Never stop thinking

Power Control ICs

EVALLED-TDA4863G-40W

Single Stage High Power Factor Flyback Converter for Offline LED Supply

TDA4863G
TLE4305G

Application Note

Revision 2.0, 2010-04-01

Industrial & Multimarket

Edition 2010-04-01

Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

TDA4863G

Revision History: 2010-04-01, Revision 2.0

Previous Version: --/--

Page	Subjects (major changes since last revision)

Contents

1 Content

The EVALLED-TDA4863G-40W is a demoboard to demonstrate the concept of a single stage PFC+Flyback converter using the TDA4863G and the CC-CV control chip TLE4305G in a LED driving application.

2 Evaluation Board

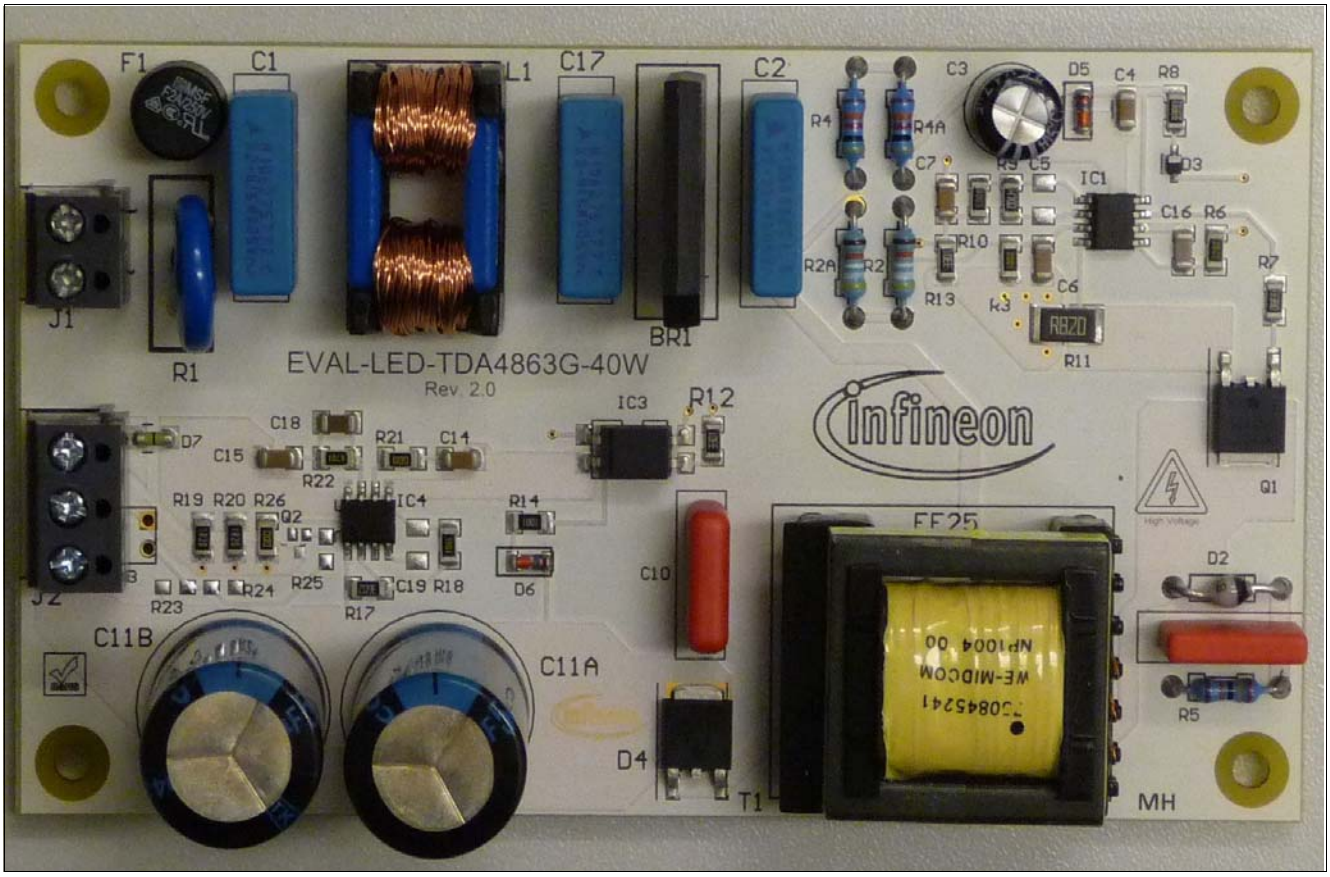

Figure 2-1 EVALLED-TDA4863G-40W

3 List of Features

- High Efficiency of ~90%
- High Power Factor up tp 0.98 and low THD
- Low System BOM, trough Single Stage Concept
- +/- 2% Accuracy Constant-Current Constant-Voltage Regulation
- Cycle-By-Cycle Peak Current Limitation
- Low In-Rush Current
- VCC Over and Under-Voltage Protection

4 Technical Specification

Table 4-1 provides a summary of the EVALLED-TDA4863G-40W performance specification.

Table 4-1 Performance Specification

Specification	Min	Typ	Max	Unit
Input Voltage	180	230[1)]	270	AC V
Output Voltage	15	22	26	V
Output Current	-2%		+2%	mA
Output Power			40	W
Output Ripple		+-15%		A

1) for a maximum ouput power of 20W the input voltage range is univerasl (90 V - 270 V)

5 Operation

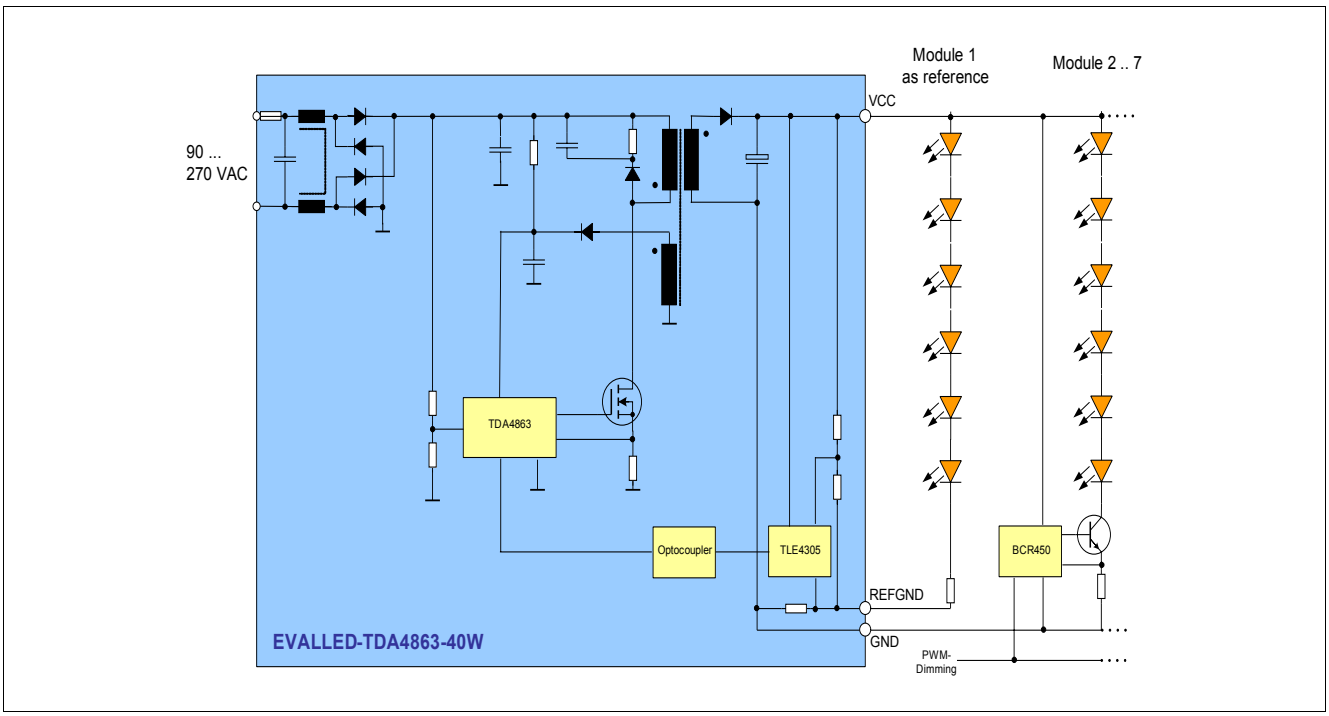

Figure 5-1 Basic Application Schematic

5.1 Basic Operation

The topology of the EVALLED-TDA4863G-40W is in principal a peak-current mode, quasi-resonant flyback converter. The current on the primary side is sensed via the sense resistor (R11). If this current reaches the thershold (Ipk), the main switch (MOSFET Q1) is turned off. Zero current detection is done via the auxilliary winding of the transformer. If zero current on the secondary winding of the transformer is detected the main switch is turned on. Figure 5-2 shows the switching waveforms. The blue curve is the voltage on the sense resistor and red curve the source-drain voltage at the main switch. This auxilliray winding is also used to supply the controller. For detailed information on the dimesoning of the transformer, sense resistor and snubber circuit see also [3] .

To achieve a high power factor the peak current (Ipk) is modulated in a way to follow the rectified mains input voltage. The input voltage is sensed via a resistive devider (R2,R2A, R3) and this signal is multiplied with the

feedback signal via the multiplier in the TDA4863G ([1]). This modulation of the peak current modulates the input current to follow the input voltage and allows for a very good power factor. Please see Chapter 6.6 for measurement result of the power factor and harmonic distortion.

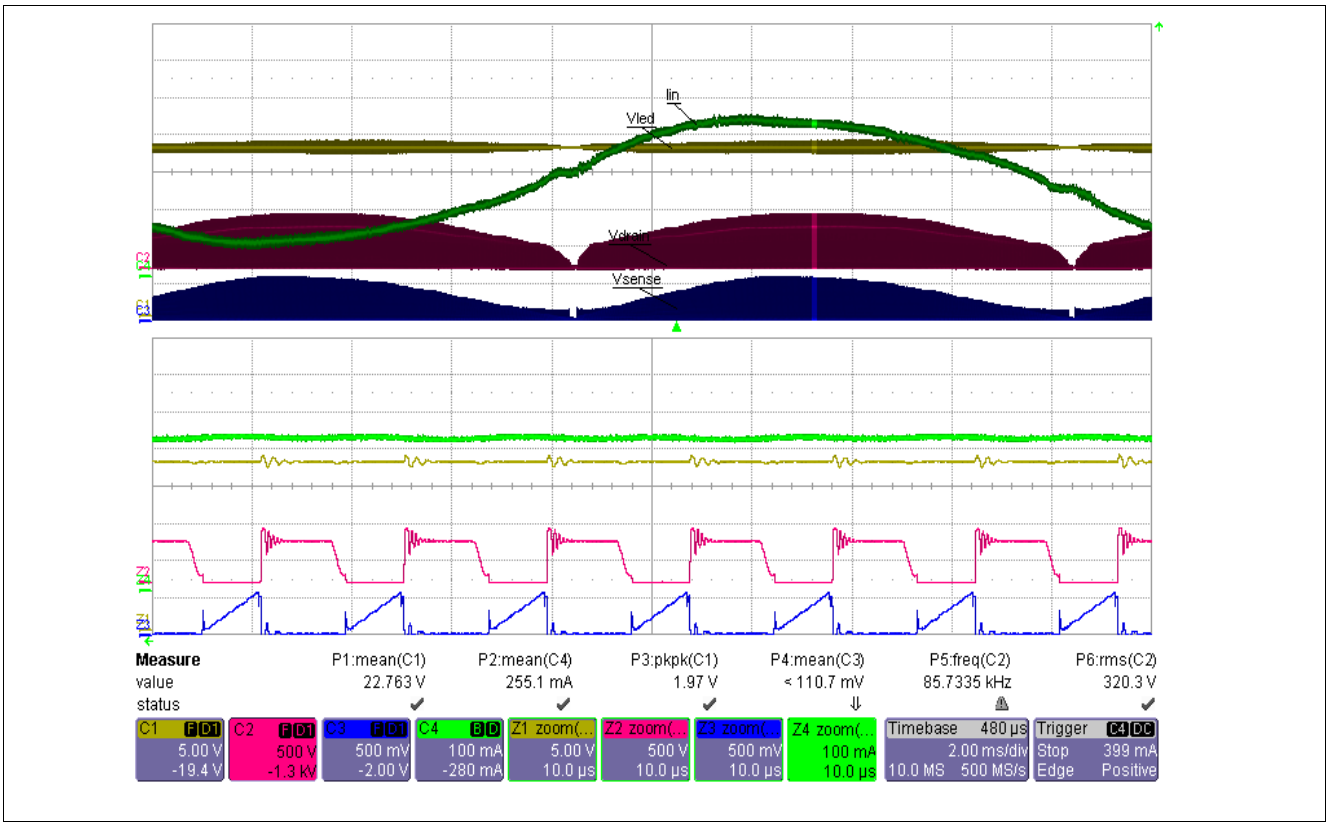

Figure 5-2 Typical switching waveforms at 230 Vac mains voltage: Input Current (green), Output Voltage

5.2 Output Control

The EVALLED-TDA4863G-40W allows for constant-current and constant-voltage output control. For this control the TLE4305G is used on the secondary side to measure the output current/voltage and feedback the control signal via the optocoupler. The current is measured via the sense resistor (R19,R20) on the secondary site. To minimize the losses in the sense resistor, the TLE4305G allows for a very low sense voltage of 0.2 V. Additionally the TLE4305G measures the output voltage and switches to a constant-voltage regulation in case the output voltage exceeds the limit set by the resistive divider (R17,R18). The time constants for the cc and cv regulation loop can be set independently with the capacitors (C14,C15) and the resistors (R21,R22).

It is necessary that the regulation time constant is lower than the mains AC frequency. To allow for a fast overvoltage protection the zener diode D6 is used.

The current regulation is set for 350mA and can be modified via R19/R20. This is true for a load connected between VCC and REFGND. Additional LED strips can be connected between VCC and GND. These additional loads are not seen by the current regulator.

6 Setup and Results

6.1 Input / Output Connector description

6.1.1 J1 - Vin

Input connector for AC supply. Please see **Table 4-1**for the maximum input voltage.

6.1.2 VCC

VCC is the positive output connector.

6.1.3 GND

GND is the negative output connector. Connect all load to this connector which should **not** be current regulated.

6.1.4 REFGND

REFGND is the negative output connector. The load which is connected between VCC and REFGND is monitored and controlled to allow constan current.

6.2 Setup

For operation of the board connect the connector J1 to an AC voltage (see **Table 4-1** for input voltage range). Please be aware that high voltages of up to 800 V will be accessable on the board.

6.3 Power Up

The EVALLED-TDA4863G-40W utilizes a startup resistor (see R4, R4A in **Figure 8-1**) for the first system startup (see **Figure 6-1**). As soon as the VCC voltage at the TDA4863G reaches the threshold it starts operating. The start-up time is ~2 seconds. To reduce the start-up time a smaller startup resistor can be choosen. Be aware, that this will have a negative impact on the efficiency.

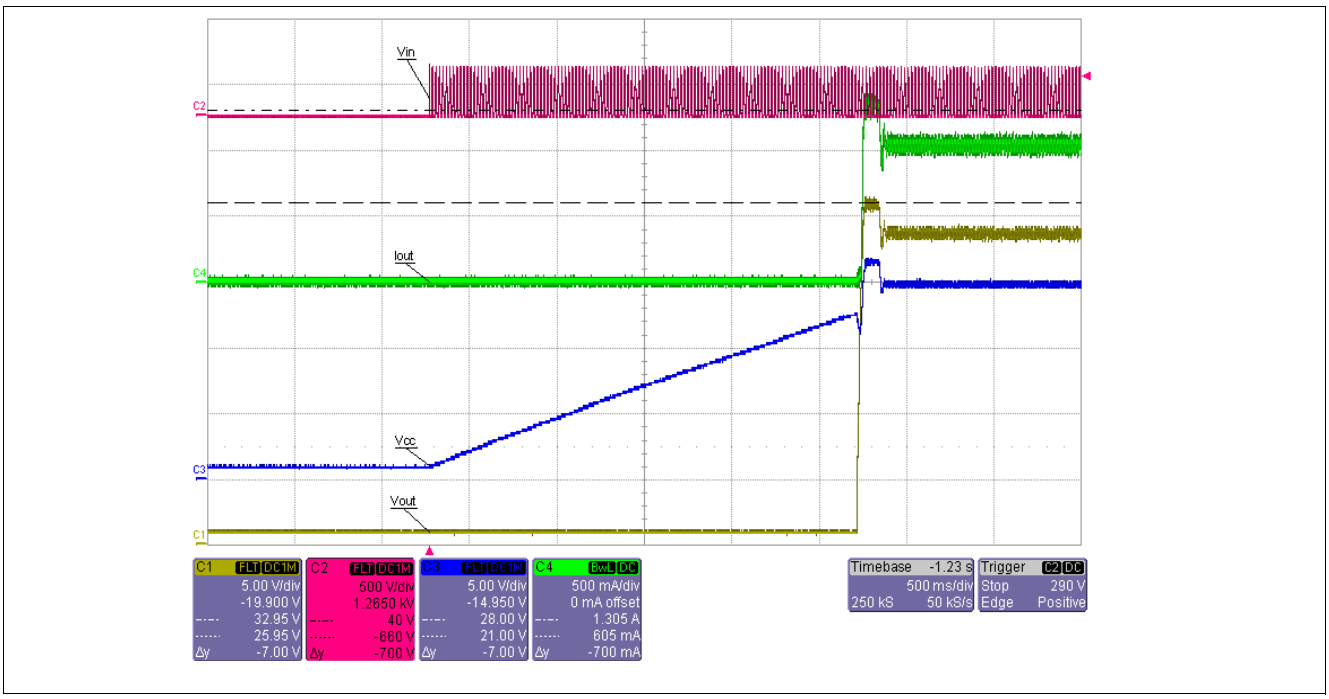

Figure 6-1 Startup: Mains Input Voltage (red), VCC at controller (blue), Output Current (green), and Output Voltage (yellow)

As already noted in **Chapter 5.2** the fast overvoltage regulation is realized with a zener diode acting directly on the optocouppler. This can be seen in **Figure 6-2**. During startup the output voltage rises till it is limited by the zenervoltage. After ~100ms the constant-current constant-voltage regulation which has a much higher time constant takes over and the output current and voltage is regulated.

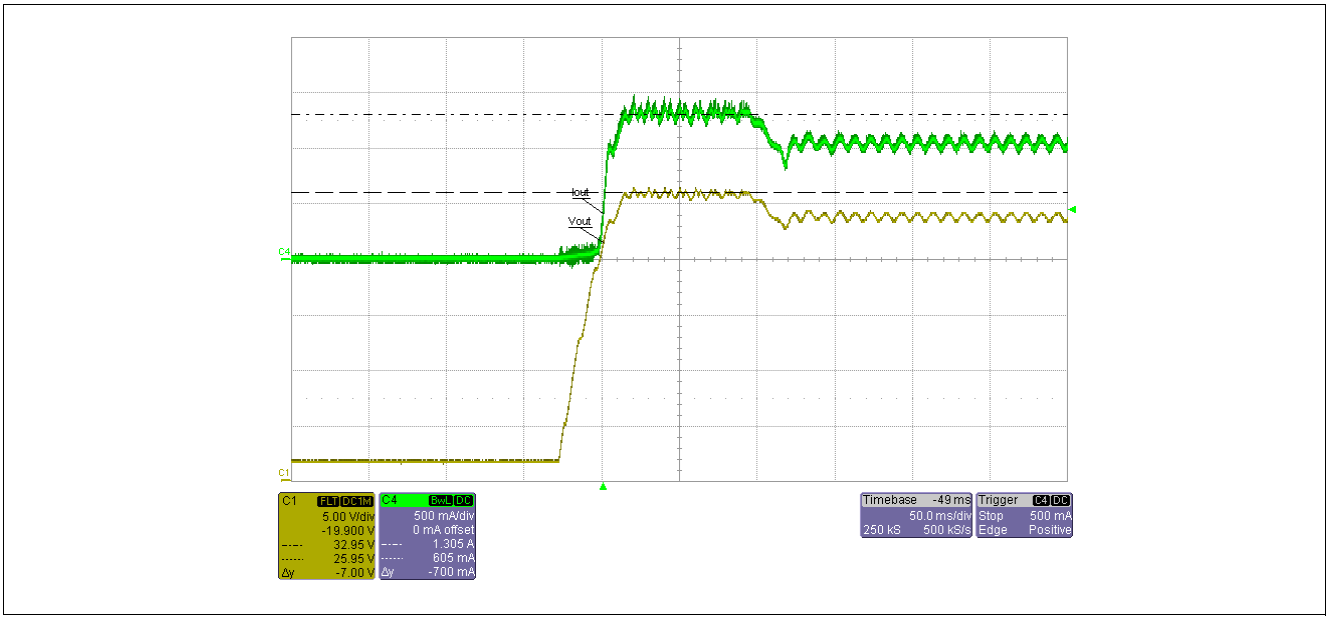

Figure 6-2 Startup: Output Current (green), and Output Voltage (yellow)

6.4 Output Ripple

In this topology the mains AC frequency is filtered on the secondary side of the flyback converter. This allows for a design with no high voltage electrolytic capacitors. The 100Hz/120Hz ripple of the output current is a function of the output power and the output capacitor (C11A, C11B). For 40W output power the ripple is +-15%

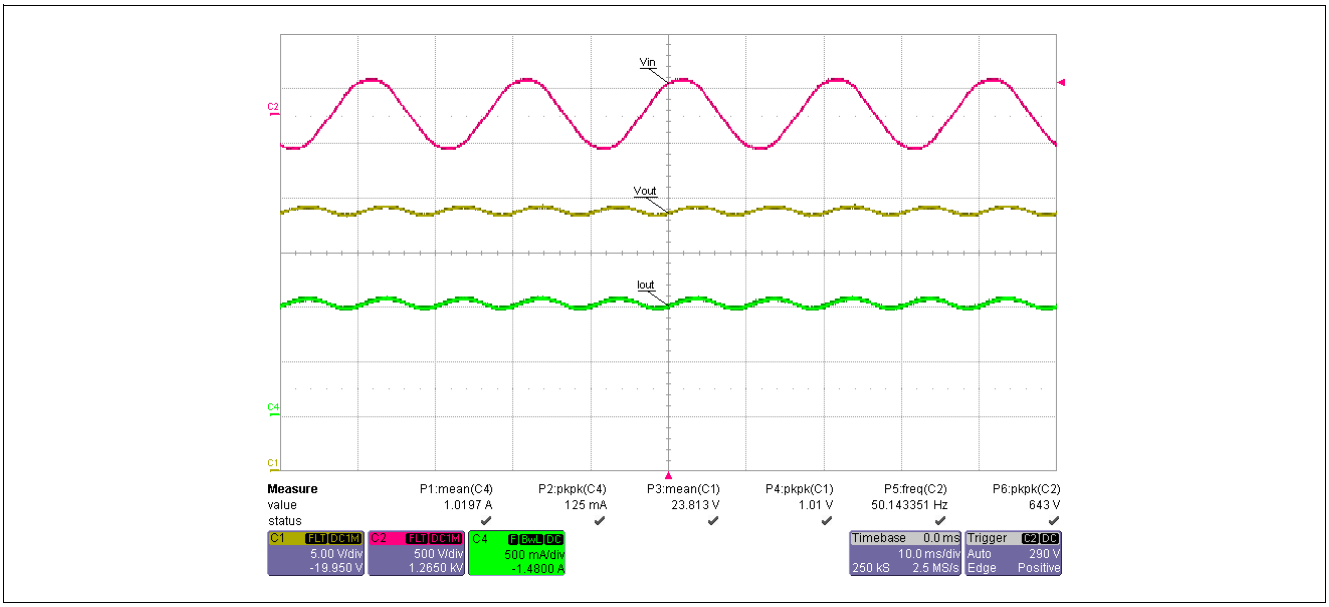

Figure 6-3 Typical Waveforms: Iput Voltage (red), Output Current (green) and Output Voltage (yellow)

6.5 Efficiency

The principle of a quasi-resonant flyback converter allows for a good efficiency of ~90%. **Figure 6.5** shows the efficiency as function of input voltage for different output power levels.

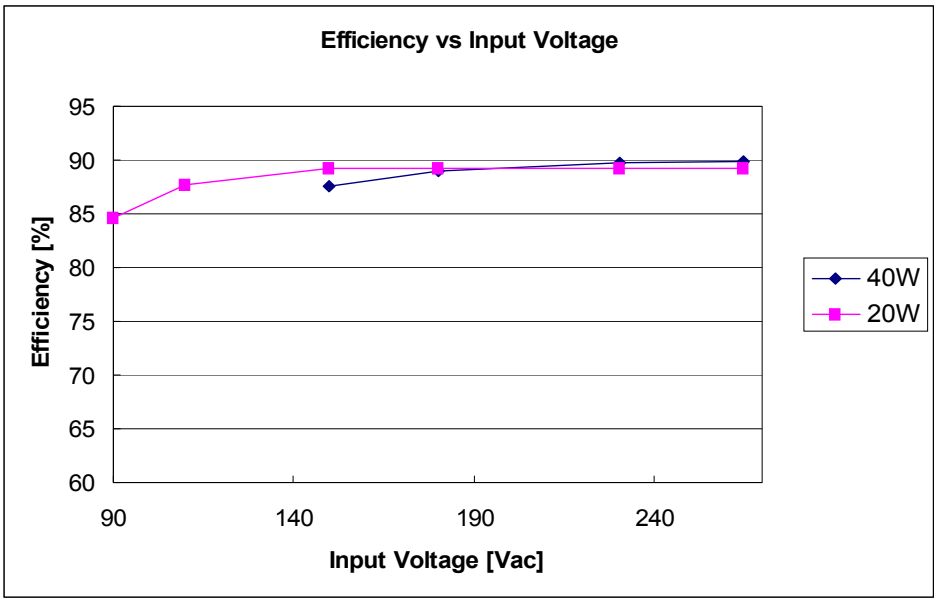

Figure 6-4 Efficiency over input voltage

6.6 Power Factor Correction

As discussed in **Chapter 5.1** the operation principle allows for a very good power factor, which is mostly limited by the input filter. **Figure 6-5** and **Figure 6-6** show the input voltage and current waveforms, the power factor and the harmonic distorsion for 110 V and 230 V AC input voltage respectively. **Figure 6-7** shows the power factor as function of input voltage and output power.

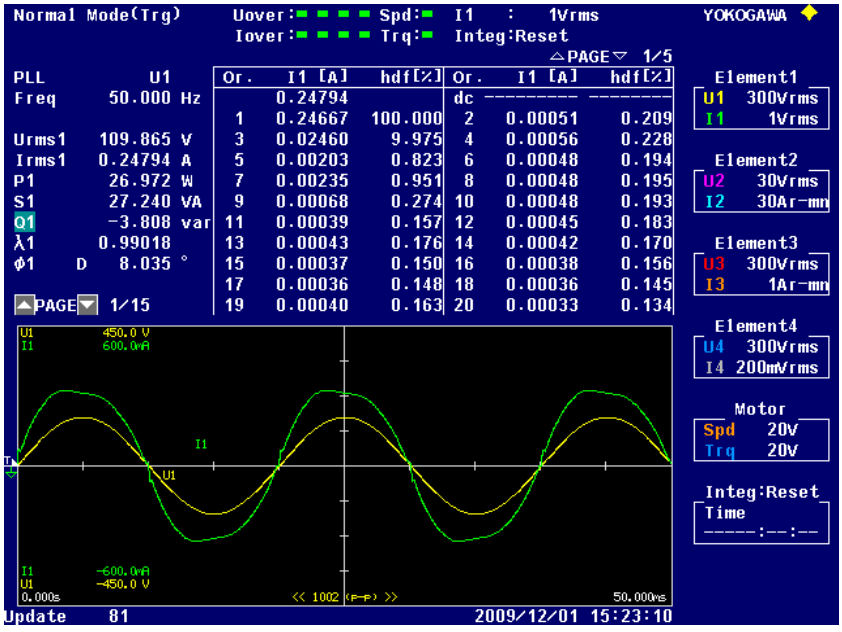

Figure 6-5 Power Factor and THD at 110 Vac input voltage and 25W output power

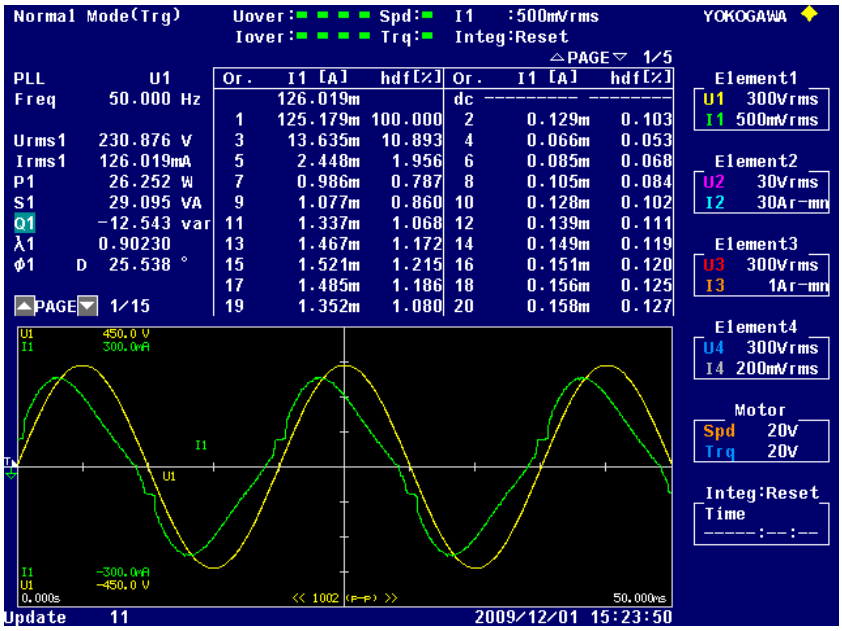

Figure 6-6 Power Factor and THD at 230 Vac input voltage and 25W output power

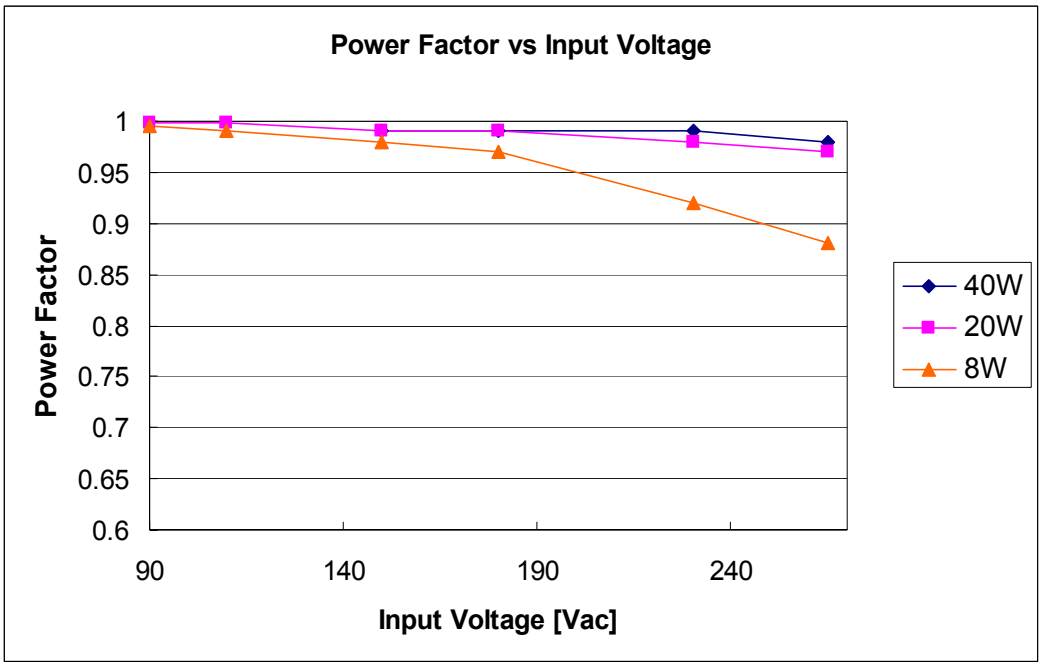

Figure 6-7 Power Factor as function of the input voltage

6.7 EMI

The soft switching and inherent jittering of the topology allow for an EMI spectrum compliant to the norm with an low BOM input filter design.

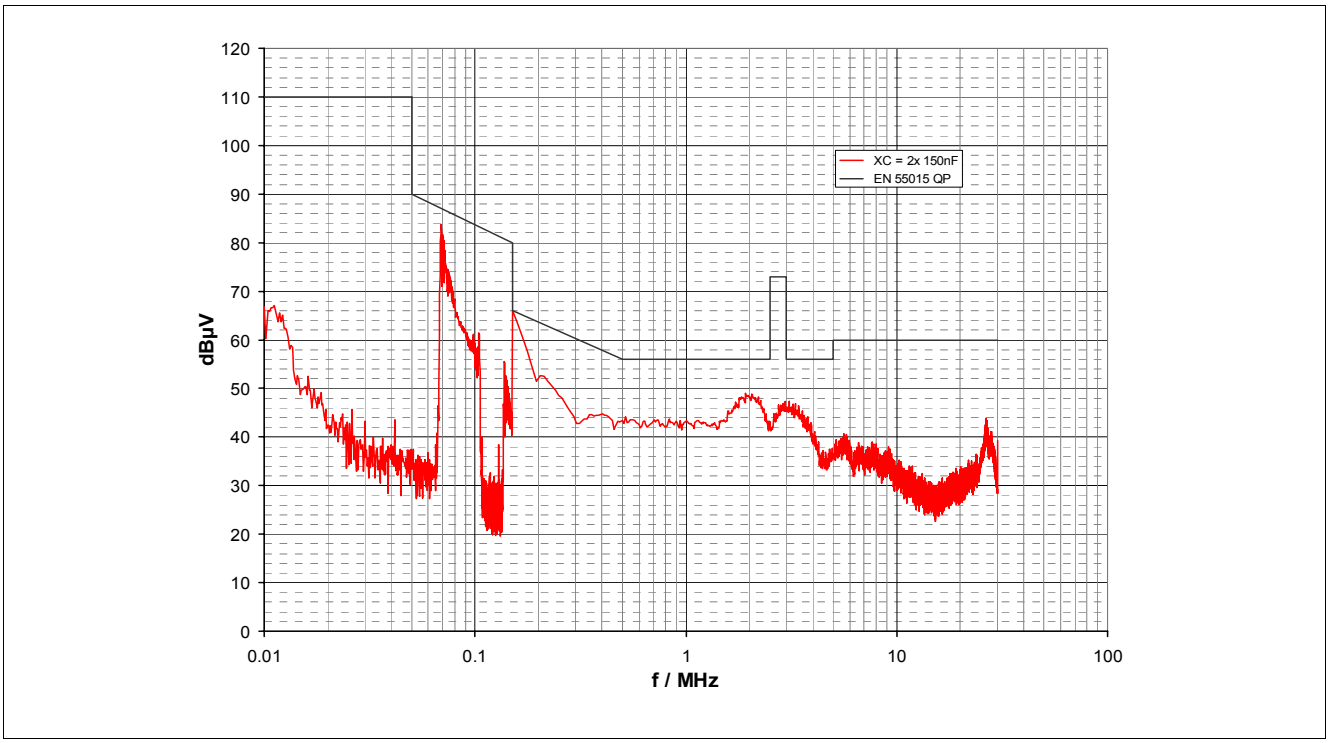

Figure 6-8 EMI Spectrum: C1 and C17 150nF, L1 2x68mH

7 Board Layout

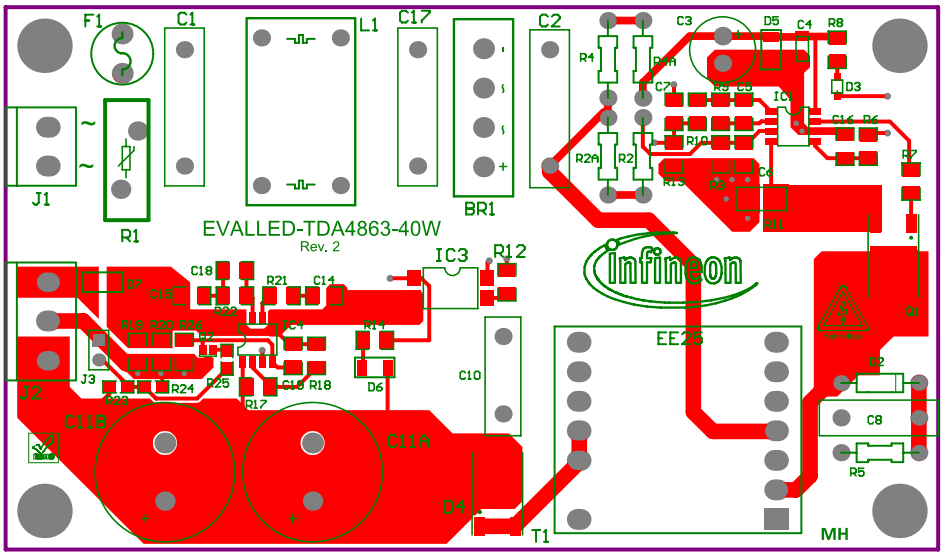

Figure 7-1 **EVALLED-TDA4863G-40W** Top Layer Routing

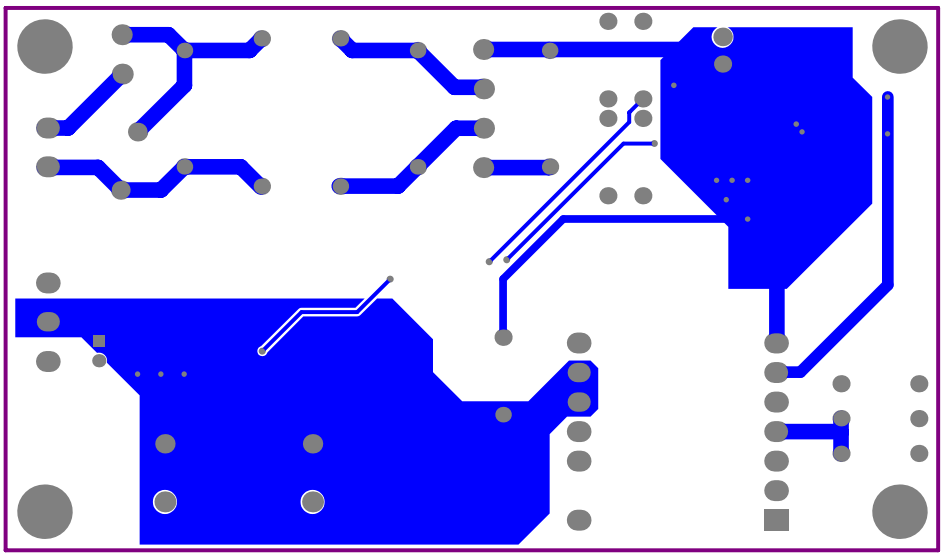

Figure 7-2 **EVALLED-TDA4863G-40W** Bottom Layer Routing

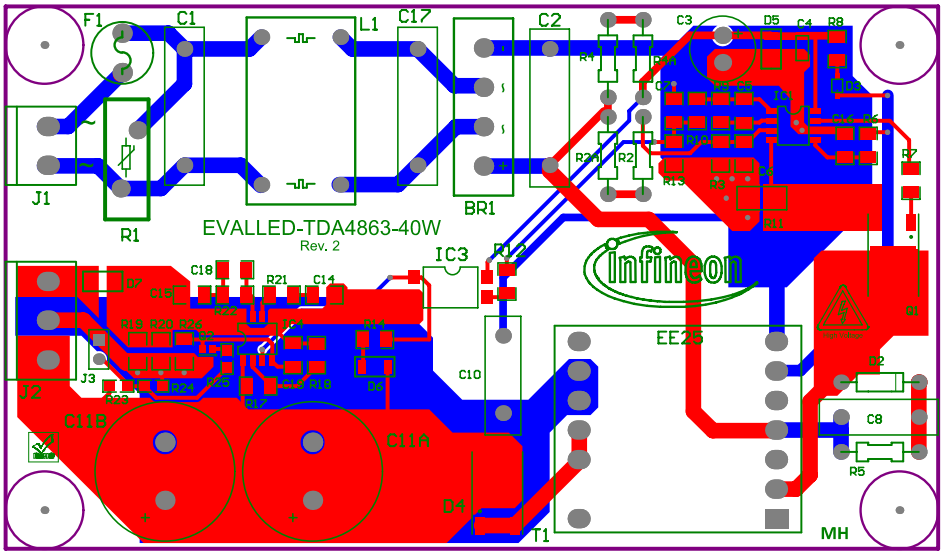

Figure 7-3 **EVALLED-TDA4863G-40W** Composite Layer View

8 Schematic and BOM

8.1 Schematic

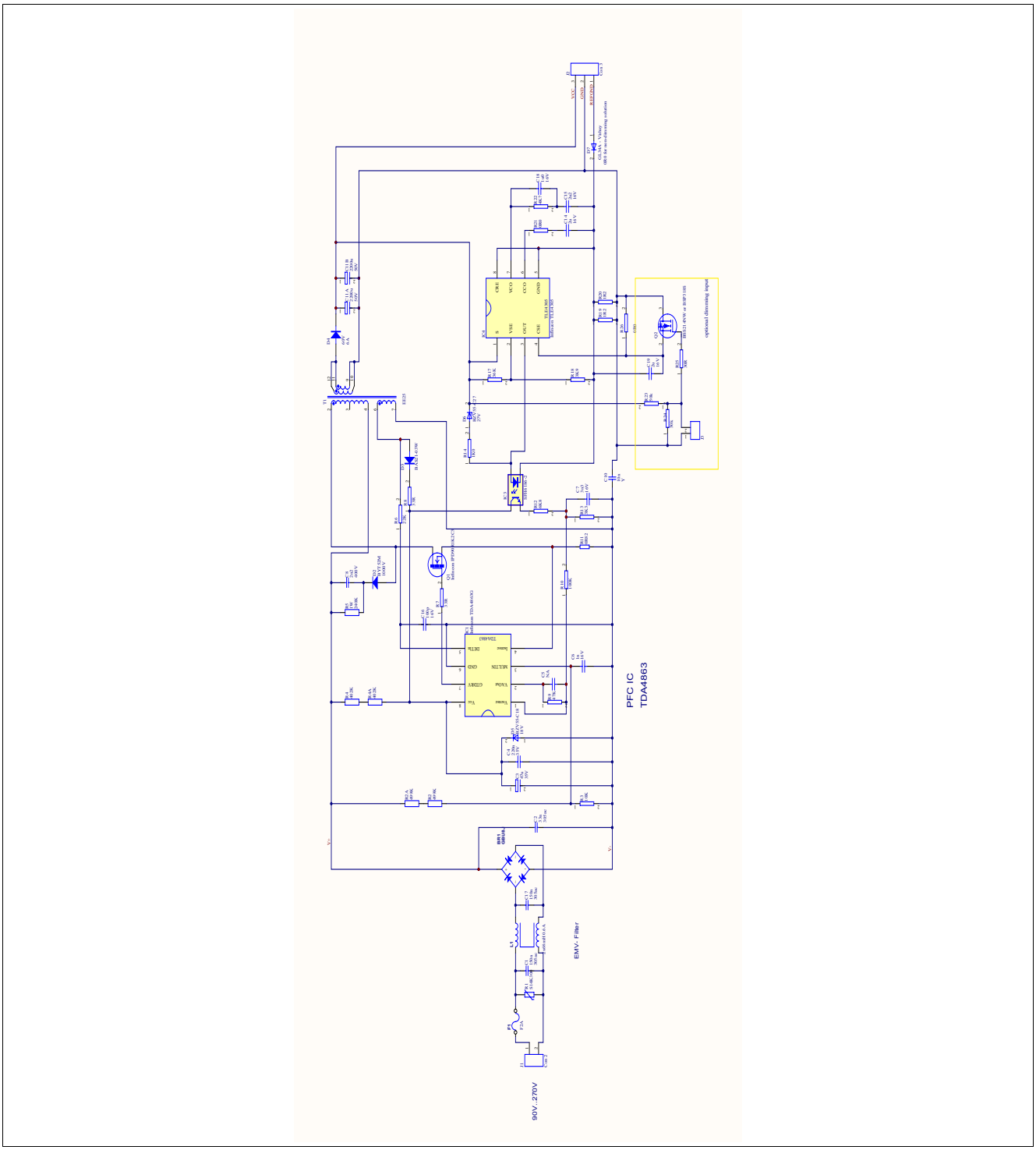

Figure 8-1 EVALLED-TDA4863G-40W Schematic

8.2 Bill of Materials

Designator	Value	Rated Voltage
BR1	GBU8J	
C1	150n	305ac
C2	33n	305ac
C3	47u	35V
C4	220n	35V
C5	NA	
C6	1n	16V
C7	3n3	16V
C8	2n2	400V
C10	10n	Y
C11A	2200u	50V
C11B	2200u	50V
C14	2u	16V
C15	2u2	16V
C16	100p	16V
C17	150n	305ac
C18	1u0	16V
C19	2u	16V
D2	1000V	
D3	BAS21-03W	
D4	6A	60V
D5	18V	
D6		27V
D7	GL34A	
F1	F2A	
IC1	TDA4863	
IC3	SFH6186-2	
IC4	TLE4305	

Designator	Value	Rated Voltage
L1	2x68mH 0.6A	
Q1	900V, 5A	
Q2	BSP318S	
R1	S14K300	
R2	499K	
R2A	499K	
R3	10K	
R4	402K	
R4A	402K	
R5	240K	
R6	22K	
R7	33R	
R8	33R	
R9	47K	
R10	100K	
R11	0R82	
R12	3K3	
R13	3K3	
R14	1K0	
R17	36K	
R18	3K9	
R19	1R2	
R20	1R2	
R21	0R0	
R22	4K7	
R23	50k	
R24	50k	
R25	30R	
R26	0R0	
T1	EE25	

Figure 8-2 EVALLED-TDA4863G-40W Bill Of Materials

8.3 Transformer

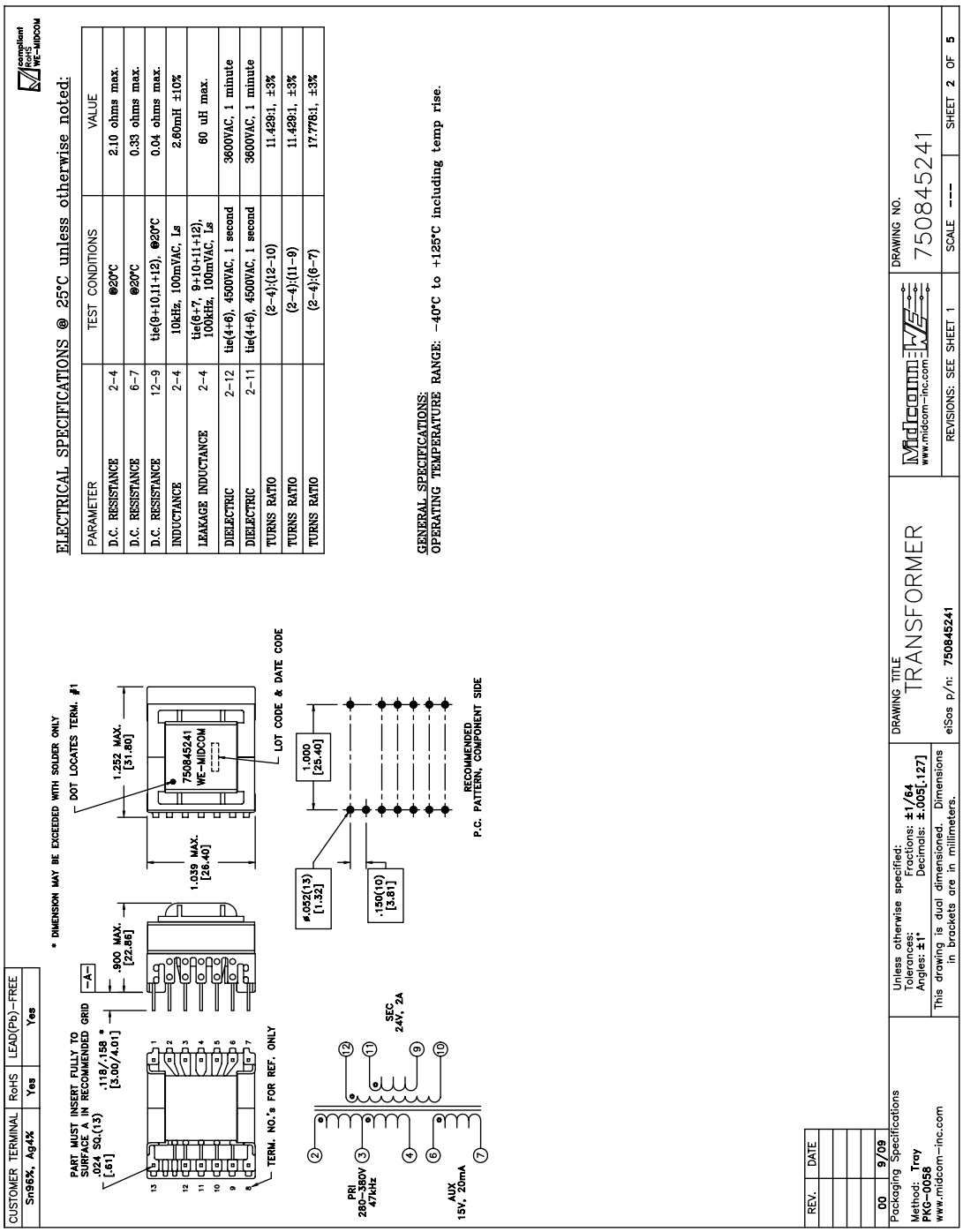

Figure 8-3 EVALLED-TDA4863G-40W Trafo Design

References

[1] **TDA4863** datasheet at **www.infineon.com**

[2] **TLE4205G** datasheet at **www.infineon.com**

[3] **Quasi Resonant Flyback** Application Note at **www.infineon.com**

[4] **Quasi Resonant Flyback** Design Tips at **www.infineon.com**

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG