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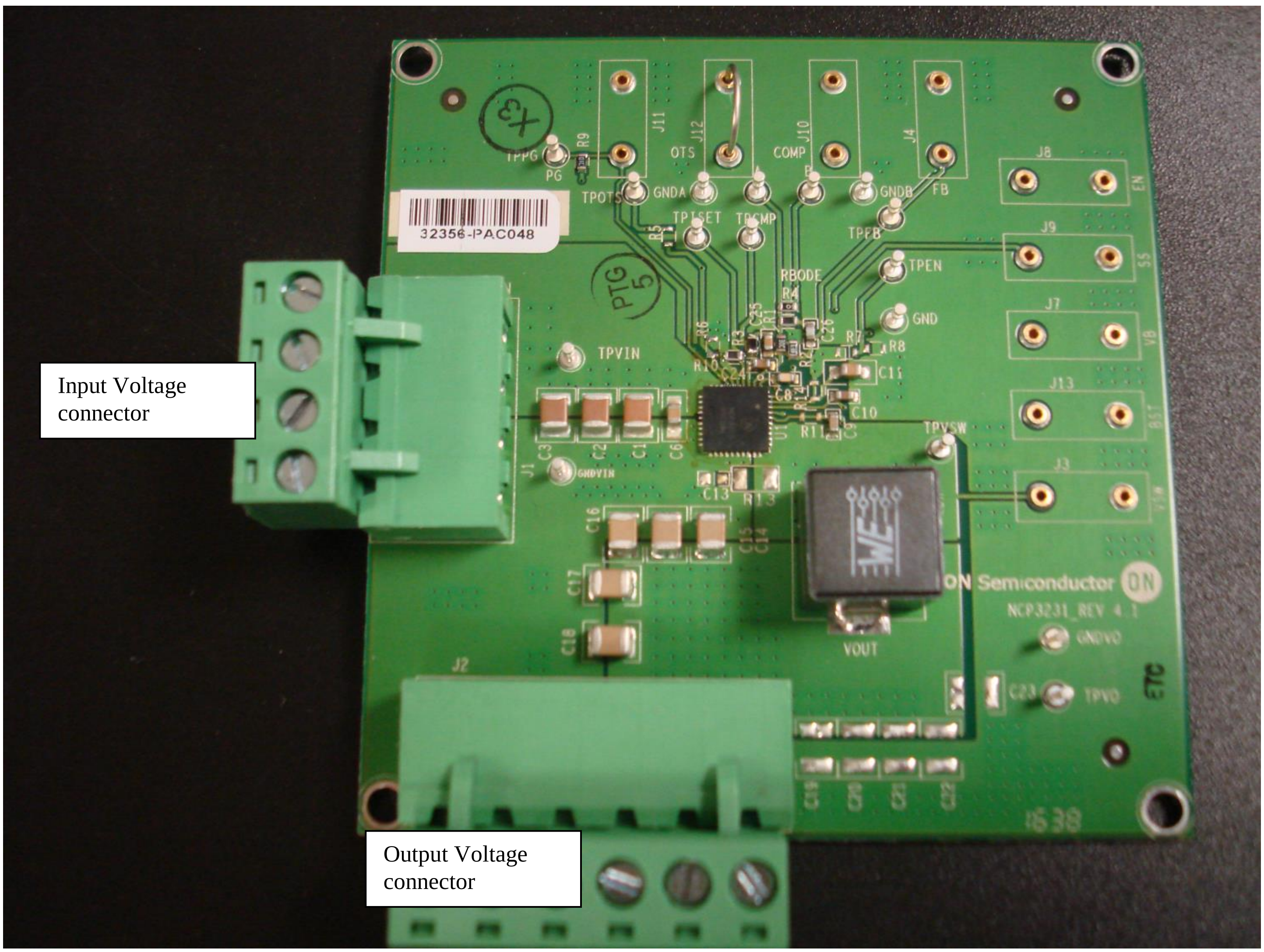
Test Procedure for the NCP3235GEVB Evaluation Board

I. Description and scope – This document applies to the NCP3231 Rev. 4.1 Evaluation Board (EVB) fab with an NCP3235 High Current Synchronous Buck Converter IC soldered into the QFN-40 footprint.

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 NCP3235GEVB. . It uses a generic NCP3231 Evaluation Board, with just the device changed to an NCP3230.



The EVB has two large green receptacles – one 4-pin (J1) for input voltage and one 6-pin (J2) for output voltage. 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.

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III. Setup and Procedure – Using the mating connectors provided, connect a power supply capable of 25 V and 10 A to the input voltage connector (J1). **Set the input voltage to ~5 V and the current limit to 1 A**. 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 30 A, which is greater than the typical current limit of the NCP3235 EVB.

For the NCP3235 MODE selection, the jumper J12 is reserved for inserting the appropriate resistor value or jumper. Please refer to the NCP32335 data sheet for the values of resistor that correspond to the desired MODE. The EVB is normally shipped with the jumper inserted (and R6 removed), which corresponds to the Automatic CCM/DCM operation mode, with both the latch-off over-voltage protection (OVP) mode and the Sonic mode enabled.

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 1.0 V ±10 mV. Connect an oscilloscope probe to the TPVSW test point and verify that the switching frequency is according to the MODE selection. This could be either CCM switching at 1.1 MHz or DCM operation, with or without the 30 kHz sonic-mode lower limit, and a CCM switching frequency of either 550 kHz or 1.1 MHZ. At this time, you may also start raising the input supply voltage up to the recommended maximum of 21 V to verify that the EVB will operate at that voltage.

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 10 A and set the input voltage to a value of 12 V. This is a good starting point for testing the current limit.

With the EVB operating with these conditions, **and the load initially turned off**, turn on the load and verify that the EVB can source the typical maximum of 15 A. Slowly increase the load setting until the EVB's over-current protection (OCP) threshold is reached (typically >20 A DC) 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. Releasing the load will cause the EVB re-start and return to the regulated output voltage.

The typical OCP threshold is 20-25 A. This value is determined by a threshold voltage which is produced by a trimmed current, called ISET, which is sourced through a resistor, RSET. The data sheet specifies a constant which has the units of Ω/A, based on this current and the measured low-side MOSFET Rds(on) value. The OCP threshold is finally set by a resistor, whose value is calculated according to the formula on the following page.

IV. Making adjustments – The NCP3235GEVB can be modified in a couple of significant ways. An important adjustment is the output voltage. The output voltage is preset to 1.000 V with R1 = 20 kΩ and R2 = 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 for the low-side OCP. This protection is set by a resistor at the RSET pin. A temperature-compensated 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 = 4 x I_{LS} x 108 Ω/A,

where I_{LS} = peak inductor current and 108Ω/A is the constant derived from the characterization of the ISET current and the measured Rds(on) of the internal low-side MOSFET. Choosing a peak current limit of ~24 A, the RSET value is ~10.5 kΩ, which was ultimately chosen for the basic EVB. This should give a DC value of approximately 21.5A at in input voltage of 12 V and output voltage of 1.000 V.