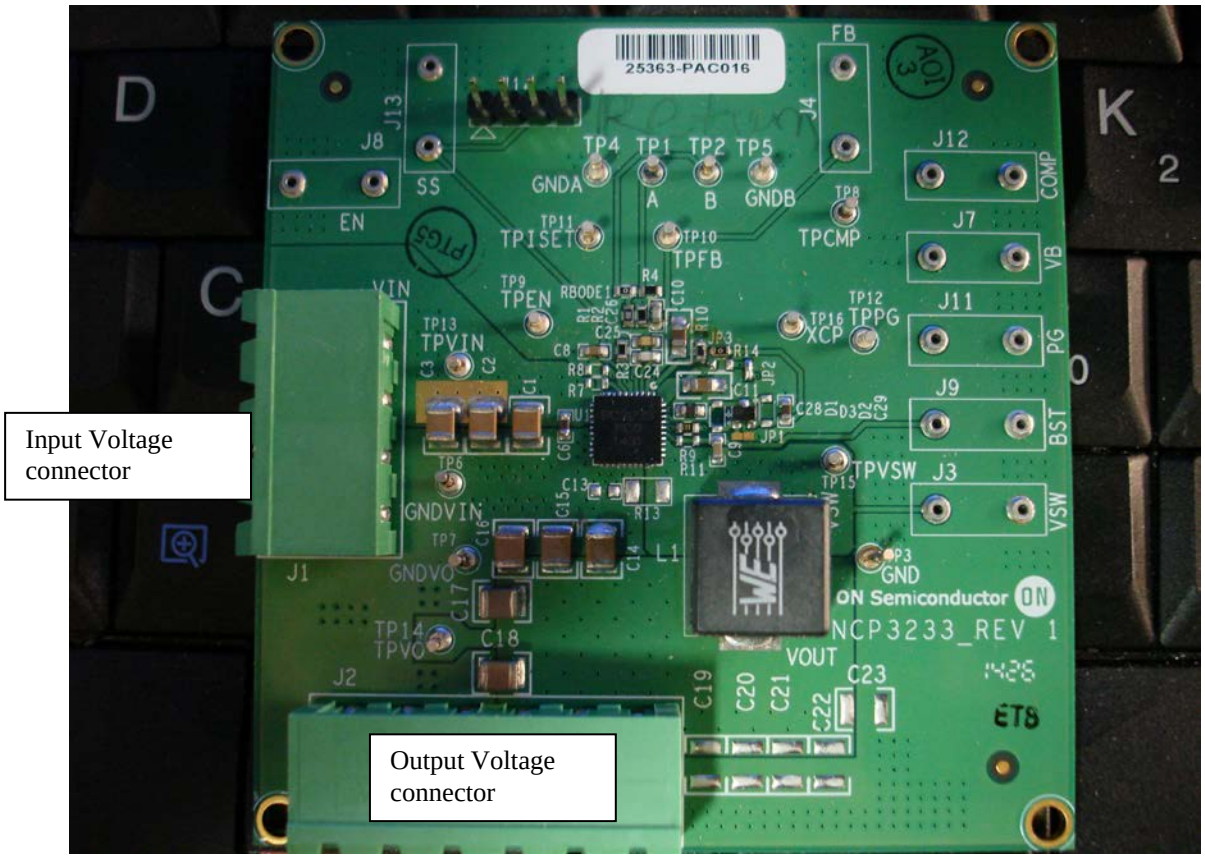
Test Procedure for the NCP3233GEVB Evaluation Board

I. Description and scope – This document applies to the NCP3233_Rev. 1 Evaluation Board (EVB) PCB fab with an NCP3233 High Current Synchronous Buck Converter IC soldered into the QFN-40 footprint. A charge pump circuit is included for operation at 3.3 V input.

This document is intended to assist the user in applying power and testing the assembly.

II. EVB Photo - Below is a photo of the standard NCP3233GEVB. **The default configuration of the EVB is for 3.3 V input operation, with the output voltage set to 1.0 V.** This can be verified by observing that the J2 and J3 solder jumpers are shorted and the J1 solder jumper is open. Also, R14, a zero-Ω resistor, should be removed. **If your board is not so configured, please perform the necessary modifications or the board may be damaged by incorrect settings or excessive voltages applied to the charge pump.**



For operation at input voltages greater than 5 V, reverse the prior settings, i.e., open J2 and J3 and short J1, and install the zero-Ω resistor into R14. The EVB should now be configured to operate from 5 V to the maximum input voltage for the EVB (~21 V).

The EVB has two large green receptacles – one (4-pin) for input voltage (J1) and one (6-pin) for output voltage (J2). The mating connectors should have been shipped with the board. The mating connectors have screw terminal connections to allow single wires to be attached to the connector pins and then the connector can be plugged into the corresponding receptacle on the EVB. Because of the potentially high currents involved, we advise that the gauge of the individual wires be at least 20 AWG x 4 for the input voltage and 18 AWG x 6 for the output voltage.

III. Setup and Procedure – Important: Unless otherwise verified, assume that the EVB is pre-set for 3.3 V operation, which means that the input supply should be set to ~3.3 V, 5 V maximum. Applying an input voltage greater than 5 V will damage the board. Using the mating connectors provided, connect a power supply capable of at least 20 V and 10 A to the input voltage connector (J1). Set the input voltage to ~3.3 V and the current limit to 2 A or less. Connect the mating connector for the output voltage (J2) to the EVB and the other end to an electronic load capable of sinking at least 25 A, which is greater than the typical current limit of the NCP3233 EVB.

After verifying the correct input and load connections and verifying the input voltage and current limit settings of the input supply, turn on power to the EVB. If no values were changed on the EVB prior to this, the output voltage should be 1.000 V ±10 mV. Connect an oscilloscope probe to the TPVSW test point and verify that the switching frequency is 500 kHz ±5 kHz.

To test the current limit of the EVB, set the electronic load to 15 A. **Increase the current limit of the input supply to at least 8 A.** This is a good starting point for testing the current limit.

With the EVB operating with these conditions, turn on the load and verify that the EVB can source the typical rating of 15 A. Slowly increase the load setting until current limit is reached and the EVB enters hiccup operation. This can be detected by observing the switch node waveform on the oscilloscope and noting when the waveform has long periods of no switching activity. The scope's time base may need to be slowed to ~ 1 ms/div. in order to observe this correctly. This behavior can also be detected by noting that the output voltage will be ~0 V. Turning off the load will cause the EVB re-start and return to the regulated output voltage.

The typical current limit is 20-22 A. This value is highly dependent on the low-side MOSFET on resistance, so this will not be an exact number or necessarily the same from board to board.

For operation at input voltages greater than 5 V, refer to the configuration instructions above to make sure that the EVB is configured correctly to bypass the charge pump circuitry and to ensure that the input voltage is applied directly to the VCC pin of the device instead of the charge pump.

IV. Making adjustments – The NCP3233 GEVB can be modified in a few significant ways. One way which has already been discussed is to change the input voltage range by enabling or disabling the charge pump circuitry.

Another important adjustment is the output voltage. The output voltage is preset to 1.000 V with R1 and R2. R1 is 20.0 kΩ and R2 is 30.1 kΩ. In order to change the output voltage, the value of R2 can be changed via the following formula:

$R2 = R1/((Vout/0.6) -1)$,

where 0.6 V is the VREF of the controller, R1 = 20 k and Vout is the desired output voltage.

One final adjustment which will be discussed here is the low-side over-current protection function (LS OCP). This protection is set by a resistor at the RSET pin. A temperature-compensated 30 uA current source develops a voltage at this pin that is compared internally to a reference voltage. When that reference voltage is exceeded, the device skips up to three on-time cycles after which the device enters the hiccup mode.

According to the device data sheet, the RSET value is determined by the following formula:

$RSET = 2 \times I_L \times R_{DS(ON)}/30$ uA,

where I_L = peak inductor current and $R_{DS(ON)}$ = the on-resistance of the low side switch (use the typical value of 2.5 milli-ohms). Choosing a peak current limit of ~25 A, the RSET value is ~5.11 kΩ. Accounting for the blanking time of 150 ns would scale the resistor value slightly higher. A value of 6.34 kΩ was ultimately chosen for the basic EVB.