NCP4305DGEVB

NCP4305 Synchronous Rectification Evaluation Board User's Manual

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EVAL BOARD USER'S MANUAL

Table 1. GENERAL PARAMETERS

SMPS Type	Supply Voltage	Reverse Voltage	Effective Resistance
LLC	5−35 V	40 V	0.9 mΩ

Description

This evaluation board user's manual describes a high efficiency synchronous rectification evaluation board that can easily replace a secondary side rectification diode in an SMPS.

The NCP4305 is used as synchronous rectification controller. The evaluation board has very few external components and illustrates how small and effective such a design can be.

The NCP4305 features a very precise 0 mV turn-off comparator that supports even very low current flowing through the MOSFET even when very low R_{DSON} synchronous MOSFETs is used.

Key Features

- Precise Turn-off Comparator
- Wide Input Voltage Range
- High Operation Frequency
- Strong MOSFET Driver
- High Efficiency
- Adjustable Minimum On and Off Times
- Light Load Detection Feature
- Capable to Operate in Positive and Negative Branch
- Small size

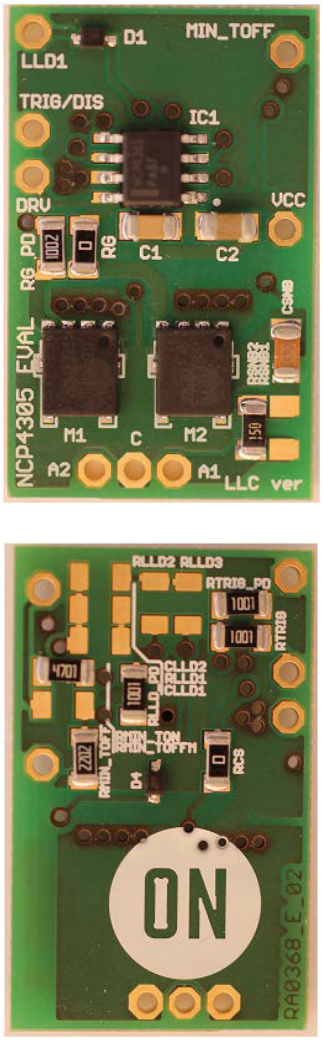

Figure 1. NCP4305 Evaluation Board

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Connection Diagram

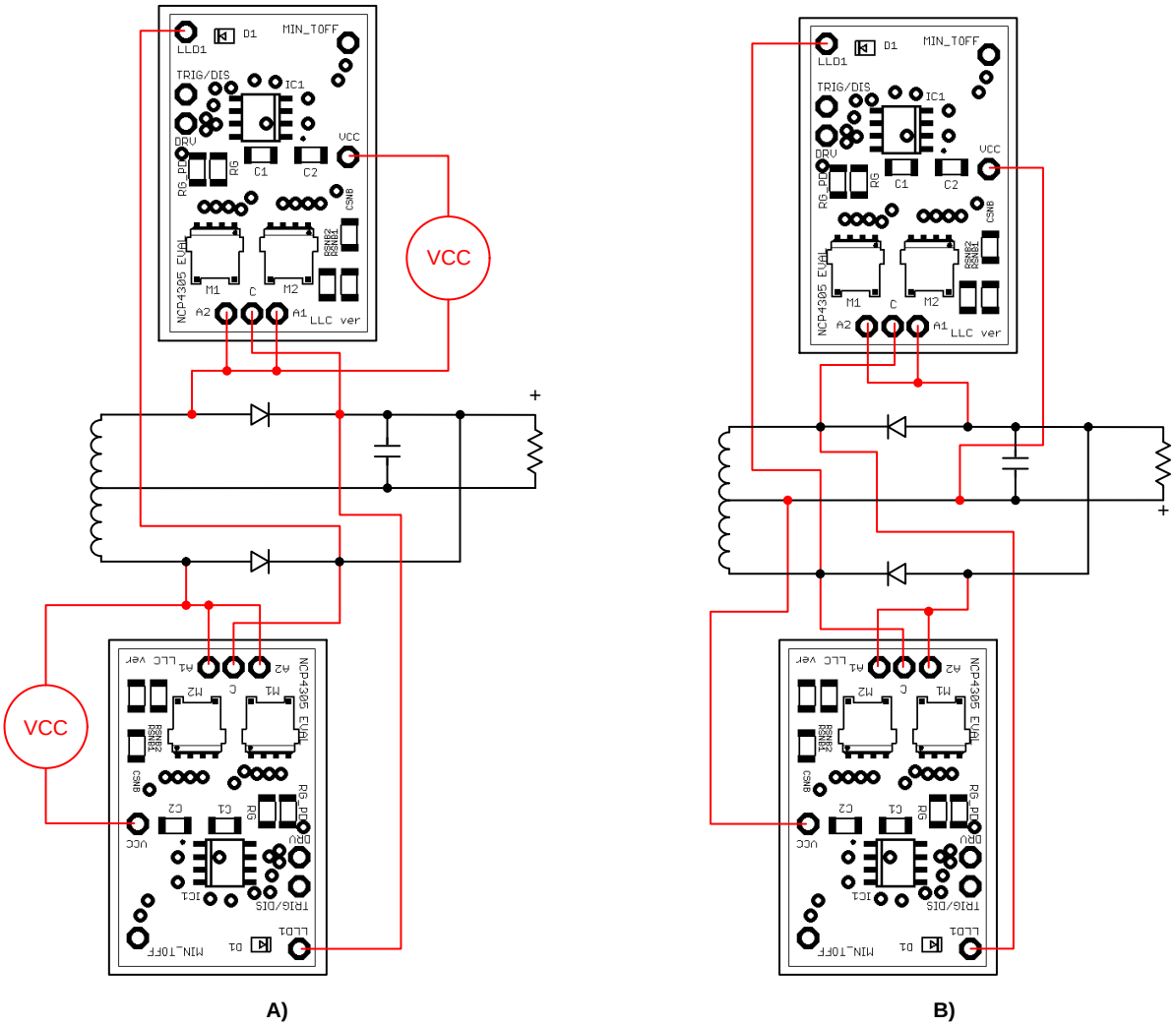

Figure 2. Possible Connections in to Circuit

The evaluation board can be connected in circuit where the rectification diode is in the positive or negative branch. When connection to a positive branch is used, it is necessary to use an external power supply (or auxiliary winding with rectification) to provide power to the evaluation board. VCC should be referenced to A1 or A2 points. When LLD function is used it is needed to connect LLD1 pin with opposite side rectifier cathode.

Evaluation Board Schematic

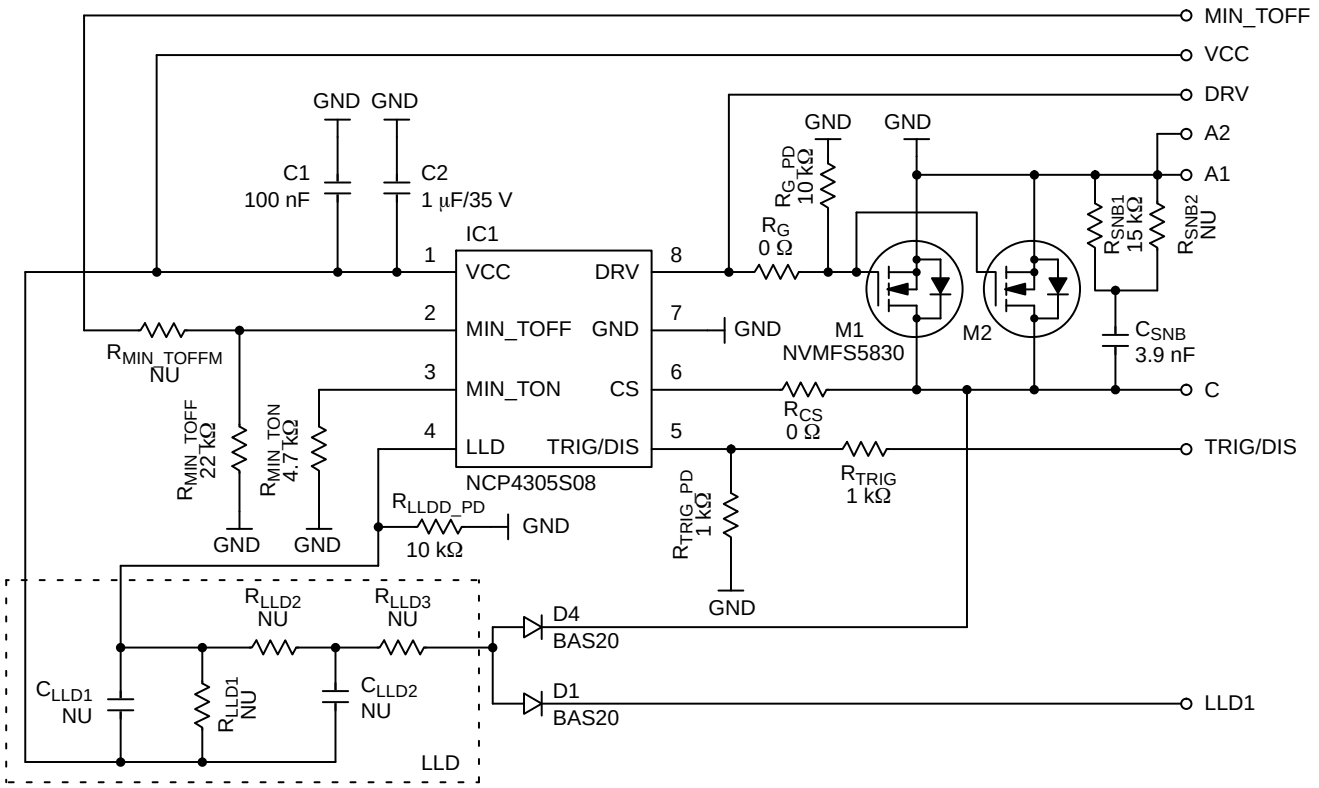

Figure 3. Schematic of the NCP4305

The evaluation board was designed to support a minimal external component count implementation. C1 and C2 are decoupling capacitors. They should be placed as close as possible to the VCC and GND pins. Resistors R_{MIN_TON} and R_{MIN_TOFF} are used to set the protection interval when the synchronous MOSFET is turned on and off. Resistor R_{MIN_TOFFM} is placed there to support a situation when an external circuit provides control for minimum off-time modulation. This is needed only in situations when the minimum off-time cannot be set across the whole range of power supply operation. Resistor R_{TRIG_PD} is only pull down for TRIG pin and R_{TRIG} is only protection resistor. A position for a gate resistor R_G is provided in case there is a need to slow down the MOSFET switching process. The turn-off (and also the turn-on) threshold can be lowed when resistor R_{CS} is used. Components C_{SNB}, R_{SNB1} and R_{SNB2} form a snubber circuit.

LLD circuit consists of C_{LLD1}, C_{LLD2}, R_{LLD1}, R_{LLD2}, R_{LLD3} and D4. Purpose of circuit is to estimate output power. This can be done in two ways. The first is to measure duty cycle of skip burst. LLD circuit time constant is high and it filters and averages duty cycle ratio. This is good for systems which transfer low energy during skip each switch cycle. When duty cycle of skip bursts is low NCP4305 enters disable mode to save energy, when it is higher SR controller starts to operate and SR transistor gate voltage is modulated according to skip duty cycle. The second option is for system which transfers lot of energy in few first pulses in skip and then transferred energy is minimal. In this case LLD circuit time constant is low and R_{LLD3} resistance is close to 0. LLD pin voltage drops down in first switching pulse in skip mode and NCP4305 wakes up fast and allows using fully open SR transistor. When skip burst ends, LLD voltage goes high and if time between skip bursts is long enough NCP4305 enters disable mode to save energy.

Circuit Layout

The PCB consists of a 2 layer FR4 board with 35 μm copper cladding. All components are surface mount and most of the components that may require adjustment are on the same side and use 1206 values for easy rework. Critical component such as blocking capacitors C1 and C2 have to be placed carefully near the IC. The synchronous driver path to the MOSFETs was done with very low resistance and parasitic inductance to minimize emissions and minimize turn-on and turn-off times. The same is true for the CS pin. For the CS pin, a kelvin contact was done to be able to sense the voltage directly at the drain. Improper connection of the GND and CS connects can impact the turn-off process especially when a very low R_{DSON} MOSFETs are used.

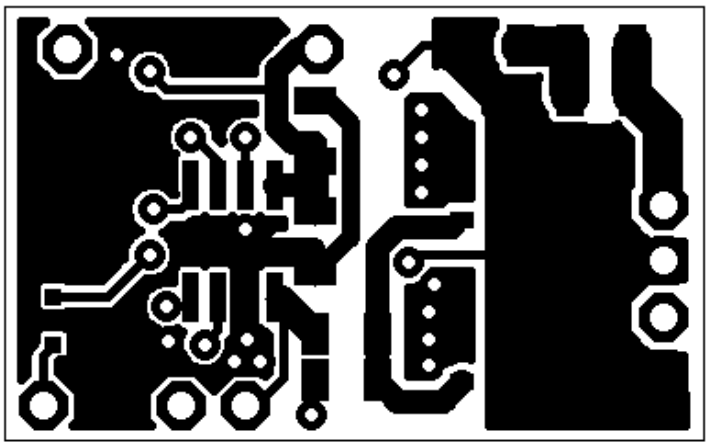

Figure 4. Top Layer

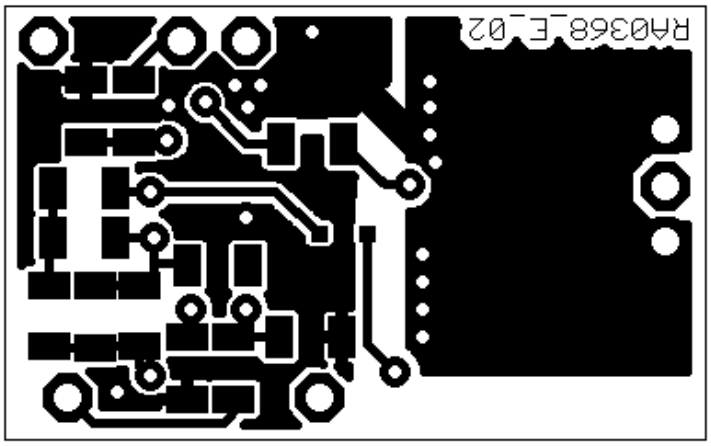

Figure 5. Bottom Layer

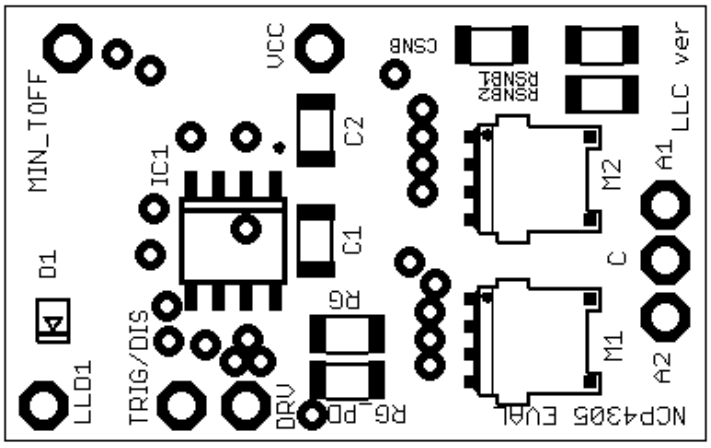

Figure 6. Top Side Components

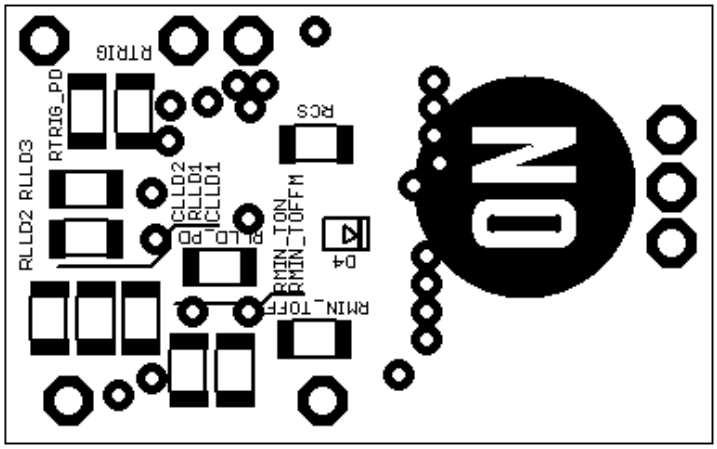

Figure 7. Bottom Side Components

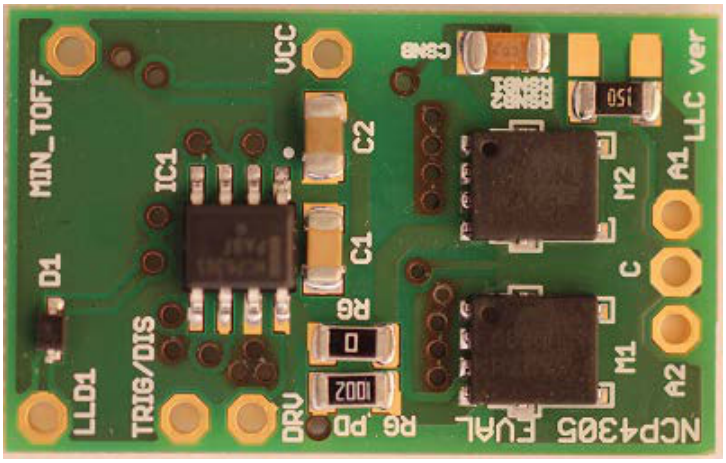

Figure 8. Evaluation Board Photo − Top Side

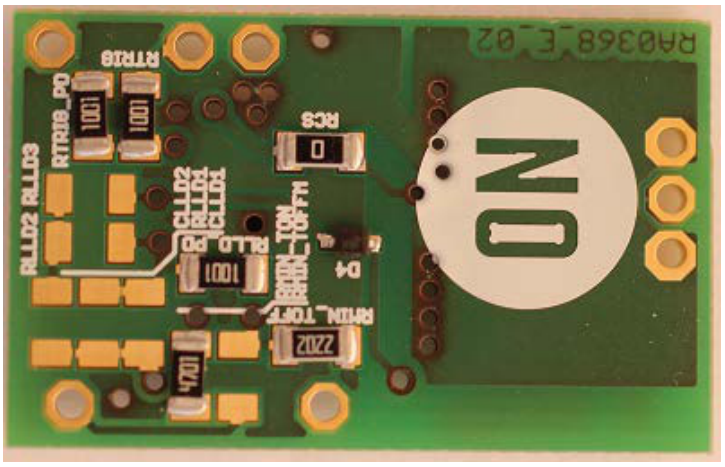

Figure 9. Evaluation Board Photo − Bottom Side

Table 2. BILL OF MATERIALS FOR NCP4305 PUT-IN BOARD SO-8FL (Note 1)

Parts	Qty	Description	Value	Tolerance	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed
C1	1	Ceramic Capacitor	100 nF	10%	1206	Kemet	C1206X104K5RACTU	Yes
C2	1	Ceramic Capacitor	1 μF/50 V	10%	1206	Kemet	C1206X105K5RACTU	Yes
C_{LLD1}, C_{LLD2}	2	–	NU	–	1206	–	–	Yes
C_{SNB}	1	Ceramic Capacitor	3.9 nF	–	1206	Kemet	C1206C392K5RACTU	Yes
D1, D4	2	Switching Diode	BAS20HT1G	–	SOD−323	ON Semiconductor	BAS20HT1G	Yes
IC1	1	Secondary Side Synchronous Rectification Controller	NCP4305D	–	SOIC−08	ON Semiconductor	NCP4305DDR2G	No
M1, M2	2	N-Channel Power MOSFET	NVMFS5830NL	–	SO−8FL	ON Semiconductor	NVMFS5830NLT1G	Yes
R_{CS}, R_G	2	Resistor SMD	0 Ω	5%	1206	Yageo	RC1206JR−070RL	Yes
R_{G_PD}	1	Resistor SMD	10 kΩ	1%	1206	Yageo	RC1206FR−0710KL	Yes
R_{LLD_PD}, R_{TRIG}, R_{TRIG_PD}	3	Resistor SMD	1 kΩ	1%	1206	Yageo	RC1206FR−071KL	Yes
R_{LLD1}, R_{LLD2}, R_{LLD3}, R_{SNB2}, R_{MIN_TOFFML}	5	Resistor SMD	NU	–	1206	–	–	Yes
R_{MIN_TOFF}	1	Resistor SMD	22 kΩ	1%	1206	Yageo	RC1206FR−0722KL	Yes
R_{MIN_TON}	1	Resistor SMD	4.7 kΩ	1%	1206	Yageo	RC1206FR−074K7L	Yes
R_{SNB1}	1	Resistor SMD	15 Ω	1%	1206	Yageo	RC1206FR−0715RL	Yes

1. All parts are Pb-Free

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