EVBUM2664

NCV7692 High-current Daylight Running Light Evaluation Board User's Manual

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EVAL BOARD USER'S MANUAL

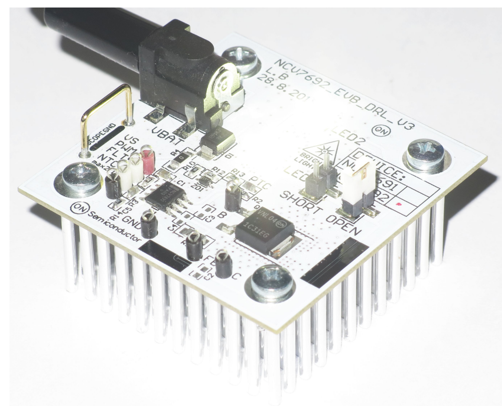

Figure 1. NCV7692 Evaluation Board

INTRODUCTION

The evaluation board demonstrates high−current daylight running light (DRL) solution. The board regulates constant current of 0.54 A through two on−board white high power LEDs in the wide range of the supply voltage. The current is reduced for the board temperature above 85°C. The cooling is provided through passive heat sink mounted on the bottom side of the board. In case of LEDs short or opening, the current source is disabled and the fault may be detected by the ECU diagnostics.

EVALUATION BOARD FEATURES

- Wide range of supply voltage: 7 to 40 V (thermally limited)
- Two high−brightness on−board white LEDs
- Nominal LED current of 0.54 A
- Over−temperature current fold−back protection
- LED short−circuit and open−load emulation jumpers
- Positions for optional EMC capacitors
- One−side components assembly
- Passive cooling (heat sink)

Table 1. ABSOLUTE MAXIMUM RATINGS

Rating	Value	Unit
Supply Voltage (Vbat)	−40 to +40	V
LED string Current (thermally limited)	1	A
Junction Temperature (NCV7692, NSS1C301E, CREE−XPGBWT)	−40 to +150	°C
Ambient Temperature	−40 to +105	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Table 2. RECOMMENDED BOARD OPERATING CONDITIONS

Rating	Value	Unit
Supply Voltage (Vbat) (thermally limited)	7 to 16	V
Rated LED string Current (for Tair < +70°C)	0.54	A
Open−Load or Short−Circuit board consumption (VS = 14 V)	max. 9	mA
Ambient Temperature (for rated LED current)	−40 to +70	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

October, 2019 − Rev. 0

Publication Order Number:
EVBUM2664/D

DAYLIGHT RUNNING LIGHT EVALUATION BOARD SCHEMATIC

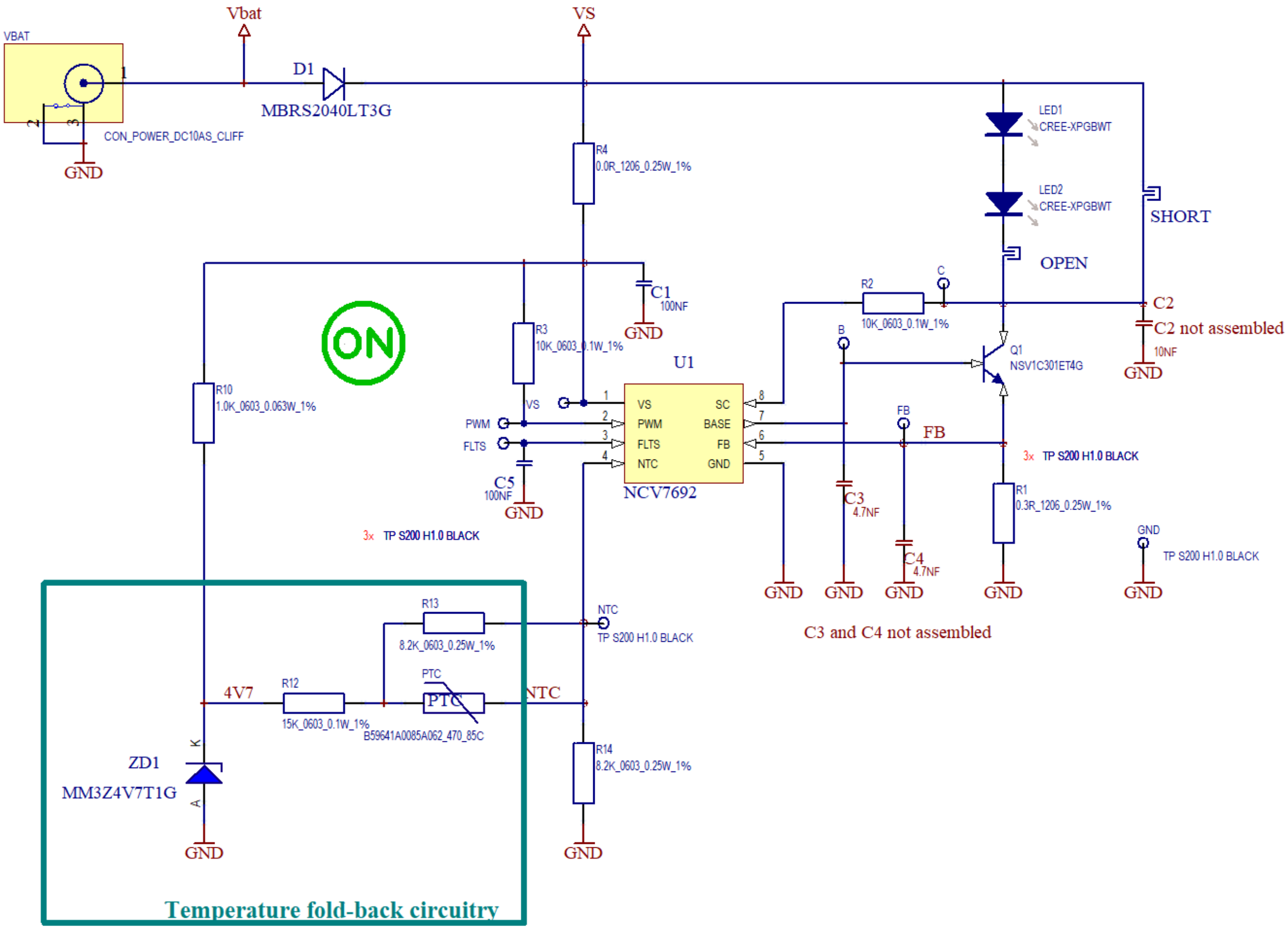

Figure 2. NCV7692 High−current Daylight Running Light Evaluation Board Schematic

Table 3. INTERFACE FUNCTION DESCRIPTION

Connector Name	Connector Type	Description / Function
VBAT	2.1 mm DC supply	Supply battery input
OPEN	SMD Jumper	Removing the jumper emulates open LED condition
SHORT	SMD Jumper	Shorting terminals by the jumper emulates short LED condition
B	Test Point	BASE output of NCV7692 / NPN base
C	Test Point	NPN collector
FB	Test Point	FB output of NCV7692 / NPN emitter

GETTING STARTED

The board is supplied through a standard 5.5 x 2.1 mm DC connector. Supply voltage ranges from 7 to 16 V. Below 7 V, the current through the LEDs starts decreasing. For battery voltage above 16 V, the board temperature is the limitation.

Because the VS Open Load Disable Threshold (5.1 V) is lower than VF of the LEDs (6 V), it may happen that device will detect Open Load detection during the slow ramp−ups on the supply pin.

Please make sure that the ramp−up of the power supply is faster than blanking time of the Open Load detection, especially when the laboratory power supplies with controlled slopes are used. Otherwise LEDs will only blink and the NCV7692 will report an error.

The thermal fold−back circuitry ensures the board temperature remains within the safe range (see following chapter for details).

Two jumpers on the board emulate LEDs short or opening. By default OPEN jumper is closed while SHORT terminals are not shorted.

The LEDs current is defined by R1 resistor. By default, it is set to 540 mA, but may be changed using following formulas:

- With no thermal fold−back (NTC pin grounded):

$$R1 = \frac{\text{FB Regulation Voltage}}{I_{LED}} \approx \frac{0.15}{I_{LED}} \quad \text{(eq. 1)}$$

- With thermal fold−back circuitry on NTC pin:

$$R1 = \frac{V_{NTC}}{10 \cdot I_{LED}} \approx \frac{1.62}{10 \cdot I_{LED}} = \frac{0.162}{I_{LED}} \quad \text{(eq. 2)}$$

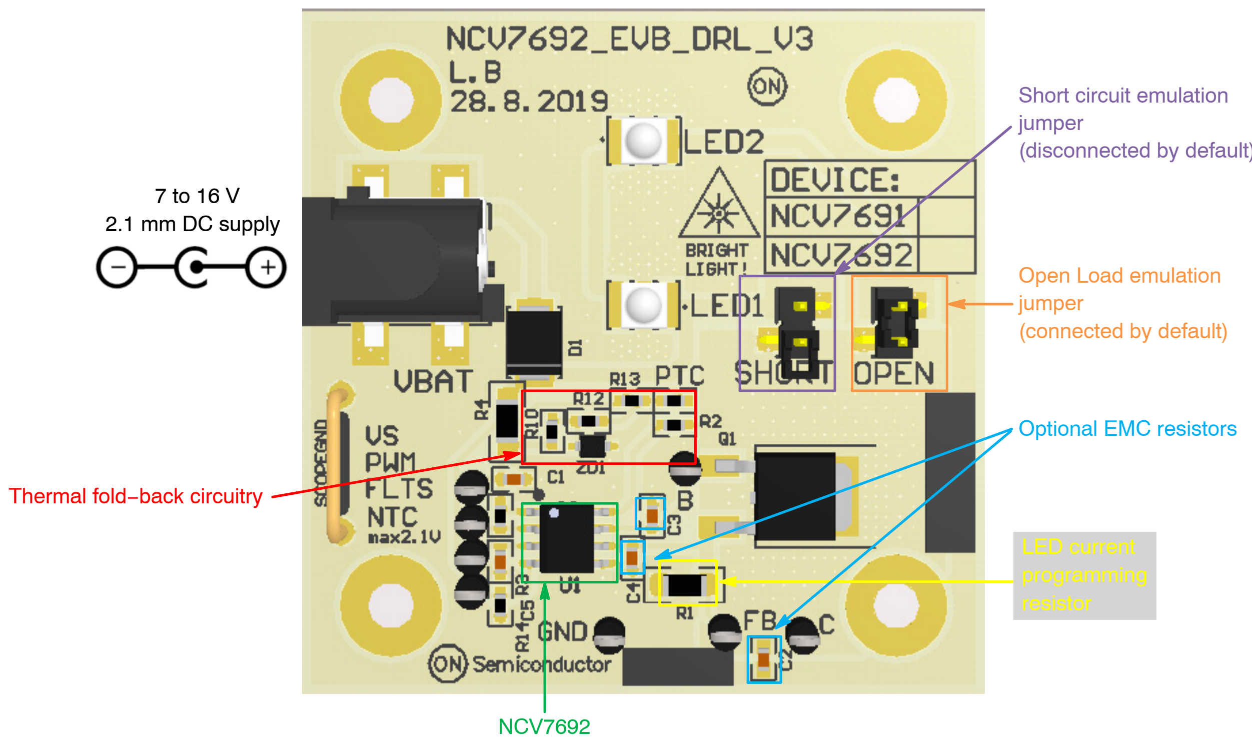

Figure 3. NCV7692 High−current DRL Board Picture

MODULES CONTROL STRATEGY

The board is designed to operate in standard "One Wire Driver Body ECU" architecture. The dimming might be provided through the PWM applied to the High−side SmartFet in the body ECU.

At the same time, the SmartFET allows diagnosis of the failure on the LED module (open load or short−circuit) (see Figure 4). In case of both LED short and disconnection, NCV7692 disables the NPN bipolar.

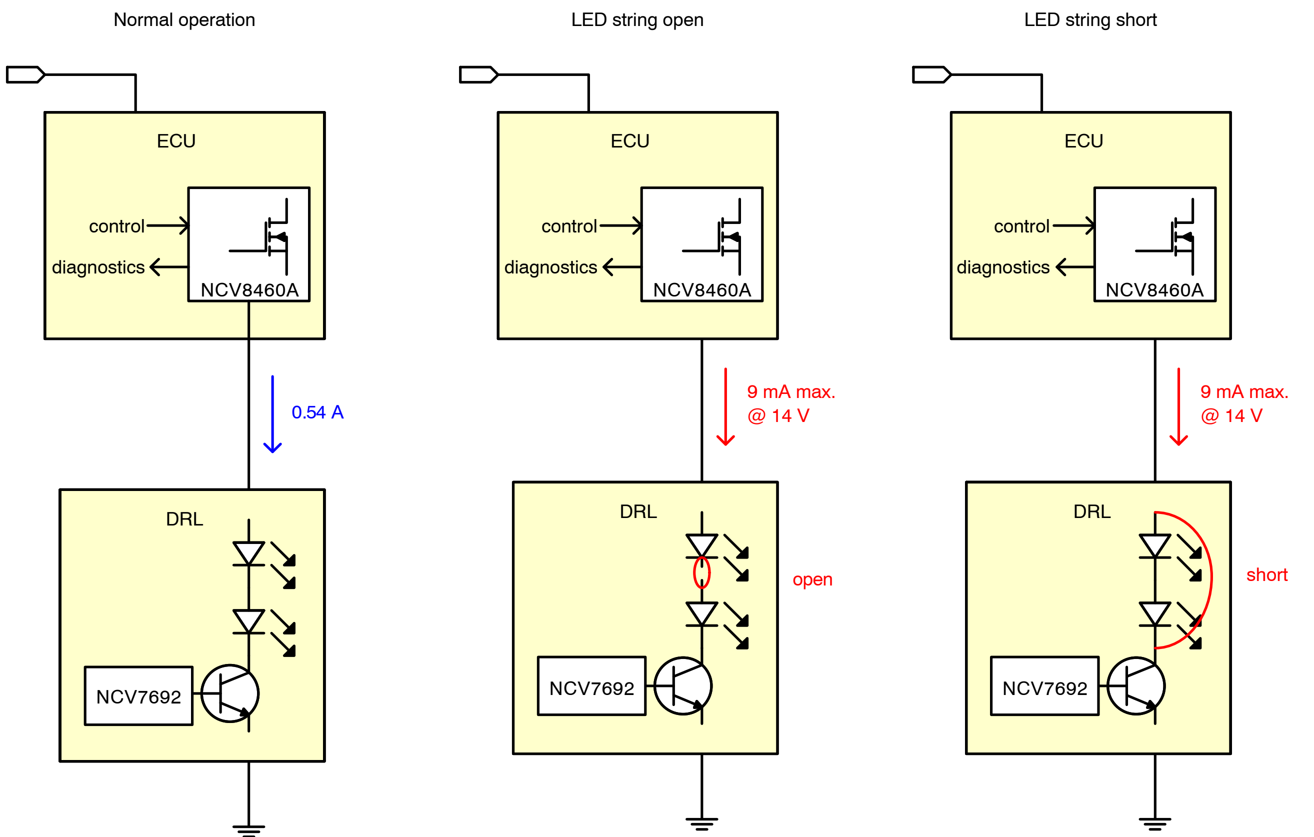

Figure 4. One Wire Driver Body ECU Diagram

THERMAL CONSIDERATIONS OF THE BOARD

As the board dissipation is typ. 7.3 W at 13.5 V battery supply, the thermal aspects should be taken into account for the board design. The main limitations are LED lifetime vs. operating temperature and NPN bipolar maximum junction temperature.

The board was designed to operate at the nominal current with ambient temperature of up to 70°C on standard FR4 PCB substrate and passive cooling with following low−cost thermal improvements:

- Thin FR4 substrate (1.0 mm)
- Thick PCB copper plating (70 μm)
- Solder filled vias around under LEDs and BJT
- Aluminum heat sink mounted to the bottom of the board, isolated by thermally conductive foil

If higher power capability is required, one or more of the following steps in the board design can be made to further improve the thermal performance:

- Cu−filled thermal vias
- Using aluminum PCB substrate instead of FR4
- Active cooling

THERMAL FOLD–BACK

To the protect power dissipating devices on the board (LEDs, NPN bipolar transistor), a circuit reducing LED current at high board temperatures is included (Figure 5).

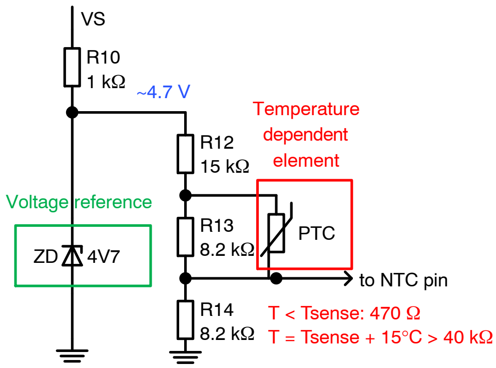

Figure 5. Thermal Fold–back Circuitry

The circuit consists of a voltage reference (ZD1 supplied via R10) and temperature dependent resistor divider. A thermistor with positive temperature dependency (PTC) is used for temperature sensing. For temperatures below the PTC sensing temperature, the thermistor has low resistance (typ. 470 Ω), so the circuitry output voltage is given by R12 and R14 while for high temperatures the reference voltage drops rapidly (Figure 6). R13 ensures the voltage on NTC input does not fall below the NTC Detection Level (max. 300 mV) at high temperature, which would result into a switch–over to the internal voltage reference of NCV7692.

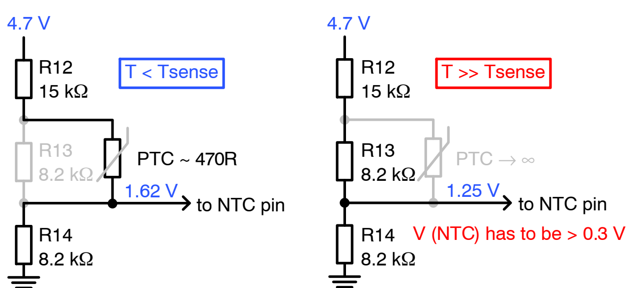

Figure 6. Thermal Fold–back CIrcuitry at Low / High Temperature

The optimal Zener voltage in terms of the temperature independency is usually between 4 and 5 V. At the same time, it should be as low as possible to allow a low–battery operation. 4V7 Zener diode is recommended as a good tradeoff. (Figure 7).

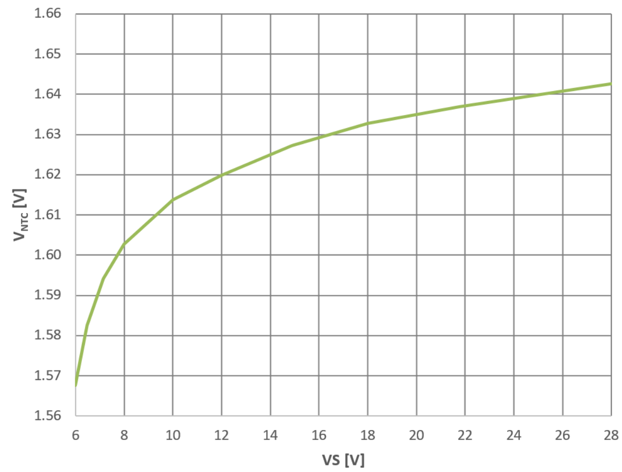

Figure 7. NTC Voltage vs. Supply Voltage (Tpcb = 25°C)

The sensing temperature (PTC parameter) has to be chosen carefully with respect to the heat distribution over the board and thermal properties of the power dissipating components. For PTC type B59641A0085A062, the current fold–back reduces the reference voltage on the NTC pin and thus LED current above the PTC component temperature of ~70°C (Figure 8).

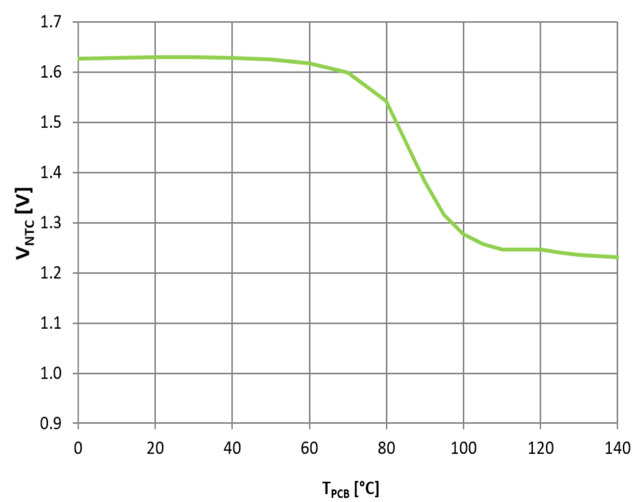

Figure 8. NTC Voltage vs. Board Temperature (VS = 12 V)

If the thermal fold–back feature is not required, components R10, R12, R13, ZD1 and PTC do not need to be assembled and NTC pin should be tied to GND (directly or via R14).

EMC RECOMMENDATIONS

If extensive EMC immunity level is required, C2, C3 and C4 capacitors can improve the EMC performance. Using C3 is usually sufficient against disturbances from the supply line. Capacitors C2 and C4 may improve the performance especially in the setup with external (off–board) LEDs.

PCB DRAWINGS

Assembly Drawings

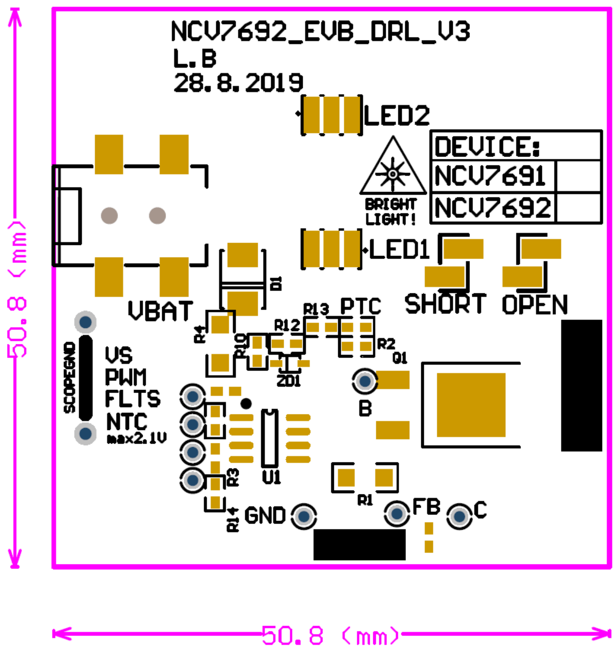

Figure 9. NCV7692 DRL EVB PCB Top Assembly Drawing

Composite Drawings

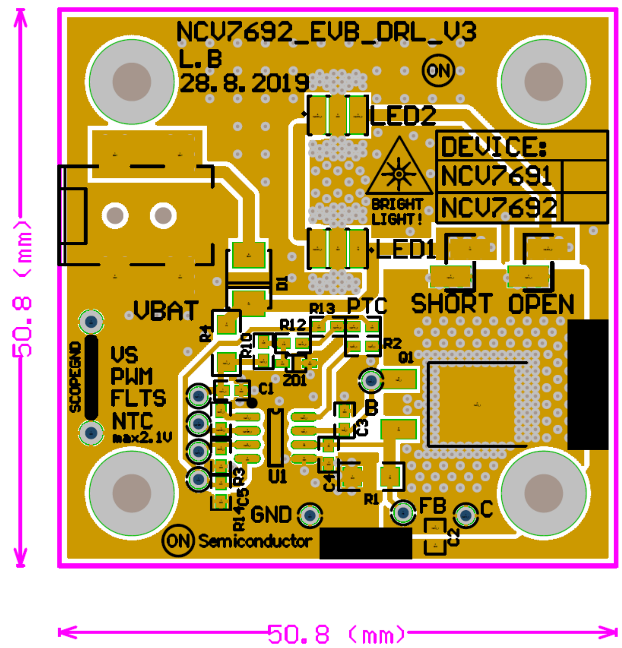

Figure 10. NCV7692 DRL EVB PCB Top Composite Drawing

PCB Preview

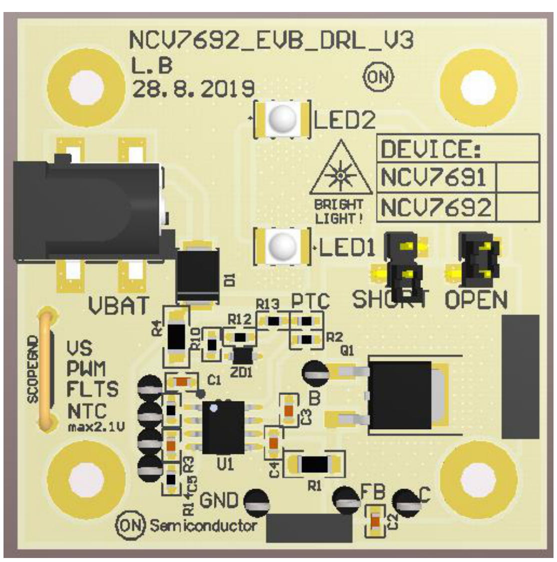

Figure 11. NCV7692 DRL EVB PCB Top Side View

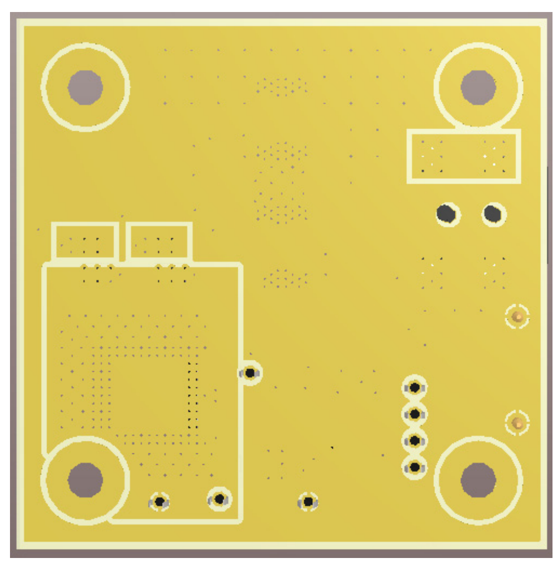

Figure 12. NCV7692 DRL EVB Bottom Side View

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ADDITIONAL INFORMATION

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