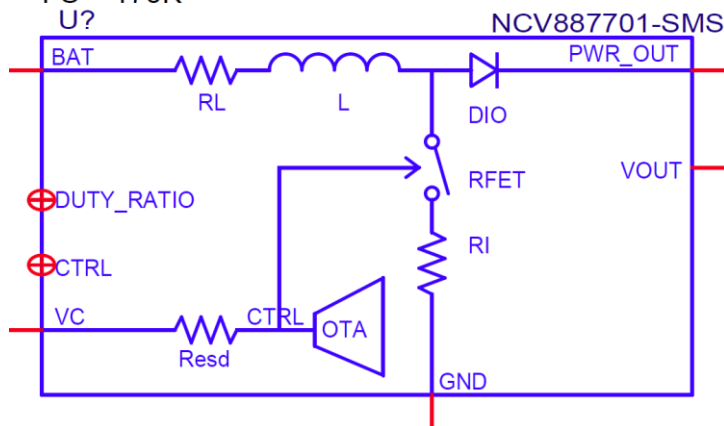


Small-Signal PSPICE Model



<http://onsemi.com>

RFET = 25M
RI = 10M
L = 2.2U
RL = 3M
FS = 170K
U?



NCV887701 PSpice Model

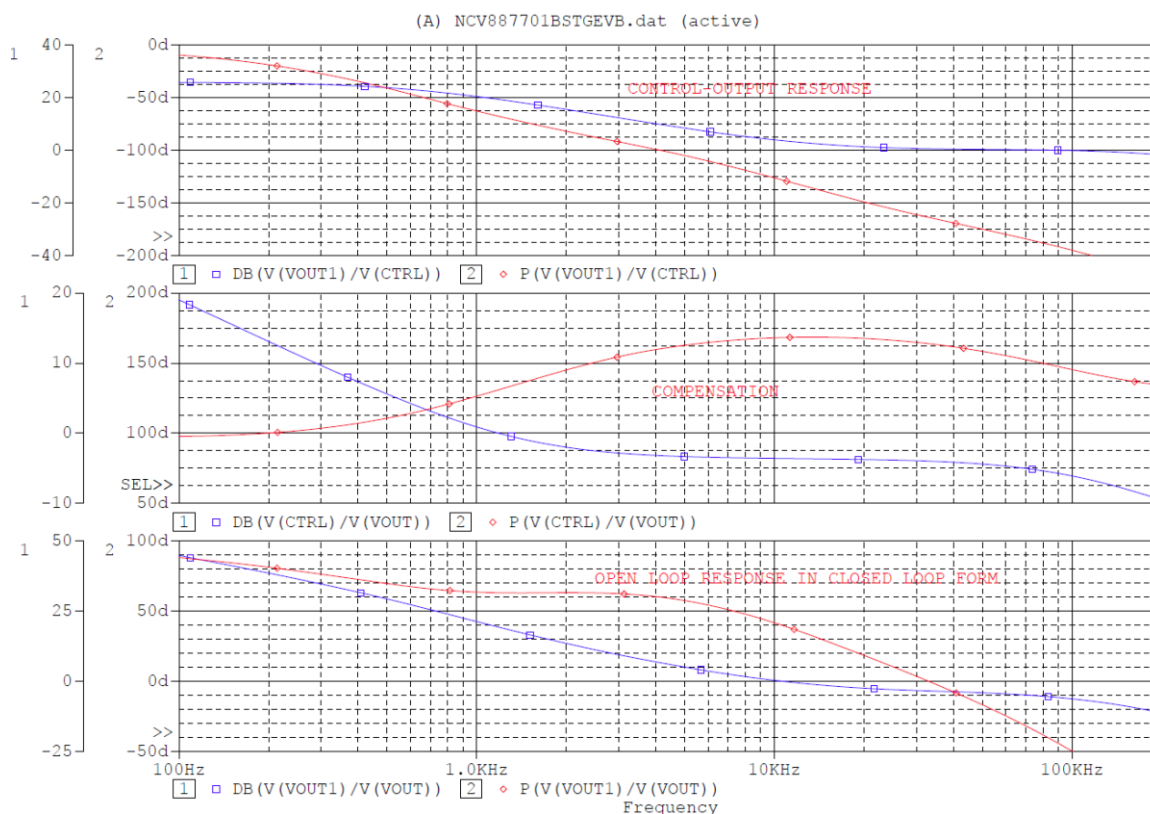


Figure 4 NCV887701BSTGEVB Evaluation Board Small-Signal Simulation Feedback Loop Response

The IC-VOUT pin serves a dual function:

- (1) Feedback control
- (2) IC-power source.

As a result of this dual function, the actual PCB physical IC-VOUT node cannot be used to perform lab measurements. The feedback loop may only be analyzed by simulation and verified in a lab environment by input line and output transient testing.

Table 1 NCV887701 Model – Node Definitions

Parameter	Monitoring Purposes Only?	Unit	Range	Comment
BAT	No	V	< 6.7 V	Power Supply Input Voltage
DUTY_RATIO	Yes	N/A	0 – 0.83	INTERNAL NODE FOR SIMULATION ANALYSIS
CTRL	Yes	V	N/A	INTERNAL NODE FOR SIMULATION ANALYSIS
VC	No	V	N/A	IC Compensation Pin
PWR_OUT	No	V	Fixed 6.8 V	IC Specific Fixed Regulation Output Voltage
VOUT	No	V	Fixed 6.8 V	IC Feedback Input Voltage
GND	No	V	0 V	Connect to Schematic Ground Reference

Table 2 NCV887701 Model – Parameters Table Definition

Parameter	Unit	Comment
RFET	Ω	MOSFET RDS(ON) (Default Value = 25 m Ω)
RI	Ω	Current Sense Resistor (Default Value = 10 m Ω)
L	H	Boost Inductor (Default Value = 10 μ H)
rL	Ω	Boost Inductor ESR (Default Value = 3 m Ω)
FS	Hz	Switching Frequency (Default Value = 170 kHz)

Feedback Loop Analysis Methodology

Simulations should be run at worst case parameter conditions (e.g.: Minimum input voltage, worst case output capacitor parasitic ESR values, etc). Additional simulations under less stringent conditions (e.g. nominal ESR, different input voltage conditions) are recommended as well for verification.

1- Control-Output (Modulator Plot) Response

This is the response of the power supply as seen by the IC's internal CTRL node (V(VOUT1)/V(CTRL)). This information is required to select OTA compensation components (R6, C2, C3).

2- OTA Compensation

From the modulator plot data, the OTA compensation network is determined (V(CTRL)/V(VOUT)) by selecting the desired zero gain and frequency values (R6/C2) and pole frequency (C3). CTRL is the OTA output (before Resd) and is a node internal to the IC and is strictly intended for analysis.

3- Loop Response (Open-Loop Response in Closed-Loop Form)

The power supply feedback loop response is obtained by plotting V(OUT1)/V(VOUT). The resulting design cross-over frequency, phase-margin and gain-margin are now obtained.

References

- [1] C. Basso, "Switch-Mode Power Supplies – SPICE Simulations and Practical Designs", McGraw Hill, 2008.
- [2] NCV8877: Automotive Grade Start-Stop Non-Synchronous Boost Controller datasheet:
<http://www.onsemi.com/PowerSolutions/product.do?id=NCV8877>
- [3] NCV887701 & NCV887720 Automotive Start Stop Grade Boost Controller Evaluation Board:
<http://www.onsemi.com/PowerSolutions/product.do?id=NCV8877>