maximum rated output current.
Ripple Voltage	Characterize the output ripple voltage across the range of minimum input voltage to maximum input voltage, from minimum rated output current to maximum rated output current.
Current Limit	Record the output current point at which the output voltage drops by 1% at input voltages from minimum to maximum.
Short Circuit Current	Measure the magnitude of the output current with dead short placed across the output at input voltages from minimum to maximum.
Transient Load	Measure the magnitude of the over/undershoot when the load changes from 50% of maximum rated to 100% of maximum rated at input voltages from minimum to maximum. Measure the time from start of over/undershoot to recovery within 1%.
Hot Start	Measure the amount of overshoot present on the output voltage when a step input is applied to the product over current and input voltage ranges. Measure time from applica tion of the step input to regulated output voltage.
Min Input Voltage	Measure the minimum input voltage for regulated output voltage across rated current range.
Thermal Shutdown	In a thermal chamber with 40-60 LFM of regulated airflow determine the max current/voltage operating point before thermal shutdown.

Mechanical Qualification and Testing Mechanical testing is performed on every product packaging type. The testing is designed to verify the package integrity when the product is exposed to a mechanical shock or when the product is used in a vibration environment.

ISR Qualification Process (continued)

Mechanical shock testing extensively evaluates the package's ability to endure repeated shocks in each axis. This testing is performed with the product mounted in a test fixture per the methods listed in Table 10. The parts are electrically tested before and after being shocked.

Mechanical vibration testing is performed to characterize the maximum level at which the package style will survive without mechanical damage. This test is performed with the leads soldered into a 0.062" thick PCB. The levels of vibration are incrementally increased until the product fails. Once a failure occurs, new product is tested starting at the previous failure level. If it passes, vibration is increased until succesive new products fail at the same level, which is recorded.

Table 10

MECHANICAL QUALIFICATION TESTS

Test	Method	Conditions	# Units
Mechanical Shock	MIL-STD-883D, Method 2002.3	Condition A, 50G peak, 1 mSec, Half Sine, 5 Shocks, 2 directions, 3 axis, (30 shocks total)	3
Mechanical Vibration	MIL-STD-883D, Method 2007.2	Condition A, 4 four minute sweeps each axis, 20 to 2000 Hz logarithmically	3

Environmental Endurance Qualification and Testing Environmental endurance testing is performed on each different package. The testing is designed to demonstrate the product's ruggedness and reliability. The products are electrically tested before and after each of the following tests.

The thermal shock test subjects the products to 100 cycles of -40°C to 125°C of thermal stress. A 15 minute dwell time is used to assure that the parts internally reach the set temperature. The ISRs are not powered.

The humidity test is carried out in a humidity chamber with 85% relative humidity and a chamber temperature of 70°C for 240 hours or 10 days. Maximum input voltage and minimum output loading are present on the units.

The accelerated life test is performed in a high temperature environment. The applied input voltage/ ambient temperature is as high as possible to avoid thermal shutdown. The ISRs are loaded to the maximum output current listed on the data sheet.

Table 11

ENVIRONMENTAL ENDURANCE TESTING

Test	Method	Conditions	# Units
Thermal Shock	MIL-STD-202F, Method 107	100 cycles, -40°C to +125°C, 15 minute dwell time	38
Humidity	MIL-STD-202F, Method 103	85% Rel. Humidity (Non-condensing), 70°C Ambient, 240 Hours., Vin=Vmax, Iout=Imin	38
Accelerated Life	MIL-STD-202F, Method 108	1000 Hours, 60°C ambient, Vin=Vmax, Iout=Imax	38

Characterization Testing Products are characterized as to their Electrostatic Discharge, ESD, breakdown level using the guidelines of MIL-STD-883D. Each pin is subjected to multiple shocks until 5000 Vdc or failure occurs. The parts are electrically tested before and after each voltage level.

Table 12

ESD QUALIFICATION TESTS

Special:

Test	Method	Conditions	# Units
ESD	MIL-STD-883D, Method 3015	High Voltage Breakdown Method, all pins until fail or 5000 volts maximum	3

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