

4.2 W off-line LED driver with primary side regulation

Data brief

Features

- Input voltage range (V_{IN}): 185 - 265 V_{AC}
- Main frequency (f_L): 50 - 60 Hz
- Maximum (rated) output power: 4.2 W
- Output: $I_{OUT} = 350 \text{ mA} \pm 5\%$
 - Over voltage = 12 V max
 - Current ripple < 10% I_{OUT}
- Minimum switching frequency in normal mode: 70 kHz
- Target average efficiency (from 1 to 3 LEDs) > 70 %
- Maximum input power in no-load < 100 mW

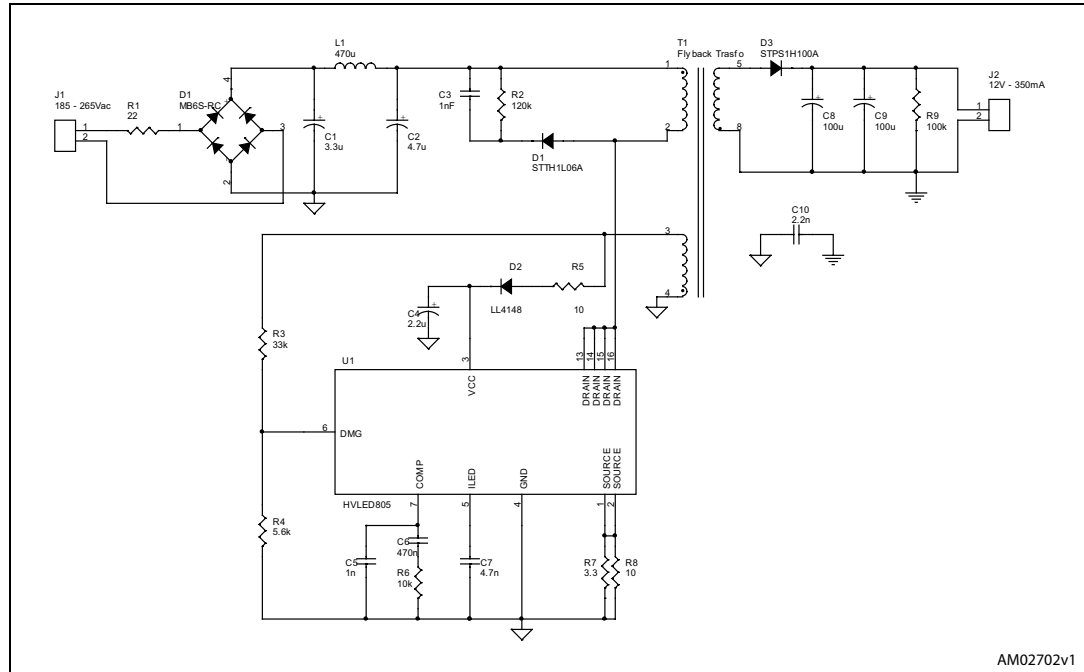


Description

The EVALHVLED805 is a demonstration board equipped with the new HVLED805 PWM current mode LED driver and is designed for European mains. It can control, with very good accuracy, from 1 to 3 LEDs having a nominal current of 350 mA. The HVLED805 has integrated high voltage startup and an 800 V power MOSFET. The high MOSFET's breakdown voltage allows very robust and reliable applications and reduces the size of the snubber and the relative power dissipation. Its accurate primary-current control eliminates the need of the optocoupler which impacts the cost, the compactness and the lifetime of the application while still maintaining a very good LED accuracy (below 5 %). Moreover, this converter, specifically designed for quasi-resonant (QR) flyback converters, enables very low turn-on losses and EMI emissions.

1 Electrical schematic

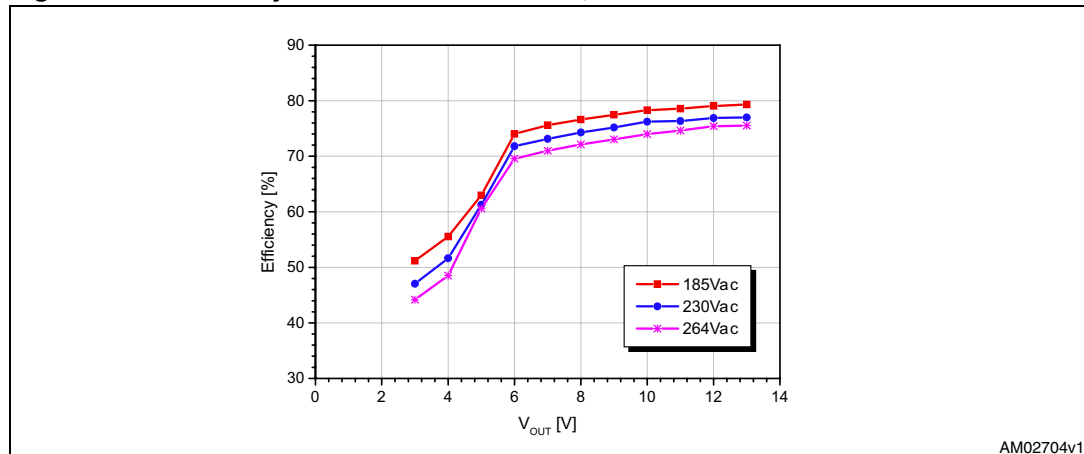
Figure 1. EVALHVLED805 electrical schematic



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1.1 Efficiency measurement

Figure 2. Efficiency measurement with one, two or three LEDs

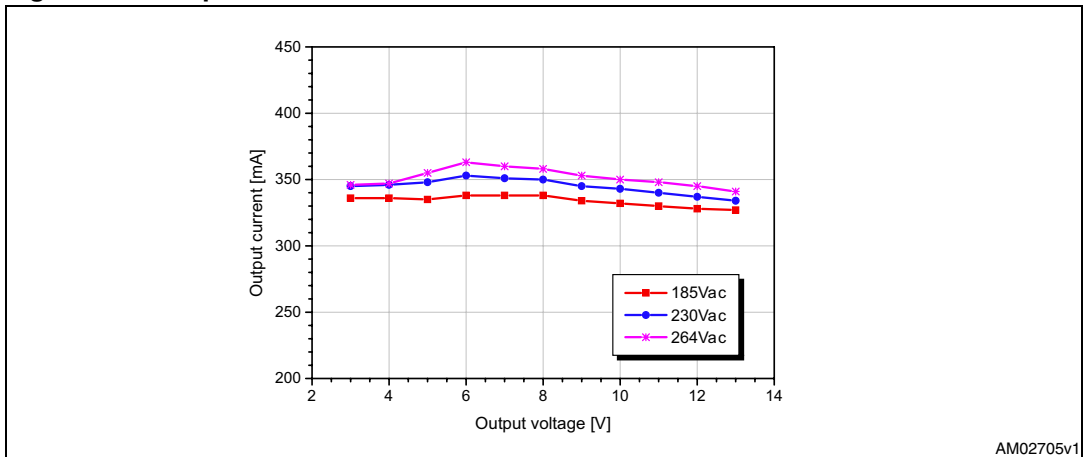


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The efficiency is always higher than 70 % when two or three LEDs are connected, whereas it drops with one LED. The reason is that at low output voltage, the auxiliary voltage is not able to supply the IC and the internal HV current generator self supplies the Vcc pin, thus dissipating a power proportional to VIN.

The output current has been measured with two or three LEDs which obtain an accuracy always below 5 %.

Figure 3. Output current characteristics



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Figure 4. Start up at 230 VAC, 3 LEDs

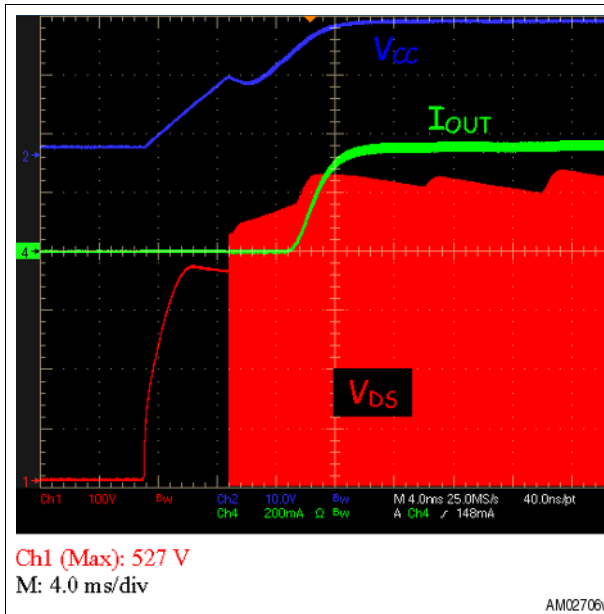


Figure 5. Start up at 230 VAC, 1LEDs

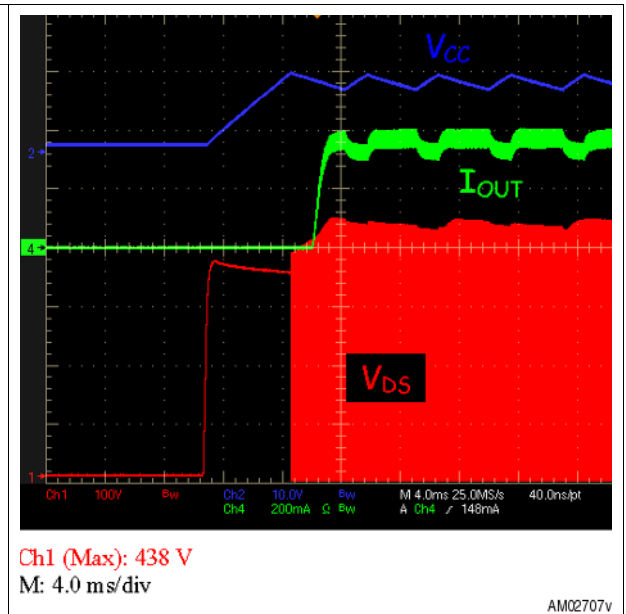


Figure 6. Normal operation at 230 VAC, 3 LEDs

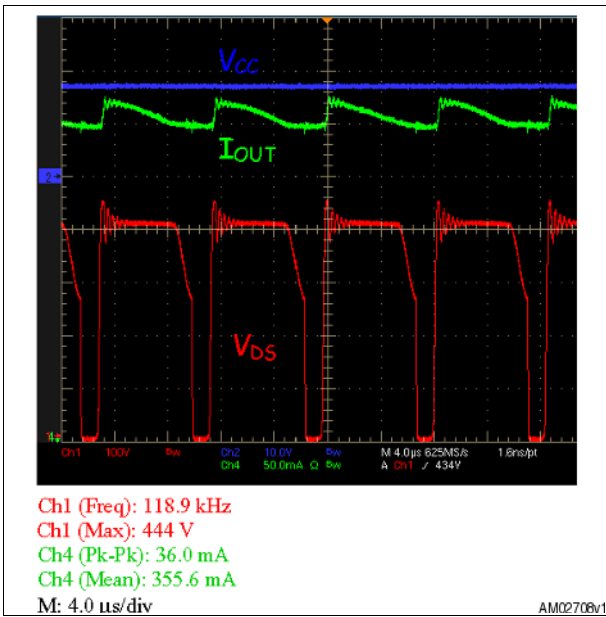


Figure 7. Normal operation at 230 VAC, 2 LEDs

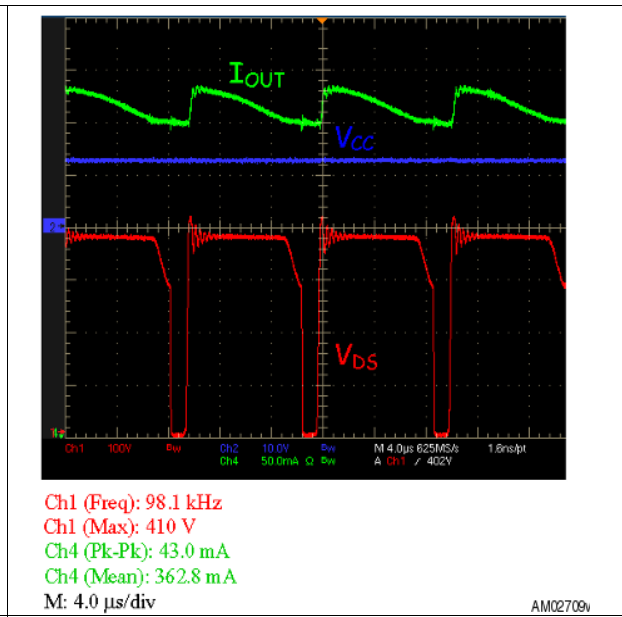


Figure 8. Normal operation at 230 VAC: 1 LEDs

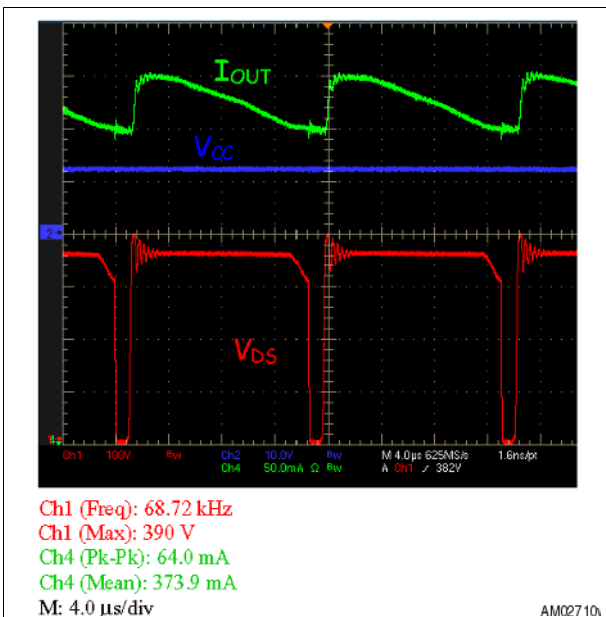


Figure 9. PCB top side and through hole components (not in scale)

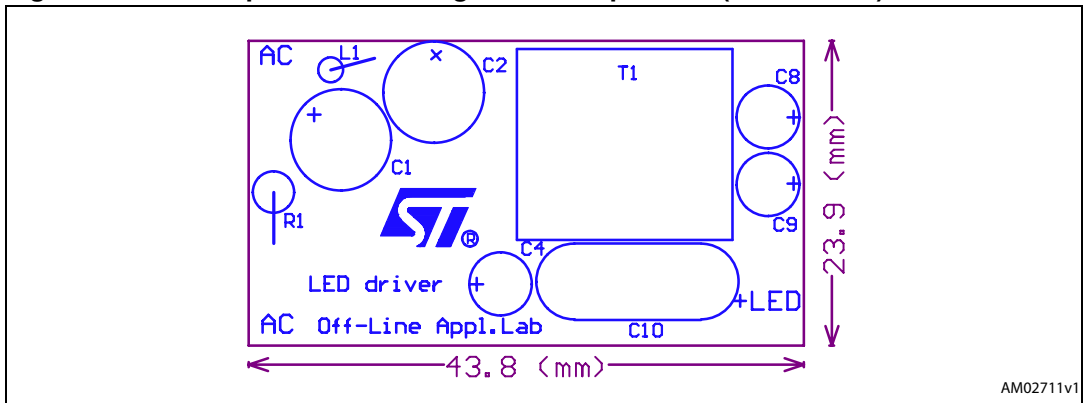


Figure 10. PCB: bottom side and SMD components (not in scale)

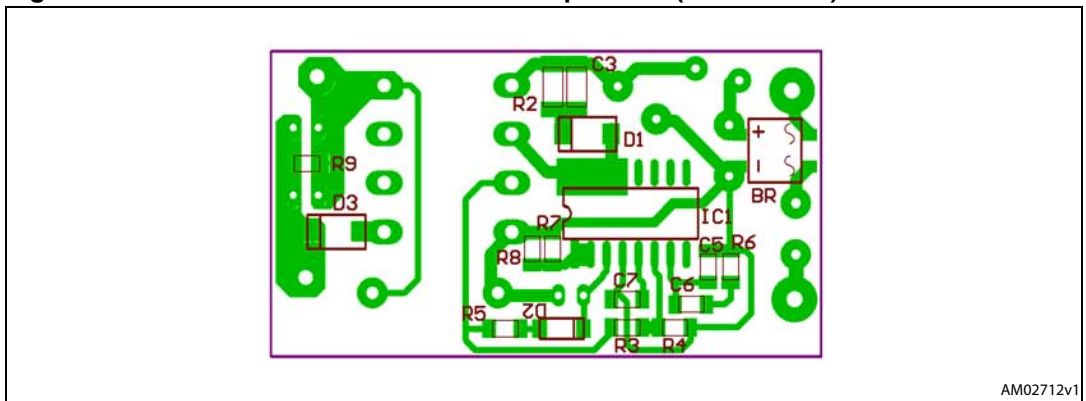


Table 1. Bill of material

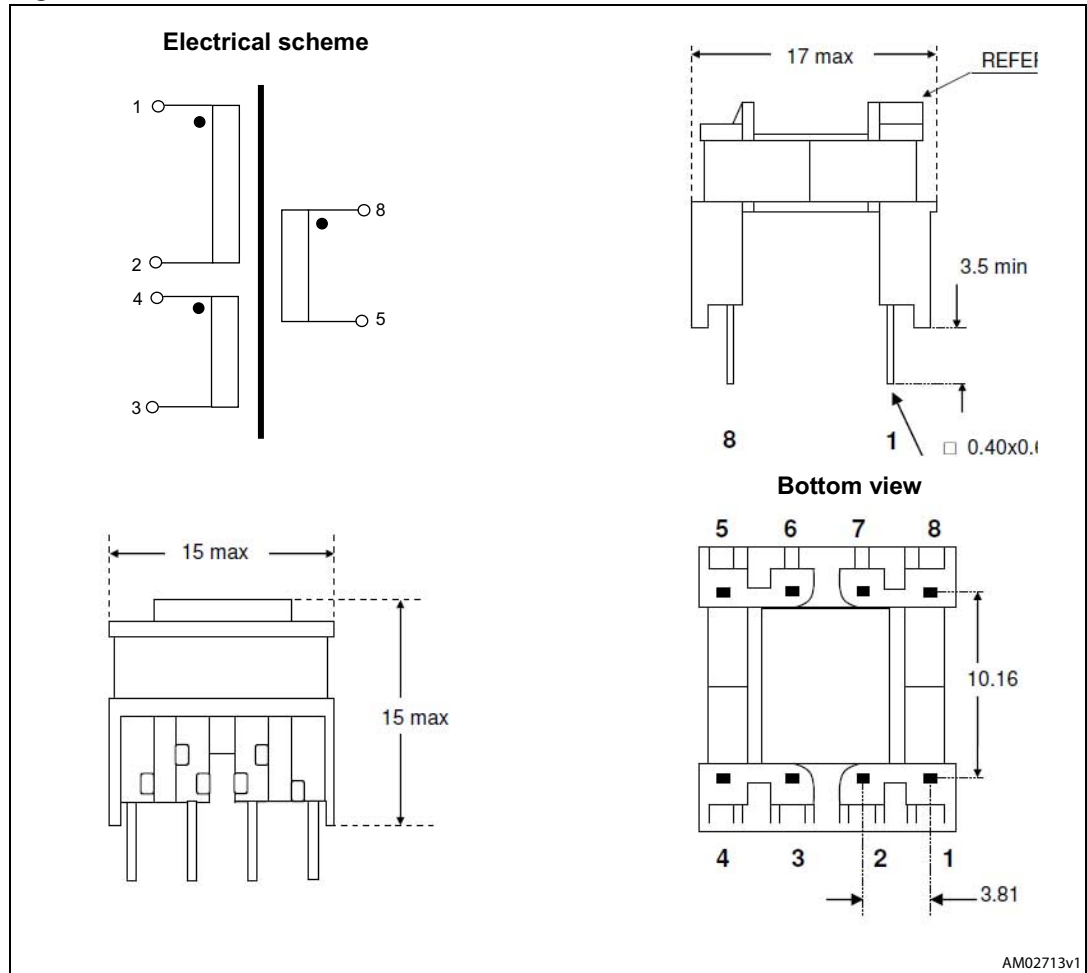
| Reference | Part | Description | Note |
|-----------|-----------------|-------------------------------|------------------------------|
| R1 | | 22 Ω | 1 W - Axial flame proof |
| R2 | | 120 k Ω | |
| R3 | | 33 k Ω | |
| R4 | | 5.6 k Ω | |
| R5 | | 10 Ω | |
| R6 | | 10 k Ω | |
| R7 | | 3.3 k Ω | 1% tolerance |
| R8 | | 10 Ω | 1% tolerance |
| R9 | | 100 k Ω | |
| C1, C2 | | 2.2 μ F | 400 V electrolytic |
| C3 | | 1 nF | 500 V - XR7 |
| C4 | | 2.2 μ F | 35 V electrolytic |
| C5 | | 1 nF | 25 V |
| C6 | | 470 nF | 25 V |
| C7 | | 4.7 nF | 25 V |
| C8, C9 | B41889A3108M | 100 μ F | 16V electrolytic Rubycon ZLH |
| C10 | Y1- Capacitor | 2.2 nF | 230V |
| D1 | STTH1L06A | Ultra-fast high voltage diode | STMicroelectronics |
| D2 | LL4148 | Small signal diode | |
| D3 | STPS1H100A | Power schottky diode | STMicroelectronics |
| L1 | B78108S1474J | 470 μ H | axial inductor Epcos |
| BR | MB6S RC | Input bridge rectifier | |
| TF | 1921.0013 Rev04 | Flyback transformer | Magnetics |
| IC | HVLED805 | Primary switching regulator | STMicroelectronics |

Note: If not otherwise specified, all resistors are 5%, ¼ W

Table 2. Transformer characteristics

| Manufacturer | Magnetica |
|---------------------------------|---|
| Part number | 1921.0013 Rev. 04 |
| Core | E13 – N87 (or equivalent) |
| Primary inductance | 2.6mH ± 15% |
| Air gap | ~ 70 µm |
| Leakage inductance | 1.42% nom |
| Primary to secondary turn ratio | 7.68 ± 5% 123:16 |
| Primary to auxiliary turn ratio | 5.59 ± 5% 123:22 |
| Primary saturation current | 0.21A _P max (B _{SAT} =0.35 T) |
| Insulation primary-secondary | 4 kV |

Figure 11. Transformer electrical scheme and dimensions



2 Revision history

Table 3. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 09-Feb-2011 | 1 | First release |
| 16-Nov-2011 | 2 | Updated Figure 1 , Table 1 , Table 2 , Figure 9 , Figure 11 |

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