TDA4863

DN-PFC-TDA4863-1

TDA4863 Driving MOSFET with large Capacitances

Author: Wolfgang Frank

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Power Management & Supply

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Revision History: 2003-03 V1.0

Previous Version:

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Edition 2003-03

Published by Infineon Technologies AG,
St.-Martin-Strasse 53,
81669 München, Germany

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1 Large Capacitances

In adapters MOSFET with a lower on-state resistances $R_{DS(on)}$ are often used in order to reduce power losses. But such transistors have typically large capacitances C_{iss}, C_{oss}, and C_{rss} according to **Figure 1**. Especially in power factor correction (PFC) preconverters this issue is even more dramatically, because there are points of operation, at which the drain-source-voltage is very low or even zero. At those points, the parasitic drain-gate-capacitance $C_{rss}(V_{DS})$ ("Miller-capacitance") increases highly nonlinearly. This can be easily seen in the datasheets of the MOSFET, as it is shown in figure 24 of [2].

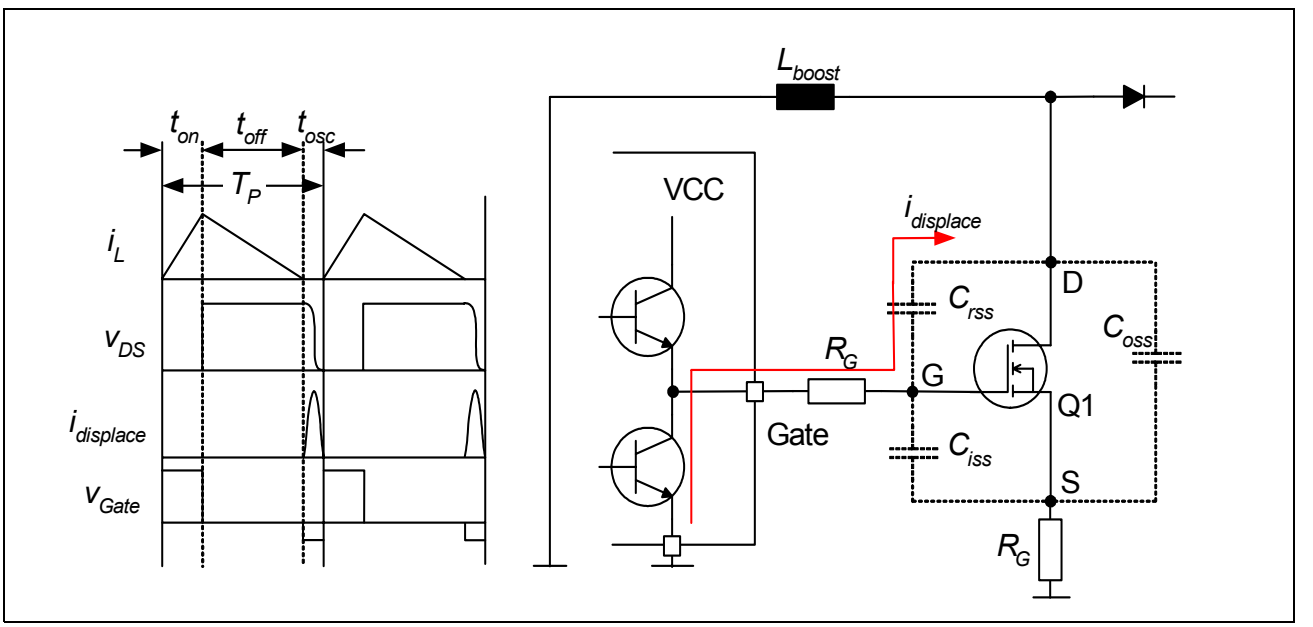

Figure 1 Equivalent Circuit of a MOSFET with parasitic Capacitors

In discontinuous conduction mode (DCM) the drain-source-voltage swings down to zero by system, if the input voltage is lower than 50% of the output voltage even without the MOSFET being switched on. This means that the drain potential also goes down to zero which will cause a capacitive current flowing into the gate pin of the MOSFET and through the capacitor C_{rss}.

The larger the capacitance C_{rss} the larger is the amplitude of the capacitive current. This may reverse bias the lower gate drive transistor and may lead to substrate currents in the control IC of the MOSFET and may cause malfunction. Substrate current can be

detected easily by measuring the voltage at the gate drive pin. Substrate currents cause a voltage of about -0,7 V.

This effect is well known. Usually schottky diodes are used directly at the gate drive pin to ground according to **Figure 2** in order to clamp the gate drive voltage of -0,3 V minimum.

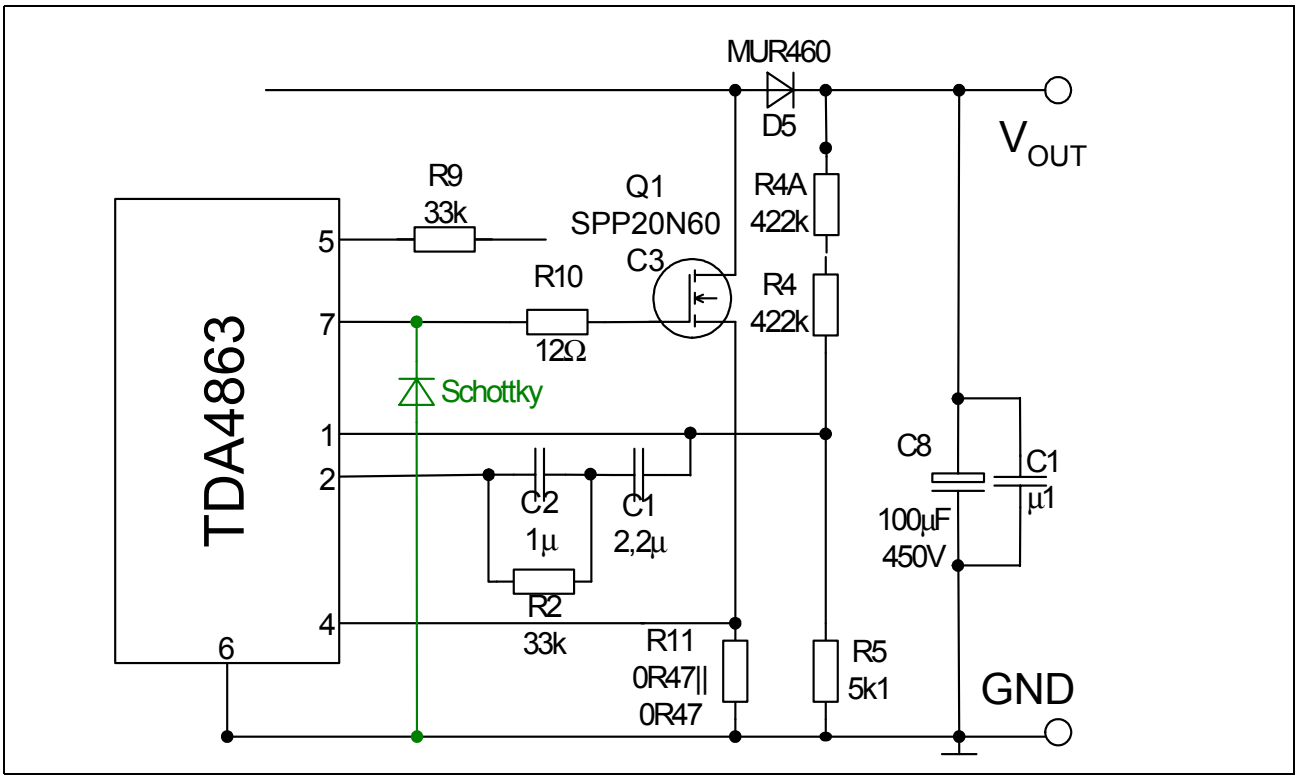

Figure 2 Gate Drive Design of TDA4863 with Schottky Clamp Diode

The rating of the schottky diode depends on the peak value and the rms value of the clamp current. But typically small signal schottky diodes with a forward current capability of approximately 100 mA are already sufficient.

2 Summary of Used Nomenclature

Physics:

General identifiers:

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

3 References

[1] **Infineon Technologies AG:** TDA4863 - Power factor controller; Preliminary Data sheet; Infineon Technologies AG ; Munich; Germany; 02 / 02.

[2] **Infineon Technologies AG:** SPP20N60C3 CoolMOS - Power Transistor; Data sheet; Infineon Technologies AG ; Munich; Germany; 10 / 02.

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Dr. Ulrich Schumacher

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