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User Guide for

# FEBFSB127H_T001 Evaluation Board

## FSB127H 100 kHz Power Switch for ATX Standby 16 W

Featured Fairchild Product:

FSB127H

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This user guide supports the 16 W evaluation board for ATX standby using FSB127H. It should be used in conjunction with the FSB127H datasheet as well as Fairchild’s application notes and technical support team. Please visit Fairchild’s website at www.fairchildsemi.com.

# 1. Overview

The highly integrated FSB-series consists of an integrated Current Mode Pulse Width Modulator (PWM) and an avalanche-rugged 700 V SenseFET. It is specifically designed for high-performance offline Switch Mode Power Supplies (SMPS) with minimal external components.

Compared with a discrete MOSFET and controller or RCC switching converter solution, the FSB-series reduces total component count, design size, and weight while increasing efficiency, productivity, and system reliability. These devices provide a basic platform for the design of cost-effective flyback converters, as in PC auxiliary power supplies.

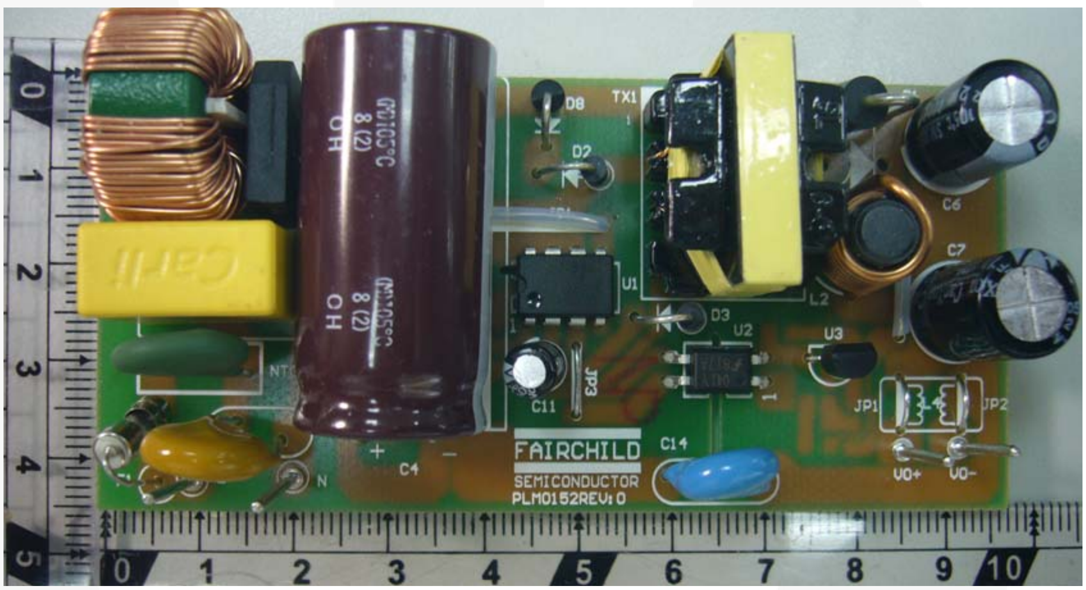



**Figure 1. Photo of FEBFSB127H_T001**

# 2. Board Configuration

- Input Voltage: 90 $V_{AC}$ – 264 $V_{AC}$
- Output Voltage: 5 V
- Output Current: 0 – 3.2 A
- Operation Frequency: 100 kHz

# 3. Schematic

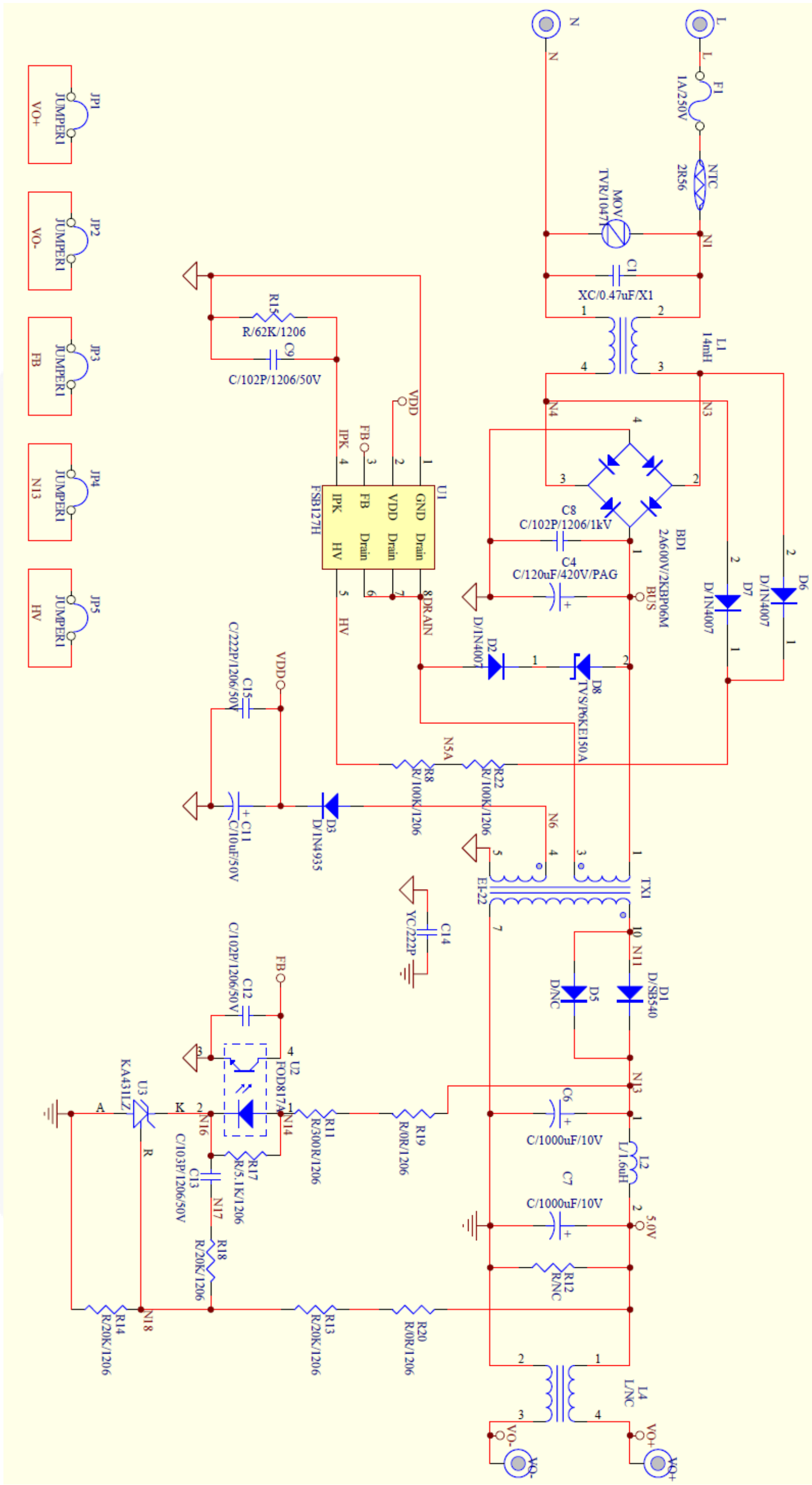


**Figure 2. Evaluation Board Schematic**

# 4. PCB Layout

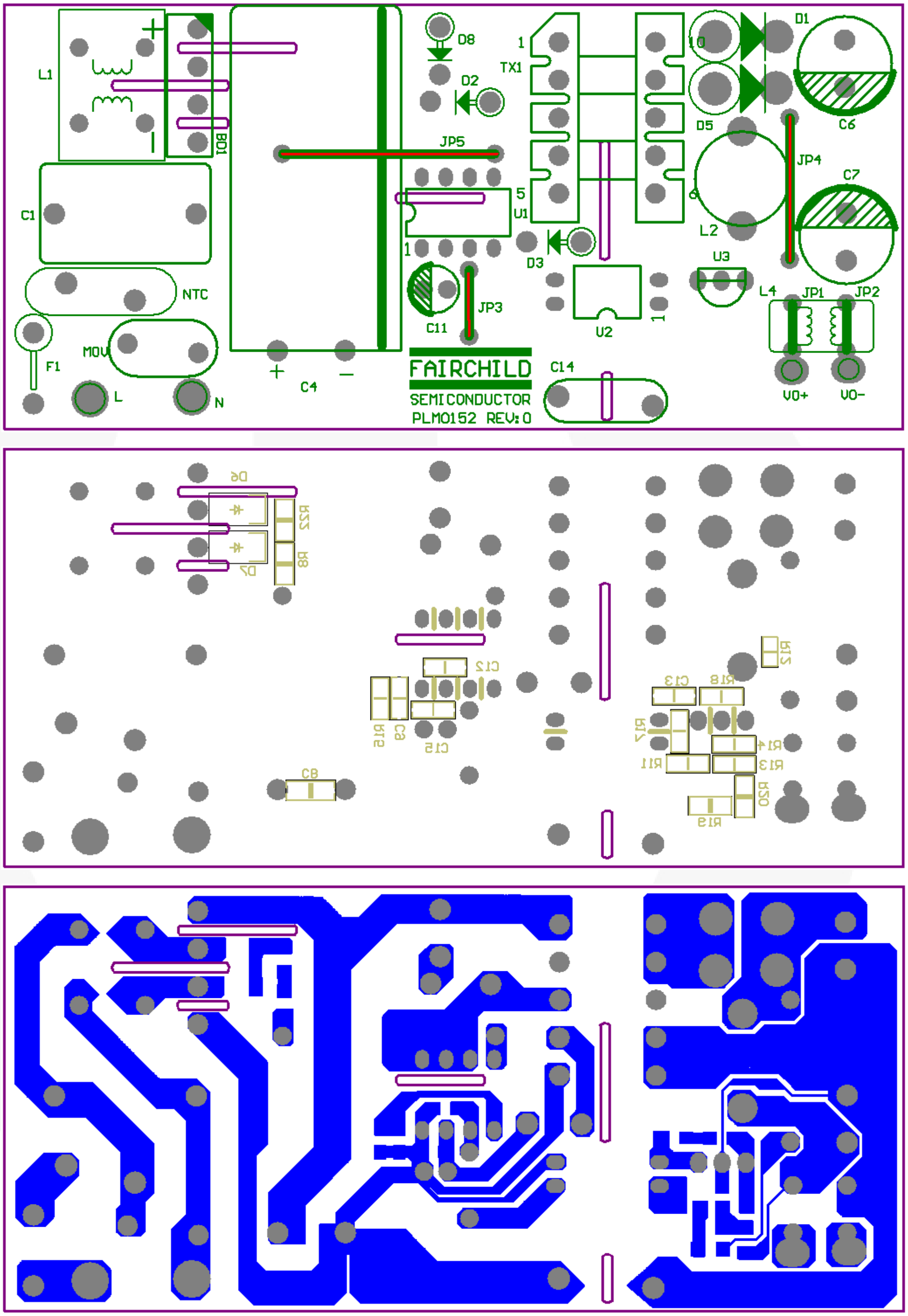


**Figure 3. Evaluation Board PCB Layout**

# 5. Test Results

## 5.1. Brown-in / Brownout

### 5.1.1. Test Condition

Decrease input AC voltage gradually and measure the turn-off threshold.

After AC power off, increase input voltage and measure the recovery threshold.

### 5.1.2. Test Result

| $R_{HV}$=200 kΩ | Minimum Load | Maximum Load |
|---|---|---|
| Turn off | 70 $V_{AC}$ | 68 $V_{AC}$ |
| Turn on | 81 $V_{AC}$ | 81 $V_{AC}$ |

## 5.2. AC Trim Up and Trim Down

### 5.2.1. Test Condition

Switch the input voltage from 90 $V_{AC}$ to 264 $V_{AC}$ or from 264 $V_{AC}$ to 90 $V_{AC}$; the output voltages should be normal.

### 5.2.2. Test Result

| | Minimum Load | Maximum Load |
|---|---|---|
| 90 $V_{AC}$ → 264 $V_{AC}$ | Pass | Pass |
| 264 $V_{AC}$ → 90 $V_{AC}$ | Pass | Pass |

## 5.3. Line and Load Regulation

### 5.3.1. Test Condition

Line regulation: 1% maximum.

Load regulation: 5% maximum.

### 5.3.2. Test Result

| Input Voltage | Max. Load | Min. Load | Load Regulation (%) |
|---|---|---|---|
| 90 $V_{AC}$ / 60 Hz | 4.971 V | 5.013 V | 0.84% |
| 264 $V_{AC}$ / 50 Hz | 4.988 V | 5.013 V | |
| Line Regulation (%) | 0.34% | 0% | |

## 5.4. DC Output Rise Time

### 5.4.1. Test Condition

Load: maximum load and minimum load. DC-output rise time: 20 ms, maximum.

### 5.4.2. Measured Waveforms

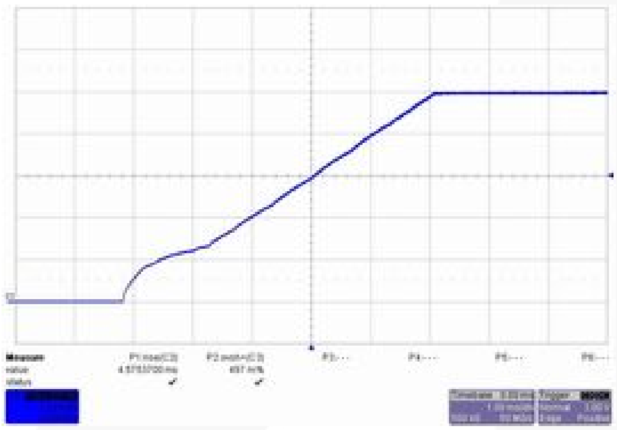


**Figure 4. 90 $V_{AC}$ / 60 Hz Maximum Load**

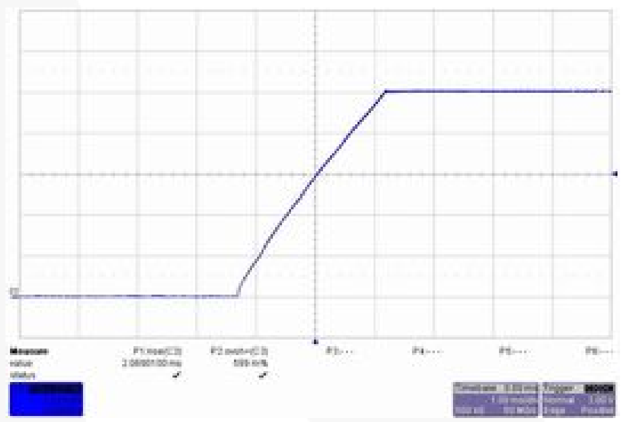


**Figure 5. 90 $V_{AC}$ / 60 Hz Minimum Load**

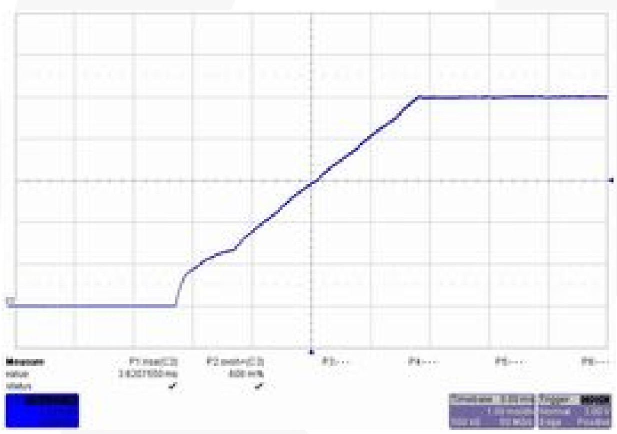


**Figure 6. 264 $V_{AC}$ / 50 Hz Maximum Load**

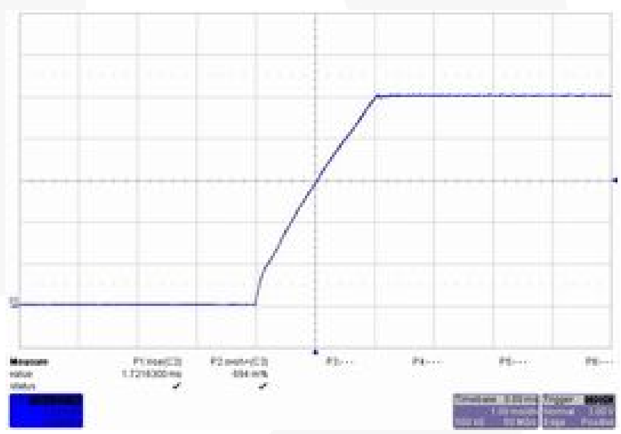


**Figure 7. 264 $V_{AC}$ / 50 Hz Minimum Load**

## 5.5. DC Transient Response

### 5.5.1. Test Condition

From 10% to 90% of the maximum load, with a 2.5 A/µs slew rate. Output load frequency is 100 Hz with 50% duty cycle.

### 5.5.2. Measured Waveforms

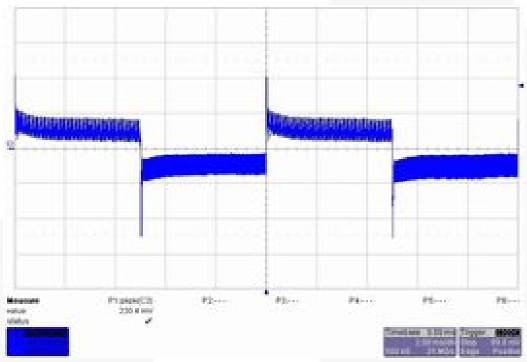


Figure 8. 90 $V_{AC}$ / 60 Hz

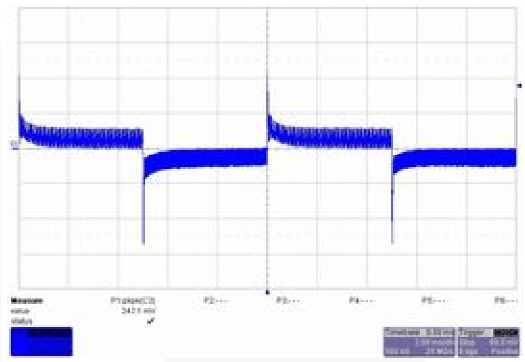


Figure 9. 264 $V_{AC}$ / 50 Hz

## 5.6. Ripple and Noise

### 5.6.1. Test Condition

Ripple and noise are measured using a 20 MHz bandwidth-limited oscilloscope with a 10 µF electrolytic capacitor paralleled with a high-frequency 0.1 µF ceramic across each output.

### 5.6.2. Measured Waveform

Ripple and noise are measured using a 20 MHz bandwidth-limited oscilloscope with a 10 µF electrolytic capacitor paralleled with a high-frequency 0.1 µF ceramic across each output.

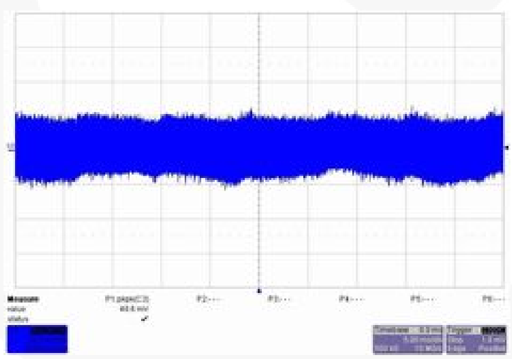


Figure 10. 90 $V_{AC}$ / 60 Hz Maximum Load

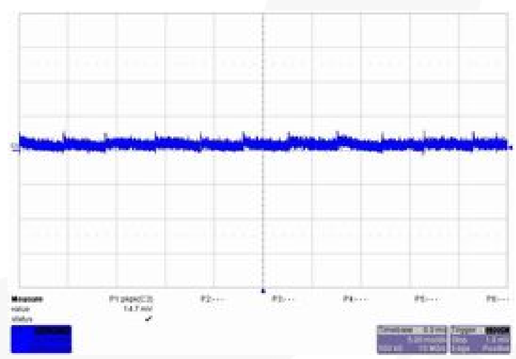


Figure 11. 90 $V_{AC}$ / 60 Hz Minimum Load

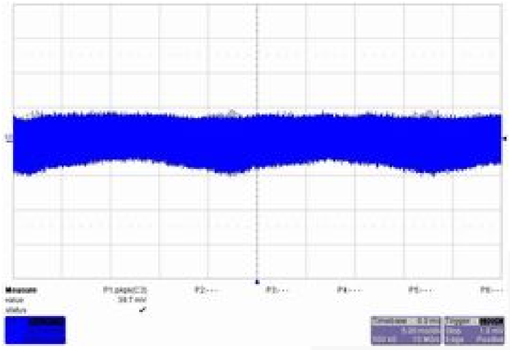


Figure 12. 264 $V_{AC}$ / 50 Hz Maximum Load

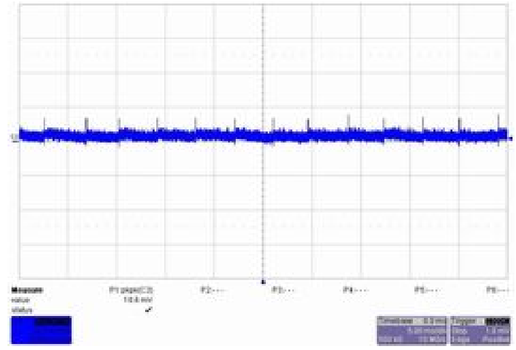


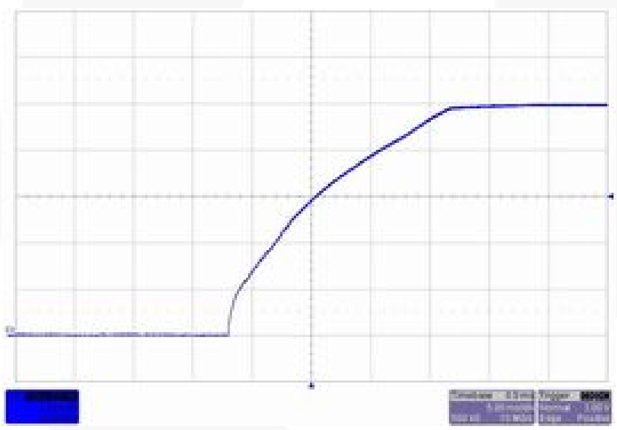
Figure 13. 264 $V_{AC}$ / 50 Hz Minimum Load

## 5.7. Capacitive Load

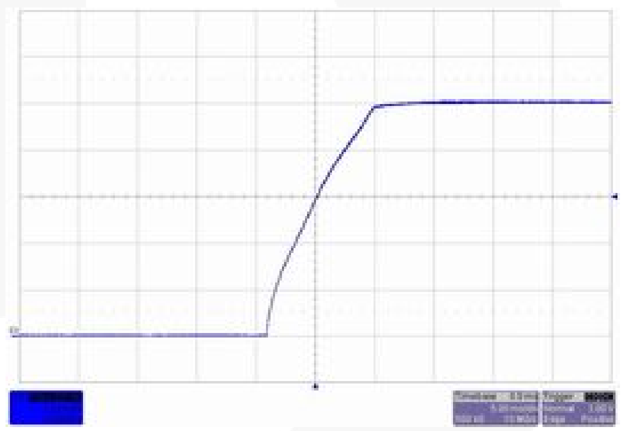
### 5.7.1. Test Condition

Output Capacitive Load = 12000 µF

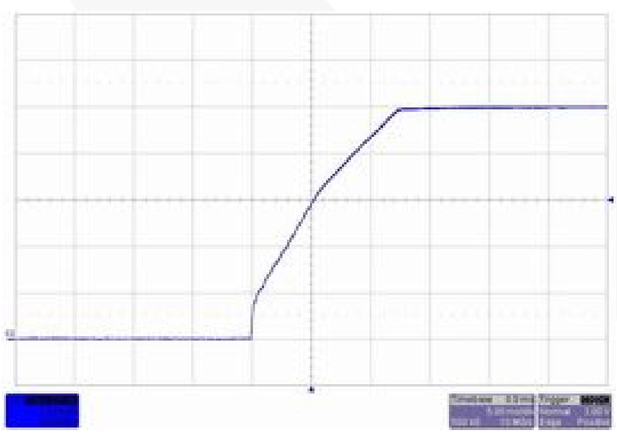
### 5.7.2. Measured Waveforms



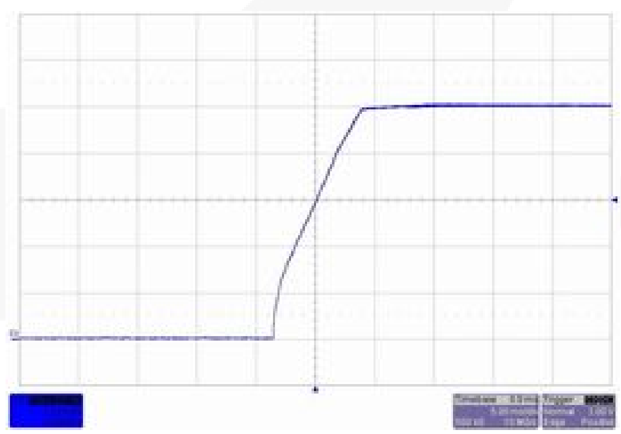
90 $V_{AC}$ / 60 Hz Maximum Load



90 $V_{AC}$ / 60 Hz Minimum Load



264 $V_{AC}$ / 50 Hz Maximum Load



264 $V_{AC}$ / 50 Hz Minimum Load

## 5.8. Power Saving

### 5.8.1. Test Condition

The input wattage is < 1 W in Standby Mode with 0.5 W loading for 2010 EuP.

The input wattage is < 0.5 W in Standby Mode with 0.25 W loading for 2013 EuP.

### 5.8.2. Test Result

| FSB127H | | Input Watts | Output Watts |
|---|---|---|---|
| A. | When $V_{IN}$= 230 $V_{AC}$, with 0.5 W Loading | 0.713 W | 0.5 W |
| | When $V_{IN}$= 240 $V_{AC}$, with 0.5 W Loading | 0.715 W | 0.5 W |
| | When $V_{IN}$= 264 $V_{AC}$, with 0.5 W Loading | 0.733 W | 0.5 W |
| B. | When $V_{IN}$= 230 $V_{AC}$, with 0.25 W Loading | 0.384 W | 0.25 W |
| | When $V_{IN}$= 240 $V_{AC}$, with 0.25 W Loading | 0.389 W | 0.25 W |
| | When $V_{IN}$= 264 $V_{AC}$, with 0.25 W Loading | 0.406 W | 0.25 W |
| C. | When $V_{IN}$= 230 $V_{AC}$, with No Loading | 53 mW | x |
| | When $V_{IN}$= 240 $V_{AC}$, with No Loading | 56 mW | x |
| | When $V_{IN}$= 264 $V_{AC}$, with No Loading | 68 mW | x |

## 5.9. Efficiency

### 5.9.1. Test Condition

Measure efficiency at minimum, mid-point, and maximum loading.

### 5.9.2. Test Result

| FSB127H | Input Watts | Output Watts | Efficiency |
|---|---|---|---|
| When $V_{IN}$= 115 $V_{AC}$, at 100% Load | 20.62 W | 16 W | 81.17% |
| When $V_{IN}$= 115 $V_{AC}$, at 75% Load | 15.28 W | 12 W | 82.42% |
| When $V_{IN}$= 115 $V_{AC}$, at 50% Load | 10.02 W | 8 W | 82.51% |
| When $V_{IN}$= 115 $V_{AC}$, at 25% Load | 5.07 W | 4 W | 81.70% |
| When $V_{IN}$= 230 $V_{AC}$, at 100% Load | 20.78 W | 16 W | 81.40% |
| When $V_{IN}$= 230 $V_{AC}$, at 75% Load | 15.11 W | 12 W | 82.24% |
| When $V_{IN}$= 230 $V_{AC}$, at 50% Load | 10.15 W | 8 W | 80.45% |
| When $V_{IN}$= 230 $V_{AC}$, at 25% Load | 5.18 W | 4 W | 78.62% |

## 5.10. Short-Circuit Protection

### 5.10.1. Test Condition

In the event of a short circuit on any DC output, the power supply should be protected from damage.

### 5.10.2. Test Result

| | 90 $V_{AC}$ / 60 Hz | 264 $V_{AC}$ / 50 Hz |
|---|---|---|
| Minimum Load | PASS | PASS |
| Maximum Load | PASS | PASS |

### 5.10.3. Measured Waveforms

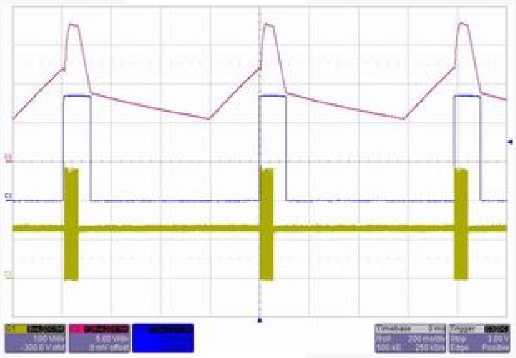


Figure 14. 90 $V_{AC}$/60 Hz, Output Short (Ch1: Drain, Ch2: $V_{DD}$, Ch3: FB)

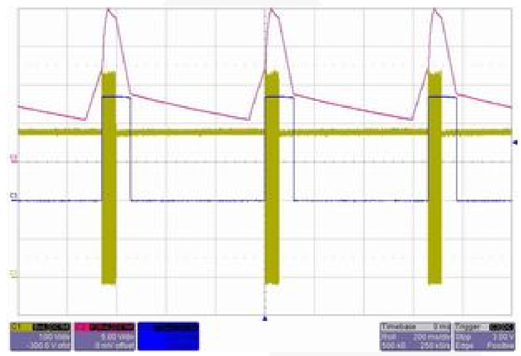


Figure 15. 264 $V_{AC}$/50 Hz Output Short (Ch1: Drain, Ch2: $V_{DD}$, Ch3: FB)

## 5.11. X-Cap Discharge

### 5.11.1. Test Condition

The X-capacitor voltage should decay to less than 37% of its original peak value in one second after the AC input is disconnected.

### 5.11.2. Measured Waveforms

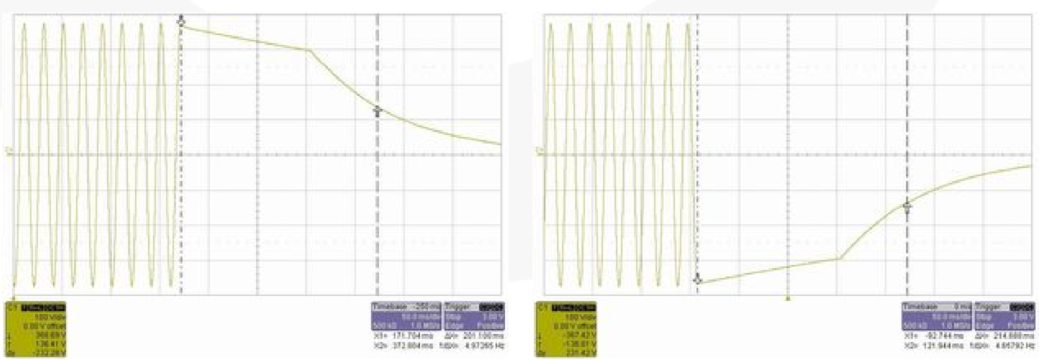


Figure 16. 264 $V_{AC}$ / 50 Hz, No Load, X-Cap=0.47 µF, $R_{HV}$=200 kΩ

## 5.12. Over-Power Protection

### 5.12.1. Test Condition

An over-current from the output return line does not damage the power supply and the OLP protection is enabled.

### 5.12.2. Test Result

| **Input Voltage** | 90 $V_{AC}$ | 115 $V_{AC}$ | 132 $V_{AC}$ | 180 $V_{AC}$ | 230 $V_{AC}$ | 264 $V_{AC}$ |
|---|---|---|---|---|---|---|
| **OPP (W)** | 24.10 W | 25.43 W | 26.42 W | 26.37 W | 26.04 W | 26.12 W |

## 5.13. Surge and ESD

### 5.13.1. Test Result

| **L-PE ±6 kV** | **N-PE ±6 kV** | **L-N ±1 kV** | **AIR ±16 kV** | **Contact ±8 kV** |
|---|---|---|---|---|
| Pass | Pass | Pass | Pass | Pass |

## 5.14. EMI Conduction

### 5.14.1. Measured Waveforms

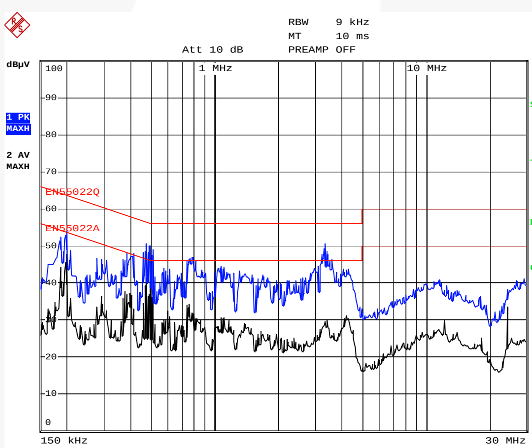



Figure 17. L: 115 $V_{AC}$ / 60 Hz

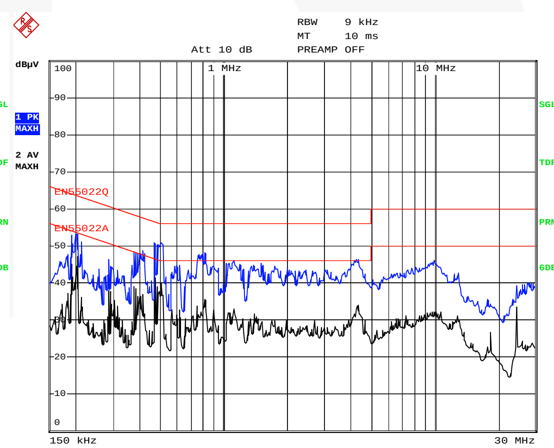



Figure 18. N: 115 $V_{AC}$ / 60 Hz

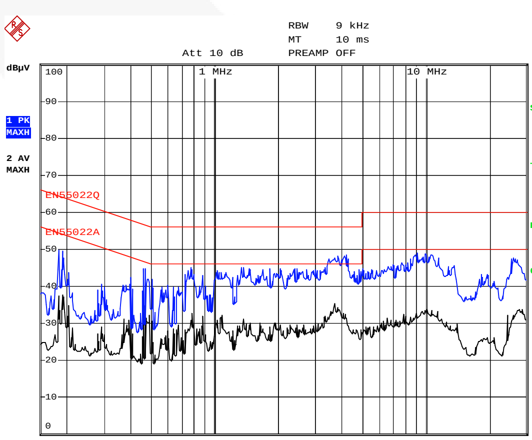



Figure 19. L: 230 $V_{AC}$ / 50 Hz

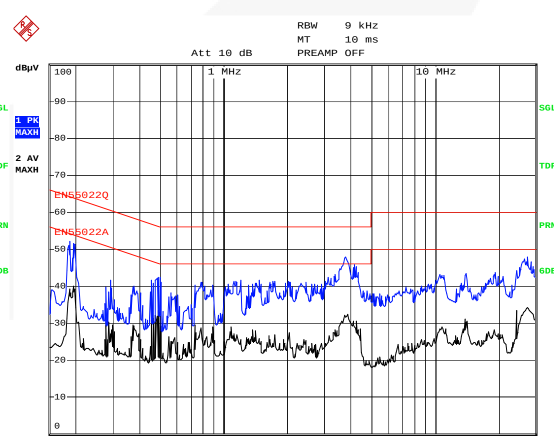


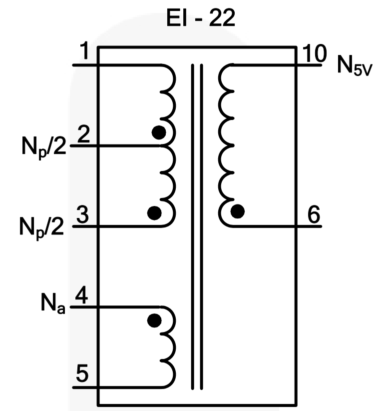

Figure 20. N: 230 $V_{AC}$ / 50 Hz

# 6. Bill of Materials

| Component | Qty | Part No. | Manufacturer | Reference |
|---|---|---|---|---|
| JUMPER WIRE 0.8Ø (mm) | 5 | | | JP1, JP2, JP3, JP4, JP5 |
| Resistor 1206 0 Ω ±5% | 2 | | | R19, R20 |
| Resistor 1206 100 kΩ ±5% | 2 | | | R8, R22 |
| Resistor 1206 20 kΩ ±1% | 3 | | | R13, R14, R18 |
| Resistor 1206 300 Ω ±5% | 1 | | | R11 |
| Resistor 1206 51 kΩ ±5% | 1 | | | R17 |
| Resistor 1206 62 kΩ ±1% | 1 | | | R15 |
| NTC 13Ø 2 ΩSCK132 | 1 | | | NTC |
| 1206 MLCC X7R 102P 50 V ±10% | 2 | | | C9, C12 |
| 1206 MLCC X7R 102P 1 kV ±10% | 1 | | | C8 |
| 1206 MLCC X7R 103P 50 V ±10% | 1 | | | C13 |
| 1206 MLCC X7R 222P 50 V ±10% | 1 | | | C15 |
| Electrolytic Capacitor 10 µF 50 V 105°C | 1 | LHK | JACKCON | C11 |
| Electrolytic Capacitor 120 µF 420 V 105°C | 1 | LHK | PAG | C4 |
| Electrolytic Capacitor 1000 µF 10 V 105°C | 2 | LHK | SAMXON | C6, C7 |
| X2 Capacitor 0.47 µF 275 V ±20% | 1 | | | C1 |
| Y1 Capacitor 222P 250 V ±20% | 1 | | | C14 |
| Inductor 14 mH | 1 | TRN0183 | SEN HUEI | L1 |
| Inductor 2.5 µH | 1 | TRN0204 | SEN HUEI | L2 |
| Transformer EI-22 900 µH | 1 | TRN0317 | SEN HUEI | TX1 |
| Schottky Diode 5 A / 40 V | 1 | SB540 | FAIRCHILD | D1 |
| Fast Diode 1 A / 1000 V | 1 | 1N4007 | FAIRCHILD | D2 |
| Fast Diode 1 A / 200 V | 1 | 1N4935 | FAIRCHILD | D3 |
| SMD Fast Diode 1 A / 1000 V | 2 | S1M | FAIRCHILD | D6, D7 |
| Bridge 2 A / 800 V | 1 | 2KBP08M | FAIRCHILD | BD1 |
| REGULATOR KA431L ±0.5% | 1 | | FAIRCHILD | U3 |
| IC FOD817A DIP | 1 | | FAIRCHILD | U2 |
| FUSE CERAMIC 250 V 1 A 3.6*10 mm | 1 | SLOW 37SG | SLEEK | F1 |
| Varistor 7ψ470 V | 1 | | | MOV |
| TVS Breakdown Voltage 143 V–158 V | 1 | P6KE150A | FAIRCHILD | D8 |
| Test Pin SG004-05 | 4 | | | L N VO+ VO- |
| PCB PLM0152 REV0 | 1 | | FAIRCHILD | |
| FSB127HNY | 1 | | FAIRCHILD | U1 |

# 7. Transformer

## 7.1. Transformer Specification




Core: EI-22 (Ae=37.5 mm$^2$)
Bobbin: EI-22

**Figure 21. Transformer Specification**

**Table 1. Winding Specifications**

| | Pins (S → F) | Wire | Turns | Winding Method |
|---|---|---|---|---|
| $N_p/2$ | 3 → 2 | 0.27φ×1 | 31 | Solenoid Winding |
| Insulation: Polyester Tape t = 0.025 mm, 3 Layer | | | | |
| $N_{5V}$ | 6 → 10 | 0.55φ×2 | 5 | Solenoid Winding |
| Insulation: Polyester Tape t = 0.025 mm, 3 Layers | | | | |
| $N_p/2$ | 2 → 1 | 0.27φ×1 | 31 | Solenoid Winding |
| Insulation: Polyester Tape t = 0.025 mm, 6 Layers | | | | |
| $N_a$ | 4 → 5 | 0.15φ×1 | 12 | Solenoid Winding |
| Insulation: Polyester Tape t = 0.025 mm, 3 Layers | | | | |

**Table 2. Specifications**

| | Pins | Specifications | Remark |
|---|---|---|---|
| Primary-Side Inductance | 1 - 3 | 900 µH ±10% | 100 kHz, 1 V |
| Primary-Side Effective Leakage | 1 - 3 | < 30 ❍H Max. | Short All Other Pins |

# 8. Revision History

| Rev. | Date | Description |
|---|---|---|
| 1.0.0 | 11/10/11 | Initial release |
| 1.0.1 | 02/04/13 | Modify description of test condition |
| | | |
| | | |

## PUBLICATION ORDERING INFORMATION

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