High Side Gate Driver Evaluation Board User's Manual

EVBUM2873/D

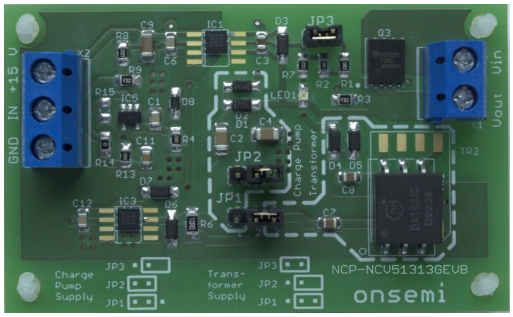


Figure 1. Evaluation Board Picture

Introduction

This user guide supports the evaluation board for the NCV51313 device. It should be used in conjunction with the NCV51313 and NCP51313 datasheets as well as **onsemi**'s technical support team. Please visit **onsemi**'s website at www.onsemi.com.

This document describes the proposed solution for 130 V floating switch using the NCV51313. This user's guide also includes information regarding operating procedures, input/output connections, an electrical schematic, printed circuit board (PCB) layout, and a bill of material (BOM) for evaluation board. The evaluation board can be used to evaluate:

- NCV51313A
- NCV51313B (on demand)
- NCP51313A
- NCP51313B (on demand)

The PCB is designed for using both available packages DFNW6 or SOIC8 (there are footprints for both packages).

Description

NCV51313 is 130 V high side driver with 2.0 A source and 3.0 A sink drive capability for DC−DC power supplies and inverters. NCV51313 offers best in class propagation delay, low quiescent current and low switching current at high frequencies of operation. This device is tailored for highly efficient power supplies operating at high frequencies. NCV51313 is offered in two versions, NCV51313A/B. NCV51313A has a typical 50 ns propagation delay, while NCV51313B has a typical propagation delay of 20 ns. NCV51313 comes in DFNW6 3 x 3 or standard SO8 package.

Driver's Key Features

- High Voltage Range: Up to 130 V
- NCV(P)51313A: Typical 50 ns Propagation Delay
- NCV(P)51313B: Typical 20 ns Propagation Delay
- Very Low Quiescent and Operating Currents
- Typ 11 ns Rise / 10 ns Fall Time under 1 nF Load
- 2.0 A Source / 3.0 A Sink Currents
- Under−Voltage Lockout for VCC and VB
- 3.3 V and 5 V Input Logic Compatible
- High dv/dt Immunity up to 50 V/ns
- High Negative Transient Immunity on Bridge Pin

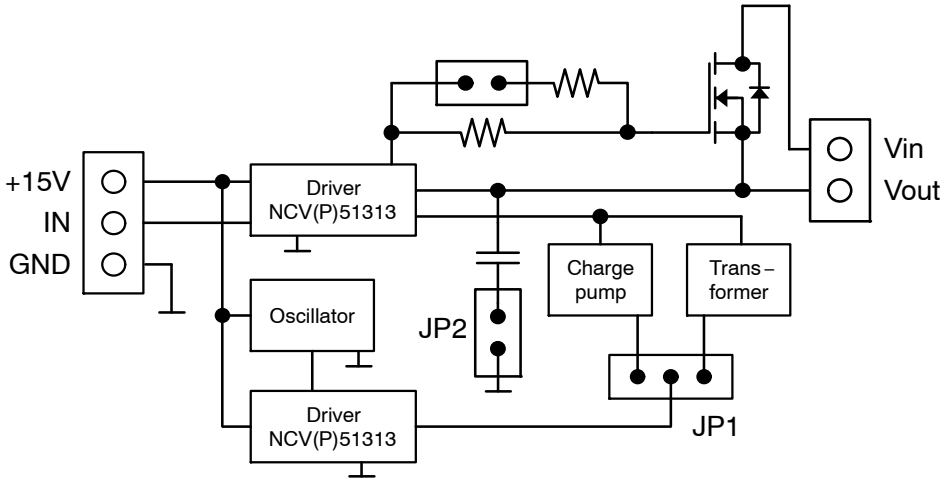


Figure 2. Simplified Block Diagram

EVALUATION BOARD OPERATION

This section describes how to operate the NCV(P)51313 evaluation board (EVB). Make external connections to the NCV(P)51313 EVB using probing directly on PCB or by installing wires into the connectors. The main connections that must be made to the EVB are the analog supply voltage, input signal, output load and monitoring equipment.

Features

- Input Voltage Up to 130 V
- Under−Voltage Lockout for VCC and VB
- High Negative Transient Immunity on Bridge Pin
- High dv/dt Immunity up to 50 V/ns
- Two Options for Floating Driver Supply:
  - By Charge Pump
  - By Transformer
- Switching Current up to 85 A

Power and Ground

NOTE: Connecting any power supply in reverse polarity (backwards) can instantly damage a device(s) when power is turned on.

The low voltage side of the EVB (V_{CC}) operates from a single 15 V power supply which is connected via X2 connector.

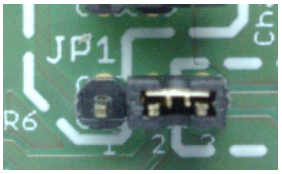
The floating driver is supplied by charge pump or via a transformer. Both options are presented on EVB. The preferred option is chosen by jumper JP1.

Output

The output of the EVB is Drain and Source terminal of the MOSFET. The MOSFET's Source terminal can be at any voltage from 0 to 130 V

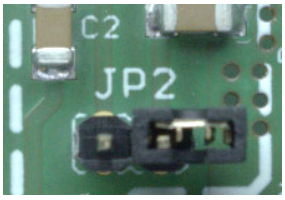
EVB Jumper Settings

JP1:



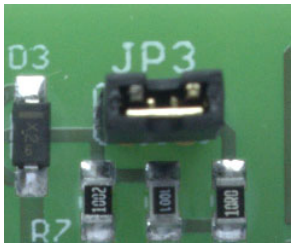
The jumper direct current from oscillator to charge pump (1−2 short) or to transformer (2−3 short).

JP2:



The jumper adds a capacitor to HB pin of IC1. It creates the current path for charging pump if the one on load is not sufficient.

JP3:



The jumper reduces gate resistance of Q3. If short, turn on time of Q3 is much shorter.

Table 1. EVB JUMPERS AND CONNECTORS

JP/CON		Description
X1	Vin	Input voltage for floating switch, up to 130 V
X1	Vout	Output voltage from floating switch
X2	+15 V	EVB supply in range 10 – 18 V
X2	IN	Control signal, H = low impedance Vin−Vout, L = high impedance Vin−Vout
X2	GND	GND of supply and input signal
JP1	1−2	Charge pump is used as supply for floating driver IC1
JP1	2−3	Transformer is used as supply for floating driver IC1
JP2	OPEN	No additional capacitor is connected to HB terminal of IC1
JP2	SHORT	A capacitor is connected to HB terminal if IC1
JP3	OPEN	High gate resistance for Q3, reduced turn on/off speed
JP3	SHORT	Low gate resistance for Q3, high turn on/off speed

Bench Setup

For elementary testing just two power supplies and a load (electronic load, light bulb, resistor etc.) is needed. For better understanding the functionality an oscilloscope is recommended.

- Set JP1 to 2−3, JP2 to OPEN, JP3 to SHORT. This is setup for transformer supply. Set JP1 to 1−2, JP2 to SHORT, JP3 to OPEN for charge pump supply.
- Connect Vin to positive terminal of power supply.
- Connect Vout to a load.
- Set a power supply to 15 V, connect negative terminal to X2/GND and positive terminal to X2/+15 V. See Figure 3.

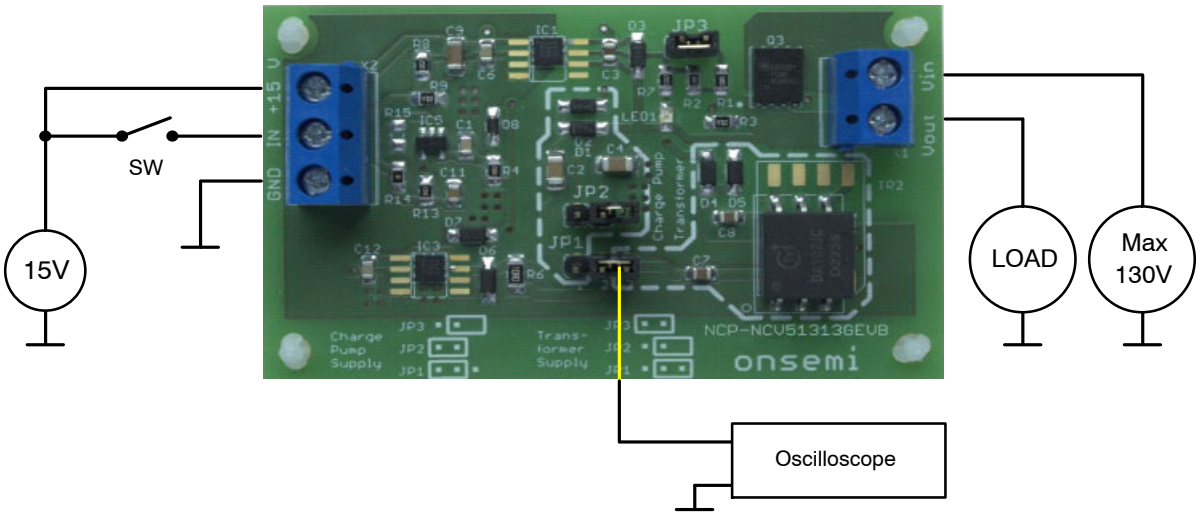


Figure 3. EVB Connection for Testing (Transformer Supply Setup)

IMPORTANT NOTICE. Never let drop voltage between VB and GND pins of IC1 below V_{Boff} level (5.9 V). If the voltage between VB and GND terminals drops below mentioned level, you can/will lose control of the output. The input signal will not be propagated to the output HO, which results into malfunction. It is recommended to keep X1/Vout terminal in range 0 – 130 V with respect to X2/GND.

Used MOSFET can handle current up to 85 A, but cooling of the MOSFET in this EVB is not sufficient to keep the continuous current at such level. Load the MOSFET with respect to maximum power loss.

Powering EVB

When power supply 15 V is turned on, consumption per Figure 4 should be measured. On oscilloscope should be seen square signal at frequency around 150 kHz, 50% duty cycle. See Figure 5.

Turn On High Side Switch

To turn high side switch on, connect X2/IN pin to supply voltage +15 V or to any other voltage source with sufficient voltage level (a signal generator, etc.). Onboard LED1 will light on. If the LED1 will not light on, check if X1/Vout

voltage is equal or greater than 0 V. If still no success, check jumper settings, and/or measure voltage on C3, if higher than V_{Bon} level.

Measured current through MOSFET Q3 is seen in Figure 6.

Reconfiguring to Charge Pump

To test performance of high side switch using charge pump supply, change jumpers positions on PCB as depicted directly on PCB. JP1 to 1−2, JP2 SHORT, JP3 OPEN. Powering the EVB and connecting X2/IN to a control signal the floating switch behavior can be checked. See in Figure 7.

The difference between transformer and charge pump supply is clearly seen on oscillator voltage (see Figure 6 and Figure 7). While for transformer supply there is no influence on oscillator voltage, the charge pump option shows spikes/drops during transition. The oscillator output can be overloaded during HS state changing. It is important to keep in mind this side effect when HS switch is designed.

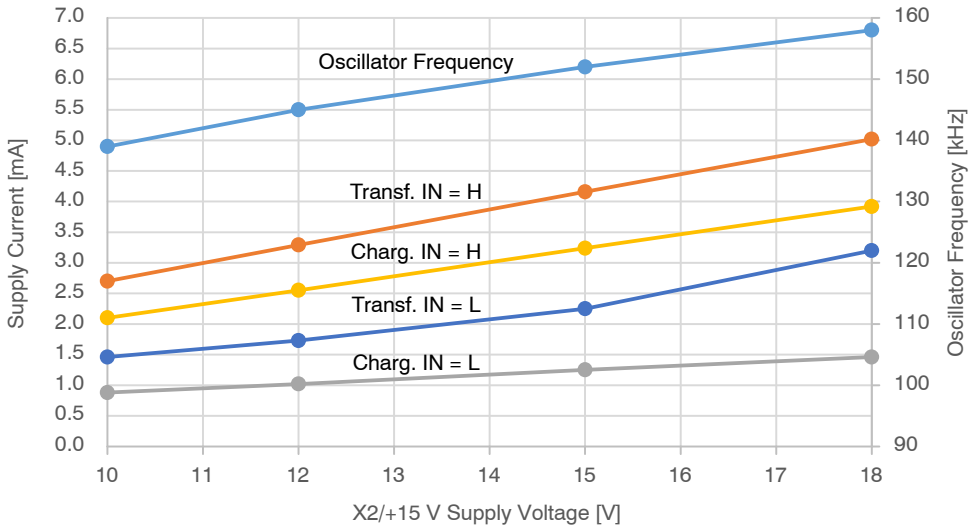


Figure 4. Consumption and Frequency

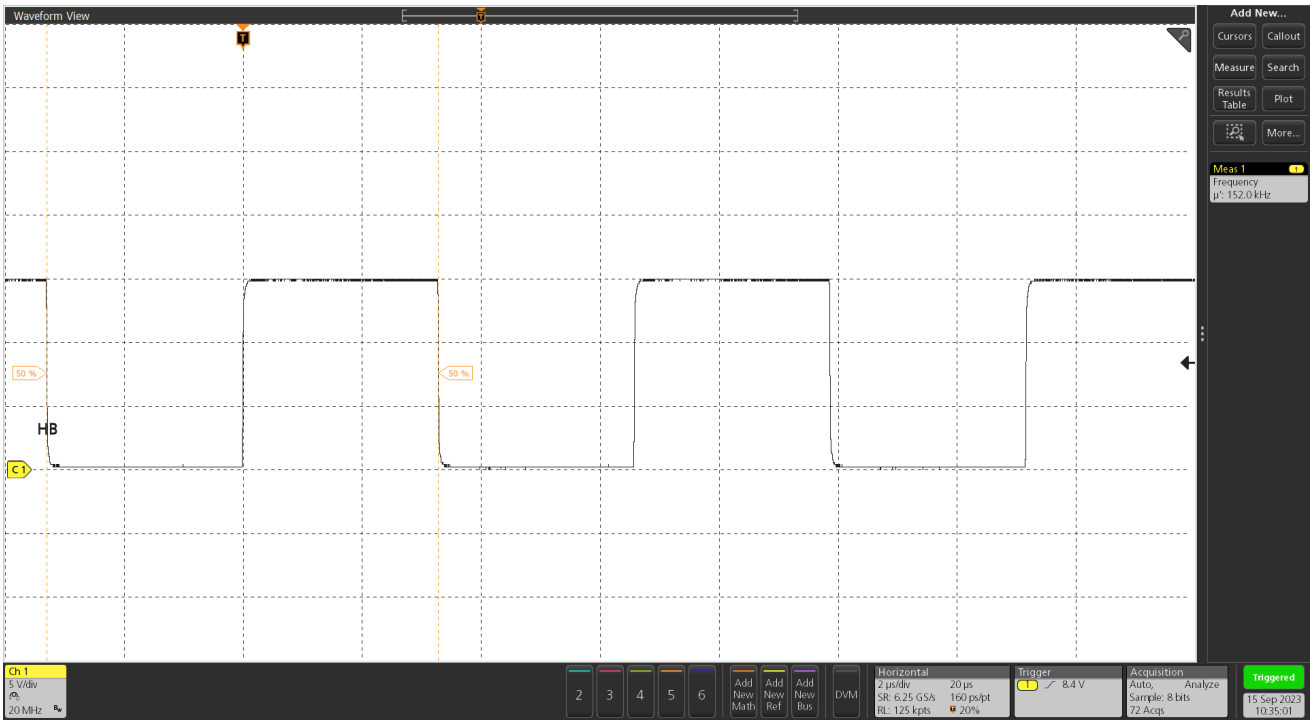


Figure 5. Oscillator Output measured at JP1

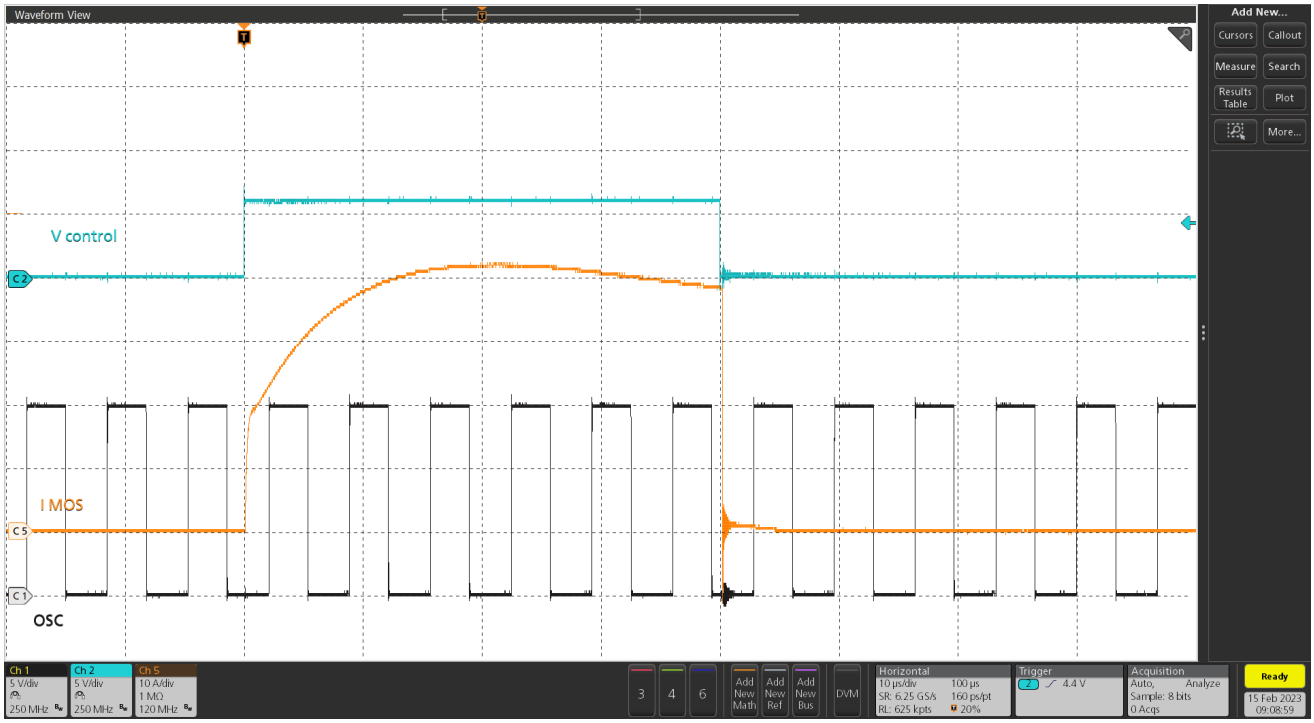


Figure 6. Measured High Side Switch Current (Transformer Supply)

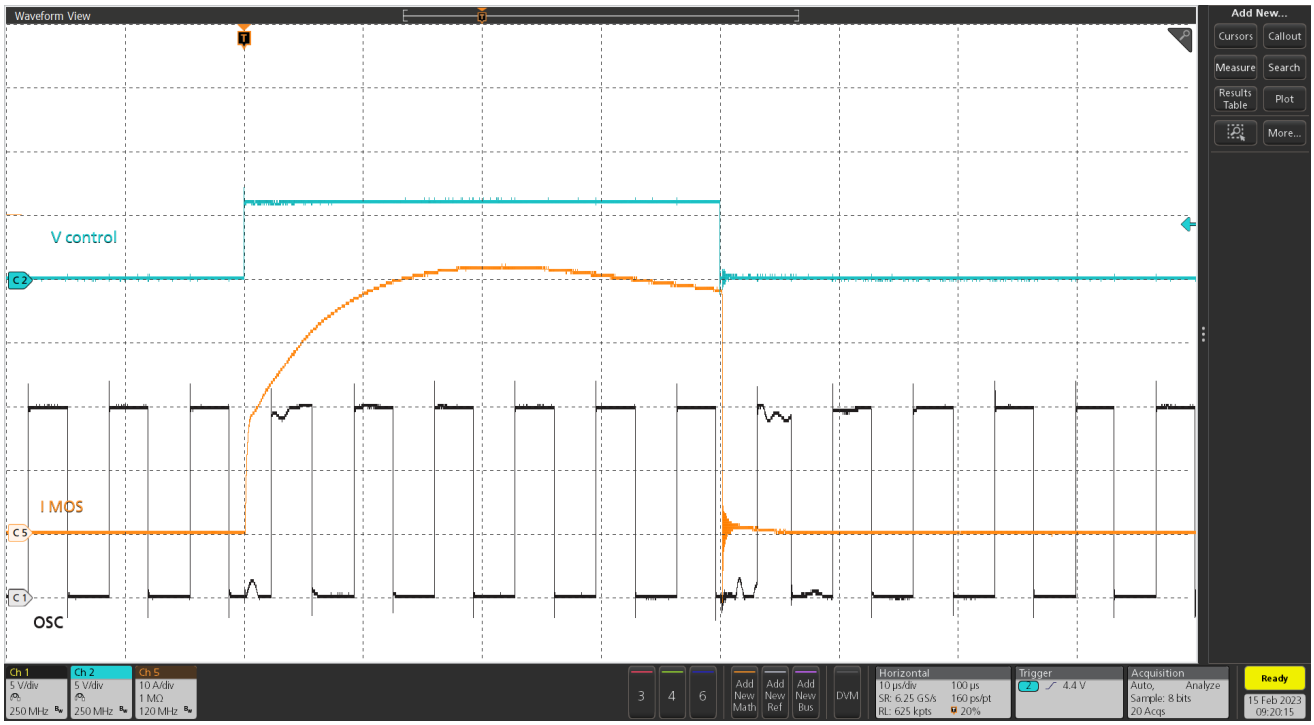


Figure 7. Measured High Side Switch Current (Charge Pump Supply)

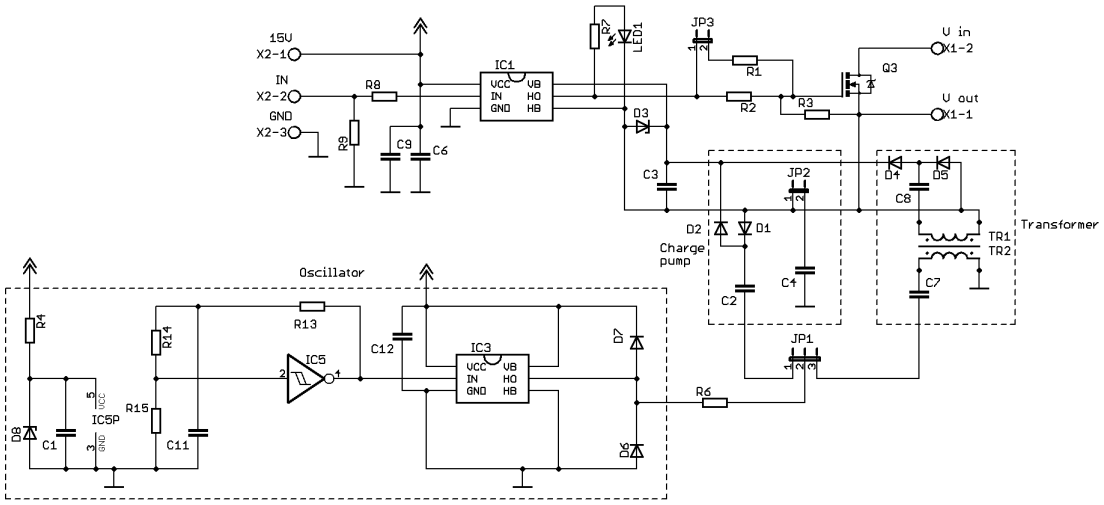


Figure 8. EVB Schematic

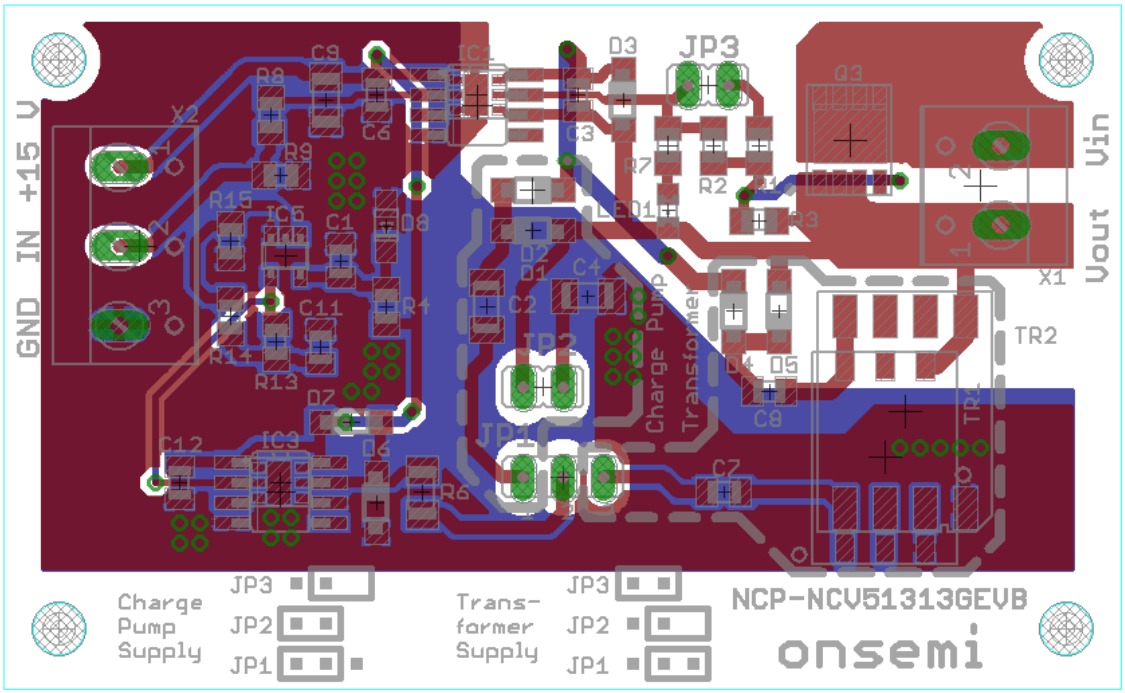


Figure 9. EVB PCB Layout

Table 2. BILL OF MATERIAL

Reference	Qty	Description	Value	Footprint	Manufacturer
C1, C6, C12	3	Capacitor, Ceramic	100 nF	SMD 0805	
C11	1	Capacitor, Ceramic	470 pF	SMD 0805	
C2, C4	2	Capacitor, Ceramic	100 nF / 200 V	SMD 1206	
C3	1	Capacitor, Ceramic	1 μF	SMD 0805	
C7, C8	2	Capacitor, Ceramic	470 nF	SMD 0805	
C9	1	Capacitor, Ceramic	10 μF	SMD 1206	
D1, D2	2	Diode	NHP120SFT3G	SOD123	**onsemi**
D3	1	Zener Diode	MMSZ18T1G	SOD123	**onsemi**
D4, D5, D6, D7	4	Diode	MBR130T1G	SOD123	**onsemi**
D8	1	Zener Diode	MM3Z4V7ST1G	SOD323−W	**onsemi**
IC1, IC3	2	High Side Gate Driver	NCV51313AMNWTWG	DFNW6	**onsemi**
IC5	1	Inverter Gate	MC74VHC1G14DTT1G	SOT23−5	**onsemi**
JP1	1	Jumper			
JP2, JP3	2	Jumper			
LED1	1	Green LED	APT2012LZGCK	SMD 0805	Kingbright
Q3	1	MOSFET	FDMS8D8N15C	PQFN8	**onsemi**
R1	1	Resistor	10 Ω	SMD 0805	
R13	1	Resistor	16 kΩ	SMD 0805	
R14	1	Resistor	0 Ω	SMD 0805	
R15	1	Resistor	NU	SMD 0805	
R2	1	Resistor	1 kΩ	SMD 0805	
R3, R9	2	Resistor	47 kΩ	SMD 0805	
R4	1	Resistor	33 kΩ	SMD 0805	
R6	1	Resistor	10 Ω	SMD 1206	
R7, R8	2	Resistor	10 kΩ	SMD 0805	
TR1	1	Transformer	DA102JC−R	MURATA_DA10X	Murata
TR2	1	Transformer (optional)	NU	VAC_T60403_K5024	Vacuumschmelze
X1	1	Connector		W237−102	
X2	1	Connector		W237−103	

Related Product Information:

[1] Datasheet of NCV51313 available on **onsemi** website.

[2] Datasheet of NCP51313 available on **onsemi** website.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
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