TDA 4863

AN-PFC-TDA 4863-3

Calculation-Tool for PFC-Preconverter using TDA 4863

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http://www.infineon.com/pfc

Power Management & Supply

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Calculation-Tool for PFC-Preconverter using TDA 4863

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Page	Subjects (major changes since last revision)
2	update

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Table of Contents **Page**

1 Short Description

This application note describes the handling of the calculation tool “PFCCal-DCM_1.xls” which is available on our website http://www.infineon.com/pfc. It is an excel-sheet and allows a flexible use for PFC preconverters used in many switch mode power supplies. The calculation is based on the condition, that the switching frequency is always above a generic minimum frequency. Please note, that the calculation tool is only suitable for DCM-designs using TDA 4863. There is no warranty for the results when using other IC.

The first sheet is a README-sheet and give a rough overview of the calculation flow. The second sheet is the calculation itself followed by two sheets providing the databases for the ferrite cores and resistive components.

For further information, please refer to the Infineon application notes concerning TDA 4863 and PFC ([1], [2], [3]).

2 Related PFC Circuit

Figure 1 shows the schematic of the PFC preconverter which the tool is related to. All components are identically enumerated as in PFCCalc.xls.

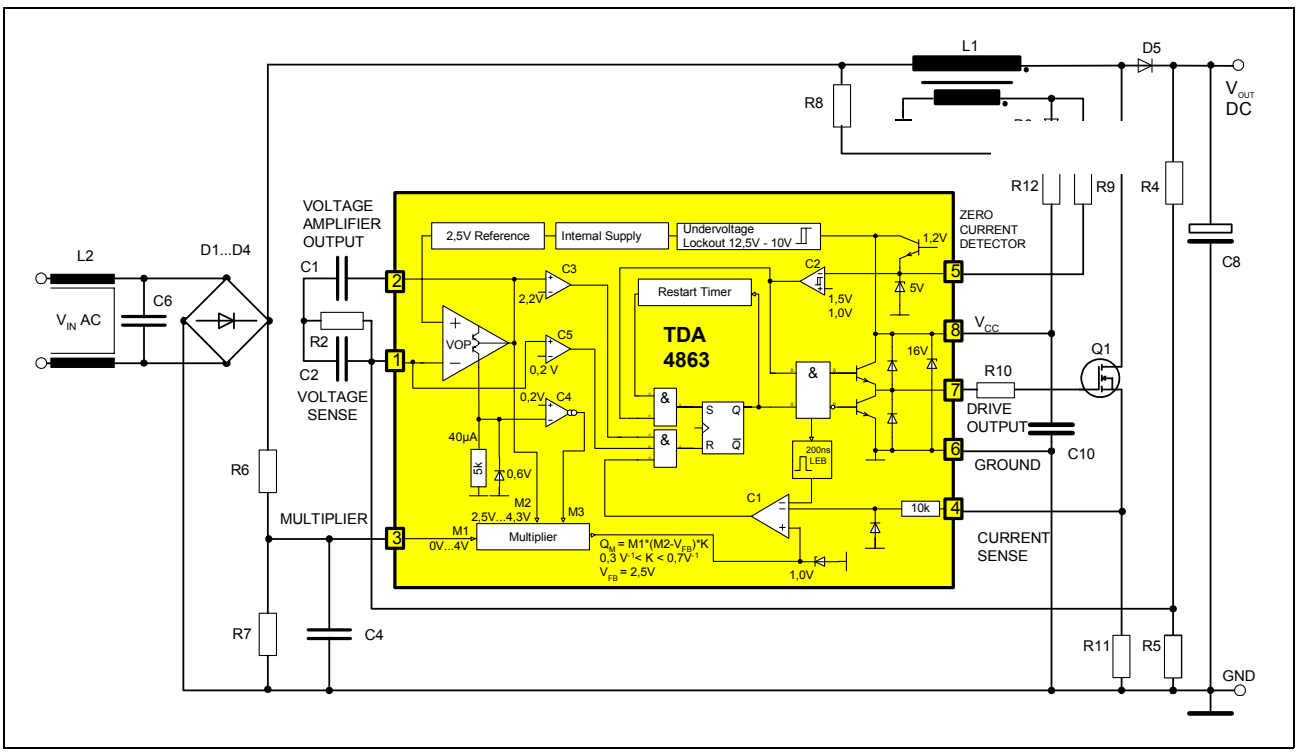

Figure 1 Schematic of PFC Circuit

3 Calculation Sections

The color of the excel cells indicate their function. Yellow cells represent input cells. They ask for basic data being filled in by the user. Nevertheless, they may also contain values by default. Green cells indicate that the value shown is the result of a component according to **Figure 1**. White cells are protected against any inputs.

Pull-down menus give the user a choice of possible values for the related component. The choice of the menu entry is not mandatory. It is still possible to use individual values which are directly typed into the cells.

3.1 Input Section

The input values of this section are:

- RMS-value of lowest AC input voltage V_{inmin}
- RMS-value of lowest AC input voltage V_{inmax}
- Rated output power of preconverter P_{out}
- Estimated efficiency eta
- Minimum switching frequency f_p

These values define the maximum inductor current $I_{inpmaxHF}$ which results in the shunt resistor R11 according to **Figure 1**.

3.2 Output Section

This section calculates the voltage divider consisting of R4 and R5 according to **Figure 1**. It is used for sensing the output voltage and for the adjustment of the overvoltage protection (OVP) level.

In line 24 the necessary resistor value for R5 is calculated based on the projected output voltage and overvoltage level. The next step is to look after the nearest value in the pull-down menu right below in line 27. This will lead to a default value for R4 calculated in line 28. Due to the high voltage stress of resistor R4, it is split into two resistors in series. It is therefore necessary to choose half the value of line 28 in the pull-down menu of line 29. The resulting series resistor and the resulting output voltage as well as the OVP level are displayed in line 30 to 32. Both the value in line 27 and in line 29 can also be manipulated manually by directly filling in the values into the corresponding cell.

The tolerance of R4 and R5 are directly influencing the precision of the output voltage and the OVP level. The menus of line 27 and line 29 contain therefore values of the E96 series with a tolerance of 1%.

This section calculates also the minimum bus capacitor C8 which provides the specified output characteristics if the mains interrupt for a given holdup time.

3.3 Multiplier Section

The multiplier section provides the information of the input voltage waveform which has to be traced. This means, that the input voltage is divided with the resistors R6 and R7 according to **Figure 1** and fed into the multiplier pin. Again, R6 is split into two resistors in series, because it is also stressed by higher voltage. Therefore, the value chosen in the menu of line 40 is doubled in line 41 and is highly recommended to be high-ohmic in order to avoid unnecessary losses. Then choose the nearest value of resistor R7 in the menu in line 43. The values of R6 and R7 must be changed if the test results in “NO” in line 44.

The tolerance of these components needs not to be very low, because it has almost no influence on the THD or the power factor. The entries of the menus are taken from the E12 series with 5% tolerance.

3.4 Inductor Section

The input values of this section are:

- the maximum flux density swing during one pulse period
- the saturation flux density
- the core type

The lines 55, 57 and 58 show default values, when using a core type of the pull-down menu. They are taken from the EPCOS data book **[4]**. However, it is also possible to fill in individual values there.

The lines 52 to 58 result in the airgap of the core which is given in line 59. If a core of the menu of line 54 is used, then the menu of line 60 will show all available airgaps of this type. Again, one can neglect those values and fill in an individual one.

Then the next integer number has to be inserted in line 63 and the effective inductance of the PFC inductor is shown in line 64. The test in line 65 and 66 proves, if the core probably saturates. It is recommended to change to a larger airgap or to a larger core if the saturation current is smaller than the highest peak inductor current I_{inpmaxHF}.

The design of the detector winding which is necessary to capture the zero crossing of the inductor current is dependent on the IC supply circuit used. Please refer to **[1]** for further information.

4 Summary of Used Nomenclature

Physics:

General identifiers:

A .....cross area
b, *B* .....magnetic inductance
C .....capacitance
d, *D* .....duty cycle
f.....frequency
i, *I*.....current
L.....inductance
N .....number of turns
p, *P* .....power
t, *T*.....time, time-intervals
v, *V*.....voltage
W .....energy
η.....efficiency

K_1, K_2 ..ferrite core constants

Special identifiers:

A_L..... inductance factor
$V_{(BR)CES}$ .. collector-emitter breakdown voltage of IGBT
V_F..... forward voltage of diodes
V_{rrm} ..... maximum reverse voltage of diodes

big letters: contant values and time intervals
small letters: time variant values

Components:

C .....capacitor
D .....diode
IC .....integrated circuit
L.....inductor
R .....resistor
TR .....transformer

Indices:

AC.....alternating current value
DC.....direct current value
BE.....basis-emitter value
CS.....current sense value
OPTO..optocoupler value
P .....primary side value
Pk.....peak value
R ..... reflected from secondary to primary side
S .....secondary side value
Sh .....shunt value
UVLO..undervoltage lockout value
Z.....zener value

fmin..... value at minimum pulse frequency
i .....running variable
in .....input value
max .....maximum value
min .....minimum value
off .....turn-off value
on .....turn-on value
out .....output value
p .....pulsed
rip .....ripple value

1, 2, 3 .....on-going designator

5 References

[1] **Infineon Technologies AG:** TDA 4863 - Power factor and boost converter controller for high power factor and low THD; Preliminary data sheet; Infineon Technologies AG; Munich; Germany; 07/01.

[2] **M. Herfurth, W Frank:** TDA 4863 - Technical description; Application Note AN-PFC-TDA4863-1; Infineon Technologies; Munich; Germany; 02/02.

[3] **W Frank:** TDA 4863 - Getting started with TDA 4863; Application Note AN-PFC-TDA4863-2; Infineon Technologies; Munich; Germany; 02/02.

[4] **EPCOS:** Data book library 2002; data book CDROM; EPCOS; Germany; 2001.

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Dr. Ulrich Schumacher

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