



TB110S Family Internal Power Supplies Test and Measurement/ Industrial Series

AN-TB110S 4/17

Overview

The SL Power Electronics' TB110S family of internal power supplies is a superior performance 110 watt AC to DC power supply designed to ensure easy integration into Test and Measurement and Industrial applications. Feature rich and highly efficient, the TB110S product family can easily fit into a 1U chassis and provides up to 110 watts. In addition, this model family has enhanced Electromagnetic Compatibility (EMC) features offering heavy industrial ESD, AC mains surge and RF immunity, resulting in a more robust and reliable product. Additionally, the TB110S AC mains emissions comply with FCC & EN55022/24 Class B levels with margin. Output emissions for differential ripple and common mode voltage and current have been reduced to minimize system level EMI and system circuit interference.

For long-term reliability, this model family has been designed using high quality components to provide long life, and thoroughly tested and approved by regulatory agencies. See the product datasheet for more details.

This application note provides guidance for proper use, system design consideration and key performance data. Additional performance data is available upon request.

Proper Use

The TB110S power supplies have high power conversion efficiency, however they do rely on convection cooling in the surrounding environment (air) to prevent overheating or excessive component temperatures. Therefore, there needs to be adequate access to ambient air to ensure proper thermal performance of the power supply.

- The supply should be mounted to an electrically conductive surface with conductive standoffs for proper EMI/EMC performance.
- Mounting standoff height should be \geq to 5mm.
- A non-conductive insulator should be placed between the bottom of the unit and any conductive surface
- Proper bonding to the end-product main protective earthing termination is required
 - For Class I input applications, the chassis must be bonded to protective earth in the end product. Using the earth terminal for the end product, protective earthing is not recommended and a separate dedicated bonding conductor and suitable termination should be used to connect the chassis to the end product protective earth.
 - Mounting holes are isolated from ground for Class II input applications
 - Use a proper mating connectors for connection to the input, output and signal connectors of the power supply
 - Do not exceed the power rating of the product.

Connections and Mating Connectors

Input Connector J1	DC Output Connector J2	Ground Connector G1	Signal Connector J3
PIN 1) AC Line PIN 2) Empty (removed) PIN 3) AC Neutral	PIN 1) (+V) PIN 2) (+V) PIN 3) (-V) PIN 4) (-V)	FG 0.187" Quick-connect tab	PIN 1) RTN PIN 2) 5Vsb Output PIN 3) Power Good/Power Fail PIN 4) Inhibit
Mating Connector: Tyco/AMP 640250-3 Pins: 640252-2	Mating Connector: Tyco/AMP 640250-4 Pins: 640252-2	Mating Connector: Molex 01-90020005	Mating Connector: Tyco/AMP 1375820-4 Pins: 1375819

Performance Verification

Efficiency

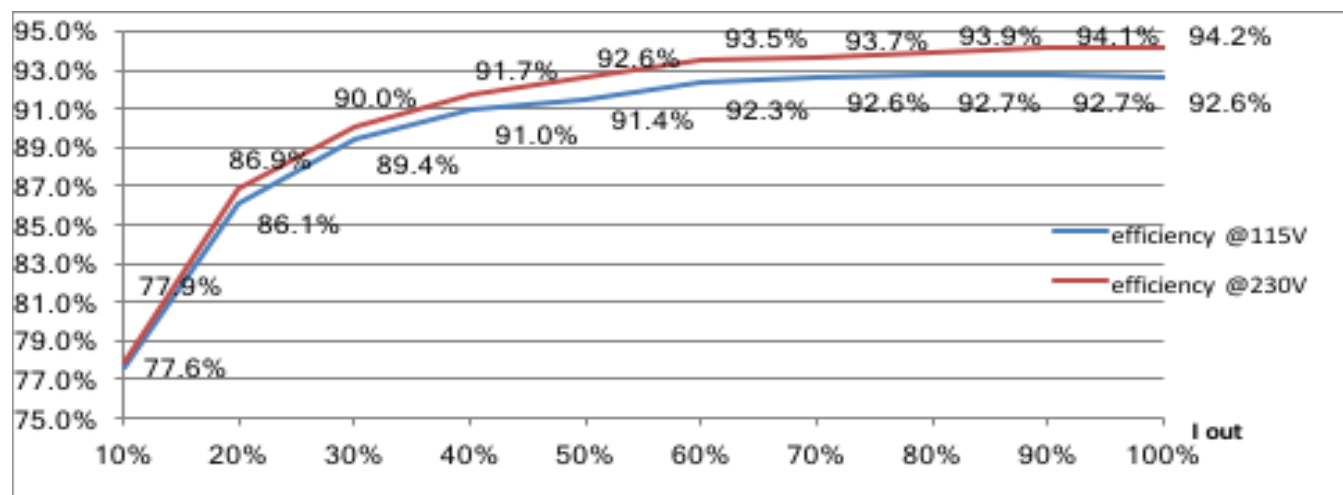


Figure 1. 24VDC output, no load on standby

Output Ripple and Noise

- Output noise and ripple limits are defined in the product datasheet and may vary depending on the output voltage. Consult the product datasheet prior to assessing the output ripple and noise measurement results.
- Noise measurements are made with noise probe directly at the end of 6" twisted pair wires terminated with a 0.1 μ F ceramic and 10 μ F electrolytic low ESR capacitors. Use a short tip oscilloscope voltage probe when making the measurement. This is required to eliminate measurement error due to impedance imbalance errors introduced by the scope probe ground lead length.

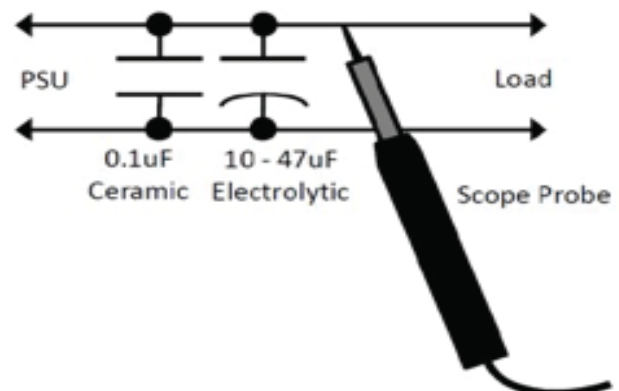
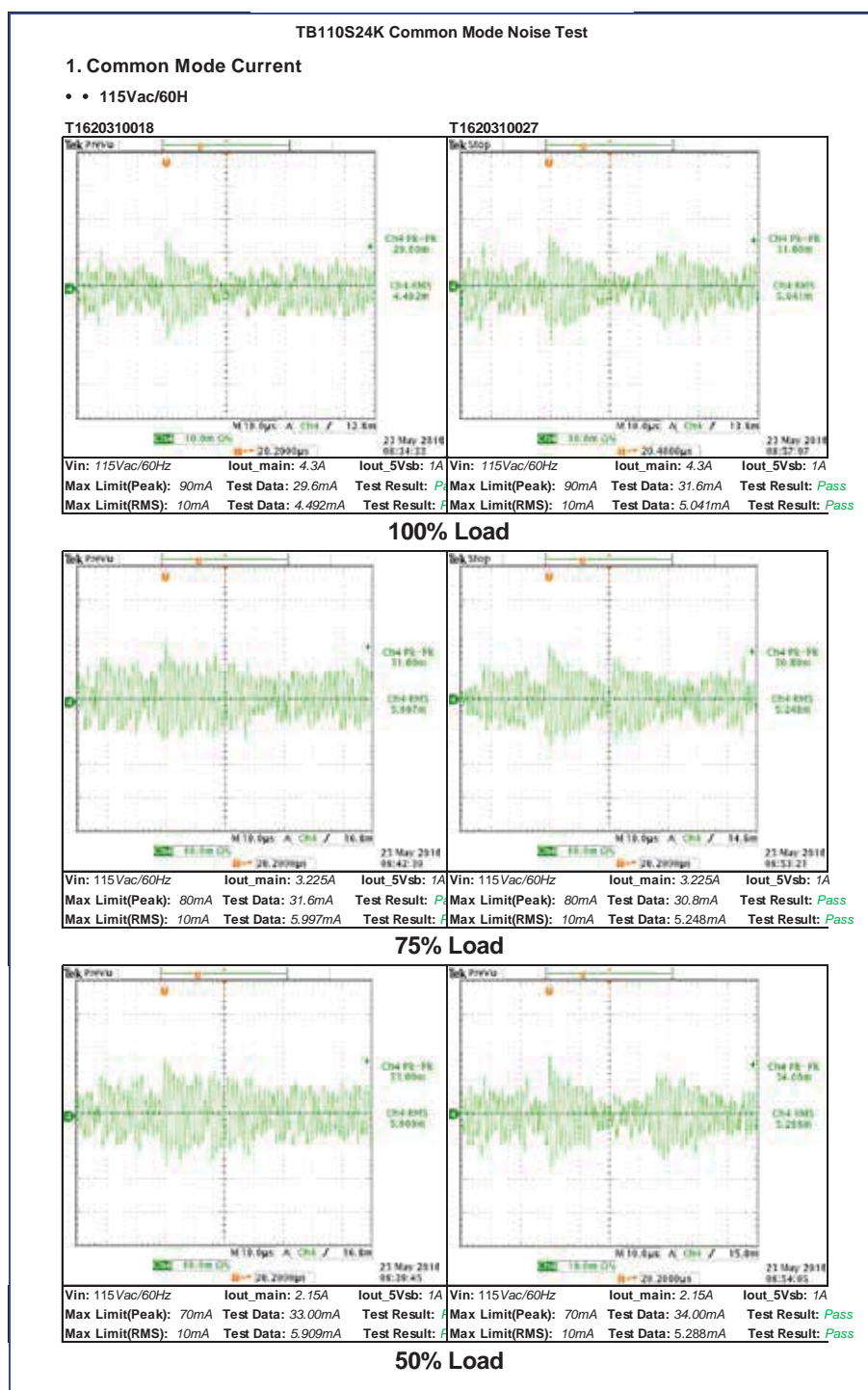


Figure 2. Noise measurement caps and probe diagram.

Common Mode Noise

■ Common mode noise is an electrical signal that appears between either output and earth ground or chassis ground. This is due to parasitic capacitance and inductive coupling in the power supply that couples electrical energy from the primary to the secondary, or from the secondary to earth ground. Although the coupling is minimized by design and construction, it cannot easily be eliminated. Be aware of any special needs in the application for low common mode noise.

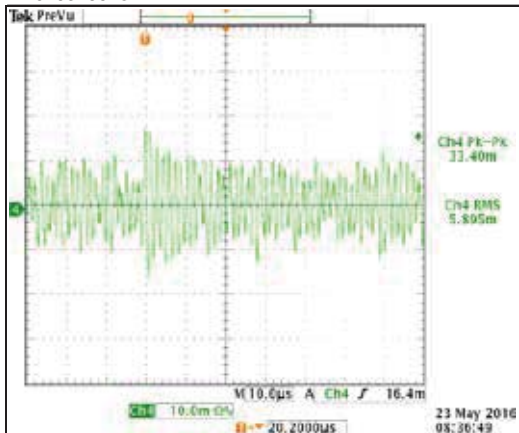
■ Typical common mode noise performance:



TB110S24K Common Mode Noise Test

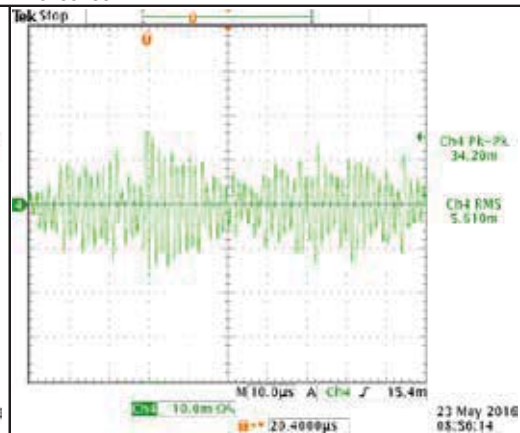
• • • • Vac/50H

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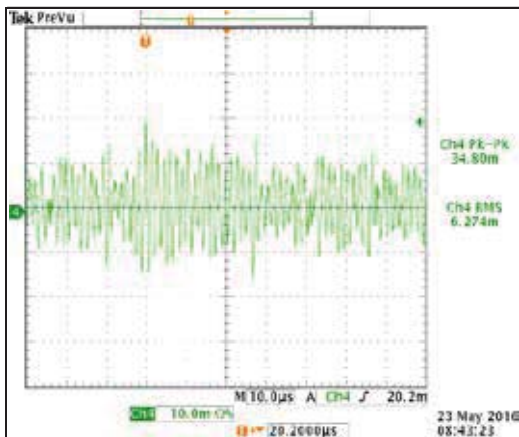
Vin: 230Vac/50Hz Iout_main: 4.3A Iout_5Vsb: 1A
Max Limit(Peak): 90mA Test Data: 33.4mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 5.895mA Test Result: Pass

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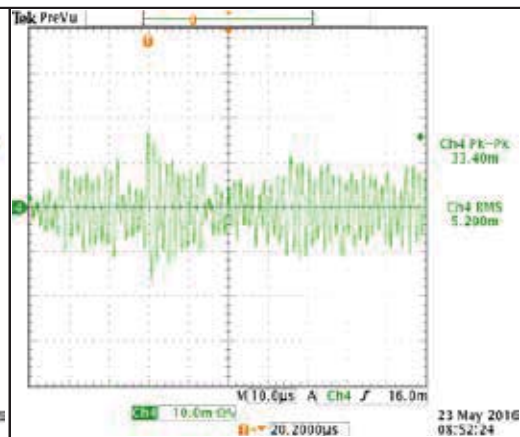


Vin: 115Vac/60Hz Iout_main: 4.3A Iout_5Vsb: 1A
Max Limit(Peak): 90mA Test Data: 34.2mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 5.61mA Test Result: Pass

100% Load

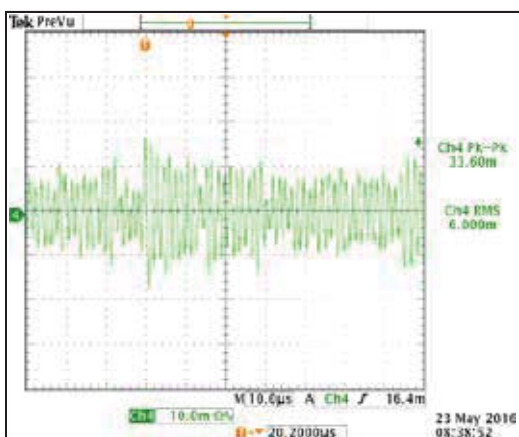


Vin: 230Vac/50Hz Iout_main: 3.225A Iout_5Vsb: 1A
Max Limit(Peak): 80mA Test Data: 34.8mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 6.274mA Test Result: Pass

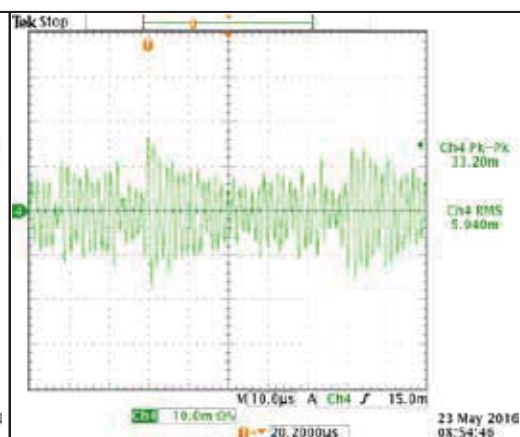


Vin: 230Vac/50Hz Iout_main: 3.225A Iout_5Vsb: 1A
Max Limit(Peak): 80mA Test Data: 33.4mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 4.59mA Test Result: Pass

75% Load



Vin: 230Vac/50Hz Iout_main: 2.15A Iout_5Vsb: 1A
Max Limit(Peak): 70mA Test Data: 33.6mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 6.009mA Test Result: Pass



Vin: 230Vac/50Hz Iout_main: 2.15A Iout_5Vsb: 1A
Max Limit(Peak): 70mA Test Data: 33.2mA Test Result: Pass
Max Limit(RMS): 10mA Test Data: 5.940mA Test Result: Pass

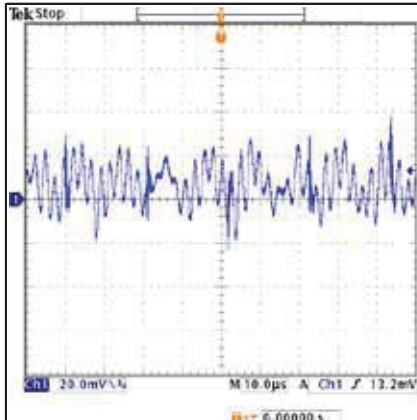
50% Load

TB110S24K Common Mode Noise Test

2. Common Mode Voltage

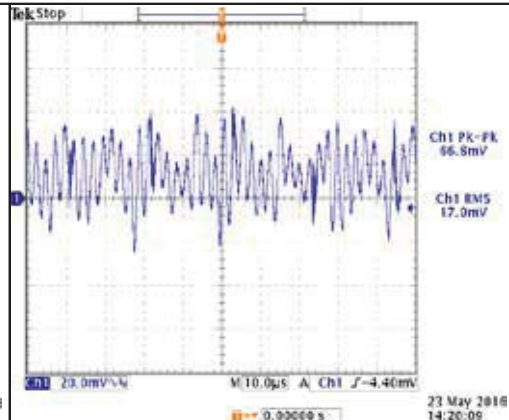
- • 115Vac/60Hz

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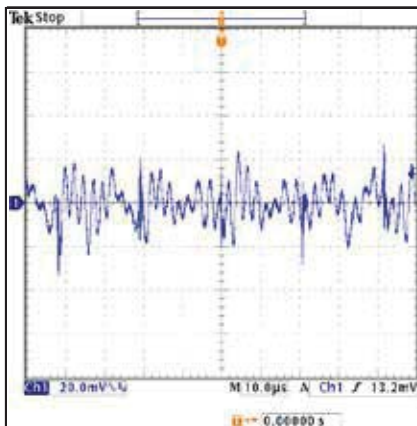
Vin: 115Vac/60Hz Iout_main: 4.3A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 61.2mV Test Result: Pass

T1620310027

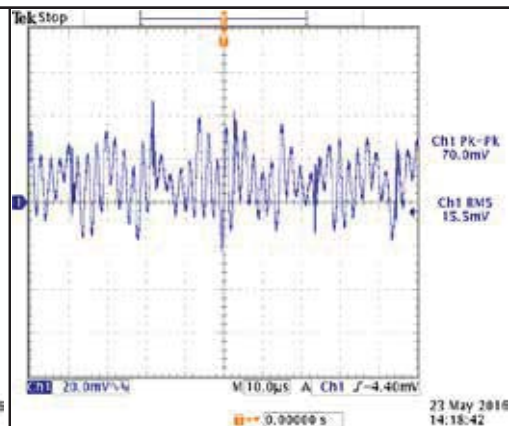


Vin: 115Vac/60Hz Iout_main: 4.3A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 66.8mV Test Result: Pass

100% Load

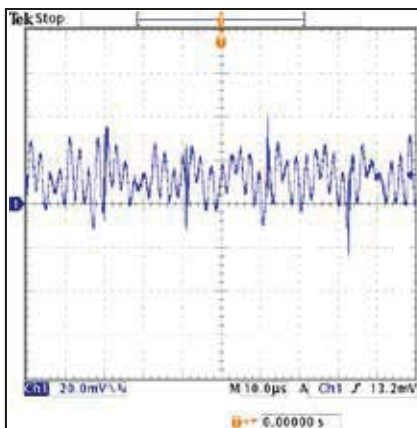


Vin: 115Vac/60Hz Iout_main: 3.225A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 60.0mV Test Result: Pass

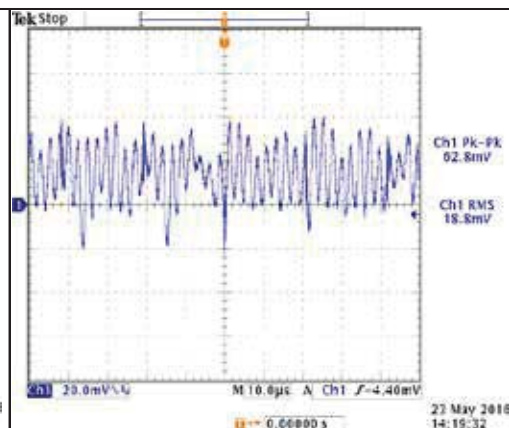


Vin: 115Vac/60Hz Iout_main: 3.225A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 70.0mV Test Result: Pass

75% Load



Vin: 115Vac/60Hz Iout_main: 2.15A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 67.2mV Test Result: Pass



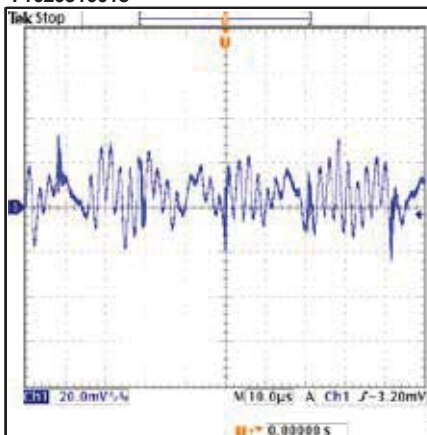
Vin: 115Vac/60Hz Iout_main: 2.15A Iout_5Vsb: 1A
Max Limit(Peak): 800mV Test Data: 62.8mV Test Result: Pass

50% Load

TB110S24K Common Mode Noise Test

- • 230Vac/50H

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Vin: 230Vac/50Hz

Iout_main: 4.3A

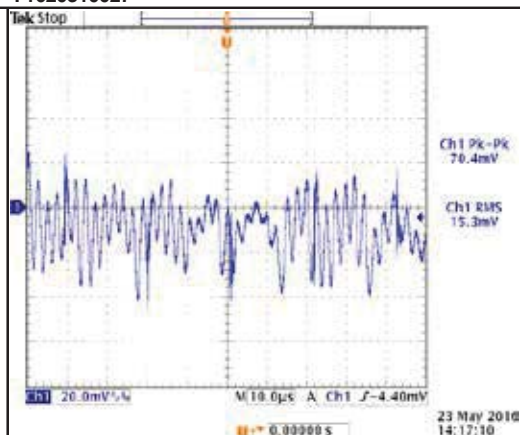
Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 57.2mV

Test Result: Pass

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Vin: 230Vac/50Hz

Iout_main: 4.3A

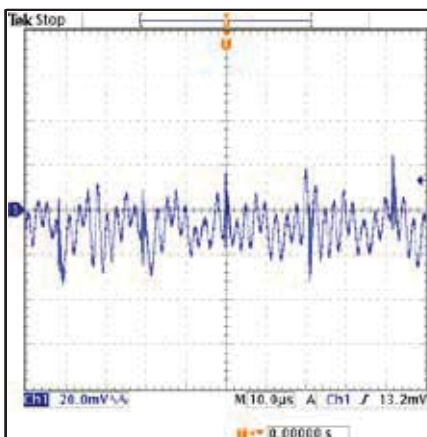
Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 70.4mV

Test Result: Pass

100% Load



Vin: 230Vac/50Hz

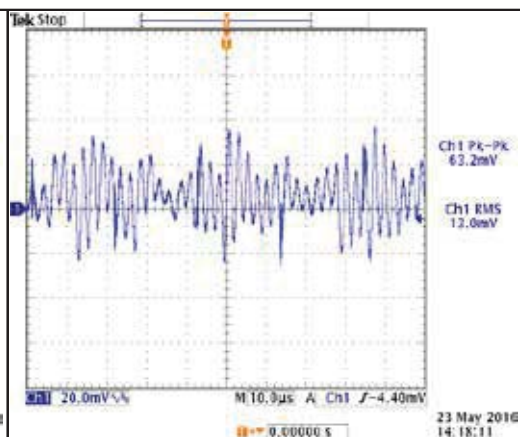
Iout_main: 3.225A

Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 58mV

Test Result: Pass



Vin: 230Vac/50Hz

Iout_main: 3.225A

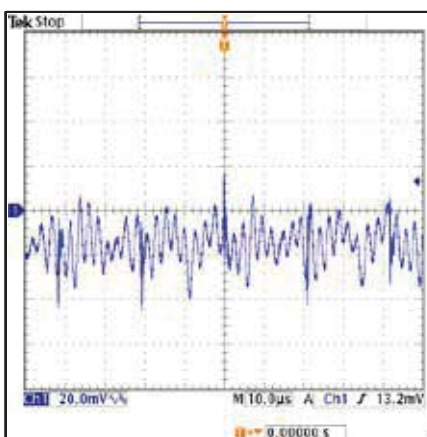
Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 63.2mV

Test Result: Pass

75% Load



Vin: 230Vac/50Hz

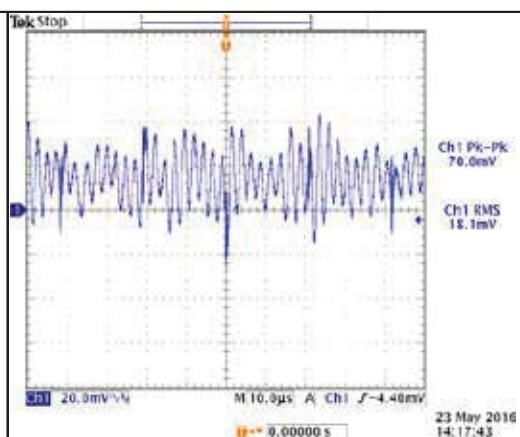
Iout_main: 2.15A

Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 61.6mV

Test Result: Pass



Vin: 230Vac/50Hz

Iout_main: 2.15A

Iout_5Vsb: 1A

Max Limit(Peak): 800mV

Test Data: 70mV

Test Result: Pass

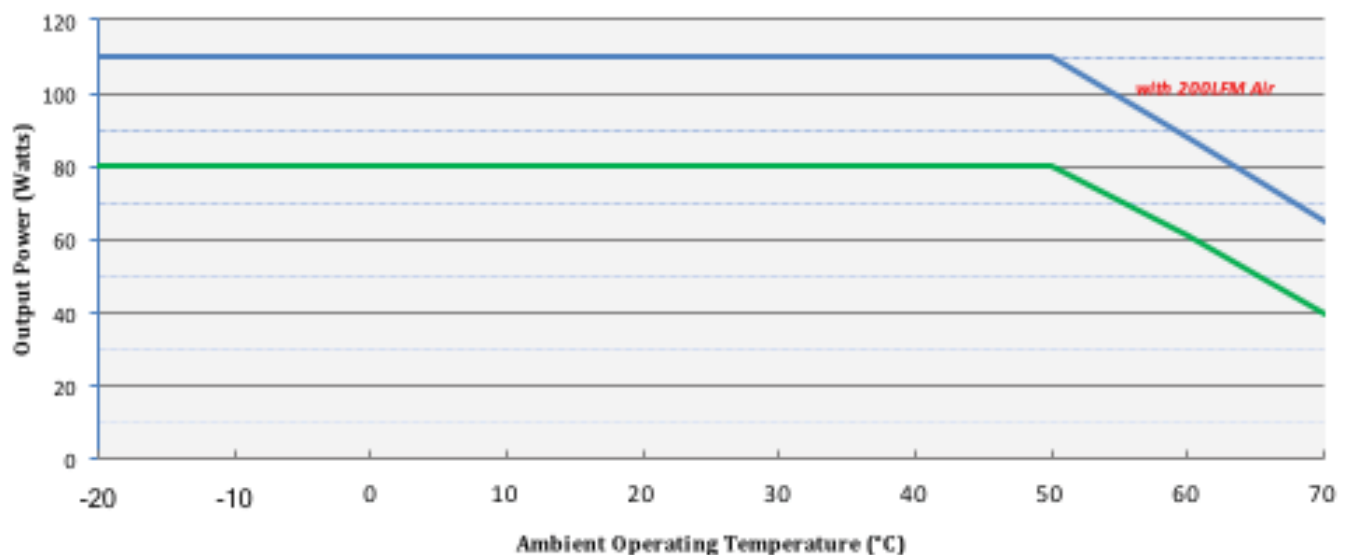
50% Load

Load and Noise Filtering Capacitors

The TB110S Series has output filtering capacitors to minimize the switching frequency voltage ripple and noise that is an artifact of the switching power conversion process. However, additional end load capacitance may be needed depending on the application. With an electronic circuitry as the load, it is recommended to add ceramic capacitors (~ 0.1 – 1uF) for noise spike reduction and electrolytic capacitors for ripple reduction and transient response voltage dip reductions. The amount of voltage dip during a transient is a function of the load step amplitude and rise/fall time of the load.

Thermal Considerations

The TB110S family is rated for 110 watts with forced air cooling or 80 watts in a free air natural convection cooled application over a -20°C to 50°C operating ambient temperature and across the entire AC input range of 85 to 264VAC without derating. Derate as indicated below for temperatures above 50°C.



Reliability and Robustness

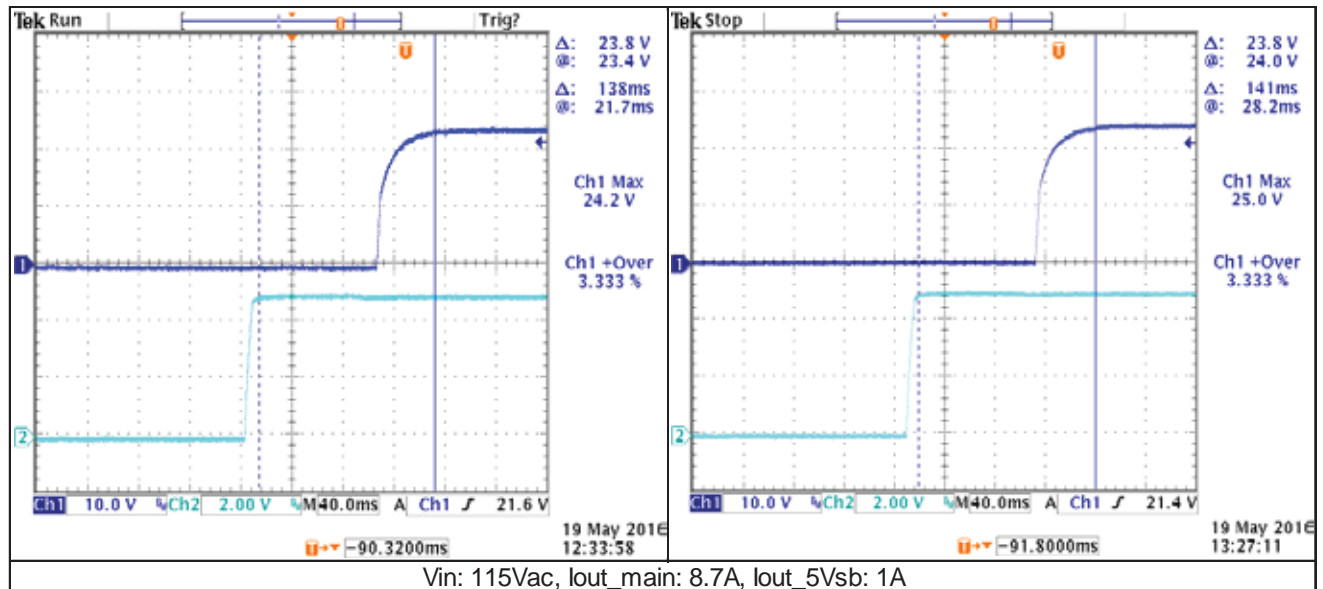
Electrolytic capacitors are one of the main life limiting components used in the power supply. Selecting high quality capacitors with long life ratings are essential to achieving long product life. SL Power Electronics uses only high quality electrolytic capacitors in its TB110S model family resulting in an expected cap life of > than 15 years in use condition of 40°C ambient, at 12 hours/day, 261 days/year. Calculations and measurements are performed to verify capacitor ripple current, voltage, thermal stress and lifetime estimations. Contact SL Power for information on other use profiles.

Performance Data

The following data is provided to aid in proper selection and system design. Additional performance data is available upon request.

Turn-On Time:

Delay from 5Vsb within regulation to Main output voltage within regulation.



Spec: 45 mS (typic Ch1: Vout_main
T3_Measured: 138 mS Ch2: Vout_5Vsb

Spec: 45 mS (typic Ch1: Vout_main
T3_Measured: 141 mS Ch2: Vout_5Vsb

Figure 3. Turn-on delay for 24V, 115VAC model

Delay from loss of AC to de-assertion of DC_OK signal.

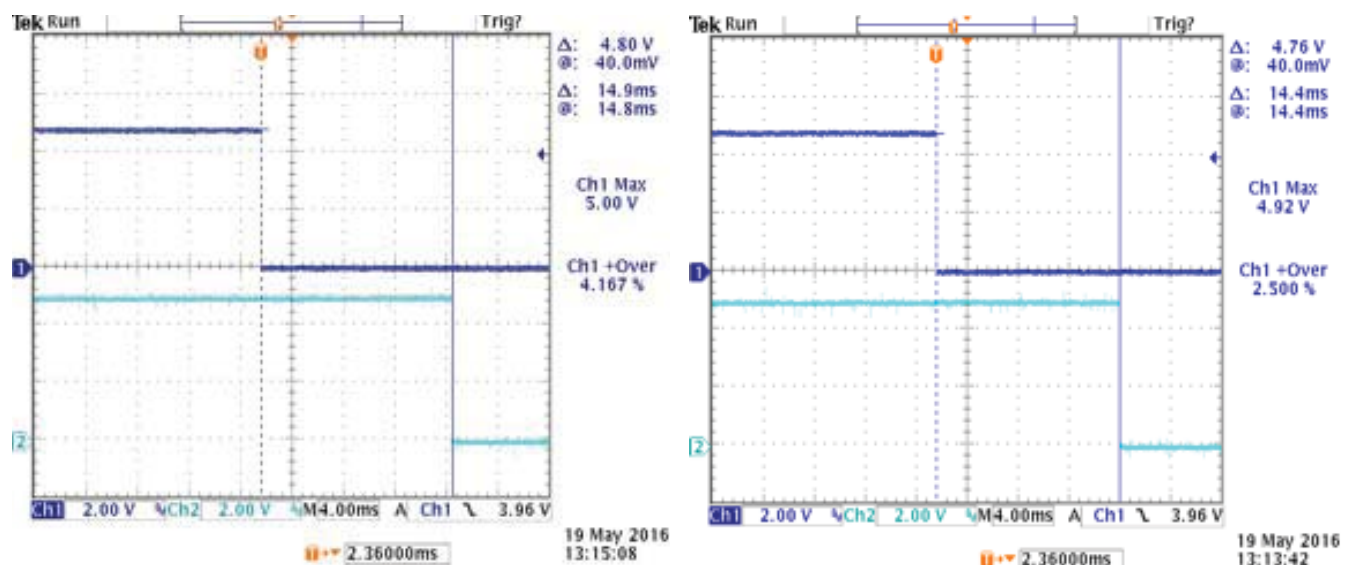
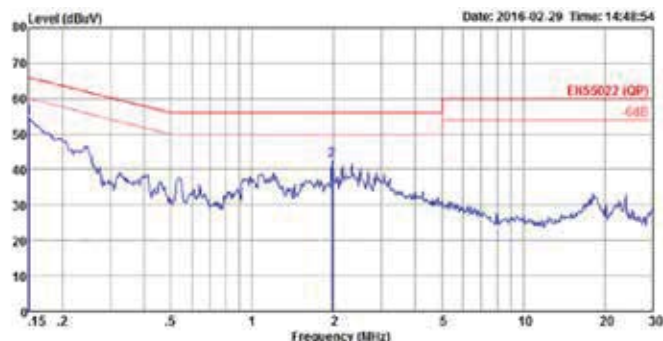
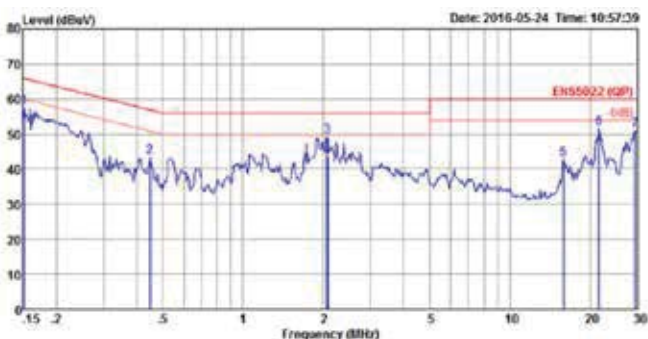
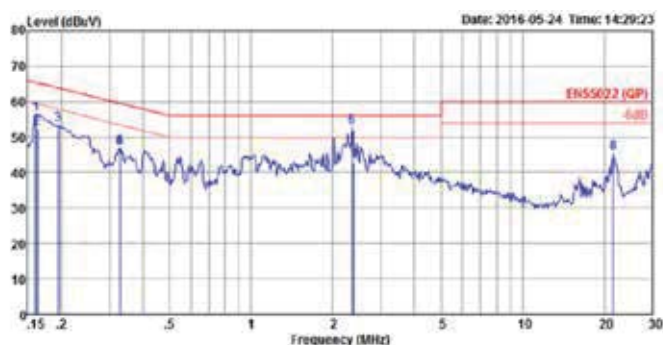
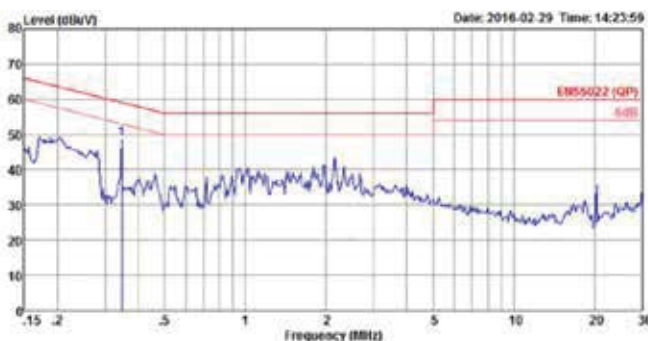
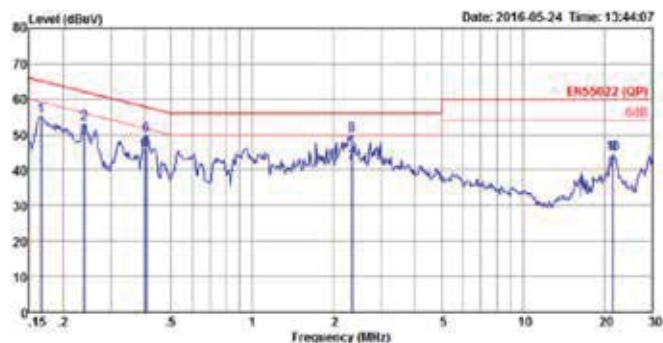
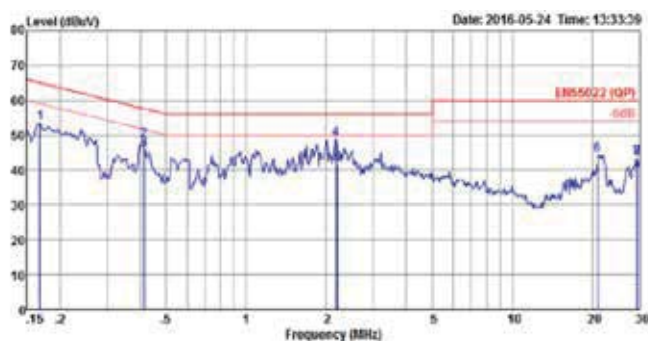


Figure 4. Delay from loss of AC to de-assertion of DC_OK signal.

Electromagnetic Interference Data: Conducted emissions

EMI plots on EMI data was collected at 10%, 50% and 100% loads, 100VAC/60Hz and 230VAC 50Hz. Excerpts shown in this application note provide typical EMI performance. The plots shown are full load, 230V/50Hz and 120V/60 Hz. The Curve is the peak measured data and Quasi-peak (QP) and Average measurements taken at peak values near the limit. The QP and Average value point data is not shown in these plots, but detailed EMI reports are available upon request. The limit line followed by a 6dB margin line is shown.



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